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Scientific Highlights/Abstracts of Original Investigations

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This abstract supplement unites *SLEEP* and the science of the SLEEP 2010 24th Annual Meeting of the Associated Professional Sleep Societies, LLC (APSS) in a convenient electronic format. All abstracts presented at SLEEP 2010 held June 5-9, 2010, in San Antonio, Texas are included in this special issue.

The abstract supplement provides all American Academy of Sleep Medicine and Sleep Research Society members, including those unable to attend the meeting, a glimpse into the new ideas and latest research taking place in the field of sleep.

This year, 1,133 abstracts will be presented at the meeting. 200 will be presented in an oral presentation format, and the remainder will be presented in a poster format. Similar to prior meetings, the Program Committee elected to:

1) Group posters into thematic groups.
2) Display each poster on one of the three scheduled poster days (June 7, 8 and 9).

The poster sessions will continue to be two hours in length to allow attendees greater opportunity to view posters and interact with presenters. This year, the abstracts were divided between basic and clinical sleep science and then assigned to one of the 27 subcategories listed to the right.

Each poster has a unique four-digit number to facilitate identification and location at SLEEP 2010.

SLEEP 2010 fosters an environment in which members and attendees obtain education on the latest basic science, clinical science and technologies, which will further promote the continued growth of the field through the dissemination of new knowledge. We look forward to sharing in the success of this pivotal event.

David F. Dinges, PhD
Editor-in-Chief

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0001

SLEEP PROMOTING EFFECTS OF MK-4305 - A NOVEL DUAL OREXIN RECEPTOR ANTAGONIST

Winrow CJ[1], Coleman PJ[2], Cox CD[2], Doran SM[1], Breslin MJ[2], Schreier JD[2], Gotter AL[1], Cui D[3], Tannenbaum PL[1], Renger JJ[1]
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Introduction: Orexin/Hypocretin is a key neuropeptide responsible for regulating central arousal and reward circuits. Two receptors respond to orexin signaling, Orexin 1 Receptor (OX1R) and Orexin 2 Receptor (OX2R) with partially overlapping brain distributions. Genetic and pharmacological studies suggest orexin receptor antagonists could provide benefit for insomnia and other disorders with disrupted sleep/wake cycles. Based on internal sleep research expertise and strong genetic validation, an effort was initiated within Merck Research Laboratories to develop Orexin Receptor Antagonists aimed as a treatment for primary insomnia.
Methods: This presentation will describe the preclinical sleep promoting effects of a series of small molecule OX1R and OX2R antagonists across species. MK-4305, a Dual Orexin Receptor Antagonist (DORA) being developed for the treatment of insomnia, was assessed in vitro utilizing binding and calcium release assays, and in vivo using receptor occupancy, locomotor, sleep and quantitative EEG (qEEG) assays.
Results: DORA compounds effectively block orexin-induced locomotor activity, demonstrate receptor engagement in an ex vivo occupancy assay and dose-proportionally promote sleep in multiple species. In rat, dog and rhesus sleep assays, MK-4305 and other DORA's reduce wake activity and proportionally increase both slow wave sleep (SWS) and rapid eye movement (REM) sleep to increase total sleep time. Preclinical studies across species showed dose-dependent and translational qEEG effects, supporting qEEG as a clinical biomarker. Sleep architecture and qEEG patterns were consistent and dose-dependent across DORA's, demonstrating modulation of low and high frequency spectral power bands. Unlike GABA modulators, orexin receptor antagonists modify sleep architecture by increasing deep sleep states at the expense of wakefulness.
Conclusion: These findings highlight the unique opportunity that a dual orexin antagonist may provide as a novel therapy for insomnia.
Support (If Any): This project was supported by Merck.

0002

DIFFERENTIAL EFFECTS OF GABAB RECEPTOR SUBTYPES, GHB, AND BACLOFEN ON EEG ACTIVITY AND SLEEP REGULATION

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Introduction: The role of GABAB receptors in sleep is still poorly understood and thus far gamma-hydroxybutyric acid (GHB) is the only approved drug targeting this receptor for the treatment of the sleep disorder narcolepsy. It is believed that GHB, by consolidating sleep and promoting EEG slow waves, reduces excessive daytime sleepiness and cataplexy associated with narcolepsy. GABAB receptors are dimers of the GABAB2 subunit and either one of the two GABAB1 subunit isoforms (1a, 1b).
Methods: To better understand the role of GABAB receptors in sleep, we performed EEG recordings in mice with complete loss-of-function of the GABAB receptor (1-/- or 2-/-) and of either subunit 1 isoform (1a-/- or 1b-/-) and evaluated the effects of the GHB-prodrug, gamma-butyrolactone (GBL), and baclofen (BAC), another GABAB agonist.
Results: We discovered that the 1a isoform protects against the spontaneous epileptiform activity observed in 1-/- and 2-/- mice and that the distribution of sleep over the day was profoundly altered in 1-/- and 2-/- mice suggesting a role for GABAB receptors in circadian phase-setting. GBL induced an anesthetic-like state distinct from physiological sleep which did not affect subsequent sleep. In contrast, BAC increased sleep need reminiscent of sleep-deprivation induced hypersomnia. All EEG and sleep effects of GBL were mediated through GABAB receptors.
Conclusion: Behavioral changes induced by GHB are compatible with anesthetic state and differ from sleep. Additionally, GHB does not affect subsequent sleep. In general, our results point to a more prominent role of the GABAB receptor subunit isoform 1a in sleep and the EEG.

0003

THE EFFECTS OF ZOLPIDEM AND TRIAZOLAM, RILMAZAFONE HYDROCHLORIDE ON THE PHYSICAL AND COGNITIVE FUNCTIONS IN HEALTHY, ELDERLY PERSONS

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Introduction: Many problems have been reported on the use of hypnotics on the elderly, such as balance disorders, falling, and memory disorders. A safer use of hypnotics is being anticipated.
Methods: We performed a double-blind crossover trial on 14 healthy elderly subjects (mean age 64.5 years) in order to investigate the residual effect of a single administration of Zolpidem (5mg) and Triazolam(0.125g), Rilmazafone hydrochloride(1mg). The subjects were given either hypnotics or a placebo at 11PM before going to bed. Objective assessments Critical Flicker Fusion Test (CFF), Total Sway Pass, Functional Reach Test (FRT), Timed Up and Go test (TUG), Simply Discriminatory Reaction test (SDR), Short-Term Memory test (STM) were conducted at 10PM before the subjects took the hypnotic, and at 4, 6, 10AM and 2PM the next day. Subjective assessments Stanford Sleepiness Scale (SSS), Alertness (VAS),Well-being (VAS), Fatigue (VAS) were conducted once every two hours from 4 o'clock on the next day of the hypnotic administration.
Results: The result of the Total Sway Pass was that Rilmazafone was significantly better than those of the placebo. However the results of Rilmazafone was not as good for the CFF and TUG, memory test than those of placebo and Zolpidem. The FRT results of Zolpidem and Triazolam were significantly better than those of the placebo. Triazolam showed little effect on the cognitive functions and the sleepiness of the subjects the day after hypnotic administration.
Conclusion: It is known that clinical parameters which focus on the 'dynamic balance' are more useful than those which focus on 'statistic balance' in order to evaluate the accidental falls in the elderly. This study suggests that Rilmazafone hydrochloride may increase the risk of falling down because both hypnotics cause the lost of 'dynamic balance'. However, the feeling of Rilmazafone medication was not good for subjective feelings than that of a placebo. These effects may be due to Rilmazafone hydrochloride's long half- life. Therefore, subjects feel sleepiness early the next morning. It may have a good affect for the people who have interrupted sleep and early morning awakenings. Zolpidem and Triazolam have a hypnotic activity without disturbing objective and subjective performance on the following day when given to healthy elders.

0004

GAMMAHYDROXYBUTYRATE AND R-BACLOFEN PROMOTE NREM SLEEP IN HYPOCRETIN/ATAXIN-3 AND WILD-TYPE MICE

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Introduction: Gammahydroxybutyrate (GHB) is an effective therapeutic for the excessive sleepiness and the sudden loss of muscle tone (cataplexy) associated with narcolepsy. The anti-narcoleptic effect of

GHB is thought to be mediated by the promotion of sleep consolidation during the rest phase. Although the mechanism of action underlying the therapeutic efficacy of GHB is unknown, it has been hypothesized to be $GABA_B$ receptor-dependent. Here, the dose-response effects of GHB and the $GABA_B$ agonist R-baclofen (BAC) on arousal state were compared in the hypocretin/ataxin-3 transgenic mouse model of narcolepsy.

Methods: Hypocretin/ataxin-3 mice (TG, n = 4) and wild-type (WT, n = 4) controls were surgically prepared for EEG and EMG monitoring using abdominally implanted telemetry units. After 3 weeks recovery, mice received i.p. drug treatments in a repeated measures, randomized crossover design. Mice were dosed at ZT-2 and ZT-6 with GHB (50, 100, 150 mg/kg), BAC (2.8, 5.6, 11.2 mg/kg), or vehicle with 3 days between treatments. Treatment timing was chosen to model the twice-nightly, GHB dosing regimen used by human narcoleptics. Physiological data and video-recorded behavioral data were simultaneously acquired and manually scored as wake, rapid-eye-movement (REM) sleep, non-REM (NREM) sleep, cataplexy, or seizure-like activity. Drug effects on these states were assessed during the first 4 h after each treatment.

Results: GHB induced a modest increase in NREM sleep time, particularly in the WT mice after the second treatment of GHB at 100 mg/kg but not in the TG mice. At the highest dose of GHB, some intrusion of seizure-like activity occurred at the expense of NREM sleep. Less seizure-like activity was observed after 100 mg/kg GHB, and none was evident after the lowest GHB dose. Seizure-like activity was predominant after the two highest doses of BAC, but was minimal after the lowest dose. The lowest dose of BAC also produced a robust increase in NREM time in both WT and TG mice. GHB (100 mg/kg) and BAC (2.8 mg/kg) increased the latency to REM sleep and decreased the latency to NREM sleep, particularly in the TG mice. In addition, the REM:NREM ratio was reduced after these treatments, indicating that these doses of GHB and BAC promote NREM sleep.

Conclusion: Of the doses tested, 100 mg/kg GHB and 2.8 mg/kg BAC administered acutely twice per day confer optimal promotion of NREM sleep during the rest phase with minimal seizure-like side effects.

Support (If Any): NIH 1R01NS057464-01A2

0005

ROLE OF NITRIC OXIDE IN THE SLEEP PROMOTING EFFECTS OF THE CHINESE HERBAL MEDICINE, SINISAN

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Introduction: Sinisan is a formula containing four herbs that is often prescribed for insomnia in traditional Chinese medicine. Nitric oxide (NO) is involved in the regulation of sleep-wakefulness. NO is synthesized from the L-Arginine (L-Arg) by NO synthase (NOS). N-nitro-L-arginine methyl ester (L-NAME) is an inhibitor of NOS. In this study, we examined the possible role of NO in the effect of Sinisan on sleep.

Methods: Seven groups of mice were used. Groups 1 and 2 intragastrically (i.g.) received Sinisan lyophilized powder (0.625 g/kg and 2.5 g/kg, respectively). Group 3 received L-Arg (125 mg/kg, i.p.) after Sinisan (0.625 g/kg, i.g.) and group 4 received L-Arg alone. Group 5 received L-NAME (80 mg/kg, i.p.) after Sinisan (2.5 g/kg, i.g.) and group 6 received L-NAME alone. Group 7 received water (20ml/kg, i.g.). Afterwards, an injection of pentobarbital (50 mg/kg, i.p.) was administered. The time spent from drug injection to loss of righting reflex was considered as sleep latency and the time from loss to recovery of righting reflex was considered as sleep time. Studies were conducted on consecutive 9 days. NO concentration and NOS activity in the brain were examined in the groups of 2 and 7.

Results: Compared to control (group 7), decreases in sleep latency and increases in sleep time were significant ($P < 0.05$) in groups 2, 3 and 6. Groups 1, 4 and 5 did not differ from control. NO concentration and NOS activity were increased in group 2 compared to group 7.

Conclusion: The low dosage of Sinisan alone did not alter sleep, but L-Arg plus the low dosage of Sinisan significantly increased sleep. The high dosage of Sinisan alone produced an increase in sleep that was blocked by L-NAME. Sinisan also increased NO concentration and NOS activity in the whole brain of mice. These data suggest that NO plays a role in the sleep promoting effects of Sinisan.

Support (If Any): Chinese National Natural Science Foundation 30672634/C0305205, 30801528/C190701 and 30870891/C090302

0006

ROLE OF GABAA-BENZODIAZEPINE RECEPTORS IN THE SLEEP PROMOTING EFFECTS OF SINISAN, A TRADITIONAL CHINESE MEDICINE FOR INSOMNIA

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Introduction: Sinisan, a formula containing four herbs, is often prescribed for insomnia in traditional Chinese medicine. GABAA-benzodiazepine receptors play an important role in the regulation of sleep. In this study, we examined the effects of Sinisan on sleep in mice and co-administered the benzodiazepine antagonist, flumazenil, to determine whether GABAA-benzodiazepine receptors were involved in its sleep promoting effects.

Methods: Four groups of mice were used in the experiments. Group 1 received Sinisan lyophilized powder (2.5 g/kg) intragastrically (i.g.); group 2 received Sinisan (2.5 g/kg; i.g.) followed by flumazenil (3.5 mg/kg, i.p.); group 3 received flumazenil (3.5 mg/kg, i.p.) alone, and group 4 (Control) received water (20ml/kg; i.g.). Afterwards, an injection of pentobarbital (50 mg/kg, i.p.) was administered. The time spent from drug injection to loss of righting reflex was considered as sleep latency and the time from loss of righting reflex to its recovery was considered as sleep time. The treatment of Sinisan was repeated for consecutive 9 days. The mRNA levels for α1 and α5 subunits of GABAA-benzodiazepine receptors in the brain cortex were quantified using reverse transcription and polymerase chain reaction (RT-PCR) in groups 1 and 4.

Results: Compared to control, increases in sleep time and decreases in sleep latency were significant ($P < 0.05$) for group 1, but not for groups 2 and 3. Compared to control, group 1 had significant increases of α5 subunits of GABAA-benzodiazepine receptors, but the change in α1 subunits was not significant.

Conclusion: Sinisan produced a significant increase in total sleep time that was blocked by the treatment of flumazenil. Sinisan also increased the expression of mRNA of the α5 subunit of GABAA-benzodiazepine receptors. The results suggest the effects of Sinisan on sleep likely involves GABAA-benzodiazepine receptors.

Support (If Any): Chinese National Natural Science Foundation 30672634/C0305205, 30801528/C190701 and 30870891/C090302

0007

ACETYLCHOLINE (ACh) RELEASE IN THE PONTINE RETICULAR FORMATION (PRF) OF SPRAGUE-DAWLEY RAT IS DIFFERENTIALLY ALTERED BY SYSTEMIC VERSUS PRF DELIVERY OF ESZOPICLONE

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Introduction: The non-benzodiazepine hypnotic eszopiclone is widely used for the treatment of insomnia. Although hypnotics such as eszopiclone have specific binding sites on $GABA_A$ receptors, the brain regions and neurochemical mechanism by which eszopiclone causes sedation remain incompletely understood. Cholinergic neurotransmission in the PRF contributes to sleep cycle control (reviewed in Monti et al., Neurochemistry of Sleep and Wakefulness, 2008) and recent studies discovered that microdialysis delivery of eszopiclone to rat PRF significantly increases ACh release in the PRF (Soc Neuroscience Abstract 285.16,

2008). The present study is testing the hypothesis that PRF ACh release is altered by systemic administration of eszopiclone.
Methods: Adult male Sprague-Dawley rats (n = 6) were anesthetized with isoflurane and a CMA/11 microdialysis probe was aimed stereotaxically for the PRF. In 3 rats ACh release was measured during PRF dialysis with Ringer's (control) followed by dialysis with Ringer's containing 100 μM eszopiclone (Soc Neuroscience Abstract 285.16, 2008). The other 3 rats were implanted with a peripheral venous catheter and PRF ACh release was quantified before and after intravenous administration of 3 mg/kg eszopiclone. ACh was measured by HPLC-EC. Data were evaluated using Mann-Whitney statistic.
Results: All microdialysis sites were histologically localized within the PRF. Eszopiclone delivered directly into the PRF caused a significant increase (93.4 %) in PRF ACh release, whereas intravenous administration of eszopiclone caused a significant decrease (50.6 %) in PRF ACh release.
Conclusion: Characterizing the effects of systemic versus intracranial drug delivery on neurotransmitter release provides a powerful tool for identifying receptor systems and brain sites of drug action (Anesthesiology 103:779, 2005; Neuroscience 144: 375, 2007). These results suggest that the sedative/hypnotic action of eszopiclone is not mediated at the level of the PRF. Ongoing studies are testing this interpretation using unanesthetized rats.
Support (If Any): Department of Anesthesiology; NIH grants HL40881 and MH45361.

0008

AMYGDALA ACETYLCHOLINE LEVELS IN SPRAGUE-DAWLEY RAT ARE INCREASED BY MICRODIALYSIS DELIVERY OF DIAZEPAM, ZOLPIDEM, AND ESZOPICLONE

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Introduction: The amygdala is deactivated during the transition from wakefulness to NREM sleep and is activated during REM sleep (Curr Neurol Neurosci Rep 6:149, 2006). The amygdala shows hyper-metabolism in patients with depression (Arch Gen Psychiatry 62:387, 2005) and insomnia (Am J Psychiatry 161:2126, 2004). Microinjection of cholinomimetics into rat central nucleus of the amygdala (CeA) demonstrates that acetylcholine in the CeA is involved in regulating states of sleep and wakefulness (Neuroscience 141:2167, 2006). Benzodiazepine and non-benzodiazepine sedative/hypnotics contribute to the clinical management of insomnia and affective disorders but their mechanisms of action remain poorly understood. The present study is testing the hypothesis that microdialysis delivery of benzodiazepine and non-benzodiazepine hypnotics to rat amygdala alters acetylcholine levels.
Methods: Adult male rats (n = 10) were anesthetized with isoflurane. A CMA/11 dialysis probe was aimed for the CeA and samples (25 μL) were collected every 12.5 min for 62.5 min during dialysis with Ringer's (control) followed by 62.5 min of dialysis with Ringer's or Ringer's containing 100 μM diazepam, zolpidem, or eszopiclone. HPLC with electrochemical detection was used to quantify acetylcholine levels (pmol/12.5 min).
Results: All dialysis sites were histologically localized to the CeA. During dialysis with Ringer's followed by Ringer's (n = 3 rats), acetylcholine levels were stable (mean ± SD = 0.224 ± 0.058) across the 125 min sample collection period. Dialysis delivery of diazepam (n = 3), zolpidem (n = 3), and eszopiclone (n = 1) increased acetylcholine levels by 46%, 12.5%, and 113%, respectively.
Conclusion: These preliminary results are a first step toward the measurement of CeA acetylcholine levels across states of sleep and wakefulness. Ongoing experiments will help identify the cell groups by which systemically administered sedative/hypnotics alter CeA acetylcholine levels and contribute to deactivation of the amygdala (Am J Psychiatry 161:748, 2004).
Support (If Any): Department of Anesthesiology and NIH grants HL40881 and MH45361.

0009

PHARMACOLOGICAL ENHANCEMENT OF SPECIFIC SLEEP STAGES IN 90-MINUTE NAPS

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Introduction: Current research finds that individual sleep stages may serve discrete and unique functions for memory and health related processes. Two pharmacological agents, sodium oxybate (SO) and zolpidem (ZOL), have been shown to increase specific sleep stages in nocturnal sleep (i.e. slow wave sleep (SWS) (and delta power) and Stage 2 sleep (and sigma power), respectively). These agents have not been tested in naps. The current study quantifies pharmacological enhancement of specific sleep parameters in a dose-dependent manner to establish SWS and Stage 2 enhancement in an early morning nap.
Methods: This within subjects, cross-over design, tested 19 subjects (11 females, 24.2 ± 4.4yrs mean age, 16.1 ± 2.5yrs mean education) in five different sessions, each separated by at least one week. Subjects spent a polysomnographically-recorded (PSG) night in the sleep lab and were woken at 5:00AM. At 8:30AM, subjects were given placebo, 2.5g SO, 3g SO, 5mg ZOL, or 10mg ZOL, and allowed to nap for 90min with PSG recording. Minutes of sleep stages and power spectral analysis of sigma, delta, alpha, and theta were compared across naps.
Results: In ZOL naps, we found a significant increase in absolute sigma power but not in minutes of Stage 2 sleep in the high dose condition, compared to placebo. We found a dose-dependent increase in minutes of SWS, and absolute delta power in both the SO naps, compared to placebo. Interestingly, both SO naps also showed significantly increased absolute alpha power, compared to placebo.
Conclusion: These results show that individual sleep parameters can be pharmacologically manipulated in a dose-dependent manner during an early morning nap. The pharmacologic ability to quantitatively and specifically tailor sleep, and possibly thus correlate sleep changes with performance on specific memory tasks, allows the potential use of drugs to improve learning.
Support (If Any): Mednick's K01 MH080992

0010

THE EFFECT OF RAMELTEON ON SLEEP AND BRAIN OREXINS IN A RAT MODEL OF INSOMNIA

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Introduction: The current project aimed to determine the effects of ramelteon (RAM), a melatonin receptor (M1, M2) agonist, on sleep and brain orexin levels in a rat model of insomnia induced by neonatal maternal deprivation (MD); a model previously used by our laboratory (Feng et al, 2007).
Methods: At three months of age, rats were implanted with EEG and EMG electrodes and PSG recordings were taken for four days. After morning treatment on the fifth day, rats were sacrificed for brain tissue collection. Tissue orexin level was determined by radioimmunoassay (Feng et al, 2007). The groups were maternal control (MC)-V (MC rats treated with vehicle), MC-20 (MC rats treated with RAM 20mg/kg), MD-V (MD rat treated with vehicle), MD-10 (MD rats treated with RAM 10mg/kg), MD-20 (MD rats treated with RAM 20mg/kg) and MD-40 (MD rats treated with RAM 40mg/kg).
Results: The latency to sleep (LS) in the MC-V rats was 27.18 and 24.96 min on treatment days 1 and 2, respectively. The LS for the MD-V group was 41.15 and 43.01 min. The difference in LS between these groups was significant on day 2 but not day 1. Compared with MD-V rats, the LS for the MD-20 group was significantly shorter on day 1 (21.04 min) and day 2 (19.94 min). Also, compared with the MD-V group, the LS for

MD-10 animals was shorter on both days, but significant on day 2 (21.99 min) only. Hypothalamus orexin levels were measured using radioimmunoassay method. Differences of orexin A levels among five groups were not significant; however more samples need to be analyzed.
Conclusion: Treatment with ramelteon 10 mg/kg significantly reduced sleep latency. However, the differences of brain levels of orexins need to be further determined.
Support (If Any): This project was supported by Takeda Pharmaceuticals North America, Inc. and The Louis Stokes Cleveland VA Medical Center.

0011

MARKED INCREASE IN SLEEP DURATION AND QUALITY IN PATIENTS WITH RHEUMATOID ARTHRITIS BY ETANERCEPT, A TUMOR NECROSIS FACTOR-ALPHA ANTAGONIST

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Introduction: Sleep is often an important issue for patient with rheumatoid arthritis (RA). There is the observation that etanercept (ETN) reduces daytime sleepiness. We investigated effects of newly introduced ETN, a TNF-alpha neutralizing agent, either as monotherapy or in combination with conventional disease-modifying antirheumatic drugs in comparison to newly introduced methotrexat (MTX) in a pilot, open, supportive care study during which nighttime polysomnography (PSG) was obtained.
Methods: 32 patients with RA (Age 49.1 ± 10.6years) were selected according to their medical history and disease activity to receive either ETN (2x25mg per week; n = 14) or MTX (12.5-17mg per week; n = 18) under PSG conditions before and after 8 and 16 weeks of treatment. Sleep was scored according to Rechtschaffen and Kales. For subjective assessments, established questionnaires such as MFI and SF36 were used.
Results: Sleep parameters in the ETN group were significantly different compared to baseline but not in the MTX control. Total sleep time (TST) changed within 16 weeks from 355.0 ± 65.1 to 422.6 ± 44.3 with ETN vs. 388.6 ± 61.7 to 377.7 ± 74.7 minutes with MTX; sleep efficiency from 77.8 ± 12.6 to 88.9 ± 9.5 vs. 84.8 ± 8.5 to 80.6 ± 11.9% and NREM-2 from 34.7 ± 15.2 to 41.2 ± 8.6 vs. 37.5 ± 11.1 to 36.3 ± 7.0%. NREM-1 sleep was reduced from 21.5 ± 13.4 to 14.2 ± 5.8 vs. 19.6 ± 13.0 to 17.1 ± 8.8 %. Slow wave sleep and REM remained unchanged. In both groups, the MFI was significantly reduced in the dimension Physical Sleepiness. In the ETN group, the SF-36 dimensions Social Functioning, Mental Health, Vitality-Energy-Fatigue were significantly improved compared to MTX.
Conclusion: Newly introduced ETN does improve sleep duration and quality as well as respective parameters of MFI and SF36 questionnaires in patients suffering from active RA. These results suggest that proinflammatory cytokines contribute to the pathogenesis of sleepiness by a reduction of sleep duration and quality and increases NREM-2 and reduces NREM-1.
Support (If Any): Supported by an research grant from Wyeth Pharma GmbH Germany and Humboldt University Berlin

0012

EFFECT OF AGE ON SYSTEMIC EXPOSURE TO ARMODAFINIL IN HEALTHY SUBJECTS

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Introduction: Changes in physiological functioning, including age-related decreases in hepatic functioning, are known to alter the pharmacokinetics of medications. NUVIGIL® (armodafinil), the longer-lasting isomer of modafinil, is metabolized primarily by the liver. The objective of this study in healthy subjects was to evaluate the effect of age on the systemic exposure to armodafinil.
Methods: Healthy men (N = 50) received armodafinil each morning for 7 days followed by 72 hours of pharmacokinetic sampling. Armodafinil was titrated in 50-mg increments as follows: 50 mg on day 1, 100 mg on day 2, and 150 mg on days 3-7. Participants were categorized as "young" (aged 18-45; n = 25) or "elderly" subjects (aged ≥ 65 years; n = 25). A *priori* subset analysis of "young elderly" subjects aged 65-74 (n = 17) and "old elderly" subjects aged ≥ 75 years (n = 8) was also performed. Area under the plasma drug concentration-versus-time curve for one dosing interval ($AUC_{0-\tau}$) and maximum plasma concentration (C_{max}) were compared across age groups. Tolerability was assessed throughout the study.
Results: Twenty-five young and 24 elderly subjects were evaluable for pharmacokinetics. Elderly subjects had an approximately 15% higher overall systemic exposure to armodafinil than the young subjects as shown by a significantly higher $AUC_{0-\tau}$ (geometric mean ratio [GMR]: 1.14, 95% CI: 1.03, 1.25) and C_{max} (GMR: 1.15, 95% CI: 1.08, 1.24). Plasma concentrations of armodafinil were increased to a greater extent in the old elderly (n = 7) subjects, who had a ~27% higher steady-state exposure than young subjects, compared with only ~10% higher exposure in young elderly subjects. Armodafinil was generally well tolerated.
Conclusion: Systemic exposure to armodafinil was higher in subjects aged ≥ 65 years as compared to subjects aged ≤ 45 years. The difference was attributable disproportionately to subjects aged ≥ 75 years. Based upon these results, dose adjustment should be considered when administering armodafinil to elderly patients.
Support (If Any): Sponsored by Cephalon, Inc.

0013

EFFECT OF ARMODAFINIL ON PATIENT FUNCTIONING AND FATIGUE: A MULTICENTER, RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED, PARALLEL-GROUP STUDY IN PATIENTS WITH RESIDUAL EXCESSIVE SLEEPINESS ASSOCIATED WITH TREATED OBSTRUCTIVE SLEEP APNEA AND A COMORBID DEPRESSIVE DISORDER

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Introduction: NUVIGIL® (armodafinil) has been shown to significantly improve overall clinical condition related to excessive sleepiness (ES) versus placebo in patients with residual ES associated with continuous positive airway pressure (CPAP)-treated obstructive sleep apnea (OSA) who had a comorbid depressive disorder. This analysis evaluates the efficacy of armodafinil for improving functioning and reducing fatigue in this population.
Methods: 249 patients with residual ES associated with CPAP-treated OSA and a comorbid major depressive or dysthymic disorder requiring antidepressant monotherapy were randomized to armodafinil 200 mg or placebo taken once daily in the morning for 12 weeks. Functional Outcomes of Sleep Questionnaire (FOSQ) and the Brief Fatigue Inventory (BFI) were used to assess patient functioning and fatigue at baseline and weeks 2, 4, 8, and 12 as secondary outcomes in the study. Tolerability was evaluated.
Results: Baseline FOSQ and BFI scores were similar between the armodafinil (n = 112) and placebo (n = 113) groups. The mean change in the FOSQ score from baseline to final visit was 2.2 for the armodafinil group and 1.7 for the placebo group (nominal $P = 0.0308$). More patients were responders (> 17.9 on the FOSQ score) in the armodafinil compared with placebo group (45% vs 28%) at final visit (nominal $P = 0.0100$). Effect on patient functioning as assessed by the FOSQ was maintained from week 4 through the final visit. Mean changes from baseline in global BFI score were greater for the armodafinil group at weeks 2, 8, and 12 (nominal $P \leq 0.0349$) but not at week 4

(nominal $P = 0.1272$) or final visit (nominal $P = 0.0523$). Armodafinil was generally well tolerated.
Conclusion: In patients with residual ES associated with CPAP-treated OSA and a comorbid depressive disorder, armodafinil administration resulted in sustained improvement patient functioning compared with placebo. Armodafinil also reduced fatigue compared with placebo but the effect was not as consistent throughout the study.
Support (If Any): Sponsored by Cephalon, Inc.

0014

INTRAHYPOTHALAMIC ADMINISTRATION OF THE FATTY ACID AMIDE HYDROLASE INHIBITOR URB597 INCREASES WAKING IN RATS

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Introduction: The fatty acid amide hydrolase (FAAH) catalyzes the hydrolysis of the endocannabinoid anandamide (ANA) as well as the anorexic lipid oleoylethanolamide and the pain-related lipid palmitoylethanolamide. Despite the evidence about the role of ANA on sleep, no solid evidence is available about the physiological properties of FAAH on the sleep-wake cycle modulation. Regarding this, we have previously reported that icv administration of FAAH inhibitor named cyclohexyl carbamic acid 3'-carbamoyl-biphenyl-3-yl ester (URB597) enhances waking and decreases sleep in rats. Additionally, we have described an increase in c-Fos expression in lateral hypothalamus (LH) of animals that received this compound.
Methods: Here, we evaluate the effects of URB597 on sleep injected into a wake-related centre: LH. To address this, male adult wistar rats (230-250 g) were implanted for sleep recordings (EEG and EMG electrodes) as well as cannulae aimed to the LH. Rats were allowed to recover for 7 days and they were housed under a controlled light-dark cycle (12:12; lights-on at 07:00h) with access to food and water ad libitum. On the experimental day, animals received an intrahypothalamic administration at the beginning of the lights-on period of either vehicle or URB597 (10, 20µg/1µL). After the microinjection, sleep recordings were obtained during 4h and the sleep-wake cycle was classified into wakefulness (W), slow wave sleep (SWS) and rapid eye movement (REM) sleep.
Results: Our results showed that intrahypothalamic injection of URB597 significantly increased W and decreased SWS as well as REMS in a dose-dependent fashion.
Conclusion: Based in our observations, it can be concluded that inhibition of the FAAH, as an element of the endocannabinoid system modulates the sleep-wake cycle inducing an enhancement in waking. Further experiments are needed to describe the neuromolecular mechanism of action of URB597 if is considered in the near future as a therapeutical option to treat sleep disorders, such as excessive somnolence.
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0015

ARMODAFINIL VERSUS MODAFINIL IN PATIENTS WITH EXCESSIVE SLEEPINESS ASSOCIATED WITH TREATED OBSTRUCTIVE SLEEP APNEA, SHIFT WORK DISORDER, OR NARCOLEPSY: PHARMACOKINETIC/PHARMACODYNAMIC MODELS FOR PREDICTING THE CONCENTRATION-EFFECT RELATIONSHIP

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Introduction: Armodafinil, the longer-lasting isomer of modafinil, is a non-amphetamine, wakefulness-promoting medication. Because armodafinil lacks the shorter-lasting *S*-isomer of modafinil, plasma drug concentration remains higher later in the dosing interval and displays less swing and fluctuation compared with modafinil. Using a pharmacokinetic/pharmacodynamic model, the current analysis compared the predicted efficacy of armodafinil and modafinil at equal doses in patients with excessive sleepiness (ES) associated with treated obstructive sleep apnea (OSA), shift work disorder (SWD), and narcolepsy.
Methods: Randomized, double-blind, placebo-controlled studies of armodafinil or modafinil in these patient populations were combined to determine the relationship between concentration and effect using multiple-component, nonlinear, mixed-effect models. Pooled data from pharmacokinetic studies of armodafinil and modafinil were used to predict plasma drug concentration profiles for each patient. Pharmacodynamic measures were pooled response from the Maintenance of Wakefulness Test or Multiple Sleep Latency Test. Separate models were constructed for each patient population to compare armodafinil and modafinil at a once-daily dose of 200 mg/day.
Results: Mean observed responses matched the models' predictions (ie, fit) for all treatments for all three patient populations, suggesting the models were appropriate. The models demonstrated the existence of an exposure-response relationship for each population. Plasma drug concentration as a function of time predicted that armodafinil 200 mg/day would result in higher plasma concentrations over the full dosing interval, but especially later in the dosing interval, compared with modafinil 200 mg/day. The predicted improvement in wakefulness, relative to placebo, was greater with armodafinil than modafinil throughout the dosing interval.
Conclusion: Based on the demonstrated exposure-response relationship and predicted plasma drug concentration data, armodafinil 200 mg/day may increase wakefulness to a greater extent than modafinil, especially at later times in the dosing interval, in patients with ES associated with treated OSA, SWD, or narcolepsy.
Support (If Any): Sponsored by Cephalon, Inc.

0016

PROMISCUOUS MODULATION OF ION CHANNELS BY SLEEP-RELATED SUBSTANCES

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Introduction: Numerous neurotransmitters, neuropeptides, and other substances have been implicated in the regulation of sleep and wakefulness. Because of functional redundancy in sleep-wake circuits, and shared anatomical and neurochemical features with non-sleep circuits, rational pharmacological manipulation remains challenging. In contrast to traditional pharmacology that emphasizes high specificity target modulation (for example, to reduce side effects), there is growing interest in understanding and exploiting multi-target modulation, especially for systems with complex physiology. Promiscuous ion channel modulation, in particular, has been demonstrated for FDA-approved antidepressant, anticonvulsant, neuroleptic, and anti-dementia medications. The two primary reasons for investigating promiscuity are 1) to explore possible mechanisms of pharmaceutical side effects, and 2) to generate testable hypotheses regarding possible "network pharmacology" mechanisms of sleep active substances.
Methods: Literature review yielded 170 endogenous and therapeutic substances shown to directly interact with the four members of the ligand-gated ion channel family (receptors for GABA, glycine, serotonin, and acetylcholine) by electrophysiology methods. Of these, 35 compounds were tested against recombinant 5-HT3 and GABA-A receptor channels, and the voltage gated T-type calcium channel, using commercially available (ChanTest) high throughput methods (patch clamp electrophysiology and fluorescence-based calcium imaging).
Results: Promiscuous modulation of ion channels is demonstrated in vitro under diverse experimental conditions. Concentration-response

data now demonstrates acute direct target modulation, gathered under similar experimental conditions for this set of ion channels. The data includes positive controls (known interactions, such as diazepam upon GABA-A receptors) as well as non-canonical interactions. Modulation data is presented in the context of the physiologically relevant concentration range for these endogenous and therapeutic agents.
Conclusion: Systematic characterization of interactions between sleep active substances and molecular targets, such as ion channels, may yield important information not only for understanding side effects of pharmaceutical agents, but also for potential drug design based on rational promiscuity.
Support (If Any): Funded by the MGH Neurology Department

0017

SLEEP DISTURBANCE AND RLS TREATMENT: COMPARING OUTCOMES BEFORE AND DURING DOPAMINE AGONIST TREATMENTS

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Introduction: Restless Legs Syndrome (RLS) is a neurologic disorder characterized by an urge to move the legs. RLS symptoms tend to follow a circadian pattern, intensifying during the evening or night, and often delay or disturb sleep. Sleep problems are a common comorbidity of RLS.
Methods: This IRB-approved, on-line survey is ongoing; data are preliminary. Subjects were managed by their PCP or Neurologist. Inclusion criteria were: US residency, age > 17, RLS diagnosis for ≥ 1 year, currently taking levodopa or dopamine agonist for ≥ 6 months, not diagnosed with peripheral neuropathy, kidney failure and not pregnant, and symptoms occurring ≥ 2-3 days per week before treatment. Subjects rated sleep disturbance on a 5-point scale from 'none' to 'very severe'. The question was administered twice, once in reference to current treatment and again referencing pre-treatment.
Results: 200 subjects have completed this survey to date. Mean current treatment duration was 2.6 years (S.D.: 1.9). 40.0% of respondents switched from another dopamine agonist or levodopa to their current medication and 49.2% had dosage levels adjusted (47.2% increased/2.0% decreased). 34.5% percent of respondents rated sleep disturbance the same (28.9%) or more severe (5.6%) over the past week than before treatment. Profiling improvers/non-improvers revealed that those with higher symptom severity (IRLS total score) had more sleep disturbance. No significant differences in demographic or treatment characteristics emerged.
Conclusion: Though 40% had changed their DA medication, continued dopamine or levodopa treatment did not improve sleep for a third of these subjects and ~6% saw their sleep problems being more severe than before treatment. Patients reporting improved sleep also reported fewer symptoms but there was no relation between medication use and sleep improvement. Physicians should assess for potential poor sleep with DA treatments and consider alternative therapies to address the problem.
Support (If Any): GlaxoSmithKline, Research Triangle Park, NC

0018

URINARY NEUROTRANSMITTER ANALYSIS OF THE EFFECTS OF GENDER, AGE AND MEDICATION IN INSOMNIA: A RETROSPECTIVE INVESTIGATION

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Introduction: Insomnia is a pathological component of many disorders but is often insidious in onset and progression, and therefore difficult to resolve. Evidence supports differences in sleep patterns and quality between genders and among various age groups. Therefore the goals of this analysis were to determine whether differences existed in key sleep neurotransmitters and hormones between gender and/or age groups, as well as to uncover any differences between various pharmaceutical interventions.
Methods: Retrospective data analysis was performed on specimens submitted to Pharmasan Labs, Inc. (Osceola, WI) for urinary neurotransmitters and salivary hormone analysis. Adult patients (18-75 years) with insomnia who collected urine and saliva specimens at night were included in the data analysis. All data were de-identified but retained gender and age information. Specimen values (n = 170-180 patients) were grouped according to specific parameters and a primary analysis of neurotransmitter and hormone levels were compared by age, gender, and pharmaceutical use.
Results: Two-tailed t-tests revealed that GABA (P = 0.0082) and glutamate (P = 0.0039) levels were lower in males compared to females. When all subjects taking neurotransmitter-modulating medications were removed, this difference disappeared. Interestingly, when subjects taking GABA-modulating medications were removed, there was no difference in GABA levels, but glutamate was still significantly lower (P = 0.03) in males. Further, GABA was significantly higher (P = 0.0228) in the 50-75 age range for the combined sexes when compared to the younger 18-49 year old age group. Even after subjects taking sleep medications were removed from the data, the difference in GABA (P = 0.035) between the age groups remained.
Conclusion: Collectively, this data indicates that there exists gender and age differences in cases of insomnia, and that traditional GABA-supportive medications designed to aid in sleep may not be the only target for sleep medications.
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0019

THE EFFECTS OF INACTIVATION OF ENDOGENOUS OPIOID SYSTEM ON THE SLEEP-WAKEFULNESS CYCLE

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Introduction: Application of low-dose naltrexone, a nonselective opioid antagonist, is considered to be a potential way for preventing/treating of various forms of cancer and autoimmune disorders. These disorders are characterized by marked sleep disturbances. Diurnal variations of endogenous opioid peptides in the brain areas, which are involved in the regulation of sleep-wakefulness cycle (SWC), correlate with the basic light-dark cycle in rodents. The present study was aimed to examine effects of low doses of naltrexone on the SWC organization in the rat.
Methods: Experiments were conducted on mongrel adult male rats weighing 330-380 g. After an adaptation period, electrodes were implanted into the following cortical areas: sensorimotor, dorsal hippocampus projection and the neck muscles, under chloralhydrate anesthesia. Following the post-surgery recovery, the animals were i.p. injected with low doses of naltrexone (Naltrexone Hydrochloride, Sigma). To asses the effects of the treatment on the SWC architecture, 24-hours EEG/EMG recordings were performed in baseline condition and in the condition of naltrexone injection (3 mg/kg and 6 mg/kg). Data obtained were evaluated statistically, using Student's t-test, results are expressed as Mean ± SE.
Results: Naltrexone injection caused a dose-dependent increase in deep slow-wave sleep from 20% (baseline condition) to 25% (naltrexone 3 mg/kg) and to 29% (naltrexone 6 mg/kg). During the first 4-hour period after the treatment, the amount of wakefulness decreased from 59%

(baseline) to 49% and 42% (3 and 6 mg/kg of Naltrexone, respectively). The mean duration of paradoxical sleep episodes during the first 4-hour period after 6 mg/kg naltrexone administration significantly decreased to 61.76 ± 14.68 sec, $P < 0.05$ compare to baseline 121.36 ± 21.68 sec.
Conclusion: These findings suggest that inactivation of endogenous opioid system facilitates the mechanisms responsible for slow-wave sleep. We hypothesize that naltrexone acts by blocking opioid receptors located on other neurotransmitter containing cells that project to the slow-wave sleep promoting structures.
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0020

KETAMINE-XYLAZINE-INDUCED INHIBITION OF NEURONAL ACTIVITY INCREASES BRAIN ENERGY CHARGE IN SLEEP-WAKE RELATED BRAIN REGIONS

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Introduction: Sleep is hypothesized to restore energy depleted during waking. We showed recently that the sleep-associated increase in the currency of cellular energy, adenosine-triphosphate (ATP), is strongly correlated with NREM slow wave activity (SWA, 0.5 - 4.5 Hz) in sleep-wake related brain regions. To further confirm the effect of SWA on brain energetics we pharmacologically induced SWA with ketamine-xylazine administration and examined the interrelationship between the changes in ATP, ADP, AMP and adenosine as well as phosphocreatine (PCr) and creatine (Cr) in sleep-wake related brain region. To further understand the cause for ATP changes we measured mRNA changes in the ATP-utilizing enzyme, Na+K+ATPase, and the ATP-synthesizing enzymes COX III and COX IVa.
Methods: Frontal cortex (FC), basal forebrain (BF), cingulate cortex (CCX) and hippocampus (HIPP) samples from male Sprague-Dawley rats were collected 90 minutes after ketamine-xylazine administration in the dark period (IP, 100 mg/kg and 5 mg/kg respectively) and saline-treated diurnal controls. ATP levels were measured by the luciferase bioluminescence method. HPLC measured PCr, Cr, ADP, AMP, and AD while RT-PCR measured Na+-K+-ATPase, COX III and COX IVa mRNA levels.
Results: As predicted, ketamine-xylazine induced increases in EEG delta activity were positively correlated with ATP changes. Moreover, ketamine-xylazine treatment decreased Cr, AMP and AD, while PCr levels increased. At the transcriptional level, mRNA levels of Na+-K+-ATPase, COX III and COX IVa decreased.
Conclusion: The data, showing a pharmacologically-induced SWA associated increase in ATP and PCr, suggest a coupling of neuronal activity and energy metabolism. They thus support the hypothesis that, during NREM sleep with high SWA, high energy molecules fuel anabolic processes not possible during wake.
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0021

LECTIN-LIKE RECEPTOR (LOX-1) MEDIATES VASCULAR DYSFUNCTION IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Lectin-like Oxidized Receptor (LOX-1) is the major receptor for oxidized LDL (OxLDL) in endothelial cells and its expression is enhanced in proatherogenic settings. We hypothesized that patients with obstructive sleep apnea (OSA) would have higher LOX-1 expression as measured by circulating soluble LOX-1 (sLOX-1) levels, compared to those without OSA and that CPAP therapy will attenuate this abnormality.
Methods: We recruited sixteen patients with newly diagnosed OSA [apnea-hypopnea index (AHI) 5.8-99.3 events/hr] and ten healthy controls [AHI 2-5 events/hr]. All participants were free of underlying cardiovascular diseases. Venous blood samples were collected the morning of the sleep study and assayed for human LOX-1 with commercially available enzyme-linked immunosorbent assay kits. Plasma levels of sLOX-1 were measured before and after 8-weeks of continuous positive airway pressure (CPAP) therapy.
Results: At baseline, sLOX-1 levels were higher in patients with OSA than in controls (365.6 ± 368.4 pg/ml and 77.0 ± 36.5 g/ml, respectively; P = 0.01). The increased levels of sLOX-1 correlated with AHI (R2 = 0.322, P = 0.002) but not with the severity of hypoxemia or the frequency of arousals. After 8 weeks of treatment with CPAP, sLOX-1 levels decreased significantly from 365.6 ± 368.4 pg/ml to 143.5 ± 87.9 pg/ml (P = 0.018).
Conclusion: Plasma levels of LOX-1are elevated in patients with OSA and are decreased after 8-weeks of CPAP therapy. LOX-1 may mediate the increased risk of cardiovascular morbidity in OSA, and nCPAP might be useful for decreasing these risks.
Support (If Any): Funding for this study was provided by the American Sleep Medicine Foundation's Physician-Scientist Training Award.

0022

REM SLEEP IS DIFFERENTIALLY MODULATED BY OREXIN TYPE 2 RECEPTORS IN LATERAL PONTINE TEGMENTUM (LPT) AND VENTRAL SUBCOERULEUS (vSubC)

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Introduction: Orexin neurotransmission plays an important role in the suppression and timing of REM sleep. The brain areas involved in these effects are unclear. Here, we use small interfering RNAs (siRNAs) to assess the role of type II orexin receptors (OxR2) in REM sleep control in two brainstem regions: lateral pontine tegmentum (LPT) and ventral SubCoeruleus (vSubC).
Methods: A pool of 3 siRNAs against OxR2 was used (siRNA-OxR2) to knockdown OxR2 in the LPT (AP -7.8, DV 6.3, ML 1.5) and vSubC (AP-9.3, DV-9.5, ML 1.5) of male Sprague-Dawley rats. A pool of 3 siRNAs with no homology to known rat genes (siRNA-scrambled) was used as control. siRNA-OxR2 or siRNA-scrambled were bilaterally microinjected into the target area on two consecutive days. Baseline sleep was recorded for 24hr and then the rats were divided into two groups to be injected either with target siRNAs or scrambled siRNAs. EEG/EMG data was recorded for at least 6 days following injections, and scored visually offline.
Results: Microinjection of OxR2 siRNA into the LPT increased REM sleep during both the dark and light periods by 47 % (N = 5, 3scored) for two days compared to the baseline. On the other hand, microinjection of OxR2 siRNA into the vSubC (N = 4, 3 scored) increased REM sleep by 55% during the dark period for 3 days but also induced nearly 20% reduction of REM sleep during daytime. No significant sleep changes were observed in 2 rats that received control siRNA.
Conclusion: Our results imply that OxR2 in both LPT and vSubC are involved in REM sleep regulation, although the effect is region specific. It appears that OxR2 in LPT is involved in modulating the amount of REM sleep while OxR2 in vSubC plays a role in diurnal gating of REM sleep.
Support (If Any): VA Merit Award (to RWM) and NIH MH039683 (to RWM)

0023

A NEW MODEL OF NARCOLEPSY ARISING FROM OE/3 (Ebf2)-NULL MUTANT MICE

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Introduction: OE/Ebf transcription factors have been implicated in neural differentiation. Mice carrying a targeted deletion of the OE3 (Ebf2) gene show a defective migration of GnRH-synthesizing neurons towards the hypothalamus. We hypothesized that there might be other alterations in the hypothalamus of OE3-null animals, specifically of the orexinergic system, which is known to control wakefulness. Immunostaining revealed that there is a loss of nearly 80% of orexinergic neurons in the lateral hypothalamus of OE3-null mice when compared to wild-type mice, which lead us to analyze a probable narcoleptic phenotype in these mutant animals.
Methods: We implanted cortical and muscle electrodes for chronic monitoring of EEG/EMG, and performed electrophysiological analysis of the sleep-wake cycle in eight wild-type and six OE3 null mice. Each mouse was recorded during a dark-cycle 12hr period, corresponding to the peak activity of the mice. Food and water were replenished at 07:00, and mice were not otherwise disturbed in any way except the minimal perturbation caused by initiation of the recording.
Results: OE3-null mice show numerous narcoleptic-like REM intrusions (9 episodes/12 h) during the recording period, whereas wild-type animals presented none. OE3-null mice also spend nearly 3X more time in REM sleep stage than wild-type animals (75.8+8.0 min/12 h vs. 28.7+3.5 min/12 h; P = 0.002) and 20% more time in nREM sleep stage (347.5+20.3 min/12h vs. 290.3+28.2 min/12h; P = 0.001). The increases in the time spent in sleeping stages correlate with a significant decrease in the time spent in the wake stage (296.6+18.2 min/12 h vs. 401.1+28.6 min/12 h; P = 0.001).
Conclusion: OE3 could be involved in regulating the development of the orexinergic circuit in the lateral hypothalamus. OE3-null mice represent a new model of narcolepsy where the orexin genes are intact but the number of orexinergic neurons in the lateral hypothalamus is severely decreased.
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0024

CHRONIC RESTRICTION OF SLEEP PRODUCES PERSISTENT METABOLIC ABNORMALITIES IN RATS

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Introduction: Recurrent bouts of sleep reduction and fragmentation in rats results in progressive increases in food and water intake, loss of body weight, increased intestinal length, and abnormalities of connective tissues. The purpose of the present investigation was to determine

the permanency of these changes once the subjects again were allowed to sleep normally.

Methods: Six cycles of 10 days of sleep restriction and 2 days of recovery were administered to rats (N = 8) housed in Bergmann-Rechtschaffen disk apparatuses. Sleep restriction was produced by applying a 6-sec ambulation requirement according to a schedule validated for consistent sleep disruption. Ambulation requirements for control rats (N = 8) were consolidated into periods that allowed uninterrupted sleep. All rats then were allowed to sleep ad libitum during the next 4 months. Food (atherogenic) and water intake, and body weight were recorded throughout. Adipocyte morphology, organ condition, and clinical chemistries were determined as end-points. Mixed effects modeling and parametric statistics were applied to the data.

Results: One rat was removed from the study when it developed an agonal status, a recognized consequence of lost tolerance to sleep restriction. For survivors, 4 months of recuperation were marked by constantly elevated food and water intake by 1.2 (95% CI: 1.08-1.33, P = 0.0009) and 1.6 (95% CI: 1.36-1.88, P < 0.0001) times baseline, respectively, despite regained body weight to 98% that of ambulation controls by 88 days of extended recovery and growth rates and adipocyte size that did not differ between groups. Clinical chemistries were normal, except for lower plasma cholesterol levels in sleep-restricted rats (449 vs 649 mg/dl, P = 0.013). Skin dermatoses that developed during sleep restriction typically were incompletely healed during extended recovery.

Conclusion: Despite 4 months of recuperation, metabolism and nutritional needs that were increased by chronic sleep restriction remained elevated relative to those of ambulation controls despite comparable growth rates and end-point body weights. Remembering that cholesterol is key to cell membranes and a myriad of body functions, lower levels in recuperating sleep-restricted rats than in controls hint at differential substrate or storage needs. Together, these long-term alterations in metabolic and nutritional parameters point to enduring, subclinical curative processes because changes at the level of the tissues appeared normalized, except for the skin.

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0025

GENE EXPRESSION PATTERNS FOLLOWING ACUTE INTERMITTENT HYPOXIA AND SLEEP FRAGMENTATION IN MOUSE VISCERAL FAT

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Introduction: Obstructive sleep apnea syndrome (OSAS) is associated with a va¬riety of cardiovascular and metabolic complications. Adipose tissues, and more specifically visceral fat (VF), are active endocrine organs with important roles in metabolic homeostasis. However, it remains unclear how VF is affected by intermittent hypoxia during sleep (IH) or by sleep fragmentation (SF), and whether these two perturbations share common, biologically relevant genomic pathways.

Methods: Adult mice CB57BL (n = 36) were exposed to either IH or SF for 6 hrs. Total RNA were isolated from VF and hybridized onto mouse whole genome oligonucleotide-microarrays. The data were imported into GeneSifter and ANOVA and false discovery rate (FDR, P-value < 0.00001) were used to identify the most highly significantly affected genes. Gene Ontology (GO) was used to identify the biological pathways in both IH and SF vs. room air, and HeatMap was also sued to visualize the clustered genes in the matrix. Venn diagram was used to identify a unique site of genes pattern for each paradigm and the common genes among those paradigms.

Results: We identified a distinct pattern of gene expression in IH (105 transcripts) and SF (81 transcripts) using very stringent P-values (< 0.00001). Of the differentially expressed genes compared to control conditions, there were 100 genes that were exclusively altered following IH and 76 genes in SF, with 5 gene transcripts being shared by both IH and SF (i.e., Trp53inp1, Rnf26, MT1, Pla2g2d, and Higd1b). Microarray findings were subsequently confirmed using real-time PCR. Hierarchical cluster and GO and Gene Pathway Enrichment analyses revealed that the vast majority of the differentially expressed transcripts in IH and SF could be incorporated into a selected number of functionally relevant pathways underlying metabolic regulation.

Conclusion: Following exposures to acute IH and SF, selected changes in gene expression patterns occur in mouse VF. Using a systems biology approach, these data reveal recruitment of functionally relevant gene pathways in adipose tissues that may play a central role in metabolic and vascular dysfunction associated with OSA.

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0026

POTENTIAL ROLE OF LEUKOTRIENE B4 PATHWAY IN INTERMITTENT HYPOXIA-INDUCED ATHEROSCLEROSIS IN MICE

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Introduction: Obstructive sleep apnea (OSA) is characterized by intermittent hypoxia (IH) during sleep, and has emerged as an independent risk factor for cardiovascular disease. Indeed, IH induces atherosclerotic lesion formation in mice. The LTB4-BLT1 axis appears to play a critical role in the formation of atherosclerotic lesions in apoE-/-/Blt1-/- transgenic mice. Furthermore, LTB4 production is increased in OSA patients and negatively correlates to hypoxic levels during sleep, with CPAP therapy decreasing LTB4 production. However, it remains unclear whether LTB4 plays a direct role in IH-associated atherosclerosis.

Methods: Macrophage transformation, activation of inflammatory pathways, atherosclerotic lesion formation were assessed following IH exposures in apoE-/-/Blt1-/- transgenic mice and apoE-/- mice. Mice were exposed to IH (alternating 21% and 5.7% O2 from 7AM to 7PM each day) for 10 weeks. LTB 4 production was assessed by ELISA. The mRNA expression of 5-LO and LTA4H was assessed by real time PCR. Monocyte transformation and migration were assessed by flow cytometry and immunohistochemistry. Induction of inflammation was examined by measuring TNF-α, IL-1, and IL-6 production. Atherosclerotic lesion formation in en face aorta was examined by oil red O staining.

Results: IH induced increased production of LTB4, as well as the mRNA expression of 5-LO and LTA4H, the key enzymes underlying LTB4 production in isolated primary monocytes of apoE-/- mice. IH was associated with transformation of monocytes to activated macrophages, as evidenced by increased expression of CD14 and CD68. IH also increased the migration of activated macrophages, as evidenced by immunohistochemistry in apoE-/- mice. In addition, IH also induced the elevated expression pro-inflammatory cytokines, TNF-α, IL-1, and IL-6 in the serum of apoE-/- mice. IH promoted atherosclerotic lesion formation in apoE-/- mice All IH-induced changes were markedly attenuated in apoE-/-/Blt1-/- transgenic mice.

Conclusion: LTB4 plays an important role in IH-induced atherogenesis via its cognate receptor Blt1, and may become a potential therapeutic target aiming to prevent and potentially reverse OSA-associated atherosclerosis.

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0027

OSTEOPONTIN: A CONNECTION BETWEEN OBSTRUCTIVE SLEEP APNEA (OSA) AND VASCULAR DISEASE

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Introduction: Obstructive sleep apnea (OSA) causes recurrent episodic oxyhemoglobin desaturation (intermittent hypoxia) that has pathological effects on vascular function. Patients with untreated OSA are at higher risk for cardiovascular disease, including hypertension, coronary artery disease, peripheral vascular disease, and stroke. However, the specific mechanisms leading to these changes remain elusive. Nuclear Factor of Activated T cells (NFAT) activation is induced by endothelin-1 in response to hypoxia, and has been shown to mediate intermittent hypoxia-induced hypertension in mice. NFAT also functions as an inflammatory modulator that regulates the expression of TNF-α, IL-6, and osteopontin (OPN), a multifunctional protein important in proliferation, migration, and remodeling in the vasculature. OPN is highly expressed by injured epithelium, endothelium and vascular smooth muscle cells. NFAT-mediated OPN expression may represent a missing link between obstructive sleep apnea and cardiovascular disease since plasma levels of OPN are increased in hypertension, coronary artery disease, acute myocardial infarction, and hypoxia.
Methods: Plasma was obtained from eligible patient volunteers before and after diagnostic polysomnography. OPN levels were compared among those with mild, moderate, and severe OSA.
Results: Of the patients studied, higher OPN levels were significantly associated with a low average oxyhemoglobin saturation in NREM sleep (P = 0.0384), oxyhemoglobin saturation nadir in REM sleep (P = 0.0384) and lower daytime oxyhemoglobin saturation (P = 0.0251). Furthermore, nighttime OPN levels showed a strong tendency to correlate with an elevated apnea-hypopnea index associated with at least a 4% oxyhemoglobin desaturation (P = 0.0545), desaturation index (P = 0.0545), average oxyhemoglobin saturation in REM sleep (P = 0.0545), and oxyhemoglobin saturation nadir in NREM sleep (P = 0.0735).
Conclusion: OPN expression parallels severity of OSA and oxyhemoglobin desaturation indices. OPN may be a molecular mediator of the vascular pathology induced by the intermittent hypoxia of sleep-disordered breathing and a marker for OSA severity.
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0028

GENETIC VARIANTS IN CPT1B/CHKB AND TCRA ARE ASSOCIATED WITH CNS HYPERSOMNIAS (ESSENTIAL HYPERSOMNIA) OTHER THAN NARCOLEPSY WITH CATAPLEXY

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Introduction: Genome-wide association studies have recently identified CPT1B/CHKB and TCRA as susceptibility loci for narcolepsy with cataplexy. The purpose of this study was to evaluate the significance of these loci in Japanese CNS hypersomnias (essential hypersomnia: EHS) other than narcolepsy with cataplexy.
Methods: We performed an association study in Japanese cases of EHS (n = 137) versus Japanese controls (n = 569 in CPT1B/CHKB, n = 433 in TCRA). Our diagnostic criteria for EHS comprised three clinical items: 1) recurrent daytime sleep episodes that occur basically every day over a period of at least 6 months; 2) absence of cataplexy; 3) the hypersomnia is not better explained by another sleep disorder, medical or neurological disorder, mental disorder, medication use, or substance use disorder. The diagnostic criteria for EHS correspond to narcolepsy without cataplexy and most of the idiopathic hypersomnia without long sleep time if we apply the criteria according to ICSD-2. The cases of EHS carried a significantly higher frequency of HLA-DRB1*1501-DQB1*0602 haplotype than Japanese general population ($P = 9.2\times10^{-11}$; OR = 3.97), as well as narcolepsy with cataplexy.
Results: We found a significant association between EHS and control groups in SNP rs5770917 located in CPT1B/CHKB (P = 0.004; OR = 1.56). Regarding SNP rs1154155 located in TCRA, there were no significant differences between EHS and control groups. Next, interaction between SNP rs1154155 and HLA-DRB1*1501-DQB1*0602 haplotype was calculated in EHS cases. A significant interaction was observed (|R| = 0.2, P = 0.02). Thus, EHS cases were subdivided into two groups, HLA-DRB1*1501-DQB1*0602 haplotype-positive and -negative EHS, for stratified analysis. We found that HLA-positive EHS was significantly associated with SNP rs1154155 (P = 0.01, OR = 2.65). In addition, SNP rs1154155 was genotyped in HLA-matched controls (n = 151) possessing HLA-DRB1*1501-DQB1*0602 haplotype, and a significant association was also confirmed between HLA-positive EHS and HLA-matched control groups (P = 0.0005, OR = 4.26).
Conclusion: TCRA, CPT1B and CHKB are candidates for susceptibility to CNS hypersomnias (EHS), as well as narcolepsy with cataplexy.

0029

SEX CHROMOSOME COMPLEMENT HAS INFLUENCES ON RAPID EYE MOVEMENT SLEEP REBOUND FROM FORCED WAKEFULNESS

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Introduction: Gonadectomy increases rapid eye movement (REM) sleep amount during recovery from forced wakefulness in males but not females suggesting that a non-gonadal determinant can impart sex differences in REM sleep recovery. The four core genotypes line (FCG) allowed us to examine the effects of genetic sex on sleep. Male FCG mice have a Y chromosome lacking the testis-determining gene Sry (designated by Y-) and therefore fail to develop testes. The presence of an Sry autosomal transgene suffices for testis development. The FCG line consists of XX, XY-, XXSry, and XY-Sry mice.
Methods: Adult mice from each of these genotypes were implanted with EEG/EMG recording electrodes and placed in a 12L:12D cycle. After recovery from surgery, they underwent 24 hrs of baseline recording followed by 6 hrs of forced wakefulness and 18 hrs of recovery sleep opportunity.
Results: There were no significant differences in baseline sleep or wake amount between any of the four core genotypes. After 6 hrs of forced wakefulness by gentle handling, mice from each of the genotypes exhibited an increase in NREM sleep and REM sleep during the initial period of recovery following forced wakefulness (ZT 6-12). There were no significant differences in the total amount of NREM sleep recovery during the last six hours of the light phase between the genotypes. However, XY- mice, which are genotypic males but phenotypic females, exhibited a larger increase of REM sleep over baseline values during the six hour recovery period (32.4 min increase) than any of the other genotypes (XY-Sry: 9 min; XXSry: 17.2 min; XX: 13.9 min).
Conclusion: These data suggest that the presence of a Y chromosome may amplify the homeostatic REM sleep response to acute sleep depri-

vation, providing the first evidence that genetic sex may contribute to the homeostatic regulation of the sleep-wake cycle.

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0030

SLEEP-WAKE REGULATION IN TYPE 1 EQUILIBRATIVE NUCLEOSIDE TRANSPORTER KNOCKOUT MICE

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Introduction: Adenosine is a ubiquitous neuromodulator which has been suggested to regulate sleep-wake behavior. The nucleoside transporters are one of the factors that regulate the levels of intra- and extracellular adenosine. Previous studies have shown that blocking type 1 ENT (ENT1) increased the levels of extracellular adenosine, inducing increased slow wave sleep. In this study, we investigated the spontaneous sleep-wake pattern in ENT1 knockout (KO) mice as well as the effect of basal forebrain perfusion of adenosine or cyclopentyltheophylline (CPT) on sleep.

Methods: Mice were implanted with EEG electrodes and microdialysis cannula into the basal forebrain. We compared the spontaneous sleep-wake pattern and non-REM delta activity (1-4Hz) of KO mice with wild type (WT) controls. We examined the changes in the sleep parameters in KO mice by comparing the correlations between the wake-time or theta activity (5-9Hz) during wake in the preceding hour and NREM delta during sleep in the following hour. Finally we also examined the effect of adenosine (100 and 300 uM) or CPT (10uM) perfusion on sleep.

Results: During light period, ENT1 KO mice showed longer waking duration and shorter NREM duration while the no changes were observed in the number of episodes. The total NREM delta activity was similar for both genotypes but only in WT mice and not in KO, a significant correlation between the preceding hour wake-time or wake-theta activity and NREM delta in the following hour was observed ($R = 0.607$, $P < 0.00001$; $R = 0.541$, $P < 0.00001$, respectively). Perfusion of adenosine and CPT differentially altered these parameters.

Conclusion: Our results suggest that ENT1 plays a role in regulation of sleep-wake behavior as implicated by the loss of correlation between wake time or wake theta activity and NREM delta activity in ENT1 KO mice.

0031

FABP4 POLYMORPHISMS, OSA, AND OBESITY AS MAJOR DETERMINANTS OF FABP4 PLASMA LEVELS IN CHILDREN

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Introduction: Children with either OSA or obesity are at increased risk for cardiovascular morbidity and the metabolic syndrome, both of which are critically affected by plasma FABP4 levels. FABP4 plasma levels are increased in some but not all children with OSA or obesity, suggesting that genomic variance in the FABP4 gene may account for such discrepancies.

Methods: Four SNPs of the human FABP4 gene (rs1051231, rs2303519, rs16909233 and rs1054135), corresponding to several critical regions of the encoding FABP4 gene sequence were used to genotype non-obese and obese children with or without OSA. FABP4 levels were also assessed in fasting morning blood samples using ELISA. Univariate analyses of variance and multivariate stepwise logistic regression were employed for data analyses.

Results: 309 children (4-10 years of age) were studied. Obese children and children with OSA had significantly higher FABP4 levels than corresponding controls ($P < 0.01$). In the univariate analysis, age, OSA, obesity, and rs2303519, rs16909233, and rs1054135 polymorphisms showed significant contributions to higher FABP4 plasma levels. However, OSA, obesity, and rs1054135 accounted for 86% of the variance in FABP4 levels, with small contributions from the other 2 polymorphisms.

Conclusion: Increased plasma FABP4 concentrations are associated with obesity and OSA in children, and such relationships are strongly modulated by FABP4 gene polymorphisms, particularly by the allelic variances in the rs1054135 polymorphism. The clinical implications of the interactions between OSA, obesity, and FABP4 genomic variance in the prevalence of vascular and metabolic morbidity are being actively explored

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0032

TEMPORAL CHANGES IN VISCERAL FAT GENE EXPRESSION IDENTIFY DISTINCT PATHWAYS DURING EXPOSURE TO CHRONIC INTERMITTENT HYPOXIA

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Introduction: OSA is associated with several cardiovascular and metabolic complications that appear to be causally related to intermittent hypoxia (IH) effects on adipose tissues. We hypothesized that exposures to IH will lead to distinct temporal patterns of gene expression in visceral fat that will reflect the selective activation of specific functional pathways.

Methods: Adult CB57BL mice ($n = 36$) were exposed to IH during sleep for 6 hrs, 1 day, 3 days, 7 days, and 13 days. Total RNA was isolated from visceral fat (VF) tissues and hybridized to whole-genome oligonucleotide microarrays. Following data filtration and normalization, an algorithm designed for time course data analysis was used to identify differentially expressed genes compared to normoxic control. Temporal patterns of gene expression were extracted using partition around medoids clustering algorithm. Differentially expressed genes in each cluster were mapped to functional categories using Gene Ontology annotations, and then integrated pathway-focused approaches with genetic network analyses to explore putative mechanisms activated by chronic IH in VF.

Results: Approximately 3500 differentially expressed genes (FDR < 0.01) were classified into 8 distinct temporal clusters. Some clusters revealed dramatic increases or decreases in visceral fat gene expression during the time course of exposure to IH. Enriched functional categories in genes showing temporal increase in expression included mitochondrial activity, catalytic activity, oxidoreductase activity, oxidative phosphorylation, fatty acid metabolic process and fatty acid oxidation. While processes enriched in temporally down regulated genes included post-translational protein modification, cytoskeletal organization & biogenesis, and blood vessel development. Furthermore, the cluster-specific and selective activation of biological pathways mapped to different gene product interaction networks.

Conclusion: Differential gene expression responses to chronic IH in visceral fat were used to define distinct molecular networks regulated in a time-dependent fashion. Our approach provides a promising framework to gain novel perspectives in adipose tissue biology using a relevant animal model of sleep disordered breathing.

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0033

ASSOCIATION ANALYSIS OF THE Gln223Arg POLYMORPHISM IN THE HUMAN LEPTIN RECEPTOR GENE, AND TRAITS RELATED TO OSAS AND BLOOD PRESSURE

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Introduction: Recent functional studies have suggested a direct effect of leptin on blood pressure. Polymorphysims of leptin receptor (LEPR) may contribute to obesity-related diseases. In this study we examined the association of the leptin gene polymorphism with obstructive sleep apnea syndrome (OSAS) and hypertension in Turkish men population.
Methods: In total 120 men 88 OSAS, 32 non OSAS were included. We evaluated anthropometric measurements, blood pressure and the Gln223Arg polymorphysims in each subject. To confirm the diagnosis, all patients underwent standard polysomnography (PSG) in our sleep disorder center. The genotype distribution of the Gln223Arg polymorphism was determined with the polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) method using MspI restriction enzyme.
Results: There were no difference in the genotype frequencies for Gln223Arg polymorphisms (Gln/Gln and Gln/Arg, Arg/Arg) between OSAS and non OSAS men (P = 0.234). There were statistically significant difference between groups of OSAS and non OSAS in systolic blood pressure (P = 0.016). It was seen that genotype frequency of Arg223Arg homozygote were more prevalent among normotensive (13.2%) compared with about 6.8% in the hypertensive men but there was no statistical significant (P = 0.281). The main finding was lower systolic blood pressure in Arg223Arg genotype but there was no statistical significant (P = 0.289).
Conclusion: It was seen that Gln223Arg polymorphism has no relation with OSAS and hypertension. By using molecular research methods of other polymorphism in Leptin receptor, it is necessary to search the effect of leptin receptor on OSAS in Turkish population that there has not enough data.

0034

microRNA AND mRNA EXPRESSION PROFILES AND SIGNALING NETWORKS IN VISCERAL FAT OF MICE EXPOSED TO ACUTE SLEEP FRAGMENTATION

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Introduction: Sleep fragmentation (SF) is one of the hallmarks of many sleep disorders and is putatively involved in adverse metabolic consequences via disruption of adipose tissue homeostasis, particularly visceral fat (VAT). However, neither the transcriptomic signature nor the identity of its corresponding microRNA (miRNAs) that underlie such VAT alterations during SF has been defined.
Methods: Adult CB57BL (n = 14) were subjected to 6 hrs of acute SF (n = 7) during sleep and controls (n = 7). VAT was harvested and total RNA and miRNA were isolated from the same tissues. Total RNAs were hybridized into mouse genome gene expression microarray (44K transcripts), and miRNA were also hybridized into mouse genome miRNA arrays (596 miRNA). Differentially expressed mRNAs and miRNA were initially identified, classified as either up or down regulated, and then each of these 2 categories was used for gene target predications, using 6 different software programs (miRanda, TargetScanS, PicTar, miRGen, miRDB, and miRPath). The predicated targets derived from miRNA and mRNA were then matched and compared, and needed to be identified in ≥ 3 software. Such "in silico validated" targets were then subjected to further analyses such as gene networks, GO and KEGG pathways. The PANTHER database was used for analyzing the significance of biological processes and pathways within each ontology term. The predicated targets for miRNA and mRNAs were then validated by RT-PCR.
Results: Eight up-regulated and 6 down-regulated miRNAs were identified at P-value < 0.001 in SF-exposed VAT. The up-regulated miRNAs predicted 111 mRNA targets, and the down-regulated miRNAs predicted 192 mRNAs target predication genes, such that 303 putative predicated genes were used for GO, KEGG, and gene networks. Most prominently among these were insulin and Wnt signaling pathways. In the initial analyses of gene expression arrays, there were 37 down-regulated genes and 42 genes were up-regulated at P-values < 0.00001. Those genes were used to predicate potential corresponding miRNA targets. For the up-regulated mRNAs, we identified 109 miRNAs, and for the down-regulated mRNAs, 79 miRNAs were predicated
Conclusion: Altered miRNA-mRNAs expression patterns emerge in VAT following SF, and appear to involve highly regulated and coordinated gene networks. Further validation and characterization of these networks and biological pathways and their functional implications may reveal important components of the metabolic consequences of sleep disruption
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0035

GENETIC SCREEN TO RESCUE NEGATIVE OUTCOMES IN A DROSOPHILA MODEL OF INSOMNIA

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Introduction: Insomnia is a complex, multigenic disorder that is characterized by sleep disruption and daytime impairment. We have created an animal model of insomnia that results in heritable disruptions in sleep. These animals are uniquely situated to provide insights into both the causes and long-term consequences of insomnia. Historically, animal models of human diseases are used to indentify single genes which are then studied individually. Given that the goal of these studies is to identify therapeutic targets, it is desirable to define their role in the context of the original disease state. insomnia-like (ins-l) flies display dominant phenotypes thereby allowing us to introgress them with genetic tools (e.g. GAL4 drivers) that allow for the spatial and temporal control of a candidate gene in the context of disease.
Methods: Drosophila GAL4 lines were backcrossed with ins-l flies for 15 generations to create ($GAL4^{ins\text{-}l}$) with ins-l phenotypes. Candidate genes are then expressed to either enhance or suppress ins-l traits including sleep, lifespan, learning impairments, and obesity.
Results: We have successfully created several $GAL4^{ins\text{-}l}$ lines that exhibit ins-l characteristics. For example, $GAL4^{ins\text{-}l}$ lines display increased sleep latency (> 3 h), reduced sleep time (< 300 min), severely fragmented sleep, such that the maximum sleep bout is less than 30 min, and increased adiposity.
Conclusion: We have created novel genetic tools that allow us to study the role of individual genes in the context of insomnia, a complex, multigenic sleep disorder. This approach allows us to identify genes that are causative with respect to insomnia as well as genes that can protect short-sleeping symptomatic ins-l flies from negative outcomes (e.g. learning deficits). We believe that the $GAL4^{ins\text{-}l}$ flies can be used to identify novel targets for the treatment of insomnia.

0036

SLEEP STAGE AND AGE DEPENDENCE OF CARDIO-RESPIRATORY COUPLING IN HEALTHY SUBJECTS

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Introduction: Recent studies have focused on various features of cardiac and respiratory dynamics with the aim to better understand key aspects of the underlying neural control of these systems. While earlier studies have focused on cardio-respiratory coupling, the nature of the interaction between these two systems remains not well understood. Here we investigate how sleep influences cardio-respiratory coupling, and how the degree of this coupling changes with transitions across sleep stages in healthy young and healthy elderly subjects.
Methods: We analyze full night polysomnographic recordings of 180 healthy subjects (age range: 20 to 89 years). Sleep stages have been scored following international standards. To quantify cardio-respiratory coupling, we apply a novel phase-synchronization analysis method to quantify the instantaneous phase difference between heartbeat and breathing signals. The degree of cardio-respiratory synchronization is defined by the proportion of synchronization episodes where the instantaneous phase difference between heartbeat and breathing is constant. For each subject, we obtain the percentage of cardio-respiratory synchronization (coupling) for each sleep stage dividing the total duration of synchronization episodes by the entire duration of a given sleep stage throughout the sleep period.
Results: We find a statistically significant difference in the degree of cardio-respiratory coupling across different sleep stages for both healthy young and healthy elderly subjects. Our analysis shows a six-fold increase in cardio-respiratory phase synchronization in NREM sleep compared to REM sleep. Specifically, during deep sleep cardio-respiratory synchronization is enhanced by a factor of 8 compared to REM sleep. Remarkably, this difference between REM and NREM sleep remains stable across all age groups, although the total percentage of cardio-respiratory synchronization significantly decreases with advanced age.
Conclusion: Sleep regulation strongly influences cardio-respiratory coupling leading to a well-pronounced stratification pattern across sleep stages. Reduction of parasympathetic tone with advanced healthy aging leads to a diminished cardio-respiratory coupling.
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0037

DEVELOPMENTAL CHANGES IN BRAIN CONNECTIVITY ASSESSED USING THE SLEEP EEG

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Introduction: Adolescence is a time of significant cognitive development. Waking EEG studies show that connectivity between brain regions, as indexed by coherence, increases in adolescence and may underlie cognitive gains. The present study measured developmental changes in coherent activity in the sleep EEG in adolescents.
Methods: All-night sleep EEG recordings in two longitudinal cohorts (children and teens) followed at 2 - 3 year intervals and one cross-sectional cohort (adults) were analyzed. The children and teen cohorts were 9/10 and 15/16 years old at the initial assessment; the adult cohort was 20/23 years old. Intrahemispheric, interhemispheric, and diagonal coherence was measured between all six possible pairings of two central (C3/A2 and C4/A1) and two occipital (O2/A1 and O1/A2) derivations. Within-subjects analyses were performed for the children and teen cohorts, and a linear regression analysis was performed across every assessment of all cohorts.
Results: Children showed only intrahemispheric coherence increases with age in the right hemisphere (C4-O2) during slow wave and REM sleep for the delta band. For teens, intrahemispheric coherence increased in the right hemisphere (C4-O2) during slow wave, stage 2 and REM sleep in all frequency bands. Furthermore, teens showed interhemispheric coherence increase with age only between occipital derivations during slow wave, stage 2, and REM sleep for the sigma band and for the delta band during slow wave sleep. Regression analysis across cohorts showed an overall linear increase in left and right intrahemispheric coherence for all sleep states across frequencies. Furthermore, coherence between diagonal electrode pairs also increased in a linear manner for stage 2 and REM sleep. No age-related trend was detected in interhemispheric coherence.
Conclusion: Our results indicate that coherence increases with age and that these increases are confined to specific brain regions. This analysis highlights the utility of the sleep EEG in measuring developmental changes in coherence.
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0038

AGE RELATED DYSFUNCTION OF WAKE-ACTIVE NEURONS

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Introduction: Sleep/wake quality changes as humans age. Many individuals experience increased nighttime awakenings and have difficulty staying awake during the day. This is likely attributed to age related neuronal dysfunction. Expression of BiP/GRP78, an ER molecular chaperone in wake-active neurons, decreases over age yielding accumulation of misfolded proteins and an increase in apoptotic factors. In young animals, but not aged animals BiP is upregulated in response to an acute stressor such as sleep deprivation. Catecholaminergic, but not orexinergic wake-active neurons also express NADPH oxidase (NOX) which interferes with BiP function, leading to neuronal dysfunction. We predicted transgenic mice with reduced BiP (+/-) would have wakefulness impairments correlated to less neuronal activity. Additionally, we predicted wake-active neurons expressing NOX would show less activity during prolonged wakefulness in 24 month aged mice versus 3 and 12 month aged mice and that these neurons show dysfunction at an earlier age than wake-active neurons not expressing NOX.
Methods: In BiP (+/-) and wild-type mice, EEG recordings and/or beam breaks monitored activity. Animals were sleep deprived for 6hrs. during the lights-on period. We used immunohistochemistry to compare neurons double-labeled for TH or OXA and c-fos between groups of mice.
Results: 24 month wild-type animals show less c-fos activity in wake-active neurons (22.6%) when compared to 12 and 3 months of age (45% and 44% respectively $P < 0.05$). A reduction in wakefulness coincided. Wake-active neurons expressing NOX show a reduction in c-fos activity in comparison to orexinergic neurons at 3 months but not 12 or 24 months ($P < 0.05$). In BiP (+/-) mice wakefulness impairments were also seen; neuronal activity will be compared.
Conclusion: Age related dysregulation diminishes maintenance of wakefulness.

0039

GAMMA OSCILLATIONS IN MOUSE PREFRONTAL CORTEX SLICES: DEVELOPMENTAL CHANGES

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Introduction: Gamma rhythms (30-80 Hz) are a prominent feature of the electroencephalogram during spontaneous behavior and following presentation of salient stimuli. Gamma rhythms often occur concurrently with theta (4-12 Hz) rhythms during waking associated with movement and during REM sleep. They have been ascribed important functions in attention, conscious awareness (binding) and learning and memory and are dysfunctional in a variety of medical and psychiatric disorders. Little is known of the mechanisms mediating the development of these rhythms in the neocortex.
Methods: Experiments were performed in acute neocortical slices prepared from wild-type or GAD67-GFP knock-in mice at different ages: Pups (p5-p13), young mice (p14-p21), pubertal mice (p35-p45), and adult mice (p81-p91). We focused on mouse prelimbic cortex, the rodent homologue of the human dorsolateral prefrontal cortex, an area implicated in attention and working memory. A brief (80 ms, 30 psi), focal kainate (1 mM) application to the slice was used to induce transient, reproducible oscillatory activity.
Results: A switch in the peak frequency of kainate induced oscillations from beta (25 Hz) to gamma (45 Hz) occurred around postnatal day 13-14, a time when cortical circuitry is maturing. Kainate-induced gamma oscillations were dependent on the activation of action potential firing and on AMPA and GABAA receptors since they were blocked by application of tetrodotoxin, DNQX or GABAzine. In contrast, the power of gamma oscillations was enhanced by acute NMDA receptor blockade by AP-5 or MK-801.
Conclusion: Gamma oscillations can be reliably induced in mouse neocortical slices, including those from mice where GABAergic neurons are labeled with GFP. A switch in peak frequency from beta to gamma frequencies occurs during early postnatal expression. A defect in the induction or maintenance of this switch may play an important role in disorders such as schizophrenia, where gamma rhythms are affected.
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0040

ASSOCIATIONS BETWEEN NIGHTTIME SLEEP DURATION AND DEVELOPMENTAL OUTCOMES IN A NATIONALLY REPRESENTATIVE SAMPLE OF PRESCHOOL-AGE CHILDREN

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Introduction: Many studies support the important role of sleep in developmental processes (cognition, emotion, and attention). However, the results have been inconsistent and difficult to interpret given varying methodology and samples. We examined a model using child and bedtime characteristics, and nighttime sleep duration in predicting developmental outcomes using standardized assessments in a large, nationally representative sample.
Methods: The analyses used data from the 9-month and 4-year waves of the Early Childhood Longitudinal Study - Birth Cohort (ECLS-B) and include approximately 8000 children who completed a direct assessment at 4 years and whose parents completed a phone interview at 9 months and 4 years. Child characteristics included parent-reported ethnicity, gender, and SES. Bedtime characteristics included (1) whether or not parents report rules about what time child goes to bed and (2) usual bedtime during the week. Nighttime sleep duration was based on parent-reported usual bedtime and wake time. Developmental outcomes were assessed using a shortened set of items from standardized assessments of children's receptive and expressive language, literacy, phonological, and early math abilities.
Results: Controlling for child and bedtime characteristics, shorter nighttime sleep duration was associated with lower scores on phonological awareness ($\beta = -.03$, $P = .05$) literacy ($\beta = -.20$, $P = .04$), and early math ($\beta = -.28$, $P = .02$). Having a rule about bedtime was the most consistent predictor of positive developmental outcomes (receptive language: $\beta = .38$, $P = .0005$; expressive: $\beta = .19$, $P = .002$; phonological: $\beta = .13$, $P = .002$; literacy: $\beta = 1.00$, $P = .001$; early math: $\beta = 1.43$, $P < .0001$). Earlier bedtime also was predictive of higher receptive ($\beta = -.09$, $P = .004$), phonological ($\beta = -.04$, $P = .002$), literacy ($\beta = -.27$, $P = .003$), and early math ($\beta = -.25$, $P = .005$) abilities.
Conclusion: These data replicate other studies showing a strong link between sleep and developmental outcomes. Specifically, these results highlight the importance of a consistent bedtime reinforced by intentional parenting practices for children's overall cognitive development. In addition, amount of nighttime sleep may have a unique contribution to certain types of cognitive processing that underlie phonological awareness and math abilities.

0041

GROWTH AND SLEEP IMPAIRMENT ARE ASSOCIATED WITH DECREASED HYPOTHALAMIC GROWTH HORMONE RELEASING HORMONE IN CHRONIC UPPER AIRWAY LOADING IN JUVENILE RATS

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Introduction: Growth retardation is a significant morbidity in children with sleep-disordered breathing (SDB). The reduction of serum insulin-like growth factor-1 (IGF-1) in children with SDB is related to reduction of slow wave sleep (SWS). Chronic airway loading (CAL) in juvenile rats, a model of SDB, is associated with impaired longitudinal growth attributed to impaired growth hormone (GH)/IGF-1 axis. In the present study we explored whether CAL affects hypothalamic growth hormone releasing hormone (GHRH) that regulates both sleep and GH homeostasis.
Methods: The tracheae of 22-day-old rats were obstructed by tracheal banding (n = 20 sham controls, n = 21 CAL), and animals were returned to their cages for 12:12 h light dark cycle, lights on at 09:00. Sixteen days after CAL surgery animals were sacrificed. Sleep architecture, serum GH, IGF-1, and hypothalamic GHRH mRNA were analyzed using telemetric transmitters (DSI, St. Paul, MN), ELISA, and real time PCR, respectively.
Results: In the CAL group inspiratory swings in esophageal pressure increased (250%, $P < 0.001$), respiratory rate decreased (30%, $P < 0.01$), and tracheal resistance increased (50%, $P < 0.02$). Body weight, and tibia and tail length gains were all 30% to 40% less ($P < 0.0001$) in the CAL group. Serum GH and IGF-1 levels decreased by 38% ($P < 0.05$) and 32% ($P < 0.001$), respectively, in CAL animals. Hypothalamic GHRH mRNA levels decreased in CAL rats by 22% ($P = 0.05$). CAL led to sleep fragmentation, i.e., there was 25% elevation in wakefulness and 15% reduction of SWS duration during 12 hrs light onset. EEG power density during the first 3 hrs of light on was 40% lower in the CAL group in the range of 0.5-4 Hz ($P < 0.001$).
Conclusion: CAL impairs sleep architecture and the GH/IGF-1 axis, and is associated with somatic growth retardation. Underlying mechanisms may involve reduction of hypothalamic GHRH that regulates both GH level and sleep architecture/consolidation.
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0042

PHARYNGEAL VOLUME AT STATIC APPLIED PRESSURES IN OBESE ZUCKER RATS IS REDUCED COMPARED TO LEAN AGE-MATCHED LITTERMATES

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Introduction: Obesity is an important risk factor for obstructive sleep apnea. We have previously shown that Obese Zucker (OBZ) compared to Lean Zucker (LNZ) rats have decreased pharyngeal airway size during inspiration. In order to examine how obesity affects pharyngeal mechanics without the confounders of flow and muscle activation, static pressure was applied in the passive isolated upper airways of rats during magnetic resonance imaging (MRI). We hypothesized that at the same applied pressure, the upper airway of OBZ rats would be smaller than LNZ rats.
Methods: 8 OBZ and 9 LNZ rats, aged 14 ± 2 weeks ($P = 0.33$), weights: OBZ = 616 ± 68g, LNZ = 405 ± 46g ($P < 0.001$) were studied. Rats were anesthetized (isoflurane) and mechanically hyperventilated (tracheotomy) to suppress muscle activity. The upper airway was sealed and connected to a measured pressure/vacuum source. We used gradient recalled MRI (slices = 15, thickness = 1 mm , matrix = 128 x 128 , field of view = 50 mm) in a 4.7T magnet to examine the pharynx at 4 static pressures (+5, -5, +2.5 and -2.5 cmH2O). The pharyngeal airway cross-sectional area was measured in all rats at 5 anatomically matched slices at the mid-pharyngeal region.
Results: At +5 cmH2O pharyngeal volume (sum of all 5 slices) was larger for LNZ (25.7 ± 11 mm3) compared to OBZ (16.5 ± 6 mm3, $P < 0.047$) and the relative increase in volume in LNZ from: -5 to +5 cmH2O, was larger for LNZ (22 ± 12 mm3) than OBZ (10 ± 5 mm3, $P < 0.016$) rats.
Conclusion: Static pressure in the passive airway dilates the lean Zucker pharynx significantly more than in the obese Zucker pharynx. This evidence suggests that obesity impairs pharyngeal dilation through a passive (anatomic) mechanism.
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0043

STATE-DEPENDENT EFFECTS OF GENIOGLOSSAL STIMULATION ON UPPER AIRWAY

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Introduction: Stimulation of the genioglossal muscle has been attempted as a therapeutic modality to improve upper airway patency in subjects with obstructive sleep apnea. We set out to determine whether changes in upper airway patency achieved during wakefulness would predict the effect of such stimulation on events of sleep-disordered breathing during sleep.
Methods: In subjects with mild-moderate, positional, obstructive sleep apnea, genioglossal muscle stimulation was achieved by placement of a single set of bipolar wire electrodes in the muscle under ultrasound guidance. During wakefulness, upper airway dimensions were measured in the stimulated and un-stimulated conditions from lateral soft-tissue neck X-rays. During sleep, subjects underwent polysomnography during stimulated and un-stimulated conditions (split-night study).
Results: In five subjects (all men, age 55 + 9 years; median AHI 13.9, interquartile range [IQR] 10.8, 43.3 per hour) stimulation of the genioglossus achieved an increment in upper airway dimensions by 28.6% (IQR 10.8, 61.2%; $P = 0.04$). Upper airway dimensions measured at the retroglossal level was greater in the stimulated condition (median 7.2 mm; IQR, 1.2, 10.6) than in the un-stimulated condition (median 5.6 mm; IQR, 1.1, 6.5; $P = 0.043$; Wilcoxon Signed Rank test). The increments in the upper airway dimensions were not correlated with the changes in sleep-disordered breathing (measured as apnea-hypopnea index; $R = 0.22$; $P = 0.7$).
Conclusion: Improvements in upper airway dimensions achieved by genioglossal stimulation during wakefulness were not related to reductions in sleep-disordered breathing achieved during sleep. We speculate that factors other than genioglossal activity alone may determine upper airway patency during sleep.
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0044

STRUCTURAL EFFECTS OF MECHANORECEPTOR MEDIATED CHANGES IN GENIOGLOSSUS ACTIVATION

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Introduction: Genioglossus muscle activation mediated by negative airway pressure mechanoreceptors is suppressed at sleep onset. This loss of muscle tone is associated with increased airway resistance and pharyngeal collapse. The structural effects associated with this loss of muscle tone have not been investigated. To evaluate the effects of mechanical receptor-mediated genioglossus activation, a retrospective analysis of sedated endoscopies was performed.
Methods: Following IRB approval, intraoperative sedated sleep endoscopies performed between January 2005 and July 2009 were retrospectively reviewed. A steady state level of arousable sedation was performed using low bolus dose and continues infusion of propofol. Fiberoptic rhinolaryngoscopy was performed including baseline exam, transition to snoring, transition to apnea, and following placement of a nasopharyngeal airway to bypass palate obstruction. Studies were excluded for primary tongue base and lower pharyngeal obstruction, inability to obtain adequate visualization of the airway, or non-plament of the nasal airway. Representative images at end expiration were digitized and compared using identifiable landmarks to calibrate image measurement software (Bersoft, Toronto, Canada).
Results: Twenty patients (17 male, 3 female) were identified from 75 patients who underwent clinical studies. Placement of a nasopharynal airway resulted in elimination of palatal snoring in all patients and reduced or eliminated inspiratory hypopharyngeal airway narrowing. At end expiration significant narrowing of the hypopharyngeal tongue base associated airway occurred (decrease 51.2%, $P < 0.003$). Significant collapse occurred in both the anterior posterior (41.0%, $P < 0.0001$) and lateral (19.6%, $P < 0.03$)dimensions.
Conclusion: Bypassing airway obstruction using a nasopharyngeal airway results in significant reductions in hypopharygeal airway size. Reduction is greatest in an anterior to posterior dimension and is consistent with loss of genioglossus muscle tone. This reduction is postulated to be due to reduction in mechanorecetptor mediated muscle activation. These data suggest sedated sleep endoscopy using propofol infusion does not eliminate negative pressure mediated mechanoreceptor muscle activation, however, placement of a nasopharyngeal airway provides a potential method to model the effects of sleep onset loss of airway reflexes.

0045

GENIOGLOSSUS (GG) SINGLE MOTOR UNIT (SMU) BEHAVIOUR DISCHARGE IN QUIET BREATHING, CO2 AND CPAP, IN HUMANS

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Introduction: Respiratory control of the diaphragm and upper airway are mediated through chemoreceptors and mechanoreceptors.
Methods: We examined the discharge properties of GG SMU to quantify neural drive during periods of quiet breathing, elevated ETCO2 and CPAP (2cmH2O increments until 10cmH2O). 15 subjects were studied awake supine, breathing through a mask. Ultrasonography assessed the anatomy & placement of 3 electrodes into GG. We measured onset time, onset and peak firing frequency relative to respiration for 96 SMUs, tracked throughout 8 conditions.
Results: The classes of units sampled at baseline were: Inspiratory Phasic units (58%). Inspiratory Tonic units (24%). Expiratory Phasic units (4%). Expiratory Tonic units (11%). Tonic units (3%). Only 16 units [Inspiratory Phasic (13) and Inspiratory Tonic (3)] did not change their class, under the different conditions, but showed a number of alterations. The onset frequency at 2cmH2O (15.1 ± 2.3Hz) & 4cmH2O (12.9 ± 1.4Hz) were lower (17.6 ± 1.4Hz) than baseline and CO2 (16.6 ± 1.2Hz; $P < 0.05$). Peak discharge frequencies at 4cmH2O (18.6 ± 1.9Hz) were reduced compared to CO2 (23.4 ± 1.6 Hz) and 2cmH2O (22.6 ± 1.5Hz; $P < 0.05$). Onset time was later at 2cmH2O (5.5 ± 2.3%TI) & 4cmH2O (10.5 ± 4.7%TI) compared with baseline (2.8 ± 3.1%TI), 2cmH2O (0.4 ± 3.7%TI) and CPAP-OFF (1.9 ± 3.3%TI; $P < 0.05$). Overall the 2cmH2O increments of CPAP progressively inhibited the number of motor units active. At ~6cmH2O there were a similar number of motor units active as compared to baseline conditions despite the elevated levels of CO2. With the pressure raised to 10cmH2O, the number of active units was 20% less than baseline.
Conclusion: Inspiratory Phasic & Inspiratory Tonic units have earlier pre-activation and increased peak firing frequencies during inspiration in response to CO2 and this increase in activity is terminated by CPAP. Single motor unit activity is altered in response to chemical and mechanical stimuli; these results have implications for understanding upper airway motor control.
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0046

DOSE DEPENDENT IMPACT OF NMDA RECEPTOR INHIBITION ON SLEEP AND BREATHING IN RATS

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Introduction: Glutamatergic neurotransmission plays important roles in respiratory rhythm generation and homeostatic reflexes. We showed that riluzole (a glutamate release inhibitor) and ondansetron (a 5-HT3 antagonist that attenuates vagal reflexes) reduced respiratory pattern variability, including apneas, in sleeping rats. This study measured the impact of memantine, an NMDA receptor and 5-HT3 receptor antagonist on sleep and breathing.
Methods: Five adult Sprague-Dawley rats underwent polysomnography (10:00 - 16:00) on 4 occasions at 3-day intervals. Prior (09:45) to each recording, the animal was injected (1 ml/kg intraperitoneal) with memantine at a dose of either: 1) 0 (saline), 2) 0.1, 3) 1.0, or 4) 10.0 mg/kg. Dose order was randomized for each animal. Sleep was staged from EEG and EMG signals and breathing was assessed by whole body unrestrained plethysmography. Apneas were scored as respiratory pauses longer than 2 seconds (equivalent to approximately 2 missed breaths). Statistical inferences were made by paired t-tests.
Results: The frequency of sleep-related apnea was reduced at the lowest dose and increased at the higher doses: 11.7 ± 2.8 (SD) for saline; 9.1 ± 3.6 for 0.1 mg/kg ($P = 0.04$ vs saline); 17.7 ± 7.5 ($P = 0.04$) for 1 mg/kg; 20.3 ± 10.8 ($P = 0.05$). Similar trends were observed for NREM and REM apnea. REM sleep expression increased by an average of 93% (range 11% to 333%; $P = 0.05$) after 0.1 mg/kg memantine and decreased by an average of 87% (range -33% to -100%; $P = 0.01$) after the 1 mg/kg dose. Sleep efficiency was not affected by memantine at the doses tested.
Conclusion: Memantine, a mixed profile NMDA and 5-HT3 receptor antagonist exhibited dose-dependent effects on respiratory pattern variability and REM sleep expression. We speculate that the dose dependencies observed may reflect the differential action of memantine at NMDA versus 5-HT3 receptors or the multiple roles of glutamate signaling in respiratory homeostasis.
Support (If Any): NIH AG016303-S109

0047

SEROTONIN 2A RECEPTOR mRNA LEVELS, BUT NOT mRNAs FOR OTHER EXCITATORY RECEPTORS THAT MEDIATE WAKE-RELATED ACTIVATION OF HYPOGLOSSAL (XII) MOTONEURONS, ARE HIGHER IN THE XII NUCLEUS AT WAKE ONSET THAN AT SLEEP ONSET

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Introduction: Motor activity of the tongue is high during wakefulness in association with various voluntary behaviors, whereas during sleep tongue muscles are relatively quiescent. Serotonin (5-HT), norepinephrine and orexins (OX) are some of the major mediators of wake-related activation of XII motoneurons that innervate the tongue. We investigated whether mRNA levels for the receptors that mediate activating effects of these modulators vary in the XII nucleus in association with the rest-activity cycle.
Methods: Adult Sprague-Dawley rats were decapitated under deep isoflurane anesthesia at 8-9 AM (rest/sleep onset; n = 8-10 animals) or at 6-7 PM (near active period onset; n = 7-9 animals), medullary slices were obtained, 500 µm tissue micropunches were extracted from the motor XII nucleus and sensory external cuneate nucleus, RNA was extracted, reverse-transcribed and subjected to quantitative PCR. 5-HT_{2A}, 5-HT_{2C}, α_{1A}- and α_{1B}-adrenergic, and OX-2 receptor mRNAs were quantified relative to the number of tubulin copies in each sample.
Results: In the XII nucleus, 5-HT_{2A} receptor mRNA levels were higher in the samples collected at active period onset than in those collected at rest onset (15 ± 4 (SE) vs. 3 ± 1.7 per 1000 copies of tubulin cDNA; $P < 0.01$), whereas the other mRNAs did not exhibit significant variations. In the external cuneate nucleus, mRNA levels for 5-HT_{2A}, 5-HT_{2C}, and α_{1B}-adrenergic receptors were 3-6 times lower than in the XII nucleus, and no mRNA exhibited significant circadian variation, although α_{1B}-adrenergic receptor tended to be twice higher at active period onset ($P = 0.056$).
Conclusion: If these mRNA changes lead to proportional changes in functional membrane receptors, our data suggest that excitatory actions of 5-HT on XII motoneurons are reinforced as a result of wake-related increase in availability of 5-HT_{2A} receptors. In obstructive sleep apnea patients in whom sleep-related upper airway hypotonia facilitates airway obstructions, low levels of 5-HT_{2A} receptors may contribute to sleep-disordered breathing.
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0048

LINGUAL MUSCLE ACTIVITY IS INCREASED IN RATS WITH SURGICALLY IMPAIRED GENIOHYOID MUSCLE FUNCTIONS

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Introduction: Obstructive sleep apnea (OSA) patients have elevated upper airway motor tone during wakefulness when compared to healthy persons. In contrast to humans, rodents exhibit no propensity for sleep-related airway obstructions, a difference that may be due to the hyoid apparatus providing more rigid support to the upper airway in rodents than in humans. In an attempt to develop a rodent model with compromised upper airway, we studied lingual muscle activity across sleep-wake states in rats with severed attachment of the geniohyoid muscle to the hyoid bones.
Methods: Adult rats were instrumented for recording of lingual, diaphragmatic and nuchal electromyograms (EMGs) and cortical electroencephalogram. The tendon connecting the geniohyoid to the hyoid apparatus was severed by a transverse cut and a barrier was inserted to impede reconnection. After habituation, recordings were obtained on days 6, 8, 12, 14 and 22 after instrumentation. Wake, slow-wave sleep (SWS) and rapid eye movement sleep (REMS) were scored and root mean square levels of lingual EMGs were measured in 10 s epochs.
Results: Lingual EMGs were recorded at 9 sites near the base of the tongue in 5 rats with the tendon cut and at 3 sites in 2 rats without a cut. In the treated, but not control, rats wake-related lingual EMG levels normalized by their mean during wakefulness on day 6 were 32% ± 8 (SE) lower on day 8 ($P < 0.004$), remained reduced by ~23% on days 11 and 14, and then increased to the initial level on day 22. No systematic changes occurred in SWS or REMS levels of lingual EMGs, and no impairments of breathing or ingestive behaviors were noted.
Conclusion: Surgically weakened support of the tongue caused an initially high and then waning wake-related activity of lingual muscles whereas sleep-related activity was not altered. This would be similar to wake-related elevation of lingual EMG in OSA patients, but the secondary increase suggests that additional time-varying mechanisms are involved.
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0049

TOPOGRAPHY OF FUNCTIONALLY DISTINCT REGIONS WITHIN THE PEDUNCULOPONTINE TEGMENTUM OF THE RAT

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Introduction: The pedunculopontine tegmentum (PPT) is a highly heterogeneous structure, which participates in sleep, motor and autonomic regulation. Previous investigations suggested a possible localization of PPT regions regulating sleep/wake states and respiratory function. The aim of the present study was to determine the functional map of respiratory, upper airway motor, cardiovascular and electroencephalographic influences within the PPT, using glutamate microinjections.
Methods: Bilateral monopolar cortical EEG, bipolar pontine EEG, genioglossus electromyogram (EMG), respiration , electrocardiogram (ECG) and arterial blood pressure (BP) were registered in 42 ketamine/xylazine anesthetized rats. Functionally distinct areas were mapped within the PPT according to responses following glutamate microinjection (10mM, 5-12 nl).
Results: Functional responses were classified as: 1) apnea; 2) tachypnea; 3) respiratory dysrhythmia; 4) BP fluctuation; 5) cardiac arrhythmia; 6) pontine-waves (p-waves) and 7) genioglossus EMG activation. Short latency apneas and respiratory dysrhythmias were elicited predominantly from the lateral portion of the PPT, in close proximity to cholinergic (NADPH diaphorase +) neurons. Tachypneic responses were most frequently evoked from ventral regions of the PPT, whereas BP disturbances were most typically observed following stimulation of the ventral portion of the anterior PPT. We elicited cardiac arrhythmic from the most ventral part of the medial PPT at the boundary with nucleus reticularis pontis oralis, whereas p-waves were registered predominantly following stimulation in the dorso-caudal portion of the PPT. Genioglossus EMG activation was observed following injections into the medial PPT.
Conclusion: The present study demonstrates substantial anatomical segregation within the PPT among respiratory, cardiovascular and electroencephalographic responses to glutamate microinjection. These findings are consistent with discrete localization of other PPT functions and suggest a potentially broad role for the PPT in autonomic modulation. Although most responses were induced from sites associated with cholinergic neurons, elaboration of the mechanisms underlying the observed responses will require future investigation.
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0050

BREATHING RHYTHM STABILIZATION IN NEWBORN MICE UNDER RESTRAINT STRESS INDUCED BY ECG ELECTRODE ATTACHMENT

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Introduction: It is widely accepted that REM sleep dominates during the early postnatal weeks in humans and animals and respiration during REM sleep is unstable. However, reports of breathing activities immediately after birth in small animals are very scant probably because it is difficult to detect respiratory signal from extremely small bodies. As we recently developed a piezoelectric (PZT)-sensor-based cardiorespiratory monitor for mice (Sato et al., 2006), we investigated the breathing rhythmicity of mice during sleep/rest or under restraint stress at early postnatal weeks.
Methods: We put a newborn mouse on a PZT sensor and started recording the signal output from the sensor for 5 min, which was followed by a simultaneous PZT and ECG recording for 5 min after attaching ECG electrodes to their paws. After the recording, 11 successive breath to breath intervals within 1 min (BB0) and that during 3−5 min (BB5) were sampled. The BB0 and BB5 were compared in mice between postnatal 4d (P4) and P12 (n = 5), and between with (BB-ECG) and without the ECG-electrode attachment (BB-PZT) (n = 5), which gave mice a restraint stress.
Results: There was no significant difference of breathing interval in P4/P12 mice between BB0 and BB5. Breathing-rate variability (BRV), a standard deviation (SD) of 10 differences between a BB0/BB5 and the previous BB0/BB5, was comparable between BB0 and BB5 in P4 mice but decreased in BB-ECG compared to BB-PZT. Whereas, BRV at P12 was not significantly different between BB0-PZT and BB5-PZT (F test; $P > 0.08$), but the BRV of BB5-ECG was significantly smaller than that of BB0-ECG ($P < 0.004$).
Conclusion: Mouse's breathing rhythm was irregular during early postnatal weeks, which was stabilized by a restraint stress at P4 and P12 at 5 min (BB5-ECG), while the irregularity in P12 mice increased immediately after the electrode attachment. PZT sensor seems to be useful for studying mechanisms of breathing control during sleep and during under stresses.

0051

WHY DOES BREATHING FREQUENCY INCREASE DURING RAPID EYE MOVEMENT SLEEP?

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Introduction: Previously, we have described that the respiratory systems receives state-specific excitatory inputs during rapid eye movement (REM) sleep. This excitation has a specific profile. It develops with a delay after the onset of REM sleep, rises to a peak in the second part of the REM period, and wanes towards the end of the period. Here, we study whether this process is responsible for the increase in respiratory frequency characteristic of REM sleep.
Methods: Six adult male Wistar rats were anesthetized and electrodes were implanted to record the electroencephalogram and electromyograms (EMG) of the diaphragm, genioglossus, intercostals, extensor digitorum and neck muscles. After recovery and adaptation, the animals were recorded in a freely moving condition during REM sleep. Recording were digitized (Spike2) and analyzed off-line. Breath-by-breath analyses of respiratory effort ($\int EMG_D/T_I$) and frequency were carried out on rectified diaphragmatic EMGs from 180 REM periods. Variation in REM sleep duration was taken into consideration by dividing each REM period into 20 equal segments, and averaging diaphragmatic effort and frequency values in each segment.
Results: The frequency of breathing increased during the second part of the REM period. During this phase, the frequency could reach values of 400 breaths per minutes. This is equivalent to three times the average level seen during NREM sleep. Frequency expressed as a function of time presented a profile similar to the REM-specific excitatory process seen previously in respiratory muscles and neurons. Diaphragmatic effort did not present a similar profile across REM periods.
Conclusion: These results indicate that the increase in respiratory frequency characteristic of REM sleep is due to a state-specific excitatory process that affects the respiratory system.

0052

RESPIRATORY VARIABILITY PRE AND POST SPONTANEOUS AROUSALS FROM SLEEP IN PEOPLE WITH AND WITHOUT ASTHMA

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Introduction: Measures of respiratory variability have revealed changes due to sighs (defined as 2x median tidal volume) in healthy adults during wakefulness. We sought to determine if there were differences in variability, as measured by autocorrelation and coefficient of variation (COV), in patients with asthma and controls. We studied subjects during sleep, and focused on spontaneous arousals as sighs are rare.
Methods: Overweight and obese subjects with and without asthma were studied during sleep (with EEG monitoring). Tidal volume was found by integrating airflow. Spontaneous arousals preceded by at least 2 minutes of stable sleep and not the result of sleep disordered breathing were identified. The autocorrelation function and COV of tidal volume were calculated for 4 blocks before and after each arousal. Each block contained 10 breaths with a 50% overlap to the preceding block (total of 25 breaths). The autocorrelation function was evaluated at 1 breath lag.
Results: Three male control subjects and 4 subjects with asthma (1 Male) have been studied. The autocorrelation was not different between asthma and control. COV was lower in those with asthma; however sample size is small. In asthma subjects, COV was at a minimum immediately prior to the arousal (0.14 ± 0.06) and increased post arousal (0.30 ± 0.12) ($P = 0.056$). This increase was accompanied by a decrease in end inspiration resistance (7.0 ± 3.4 cmH2O/L/s to 5.8 ± 2.5 cmH2O/L/s) and an increase in mean tidal volume (0.34 ± 0.07 L to 0.43 ± 0.09 L).
Conclusion: Since deep inspiration may be an important bronchodilator, the analysis of breathing patterns during sleep in people with asthma may yield important insights into nocturnal asthma exacerbations.
Support (If Any): R01 HL090897, Ruth L. Kirschstein NRSA (T-32 grant) from the National Heart, Lung and Blood Institute

0053

INFLAMMATORY AND MECHANICAL PULMONARY CHANGES IN MICE EXPOSED TO A MODEL OF SLEEP APNEA

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Introduction: Sleep apnea leads to intermittent hypoxia (IH), a noxious stimulus capable of triggering inflammation. Upper and lower airway inflammation has been reported in sleep apnea, but lung tissue inflammation was not, to our knowledge, documented. We tested whether mice submitted to IH, a model of sleep apnea, develop inflammatory cell or cytokine responses in the lung parenchyma, and

whether the inflammatory changes are reflected in pulmonary compliance and/or resistance.
Methods: We exposed 8-week-old specific pathogen-free inbred Balb/c mice to 35 days of sham IH (n = 10) or IH (n = 10) from 9 AM to 5 PM. The FIO2 in the cage was reduced during 30 seconds to the nadir of 6%, alternating with 30 seconds of air insufflation to restore the FIO2 to 21%, totalling 480 cycles of hypoxia/reoxygenation per day. At the 35th day, static elastance, viscoelastic component of elastance, resistive, viscoelastic, and total pressures were determined by the end-inflation occlusion method. Microscopic examination of HE stained lung tissue was performed to quantify inflammatory cells infiltrates. Cytokines IL-1, IL-6, and TNF-alpha in lung tissue were determined by ELISA in homogenized lung parenchyma.
Results: The number of polymorphonuclear cells/mcm2 of lung tissue was increased in the IH group, and the mononuclear count was decreased. In the IH group, delta P2 and delta Ptot were significantly decreased, despite the presence of pulmonary infiltration. The cytokines studied did not show any difference between groups.
Conclusion: This model of sleep apnea led to a mild lung inflammation, evidenced by the increase in polymorphonuclear cells in lung tissue, interfering in the viscoelastic properties of lung parenchyma. The possibilities exist that either IH-induced lung inflammation is mediated by cytokines different from the ones studied or that cytokines are concentrated in specific sites in the parenchyma and were diluted during lung tissue homogenization.

0054

THE EFFECTS OF GHRELIN ON SLEEP EEG AND NOCTURNAL HORMONE SECRETION ARE INFLUENCED BY GENDER, AGE AND TIME OF ADMINISTRATION

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Introduction: We showed previously that the neuropeptide ghrelin increases slow-wave sleep (SWS), growth hormone (GH) and cortisol in healthy young male volunteers. We tested whether the effects of ghrelin on sleep-endocrine activity are influenced by gender, age and time of administration.
Methods: In three protocols simultaneously sleep EEG was recorded (23:00 - 07:00) and the secretion of GH and cortisol was assessed (22:00 - 07:00). 50 µg ghrelin or placebo were injected hourly (22:00 - 01:00) to healthy volunteers from three groups: 1) 10 young women, 2) 10 elderly, postmenopausal women and 3) 10 elderly men. Furthermore ghrelin or placebo were injected hourly to 12 young men between 04:00 and 07:00. In this protocal sleep EEG (from 23:00) and hormone secretion (from 22:00) were examined until 10:00 h.
Results: In the elderly men after ghrelin SWS (ghrelin [G]: 44.3 ± 7.7, placebo [P] 33.4 ± 5.1 min), stage 2 (G 221.0 ± 12.2, P 183.3 ± 6.1 min) and nonREM sleep (G 318.2 ± 11.0, P 272.6 ± 12.8 min) increased significantly, whereas stages 1 and REM decreased. In the other three groups (young and elderly women, early morning administration) sleep remained unchanged after ghrelin. In all groups GH and cortisol increased after placebo.
Conclusion: The effects of ghrelin on sleep are influenced by gender, age and time of administration. Similarly to young men ghrelin promoted nonREM sleep in elderly men. Descriptively the relative increases of SWS and stage 2 were higher in elderly men than in young men in ourprevious study. A sexual dimorphism was found as sleep remained unchanged after ghrelin in women. In contrast to the effect of ghrelin given to young men around sleep onset no change was found after administration during the early morning. We confirm that ghrelin is a common stimulus of the somatotrophic and the hypothalamo-pituitary-adrenocortical systems.
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0055

EFFECTS OF SLEEP RESTRICTION ON GLUCOSE REGULATION DURING DIET-INDUCED WEIGHT LOSS

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Introduction: Sleep loss is associated with reduced insulin secretion and action, decreased glucose tolerance, and increased risk of type-2 diabetes. Since diet-induced weight loss represents an important strategy for metabolic risk reduction, we examined the effect of combined caloric and sleep restriction on glucose regulation in overweight adults.
Methods: Ten participants (3F/7M; mean [SD] age 40 [5]y; BMI 27.4 [2.0]kg/m^2) each completed two 14-day studies in random order at least 3 months apart. Studies were carried out in the laboratory with 5.5 or 8.5h time-in-bed (TIB) and balanced caloric intake equal to 90% of the subjects' resting metabolic rate. Sleep was monitored by polysomnography. Oral and intravenous glucose challenges were performed to measure glucose tolerance, glucose effectiveness, insulin secretion, and insulin sensitivity after each intervention. We also measured 24-h blood concentrations of the glucose-regulatory hormones ghrelin, growth hormone, cortisol, epinephrine, and norepinephrine.
Results: Bedtime restriction reduced daily sleep by 122 [25]min. TIB-8.5h and TIB-5.5h resulted in similar weight loss (3.0 [1.1] vs. 2.9 [1.4] kg), but loss of lean body mass was higher during TIB-5.5h (75 vs. 49%). Independent of final body composition, sleep restriction was accompanied by lower fasting blood glucose concentrations, reduced insulin secretion and sensitivity, and decreased glucose effectiveness, without deterioration in glucose tolerance. Ghrelin and growth hormone concentrations increased, epinephrine concentrations decreased, and cortisol and norepinephrine remained comparable during TIB-5.5h vs. TIB-8.5h.
Conclusion: Our results indicate that sleep restriction enhances the neuroendocrine response to caloric restriction characterized by peripheral insulin resistance and decreased beta-cell function, which matches the pattern of ghrelin-mediated changes in glucose metabolism. In the setting of preserved oral glucose tolerance and lower fasting glucose concentrations, these findings suggest that sleep loss triggers a set of adaptations to enhance carbohydrate partitioning towards glucose-dependent tissues at times of restricted energy availability.
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0056

THE ABILITY OF A DOPAMINE D2 RECEPTOR AGONIST TO ALTER REM SLEEP IS SEX DEPENDENT

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Introduction: Restraint is a psychogenic stressor that increases rapid eye movement (REM) sleep amount in mice. The pituitary hormone prolactin, a potential regulator of the ability of stress to increase REM sleep, is negatively regulated by dopamine D2 receptors in pituitary lactotrophs. In the current study, we tested the hypothesis that the ability of restraint stress to increase REM sleep amount is sensitive to dopamine D2 receptor activation by administering the dopamine D2 receptor agonist cabergoline prior to restraint stress in male and female mice.
Methods: Male and female C57BL/6J mice (3-4 months of age) were implanted with EEG/EMG recording electrodes and placed in 12:12 LD. Mice underwent a control procedure in which they received an i.p. injection of either 0.25 mg/kg cabergoline or vehicle prior to 1-hr of sleep deprivation by gentle handling during the light phase (ZT 5-6). Six days after the control procedure, mice received cabergoline or vehicle prior to 1-hr restraint stress (ZT 5-6). Polysomnograms were hand scored in ten second epochs as wake, rapid eye movement (REM), and non-rapid eye movement (NREM) sleep.

Results: In control conditions, during the day (ZT 6-12) cabergoline attenuated REM sleep in females who exhibited 32.7% less REM sleep (P = .05) than those that received vehicle. During the night (ZT 12-24) cabergoline did not have effects on REM sleep in females or males. After restraint stress however, cabergoline attenuated dark phase REM sleep in males, who exhibited 39.1% less REM sleep (P = .04) than those that received vehicle. Cabergoline had no significant effects on NREM sleep amount in any of the conditions.
Conclusion: These data support the hypothesis that sex differences in the ability of restraint stress to alter REM sleep are dependent on dopamine D2 receptor regulation of pituitary prolactin.
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0057

TOWARDS IDENTIFICATION OF NEUROCHEMICAL AND SLEEP EEG MARKERS OF ANHEDONIA IN A NEW MOUSE MODEL OF DEPRESSION

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Introduction: Anhedonia, a decreased sensitivity to rewards, is a core feature of clinical depression. Recently, a new model of stress-induced anhedonia in mice was proposed (T.V.Strekalova et al., 2002-2009).
Methods: In this model, chronic stress induces anhedonia defined by a decrease in sucrose preference only in a subgroup of animals, while the remaining subgroup does not show hedonic deficit. Therefore, the non-anhedonic animals are considered as an internal control for the stress effects not associated with anhedonia.
Results: Importantly, stressed anhedonic but not non-anhedonic mice display other neurobiological changes typical for a depressive state. Lately, specific changes in the brain peroxidation enzymes activity and metabolism of arachidonic acid were found to correlate with an occurrence of the anhedonic state. The latter mechanism is known to be also critically important in the cerebral prostaglandin synthesis. The sleep EEG study with our model revealed significantly advanced shift in circadian rhythm in anhedonic mice, as compared to the non-anhedonic and control animals. Such changes in the paradoxical sleep (PS) were most eminent among other states (waking and slow wave sleep). Besides, in the anhedonic group, a slight though significant decrease in total amount of slow wave sleep in the dark period and sharply increased percentage of the PS during the light period, as compared to two other groups, were documented. However, a latency of PS did not change during the light period while it was increased greatly during the dark phase of the nychthemeron.
Conclusion: A body of evidences suggests that D2/E2 ratio plays an important role in a control of sleep-wakefulness cycle, in particular, in the regulation of PS and also involves in the pathogenesis of depressive disorder. Our data obtained here support this link. Further studies are necessary to elucidate its molecular mechanisms; such studies are now underway.

0058

CARDIO-RESPIRATORY PATTERN OF NORTHERN FUR SEALS DURING SLEEP AND WAKING

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Introduction: In contrast to humans, prolonged apnea and profound bradycardia is a normal event for marine mammals. The objective of this study was to examine the cardio-respiratory pattern across the sleep-wake cycle in the northern fur seal (a species of pinnipeds) while on land.
Methods: Electrocardiogram and respiratory rate were analyzed in relation to the sleep-wake cycle in 5 captive juvenile northern fur seals (*Callorhinus ursinus*) implanted for sleep recording. Inter-breath intervals and beat-to-beat heart rate (HR) were calculated during one 24-h period in each seal.
Results: The breathing pattern of fur seals was regular during quite waking (QW) and slow wave sleep (SWS): all pauses were shorter than 30 sec with 80-94% of them lasting 8-20 sec. The mean breathing pause did not differ between QW and SWS (means varied between 11-18 and 15-18 sec in different seals). REM sleep was characterized by increased irregularity in breathing, with apneas lasting between 30-62 sec (2-15% of all REM sleep pauses in different seals, on average 7±3%). These apneas were followed by periods of ventilation with instantaneous respiratory rates up to 15 breath/min without awakening. During QW and SWS HR varied between 60 and 150 beats/min. The eupneic HR was 90-150 beats/min and apneic HR was 60-90 beats/min, with higher rates during the post apneic periods. During REM sleep instantaneous HR occasionally decreased to 35-55 beats/min. Profound declines coincided with the longest apneas and extensive muscle jerks and REMs. These periods of bradycardia were followed by episodes of tachycardia with instantaneous HR rising above 160 beats/min.
Conclusion: The breathing pattern of northern fur seals on land is regular during QW and SWS and arrhythmic in REM sleep with occasional apneas exceeding 1 min. Breathing bradycardia (an important component of the dive response) in fur seals is pronounced on land during waking, SWS and REM sleep.
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0059

CIRCADIAN VARIABILITY OF FIBRINOLYTIC MARKERS IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) may affect the timing of stroke and acute coronary syndromes (ACS). While stroke and ACS generally cluster between 6 am and noon, ACS occurs earlier (midnight to early morning) in OSA patients. Plasminogen Activator Inhibitor-1 (PAI-1) is fibrinolytic and inhibits tissue-type plasminogen activator (t-PA). PAI-1 levels are elevated in patients with ACS and stroke. Variation in levels and circadian rhythm of PAI-1 and t-PA in OSA patients has not been studied comprehensively and may contribute to the earlier onset of ACS.
Methods: Plasma samples were collected every 2 hours, over a 24-hour period for analysis of antigen and activity for PAI-1 and t-PA. Presence or absence of OSA (apnea-hypopnea index of 5 or greater) was confirmed by overnight polysomnography. Baseline characteristics were compared in the OSA and non-OSA group using Wilcoxon exact rank sum tests or Fisher's exact tests. PAI-1 and t-PA oscillations were evaluated by fitting non-linear mixed effect models.
Results: Mean amplitude of the PAI-1 antigen, in the OSA group (n = 9), was 5.16 units higher than that of the non-OSA (n = 8) group, (P = 0.07). Mean peak amplitude of the PAI-1 activity, and t-PA antigen and t-PA activity, did not differ significantly in the OSA and non-OSA groups (P > 0.1). Difference in mean peak times of t-PA antigen between the OSA and non-OSA groups was 4 hrs and 42 minutes (P = 0.01) with a

later peak time for the OSA group (6:50 am vs. 02:11 am). Mean peak timing of the PA1-1 antigen and activity and t-PA activity did not differ significantly in the two groups (P > 0.1).
Conclusion: The presence of OSA selectively affects the amplitude and timing of fibrinolytic markers involved in ACS and strokes. Intermittent hypoxia and changes in circadian clock genes in OSA patients may underlie these shifts, and require further study.
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0060

CARDIAC RESPONSES OF 2- TO 3-YEAR-OLD CHILDREN TO AFFECT-ELICITING STIMULI IN NAP AND NO-NAP CONDITIONS

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Introduction: Little is known about the relationship between napping and affect responding in pre-school aged children. A previous study of 2- to 3-year olds by Berger et al. showed differences in facial expression to emotional stimuli during Nap and No-Nap conditions. This report describes cardiovascular changes recorded in the Berger et al. study. Of interest was whether withholding a habitual nap would alter the cardiac response to the emotional stimuli.
Methods: Participants were 8 health children aged from 30 to 36 months with no sleep/emotional/behavioral problems. Children followed a strict sleep/wake schedule that optimized sleep opportunity (> 12.5hrs, TIB/24hrs) and stabilized the circadian system for > 5 days before two emotion assessments occurring at the same time under Nap and No-Nap conditions. In each condition, 6 positive, 3 negative, and 3 neutral affect-eliciting pictures were presented. ECG was sampled continuously at 1024 Hz. Differences in mean and standard deviations of RR intervals were obtained by subtracting baseline values from the seven seconds before each picture from the values obtained during picture viewing.
Results: The affect-eliciting pictures resulted in significant slower heart rate (P < .05). Repeated measures ANOVA revealed no changes in mean heart rate or heart rate variability associated with stimulus valence or Nap and No-nap Conditions.
Conclusion: The stimuli used in the present study have proven to elicit different affect responses with older children and adults (Sharp et al., 2006), but these stimuli may not be as effective in promoting cardiovascular changes reflecting affect change in young children. Different stimulus sets may be needed to investigate modulation of children's physiological reactions to emotional events by sleep restriction.

0061

NON-INVASIVE MEASUREMENT OF INDEX OF VESSEL STIFFNESS IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: The magnitude of acceleration of blood pressure (BP) is estimated from the second derivative of a BP waveform and provides insight into vessel tone and/or diameter. The ratio of the second nadir and the first peak of the second derivative (D:A ratio) of the BP waveform correlates with aortic pressure augmentation index, a measure of arterial stiffness. We have previously demonstrated that children with OSA have elevated BP and abnormal autonomic control of the cardiovascular system. Here we test the hypothesis that the D:A ratio in children with OSA is lower than in healthy controls, indicating an increase in arterial stiffness.
Methods: 126 children (58 controls, and 68 with OSA with an obstructive index > 5 / hour) were enrolled. BP and ECG were recorded continuously during otherwise standard polysomnogram. The 2nd derivative of the BP waveform was calculated for each cardiac cycle. A least-square means comparison of the D:A ratio between groups was made in a model which included gender, race, body mass index Z score and age.
Results: The D:A ratio was lower in children with OSA compared to controls during stage 2, - 0.1541 vs. -0.1218, P = 0.05 and during REM sleep -0.2032 vs -0.1545, P = 0.01.
Conclusion: These findings indicate that the 2nd derivative of BP waveform is different in children with OSA compared to controls. The differences in the D:A ratio remain significant after adjusting for demographic characteristics. The findings support the hypothesis that arterial stiffness is increased in children with OSA.
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0062

EFFECTS CAROTID OCCLUSION ON SLEEP-WAKE ACTIVITY IN RATS

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Introduction: Cerebral ischemia can be accompanied by disturbances of sleep-wake activity. Bilateral occlusion of the common carotid artery in rats is an experimental model of chronic cerebral hypoperfusion. We wanted to test whether bilateral carotid occlusion can be used for modeling ischemic sleep-wake disturbances. We have studied the effects of bilateral carotid occlusion on sleep-wake activity in rats
Methods: The experiments were performed on male Wistar rats with implanted EEG electrodes. The animals were kept under conditions of controlled temperature (24 +/- 1C) and lighting (lights on 8:30 - 20:30 h). The animals were exposed to bilateral occlusion of the common carotid artery (n = 6) or sham operation (n = 6). Sleep-wake activity was recorded for 24 h before the carotid occlusion/sham operation (baseline day) and on post-occlusion days 1, 2, 7 and 12.
Results: Bilateral carotid occlusion resulted in a decrease in non-REM sleep (NREMS) during the 12-h light phase on post-occlusion days 1 and 2. By post-occlusion day 7, NREMS recovered and did not differ significantly from the baseline day value. During the dark phase, a tendency to an increase in NREMS was noted on post-occlusion days 1 and 2. REM sleep was suppressed by both carotid occlusion and sham operation in the light phase on days 1 and 2.
Conclusion: Bilateral carotid occlusion resulted only in transient sleep disturbances. Carotid arteries are not the main sources of cerebral blood supply in rats, which may explain the lack of long-term effects on sleep. Bilateral carotid occlusion in rats, however, results in a long-term decrease in brain perfusion with several other consequences, e.g. brain lesions, impaired learning. Our findings demonstrate that normal sleep-wake activity may be preserved even in moderate cerebral ischemia.

0063

PROTEOMICS STUDY ON GENDER DIFFERENCE OF VASCULAR INJURY BY CHRONIC INTERMITTENT HYPOXIA

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Introduction: Obstructive sleep apnea-hypopnea syndrome (OSAHS) is regarded as an independent risk factor for cardiovascular disease,

and treating of OSAHS effectively becomes one of the important strategies for control of cardiovascular disease. However, the current therapies for OSAHS have not showed excellent effects. Recently, the cardiovascular protective effect of estrogen has been convinced, but it is not used widely in clinic for the side effects. Thus, it is important to find drugs with role of estrogen and avoiding side effect. That needs to study the mechanism of protective effect. Till now, there is still no report on protein change of vascular system of OSAHS patients. Quantitative proteomics study will provide new method to study proteins. Thus, the aim was to find gender difference of proteins expression of vascular system under CIH, and further find key protein as target for prevention and therapy.

Methods: A new device for mimic sleep apnea related CIH was designed by our study group, with which C57BL/6J mice (20 male and 20 female) were randomly divided into 4 groups, exposed to CIH or control 8h/d for 28days. Protein difference related to CIH induced vascular injury of different gender was identified by iTRAQ proteomics study.

Results: 163 proteins was identified by iTRAQ proteomics analyzing method, and 34 were difference proteins between different gender which might correlate with vascular injury by CIH.

Conclusion: The study implies CIH can induce vascular injury with gender difference. That about 34 different proteins were identified implies clues for further study and provides basic for searching target proteins of vascular protective effect of estrogen.

0064

CHRONIC INTERMITTENT HYPOXIA REGULATES OXIDATIVE STRESS AND ANTIOXIDANT DEFENSE SYSTEM IN MICE AND GENDER DIFFERENCE

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Introduction: Oxidative stress related to chronic intermittent hypoxia (CIH) is the major mechanism of cardiovascular injury for patients with Obstructive sleep apnea-hypopnea syndrome (OSAHS). Thioredoxin (Trx) represents antioxidant defense system, and thioredoxin-interacting protein (Txnip) expression is an endogenous inhibitor of thioredoxin. Several studies have shown that many factors protected oxidative injury by inhibition of Txnip expression. Till now, it is still unknown how CIH regulates antioxidant defense system (Trx/Txnip) and if there is gender difference. So the purpose of this study was to compare the oxidative stress and anti-oxidative system in mice and different gender under CIH.

Methods: Twenty male and 20 female C57BL/6J mice were separately divided randomly into CIH group and control (10 each group). The CIH group was alternatively exposed to CIH device , which was alternatively flushed with 100% oxygen or 100% nitrogen under time-concentration cycled mode in a 90- second-long cycle, eight hours per day. The control group was used the same device with compress air instead of oxygen and nitrogen. Mice were sacrificed after 28 days of treatment. Serum OxLDL level was detected by ELISA; Trx and Txnip expression of liver tissue were detected by real-time PCR.

Results: After CIH exposure, male mice showed a higher level of serum OxLDL than control ($P = 0.032$) , but no significant difference was found in female mice. Lower level of Trx mRNA was found in the male than that of the female ($P = 0.013$). Txnip mRNA expression of male was higher than that of the female ($P = 0.022$).

Conclusion: CIH can cause activation of oxidative stress system and inhibition of the protective factor Trx and gender may play a role of in this process.

0065

CIRCADIAN VARIATION OF THE INFLAMMATORY CYTOKINES INTERLEUKIN-6 (IL-6) AND INTERLEUKIN-1 RECEPTOR ANTAGONIST (IL-1RA) UNDER CONSTANT ROUTINE CONDITIONS

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Introduction: High circulating plasma levels of the pro/anti-inflammatory cytokine interleukin-6 (IL-6) are a risk factor for cardiovascular disease. Time-of-day dependent changes in IL-6 have been reported for subjects maintaining a sleep/wake schedule, and no time-of-day dependent changes have yet been reported for the anti-inflammatory cytokine interleukin 1 receptor antagonist (IL-1ra). We tested for circadian variation in IL-6 and IL-1ra using a constant routine.

Methods: Twenty-three healthy subjects [11 female; 28.3 ± 9.3 (SD) years] underwent a 40 h constant routine [constant wakefulness, posture, nutrition intake and dim light exposure (< 1.5 lux)], during which hourly plasma samples were taken. Plasma melatonin was assayed using an ^{125}I radioimmunoassay technique (Elias USA, Inc., Osceola, WI). Plasma IL-6 and IL-1ra levels were measured using ELISA kits (R & D Systems, Minneapolis, MN). Circadian phase was assessed by calculating the dim light melatonin onset ($DLMO_{25\%}$). The $DLMO_{25\%}$ was assigned circadian time zero (CT0). IL-6 and IL-1ra data were interpolated to obtain levels at equal sampling times with respect to the $DLMO_{25\%}$, were Z-score transformed, and averaged into 2 h bins. Repeated measures ANOVA with the Huynh-Feldt degree of freedom correction for violations of sphericity were used to test for significant effects of circadian phase.

Results: A significant effect of circadian phase was observed for both IL-6 ($P = 0.04$) and IL-1ra ($P = 0.03$). IL-6 levels were high throughout the late biological day and early biological nighttime, with a nadir near CT10-CT12, which is the circadian phase that corresponds with the end of a habitual sleep episode and the beginning of the biological day. IL-1ra levels showed a similar pattern, but with a slightly later nadir near CT12-CT14.

Conclusion: These findings indicate circadian variation in circulating levels of IL-6 and IL-1ra. The circadian clock or its down stream effectors (e.g. cortisol) could be driving this circadian variation.

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0066

EFFECTS OF SLEEP RESTRICTION AND EXERCISE ON CARCINOGENESIS IN APC MIN+/- MICE

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Introduction: Epidemiological evidence suggests that individuals with short sleep durations (< 7 hrs/night) have an increased risk of cancer mortality, whereas physically active individuals have a reduced risk of colorectal cancer. Our aim was to investigate the effects of chronic sleep restriction and exercise on carcinogenesis in a mouse model of colorectal cancer.

Methods: Seventy-four C57BL/6 and APC Min+/- mice were randomized to one of four 11-week treatments: (1) normal sleep + sed-

entary; (2) sleep restriction + sedentary; (3) normal sleep + exercise; (4) sleep restriction + exercise. In the treatments involving sleep restriction, mice were prevented from sleeping during the 12-hr dark period, an intervention that elicits a daily sleep loss of approximately 4 hr/day. Normal sleeping mice were allowed to sleep ad libitum. Mice in the exercise training treatments ran on a treadmill at a moderate pace (1 hr/day), whereas mice in the sedentary treatments were handled similarly but did not run. Plasma corticosterone levels, blood leukocyte numbers, peritoneal exudate cell cytokine production (IL-1β, TNF-α, and IL-6), and intestinal polyp number and burden were assessed immediately after the 11-week treatments.
Results: Sleep restriction increased polyp burden, and peritoneal exudates pro-inflammatory cytokine protein levels of IL-1β and TNF-α. Exercise reduced polyp numbers, polyp burden, and pro-inflammatory cytokine protein levels (IL-1β, TNF-α, and IL-6) in the normal sleep treatments, but not in the sleep restriction treatments. We did not find any significant changes in corticosterone levels with treatments suggesting that the effects were not due to stress. However, sleep restriction and exercise attenuated circulating blood leukocyte numbers, which may have influenced carcinogenesis.
Conclusion: These data suggest that chronic moderate sleep restriction might promote carcinogenesis. Exercise reduced carcinogenesis under normal sleep conditions. Under sleep deprivation conditions, exercise neither reduced nor exacerbated carcinogenesis.
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0067

TUMOR NECROSIS FACTOR-ALPHA MODULATES GENE EXPRESSION IN HYPOTHALAMIC NEURONS

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Introduction: A growing body of evidence supports a role of the cytokine tumor necrosis factor-alpha (TNF) in sleep disorders such as narcolepsy and sleep apnoea, as well as in fatigue associated with infectious and autoimmune diseases. TNF is produced in the central nervous system (CNS), mainly by microglia cells and astrocytes, but also by neurons. Subcutaneous infusions of TNF impairs locomotor activity in mice and lowers the expression of clock genes. In the study presented here we investigated TNF-inducible gene-expression profile in murine hypothalamic neurons using DNA microarray technology to identify TNF mediated neuronal dysfunctions.
Methods: To assess the effect of TNF on murine hypothalamic neurons (mHypoE-N1), they were treated for 4 h with TNF. Thereafter cells were harvested, RNA extracted and after cDNA synthesis and labeling the probes were hybridized on the microarray (Agilent). Three replicas were analyzed and compared to mock treated neurons. The data obtained were compared with those obtained from TNF treated murine dorsal root ganglion cells. Genes of interest which were modulated by TNF were verified either by real-time reverse transcriptase-polymerase chain reaction or ELISA techniques.
Results: Our data show that numerous genes expressed in N1 hypothalamic neurons respond to TNF with a more than two-fold induction rate. Of the transcripts altered in TNF treated neurons the majority were identified as immune response genes or genes involved in neuronal function. A comparison of our TNF induced gene expression profile obtained from N1 neurons with profiles from dorsal root ganglion cells revealed a striking CNS specificity.
Conclusion: This study of hypothalamic neurons suggests that TNF, a cytokine which is upregulated in sleep disorders, activates both immune response genes and genes involved in the function of neurons. In future studies we will assess the expression of TNF target genes in the cerebrospinal fluid of patients with sleep disorders.

0068

EFFECTS OF SEX AND ADIPOSITY ON IL-6 RESPONSE TO TOTAL SLEEP DEPRIVATION

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Introduction: IL-6 is a pro-inflammatory marker that has been found to increase in response to sleep deprivation in previous studies. However, this research has typically been conducted in relatively homogeneous populations, leaving unanswered questions regarding differential vulnerability to the effects of sleep loss across populations.
Methods: 47 participants (62% male, 75% Caucasian, mean age 35y, mean body mass index [BMI] = 24.3kg/m^2) underwent two nights of baseline sleep followed by either 64 hours of total sleep deprivation (n = 33) or two nights of full (8-9h/night) sleep opportunity (n = 14) under controlled laboratory conditions. IL-6 was measured every four hours over two 24-hour periods: baseline and the period ending at 64 hours of wakefulness (or control sleep). Adiposity was determined by BMI, bioimpedance and waist circumference measurements.
Results: The sleep-deprived group showed a significant increase in mean IL-6 levels following sleep restriction ($t = -2.21$, $P = .034$). Subgroup analyses indicated that men had significant increases in IL-6 ($t = -2.28$, $P = .034$) in response to sleep restriction while female participants did not. Within sex- and adiposity-based groups, only men with low (compared to moderate) adiposity showed significant increases in IL-6 in response to sleep deprivation ($t = -2.64$, $P = .027$). There were no significant changes among control participants (all P values > .27); a comparison of change in IL-6 between participant and control groups approached significance ($Z = -1.88$, $P = .060$).
Conclusion: Despite relatively small samples sizes, this study provides evidence for differential vulnerability to the pro-inflammatory effects of sleep deprivation. Prior research suggests that women may be more vulnerable to the effects of sleep loss; however, results from the current study suggest that there may be a different pathophysiology of sleep deprivation among men, as measured by change in IL-6. This research also provides preliminary evidence that adiposity may be a moderator of inflammatory changes in response to sleep deprivation.
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0069

A PILOT STUDY: IMPROVEMENT IN INSOMNIA SEVERITY IS ASSOCIATED WITH DECREASED SOLUBLE CD4-LIGAND IN HIV-SEROPOSITIVE PATIENTS

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Introduction: There is a high prevalence of insomnia in the HIV-seropositive population. When present, insomnia is associated with decreased medication compliance, impaired immune function, and dysregulated circadian rhythm, altogether leading to poorer disease outcomes. Insomnia patients have also been reported to have a higher cardiovascular risk, which is correlated with raised levels of inflammatory markers. Recent studies have shown that successful treatment of sleep disorders like OSA correlates with decreased levels of inflammatory mediators. We carried out this study to test the hypothesis that improvement in insomnia with treatment would be associated with decreases in the inflammatory markers interleukin-2 (IL2), interleukin-6 (IL6), and the soluble CD40 ligand (sCD40L) in HIV+ patients.
Methods: Study participants: 14 study participants with HIV and insomnia undergoing HAART therapy were randomized to receive either Doxepin, Temazepam or Placebo x 12 weeks. At the first and final study visits, subjects were administered the Insomnia Severity Index (ISI) their CD4 count was recorded and serum samples were obtained for IL2, IL6 and SCD40L analysis. Analysis was carried out by comparing the

change in inflammatory markers with treatment in responders (< 50% decrease in ISI) vs responders (≥ 50% decline in ISI).
Results: Responders to treatment had a significantly greater decrease in sCD40L than non-responders (P = 0.03). There were no significant differences between responders and non-responders on IL2, IL6 or CD4 count.
Conclusion: This study provides preliminary evidence that HIV+ individuals who respond to insomnia treatment may experience a greater decrease in sCD40L than non-responders. sCD40L is an inflammatory cytokine whose most clearly defined role is in the vascular system. Recent studies found elevated levels in OSA patients, which were reduced after successful cPAP therapy. sCD40L levels are also elevated two-fold in untreated HIV-seropositive patients, and CSF levels are higher in patients with HIV-1 associated dementia (HAD). As a result, this study suggests the possibility successful treatment of insomnia could decrease the inflammatory cytokine sCD40L, which could potentially have a favorable impact on cardiovascular risk and HAD in HIV+ individuals.

0070

TUMOR NECROSIS FACTOR-ALPHA IS A MAIN REGULATOR OF SICKNESS BEHAVIOR AND CLOCK GENE EXPRESSION

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Introduction: The activation of the immune system during infectious or autoimmune diseases leads to a series of behavioral and physiological alterations collectively referred to as "sickness behaviour syndrome (SBS)." It reflects a reorganization of metabolic functions of the host during disease. These changes are thought to be mediated mainly by pro-inflammatory cytokines including TNF-alpha, interleukin-1 and interleukin-6. Our recent data show that TNF-alpha leads to a deregulation of circadian functions and thereby to the sickness behavior syndrome (SBS). The purpose of this project was to characterize the contribution of different cytokines in immune activation on the development of SBS.
Methods: We administered agonistic CD40 antibodies to mice, leading to a marked appearance of cytokines in the blood and the induction of classical SBS symptoms, i.e. decrease of locomotor activity and weight loss. We assessed clock gene expression and SBS in TNFR1-/-, IL-6-/-, and MyD88-/- mice.
Results: As true for wildtype, treating IL6-/- mice with anti-CD40 led to a strong reduction in nocturnal infrared and running wheel activity, and to a reduction in clock gene expression levels in the liver. By contrast, TNFR1-/- mice and MyD88-/- did not show a reduction of the infrared and running wheel activity upon anti-CD40 injection and only minor changes to clock gene expression. However, continous TNF-alpha infusion to MyD88-/- mice induced again similar responses as in wildtype.
Conclusion: We suggest that the increase of TNF-alpha, as seen in infectious and autoimmune diseases, impairs clock gene functions and is a major regulator of SBS induction.

0071

SLEEP DISTURBANCES IN A MOUSE MODEL OF BIPOLAR DISORDER

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Introduction: Many psychiatric disorders are associated with sleep disturbances. For example, there is marked sleep disturbance associated with the manic phase of bipolar disorder (BD). Recently, a mouse model of the manic phase of BD was created; this model has a point mutation in the α3 Na+,K+-ATPase pump (ATP1A3) and mimics the manic phenotype seen in patients with BD, including cortical neurons having altered Ca2+ kinetics, increased risk-taking behavior, and hyperactivity. Because impaired sleep is an important component of BD, and a potential therapeutic target, we aimed to determine whether sleep-wake behavior is disturbed in a mouse model of BD.
Methods: ATP1A3-mutant (n = 6) and wild-type mice (n = 6) were implanted with electroencephalogram and electromyogram electrodes for determination of behavioral state. After habituating to the recording tether, 24 hours of data were recorded, scored and analyzed to determine sleep-wake architecture.
Results: ATP1A3-mutant mice have altered circadian rhythms and sleep. Compared to wild-type mice, manic mice had a 27% increase in waking and a 44% and 30% decrease in non-REM and REM sleep, respectively (P = 0.009). The increased amounts of wakefulness were primarily due to an enhancement of active wakefulness (P = 0.003), although quiet wake was also elevated (P = 0.033). Compared to wild-type mice, manic mice had normal numbers of non-REM bouts, but had fewer REM episodes (P = 0.006). This decrease in the number of REM sleep bouts could be due to an inability to maintain non-REM sleep because the duration of non-REM bouts was greatly suppressed (P = 0.009). ATP1A3-mutant mice also demonstrate decreased REM sleep latency (P = 0.026).
Conclusion: This study demonstrates that ATP1A3-mutant mice not only show behavioral characteristics of mania during waking but also mimic the sleep disturbances seen during the manic phase of bipolar disorder. These mice could be a useful tool to investigate the role sleep disturbance plays in promoting manic behaviors in BD.

0072

REDUCED GAMMA RANGE ACTIVITY AT REM ENTRY IN FEAR-CONDITIONED WISTAR-KYOTO COMPARED TO WISTAR RATS

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Introduction: Following fear conditioning (FC), Wistar-Kyoto rats (WKY) compared to Wistar rats (WIS) showed increased REM sleep (REM) fragmentation. Compared to WIS, WKY showed decreased gamma power (30-50 Hz) during REM. Gamma oscillations characterize periods of focused attention, REM as well as waking. We hypothesized that gamma power after REM onset (ARO) would be differentially altered by FC in WKY and WIS.
Methods: Animals (N = 4 WIS; N = 6 WKY) had baseline sleep recorded from 1100 to 1500 hr. The next day they received ten tones (800 Hz, 90 dB, 5 s; 30 s ISI), each co-terminating with an electric foot shock (1.0 mA, 0.5 s). The following day (Day 1) and again on Day 14 three tones were presented, without shock, and sleep was recorded (1100 to 1500 hr). Gamma power (30-50 Hz) normalized to total power (0-50 Hz) was analyzed at 10 s intervals, from 35 s before to 105 s ARO.
Results: WKY had lower gamma power than WIS at all time points. At 25 s ARO, WKY had a significant increase in gamma power from baseline on Day 14 only [0.09 ± .01 vs. 0.11 ± .01; P = .001]. At 25 s ARO, WIS had a significant increase from baseline on Day 1 only [0.17 ± .02 vs. 0.22 ± .02; P = .01]. There was a significant day x strain interaction for gamma power at 25 s ARO [DF = 2, F = 8.288, P = .003].
Conclusion: Gamma power during REM was consistently higher in WIS than in WKY, possibly contributing to WIS's resistance to REM fragmentation following FC. After FC, WKY showed a small increase in gamma power at REM entry, only at Day 14, but did not attain the level shown by WIS; WKY may not reach the "full" REM state necessary for normal REM maintenance.
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0073

MANIPULATING FINGER TEMPERATURE TO PROMOTE SLEEP

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Introduction: An increase in distal skin temperature (DST) best predicts rapid sleep onset. Thermal suggestions with and without biofeedback are equally effective to increase DST. This study explores whether exposure to red light enhances the effect of thermal suggestions, since red light triggers a sensation of warmth.
Methods: Finger temperature (FT), sleep onset latency (SOL) (actigraphy and sleep diary) and relaxation (GSR) were measured with six healthy volunteers (three male) in their homes in four conditions (each lasting five consecutive days); control, thermal suggestions, red light, and biofeedback with red light reflecting FT with intensity changes. Based on previous research we expected thermal suggestions to increase FT and reduce SOL compared to the control condition. Furthermore, it was explored whether red light (below 50 lx) enhances these effects and how this compared to biofeedback. GSR measures were used to explore whether the effects on FT and SOL were mediated by relaxation.
Results: Over time, FT seemed to increase, while GSR seemed to decrease in all conditions. The two lighting conditions seemed to have a higher offset in FT, and this difference was stable over time. Subjective SOL seemed to decrease in all measurement conditions compared to control, although this was not supported by the objective data.
Conclusion: The higher offset in the lighting conditions might be due to light exposure before starting the measurement, for which we were not able to control in this study. However, it points to the potential of thermal suggestions supported by red light to increase FT and the subjective experience of falling asleep. This effect might be strengthened by relaxation-induced sleepiness, although this could not yet be validated by this study. In a follow-up experiment, including more subjects, we will control for confounds that may contribute to differences in FT offset.

0074

OBJECTIVE AND SUBJECTIVE SLEEP QUALITY IN WOMEN WITH PERIMENOPAUSAL SYMPTOMS

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Introduction: Sleep complaints are one of the most common and bothersome symptoms of the perimenopause yet objective polysomnographic (PSG) studies have failed to find evidence of disturbed sleep when comparing pre-, peri-, and post-menopausal women. Few studies have compared sleep quality within groups of perimenopausal women with and without symptoms. Also, sensitive measures of sleep disturbance, such as quantitative sleep EEG microstructure and cardiovascular indices have not been applied.
Methods: We compared subjective and objective measures of sleep quality in six women with perimenopausal vasomotor, mood, and sleep-related symptoms (symptomatic; age: 49.0 ± 1.8 y) and six women with minimal symptoms (controls; age: 50.0 ± 1.3 y). None showed evidence of sleep-related breathing or periodic limb movement disorders.
Results: Symptomatic women had higher Pittsburgh sleep quality index scores ($P < 0.01$), reflecting poorer sleep. After an overnight laboratory study, symptomatic women reported having a poorer sleep, with more difficulty falling asleep ($P = 0.03$) and a more restless sleep ($P = 0.04$) than controls. Sleep efficiency, wakefulness, and time spent in any sleep stage did not differ between the two groups ($P > 0.1$). Based on quantitative measures of the sleep EEG, symptomatic women tended ($P = 0.09$) to have less delta power (0.3-4 Hz) during NREM sleep than controls. Based on heart rate variability analysis in the frequency domain, symptomatic women (n = 5) showed a trend for less high frequency power ($P = 0.09$), reflecting reduced parasympathetic nervous system (PNS) activity, and a higher low frequency/high frequency ratio ($P = 0.07$) during NREM sleep. They also tended to have a higher autonomic arousal index, assessed on the basis of changes in the heart interbeat interval, than controls ($P = 0.09$).
Conclusion: These preliminary results show that symptomatic perimenopausal women perceive their sleep to be poorer, which may be influenced by a tendency for lower delta power, reduced PNS activity and increased autonomic arousals during NREM sleep compared to women with minimal perimenopausal symptoms.
Support (If Any): SRI International Developmental Grant

0075

THE EFFECTS OF A FATTY ACID SYNTHASE INHIBITOR ON SLEEP IN MICE

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Introduction: In rodents, the daily 12:12 h dark-light period comprises two metabolically distinct phases. The dark phase, when the majority of food intake occurs, is characterized by increased lipogenesis. During the light period, lipolysis is predominant. Sleep-wake activity displays patterns specific for both phases. The synthesis of fatty acids (lipogenesis) is catalyzed by fatty acid synthase (FAS). FAS inhibitors have robust food intake and body weight suppressing effects when administered centrally or peripherally. The aim of the experiment was to study the effect of a synthetic FAS inhibitor, C75, on sleep, body temperature and locomotor activity in mice.
Methods: Male C57Bl/6 (29-32 g) mice were implanted with EEG, EMG electrodes and a telemetry transmitter for body temperature and locomotor activity measurements. Groups of mice (n = 4-8) received intraperitoneal injections of RPMI 1640 (10 ml/kg) on the baseline day and one dose of C75 (7.5 mg/kg or 30 mg/kg) 5-10 min before dark onset on the following day. Sleep, locomotor activity and body temperature were recorded for 24 h after control and C75 injections.
Results: The FAS inhibitor significantly suppressed body temperature and locomotor activity immediately after injection. These effects were more pronounced and longer lasting after the high dose of C75. Wakefulness increased and REMS was suppressed after both doses of FAS inhibitor. REMS completely disappeared for 12 hours after the high dose of C75. EEG slow-wave activity during NREMS was significantly suppressed for 6 and 12 hours after the low and high doses of FAS inhibitor, respectively.
Conclusion: Present data are consistent with the hypothesis that disruption of lipid metabolism may interfere with normal sleep-wake activity.

0076

UNMASKING THE POWER OF DELTA POWER: INTEGRATED ANALYSIS OF SLOW WAVE SLEEP, RESPIRATION AND HIGH FREQUENCY HEART RATE FLUCTUATIONS ACROSS THE LIFESPAN

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Introduction: During non-rapid eye movement (NREM) sleep, the scalp electroencephalogram (EEG) in the 0.5 to 4 Hz (delta) range reflects dynamic changes within cortical activity. Models of sleep

regulation do not adequately explain the biological role of periods of NREM sleep associated with low absolute delta power, especially during the second half of the night. The sleep spectrogram is an EEG-independent, electrocardiogram (ECG) - derived method to map the coupling of heart rate variability and respiration-driven ECG-QRS amplitude fluctuations. High frequency coupling (HFC), a proposed cardiopulmonary spectrogram biomarker of "effective" sleep, occurs in discrete, intermittent "blocks" throughout polysomnographic sleep. We tested the hypothesis that relative rather than absolute delta power might be associated with the phase transition to effective (i.e., HFC) sleep throughout the night.

Methods: Instantaneous delta power (form the C4-A1 EEG) and HFC power (from the polysomnogram ECG) were correlated in 2.1 minute epochs in a cross-sectional dataset of over 6000 subjects from birth to the 9th decade, including subjects from the NIH Collaborative Infant Home Monitoring Evaluation (CHIME) and Sleep Heart Health Study (SHHS).

Results: Fluctuations in relative delta power were significantly correlated with fluctuations in HFC, both in the first and second halves of the sleep period, from age of 5 to 90 years. This finding suggests that the physiologic effectiveness of decreasing sleep drive occurs in intermittent, sustained pulses throughout the sleep period. A distinctive developmental profile of delta power-HFC correlations was observed (r less than 0.05) at birth, peaking at 10-11 years (r: 0.55), decreasing to adult levels (r: 0.4) by the 3rd decade and remaining relatively stable through the 9th decade.

Conclusion: Quantitative analysis of relative delta power unmasks a physiologic interaction with a cardiopulmonary biomarker of effective sleep. This approach may be useful both as a mechanistic probe and for clinical monitoring.

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0077

FRACTAL PATTERNS OF MULTI-UNIT ACTIVITY OF THE SUPRACHIASMATIC NUCLEUS (SCN): SCN-INTRINSIC AND SCN-EXTRINSIC NETWORK PROPERTIES

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Introduction: Many physiological processes exhibit 'scale-invariant' or 'fractal' properties, generating fluctuations that display similar patterns across wide time scales. These fractal patterns are robust in healthy biological systems but can be significantly altered under pathological conditions and can be predictive of mortality. The suprachiasmatic nucleus (SCN) controls many endogenous 24 h physiological rhythms, but our recent studies indicate that the SCN also functions across a wider range of time scales from minutes to hours and is a critical neural node for orchestrating fractal patterns in heart rate and motor activity fluctuations. Here we determined whether this scale-invariant regulation is a property intrinsic to a neuronal network within the SCN itself or it requires feedback interactions with other control nodes in the nervous system.

Methods: To distinguish between these hypotheses, we analyzed multi-unit activity (MUA) of the SCN: (A) in vivo activity of 3 freely moving adult C57BL6 mice under light-dark (LD; 12h:12h) cycles and under constant darkness (DD); and (B) in vitro from 4 additional mice.

Results: Using fractal analysis, we showed a robust fractal pattern in the MUA of in vivo SCN over a wide range of time scales from ~1 min to ~3.5 h. The long-range fractal pattern was consistent for all mice and persisted during light-dark and constant dark conditions. However, the fractal pattern was completely abolished in vitro SCN activity fluctuations despite the clear presence of circadian rhythms in the recordings ($P < 0.0001$).

Conclusion: Our prior findings indicate that the SCN is a critical control node for the generation of scale invariant behavior, and the discovery that scale-invariant MUA occurs within the in-vivo SCN suggests that the SCN provides a useful model system to study the minimal neuronal network required for the generation of scale invariance. However, our in-vitro findings also indicate that the SCN is not sufficient to impart scale invariance when isolated from the rest of the nervous system. Thus, the fractal pattern in SCN neural activity must reflect a network of feedback interactions between the SCN and other neuronal nodes.

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0078

MAGNITUDE OF ACUTE ALERTING EFFECT OF LIGHT DEPENDS ON PRIOR LIGHT HISTORY

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Introduction: Light exposure at night has been shown to have an acute, dose-dependent effect on several measures of alertness. However, it is unknown whether the acute alerting effect of light depends on the preceding light history. Therefore, we tested in humans the hypothesis that prior exposure to very dim light compared to typical indoor light magnifies the acute alerting effect of a light stimulus during the biological night, as assessed by: a) subjective alertness (visual analog scale, VAS); b) reaction time and lapses of attention (Psychomotor Vigilance Task, PVT) and c) spectral composition of the waking EEG.

Methods: Fourteen healthy adults (18-30 years of age; 6 F) who completed a 32-day inpatient protocol were included in this analysis. Each subject was exposed to two 6.5-h experimental light exposures (LE) of typical indoor light level (90 lux), each beginning 1 hour before habitual bedtime. Each LE was preceded by 3 days of either very dim light (1 lux) or indoor room light (90 lux) throughout the waking episode, in counter-balanced order. Neurobehavioral test batteries were administered every 30-60 minutes beginning 3 hours before, during, and 3 hours following the LE and the waking EEG was recorded throughout. Mixed model analysis of variance (ANOVA) was used to compare the influence of the preceding light history on subjective alertness, sustained attention, and waking EEG power density during and after the LE.

Results: Subjective alertness in response to LE was higher following the 1 lux than the 90 lux prior light conditions ($P < 0.001$). PVT median reaction times were shorter ($P = 0.002$) and there were fewer lapses of attention ($P = 0.038$) when the LE followed the 1 lux compared to the 90 lux prior light condition. There was no significant effect of prior light condition on the EEG power spectrum during the LE, but there were significant effects in the 3 hours following the LE. EEG power density in the delta and theta frequencies (3.0-5.5 Hz and 8.0-8.5 Hz) was lower ($P < 0.05$, t-test) when the LE followed the 1 lux compared to the 90 lux prior light condition.

Conclusion: The magnitude of the acute alerting response to a light stimulus depends on the light intensity to which an individual was previously exposed. The result suggests that sensitization and adaptation to light are important determinants of human alertness.

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0079

GENERALIZABILITY OF TRAIT ASPECTS OF INDIVIDUAL DIFFERENCES IN SLEEP ARCHITECTURE

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Introduction: In a recently published study of individual differences in sleep architecture (Tucker et al., 2007), the trait aspect (stability and robustness) of repeatedly measured, visually scored sleep variables was quantified. This was done using the intraclass correlation coefficient (ICC), which is a function of between-subjects variance and may therefore vary from one sample to another. As such, it is important to examine the replicability of reported ICC values. We pursued this using data from another study involving repeated PSG recordings of sleep.

Methods: As part of a larger study, 21 healthy subjects (ages 21-38y; 9 women) underwent two 36h total sleep deprivation sessions during separate, strictly controlled laboratory visits. Each sleep deprivation session was preceded by baseline sleep and followed by recovery sleep (both 12h TIB, 22:00-10:00) in the laboratory. PSG records for the two baseline and the two recovery sleep periods were visually scored by R&K criteria. Out of the 84 total records, 13 were discarded because of equipment malfunction. For each of the remaining 71 records, 14 sleep variables were assessed: TST, SE, S1, S2, SWS, REM, WASO, movement time, sleep cycles, stage transition index, and latencies to S1, S2, SWS and REM.

Results: For all 14 sleep variables examined, the ICC values obtained in the present study were compared to the ICC values reported for the previously published study. The smallest ICC difference (0.01) between studies was for TST (ICC = 0.45, in the previous study it was 0.46). The largest ICC difference (0.38) was for sleep latency to S1 (ICC = 0.01, in the previous study it was 0.39). The average (± standard error) ICC difference between studies across the 14 sleep variables was 0.12 (± 0.01). SWS, which displayed the most trait-like individual differences in the previous study (ICC = 0.73), was also highly trait-like in the present study (ICC = 0.71).

Conclusion: This study showed that ICC values quantifying trait aspects of individual differences in visually scored sleep architecture, for nocturnal sleep recordings of 12h TIB, exhibit high replicability over a wide range of sleep variables.

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0080

MEMORY CONSOLIDATION: THE TEMPORAL RELATIONSHIP BETWEEN LEARNING AND SLEEP

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Introduction: Learning followed by a period of sleep, even as short as a nap, promotes memory consolidation. While it is now generally recognized that sleep facilitates the stabilization of information learned before sleep, the temporal nature of the effect of sleep on declarative recognition memory is yet to be understood. While previous studies using declarative stimuli have demonstrated that emotionally arousing material benefits from sleep fairly consistently, neutral, less salient, stimuli have displayed mixed sleep effects. We utilized a staggered sleep onset schedule design paradigm and examined its impact on the recognition of neutral stimuli.
Methods: Subjects completed an initial study session involving 150 neutral pictures of people, places, and objects. Immediately following the picture presentation, all subjects were asked to make recognition judgments on a subset of "old", previously seen, pictures versus "new", previously unseen, pictures. Subjects were then divided into one of four groups who either took a 90-minute nap immediately, 2 hours, or 4 hours after learning, or remained awake for the duration of the experiment. 6 hours after initially learning, subjects were again tested on another subset of "old" and "new" pictures.
Results: Interestingly, we found a stabilizing benefit of sleep on the memory trace reflected as a significant positive correlation between performance at retest and the time elapsed before napping ($P = .047$). We found a significant interaction between the groups and their performance from test to retest ($P = .037$), with the 4-hour delay group performing significantly better than both those who slept immediately and those who remained awake ($P = .018$, $P = .003$, respectively).
Conclusion: These findings add to the understanding of memory processing in humans, suggesting that, while sleep is indeed necessary for the consolidation of neutral recognition memory, a degree of prior waking processing of the learned information may be necessary to increase sleep benefits.

0081

STATISTICAL REPRESENTATIONS BENEFIT FROM A NAP

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Introduction: The consolidation of memory during sleep has been increasingly documented in the last decade. Perceptual learning, and in particular the important field of exposure learning, is currently underrepresented in this research. Here, we evaluate the contribution of a nap to the offline consolidation of higher-order statistical patterns.
Methods: 24 participants were divided equally between Nap and Wake groups, with both groups trained at 12pm and retested at 4pm on the same day. The Nap group were monitored with polysomnography while asleep. Participants were exposed to a 7 minute auditory stream of pure tones generated stochastically from a transition matrix specifying non-uniform second-order transition probabilities such that each tone could be predicted using the previous two tones. Immediately following the tone stream, participants heard 84 two-alternative-forced-choice (2AFC) trials, each comprising a short tone sequence generated from the same transition matrix and a short randomly ordered tone sequence, and asked to indicate which sounded more familiar. Following a nap or an equivalent period of normal waking activity, participants were retested with 84 equivalent 2AFC stimuli. Performance was measured as the proportion of trials on which the structured sequence was chosen.
Results: Performance for the Nap group improved by 2.9% across retention, while performance for the Wake group declined by 5.4%. These changes in performance differed significantly between groups (t-test; $P = 0.013$). Interestingly, improvement across the nap correlated significantly with the proportion of slow wave sleep (SWS) ($r = 0.59$; $P = 0.043$); no other sleep stage, or total sleep time, showed a significant correlation.
Conclusion: This result extends recent observations of enhanced abstraction and integration after overnight retention intervals by demonstrating that the representation of statistical patterns is also strengthened across sleep relative to wake. The correlation with SWS suggests an active process, potentially strengthening declarative representations of the sequence. In keeping with our previous results comparing overnight sleep and wake groups, these data show that abstract representations of statistical patterns consolidate across just 2 hours of sleep.

0082

EFFECTS OF DAYTIME NAPPING ON TEMPORAL AND SPATIAL RELATIONS

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Introduction: Three important questions remain little explored in the study of sleep and memory - the effect of daytime naps, sleep's role in relational memory, and whether sleep has a long-lasting effect on memory. The present study investigated the immediate and long-term effect of a daytime nap on integrating temporal and spatial relations of items learned separately.
Methods: Subjects learned to group pictures into triplets. Pictures in each triplet were consistently presented in a particular temporal order, and each in a particular quadrant of the monitor. Thus a picture could be related to ones from other triplets by either sharing the same temporal order or the same spatial location of presentation. After an intervening period in which subjects either took a nap ($n = 15$) or stayed awake ($n = 15$), a membership recognition task was given. Subjects were tested on pairs of pictures. Each pair could either be a match, a non-related non-match, a temporally-related non-match or a spatially-related non-match. Subjects, forming relational links between pictures indirectly related through either a temporal or a spatial association, were predicted to have a higher false alarm rate for the temporally- or spatially-related non-match questions. Subjects were tested again one week later.
Results: The nap subjects made significantly more false alarms on temporally-related non-match questions only. The effect faded after one week. Interestingly, nap subjects also maintained the ability to recall the temporal order of a given picture better. Slow wave sleep correlated significantly with memory performance.
Conclusion: The results suggest that while strengthening learned items, a daytime nap also contributes to reorganization of memory networks, particularly integration of temporal relations, and allows flexible representations of memory traces.

0083

SLEEP RESTORES THE HUMAN BRAIN CAPACITY TO LEARN

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Introduction: In contrast to consolidation, the role of sleep in preparing the brain for initial memory formation/encoding remains largely uncharacterized. Several NREM models propose a role for sleep-oscillations in restoring the neural dynamics required for optimal learning. Here we test

the hypothesis that the ability of the human brain to form new episodic memories deteriorates with accrued wakefulness, but that sleep and sleep-oscillations restore this neural capacity for efficient learning.
Methods: Thirty-nine participants (20.7 ± 0.3 years) performed two separate episodic memory-encoding sessions: 1) 12noon, and 2) 6PM. After the first learning session participants were randomly assigned to a control-group (n = 19) that remained awake across the 6hr delay, or a nap-group (n = 20), who obtained a 100 min PSG monitored sleep period. Learning was measured using a face-name associates task, allowing for the examination of both basic item learning (face) and more hippocampal-dependent associative learning (face-name).
Results: In the control-group, hippocampal-dependent associative learning capacity exhibited a marked deterioration across 6hrs of wakefulness, yet in the nap-group, sleep blocked this deterioration. Specifically, the change in hippocampal-dependent learning ability between sessions (session2-session1) was significantly different between groups (P = 0.049). Additionally, this restoration of associative hippocampal-dependent learning in the nap-group correlated significantly with NREM-stage2 (P = 0.015), and specifically the number of fast sleep spindles over left and right prefrontal regions (P = 0.029 and P = 0.047, respectively). No other sleep stage, or measure of spectral power during sleep, predicted learning restoration, including slow-wave activity.
Conclusion: Here we demonstrate that the ability of the human brain to learn is not stable across a day, deteriorating over a 6hr-waking interval. However, sleep, and specifically NREM-stage-2 and associated spindle-oscillations, restore this encoding capacity, particularly for aspects of learning that rely on the hippocampus. Such evidence supports a model of sleep-dependent hippocampal-neocortical memory transfer, which, as a consequence, reinstates efficient next-day learning ability.
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0084

A CORRELATIONAL ANALYSIS OF SLEEP VARIABLES AND IQ IN YOUNG AND ELDERLY ADULTS

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Introduction: Several investigators have reported significant correlations between sleep spindle parameters and measures of intelligence (IQ). Virtually all of these studies have examined this relationship in young adults only. Given that certain aspects of IQ change with age, it is important to examine the relationship among sleep parameters and IQ in elderly adults as well.
Methods: The sample included 24 young adults (M age = 20.75 yrs; SD = 1.78 yrs; range = 17 to 24; 12 females) and 24 elderly adults (M age = 71.17 yrs; SD = 6.15 yrs; range = 60 to 85; 12 females). In-home sleep recordings were obtained from all participants for a total of three nights; the data reported here are from the second night. All participants also completed the Multidimensional Aptitude Battery-II as a measure of IQ. Pearson's correlation coefficients were computed separately for each age group to assess the pattern of relationships between sleep parameters (i.e., Stage 2 sleep spindle density, REM density, the percentage of time spent in Stage 1, Stage 2, SWS, and REM) and indices of IQ (Overall IQ, Verbal IQ, and Performance IQ).
Results: Consistent with previous findings, there was a positive correlation between baseline Stage 2 spindle density and Performance IQ in young adults [r(22) = .48, P = .017]. In the elderly adults, the percentage of time spent in Stage 2 sleep was positively correlated with Overall IQ [r(22) = .52, P = .009], Verbal IQ [r(22) = .50, P = .013], and Performance IQ [r(22) = .43, P = .036]. Surprisingly, the percentage of time spent in SWS was negatively correlated with Overall IQ [r(22) = -.49, P = .016], Verbal IQ [r(22) = -.45, P = .029], and Performance IQ [r(22) = -.43, P = .035] in the elderly adults.
Conclusion: The results of this study suggest that the pattern of correlations among sleep variables and indices of IQ is different in young and elderly adults. These results may have implications for the study of cognitive aging.
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0085

ASSESSING VULNERABILITY OF ATTENTION IN WORKING MEMORY DURING SLEEP DEPRIVATION USING fMRI

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Introduction: Several distinct cognitive processes underlie working memory, and these processes may display differential vulnerability to total sleep deprivation. By manipulating the attentional difficulty in a verbal working memory (WM) task by degrading visual stimuli, we aim to elucidate the neural substrates of the attentional processes in WM and assess their changes during total sleep deprivation (TSD).
Methods: Twelve (age = 24.5 ± 3.9yrs, 7F) subjects performed a verbal WM task during an event-related FMRI design in which attentional difficulty was manipulated by degrading pixels (0% versus 40% degraded). Participants attended to words (learn event), rehearsed the words for several seconds (rehearse event), and performed a 2-option forced choice recognition test (recognize event). Participants were tested 12 hours after a normal night of sleep and were tested after 36 hours of TSD to control circadian effects on activation. Behavioral and imaging data were analyzed with a 2x2 (Night-by-Degradation) ANOVA.
Results: A main effect of night was found where response times were higher and accuracy lower during TSD compared to normal sleep. Clusters of activation showing a night-by-degradation interaction during the learn event were identified in the left and right frontal gyrus, left and right insula, right anterior cingulate and right medial occipital lobe. There was no difference in activation between difficulty levels during normal sleep, but degraded words exhibited significantly greater activation than non-degraded words during total sleep deprivation.
Conclusion: Sleep deprivation differentially affects the learning of verbal material when difficulty is varied. During TSD both difficulty levels showed equal performance decrements, but degraded words elicited greater activation in brain areas associated with selective attention and the dorsal visual stream. These data suggest greater demands are placed on the attention component of WM during TSD, suggesting potential human factors interventions designed to aid selective attention may help mitigate errors during TSD.
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0086

THE IMPACT OF VARYING SLEEP LENGTH ON SLEEP-DEPENDENT LEARNING

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Introduction: Recent work has focused on the role sleep plays in memory, specifically memory consolidation, with declarative and procedural memory being found to benefit from sleep. However, limited data exists on the relationship between sleep extension and neurobehavioral function-

ing, especially learning and memory. The current study addressed whether varying sleep length prior to learning affects memory performance.
Methods: Seventeen normal sleepers (mean age = 28.9 years; 13 F) completed 7-night sleep extension (SE) and sleep restriction (SR) conditions during 2 separate weeks with a washout period of 1 week between sessions. Subjects were monitored via actigraphy/sleep diary while maintaining a pre-determined sleep schedule of either 6 or 10-hours time in bed (TIB) in random order. On night 8 of each condition 8-hour PSG and pre-and post-sleep declarative word pair task (WPT) and procedural finger-tapping task (FTT) were completed.
Results: Actigraphy data showed that mean TIB (SR 6.1 ± .19h; SE 9.9 ± .17) and mean TST (SR 6.0 ± .53h; SE 7.7 ± .78) differed significantly between conditions. PSG sleep differed between conditions only for mean minutes of stage 1 (SR 41.38 ± 13.3; SE 47.24 ± 16.4; $P < .05$). WPT and FTT showed better performance post-sleep compared to pre-sleep ($P < .001$). Recall of related word pairs on the WPT was significantly better than for unrelated word pairs across conditions ($P < .001$). Performance on WPT and FTT did not differ significantly between SR and SE. However, post-hoc analyses comparing only participants with at least a 2-hours average sleep difference between conditions found the condition effect approached significance ($P = .072$) for recall of unrelated word pairs, with those in the 10-hour condition performing better than the 6-hour condition.
Conclusion: These findings indicate that recent sleep duration may influence recall of new unique declarative memories compared to those memories involving previously formed relationships.

0087

BRAIN NETWORKS IN STAGE 2 SLEEP AND WAKE AT REST AND FOLLOWING AUDITORY STIMULATION

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Introduction: Event related potential (ERP) studies have found a remarkable degree of similarity in the brain's responses to auditory stimulation in sleep versus wake, including an ability to "discriminate" features of a simple tone stimulus, recognize one's own name, and detect semantic dissonance in speech. In contrast, the brain in sleep, unlike wake, remains unaware of the stimulus. We hypothesized that this difference in the processing of sound in sleep versus wake is reflected in the network of connections.
Methods: Nine normal subjects fell asleep while their brain activity was recorded using a 64+8-channel electroencephalogram or EEG (ActiveTwo, BioSemi. Inc). A pure tone auditory stimulus (1000Hz) was played at an interval of 3000 ± 200ms throughout the course of the ~2-2.5 hour recording. Polysomnography data were scored using software (Morpheus, WideMed Inc.) and manually verified. Data from wake and stage 2 (S2) sleep were compared. Epochs 400-0 ms before and 0-400 ms following tone onset were used for analysis. As a measure of the interaction across the brain network, we computed the Pearson cross-correlation between each pair of electrodes.
Results: Following stimulation, the strength of an individual connection changed similarly in wake and S2 sleep. Modularity analysis revealed two modules that correspond to the two hemispheres both before and after stimulus onset and in either state of arousal. Mean connection strengths across the network prior to or following stimulation did not significantly differ between the two states either. The only difference observed was that connection strength was more homogeneous, i.e. less variable, in S2 sleep than in wakefulness at rest, but more variable following stimulation.
Conclusion: On the whole, there was striking similarity in the way the brain networks in sleep and wake changed following the sound, bolstering the idea that the brain in sleep is a brain that actively, albeit somewhat unreliably, processes external sound.

0088

DIRECTING SLEEP TO SELECTIVELY FORGET AND REMEMBER HUMAN MEMORIES

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Introduction: Substantive evidence implicates sleep in the consolidation and strengthening of human memories. However, numerous circumstances exist where forgetting is as critical as remembering: in day-to-day life and in clinical disorders. Despite Crick and Mitchenson (1983) proposing a role for sleep in memory erasure, no empirical studies have examined this targeted forgetting and remembering hypothesis of episodic memories. Using an established paradigm, here we investigate whether the role of sleep in offline memory processing is more nuanced than previously believed: that is, can sleep obey waking cues to carry out both selective remembering and targeted forgetting of human memories?
Methods: 30 subjects (20.1 ± 2.26 years) learned 100 words at 11AM. Cues were then paired with the words, tagging them to either be remembered or forgotten. Subjects were then assigned to either a nap-group, who underwent a 100-minute polysomnography monitored sleep opportunity, or a no-nap-group, who remained awake. At 5PM, both groups recalled as many words as possible, irrespective of prior cue.
Results: There were significant effects of Cue (Remember > Forget, $P < 0.05$), a near-significant effect of group (Nap > No-Nap, $P = 0.069$), and, most importantly, a Group-by-Cue interaction ($P < 0.05$). Specifically, the nap-group recalled significantly more Remember words than the no-nap-group, yet both groups demonstrated identical (and lower) recall of Forget words. Thus, sleep ignored the consolidation of one class of memories, yet preferentially strengthened another. Within the nap-group, this differential memory benefit correlated significantly with fast sleep-spindles in parietal-lobe derivations, left ($P = 0.008$) and right ($P = 0.04$).
Conclusion: These findings demonstrate that sleep can, in a selective manner, aid in the preferential remembering and forgetting of human memories, based upon prior waking instruction; an effect associated with regionally specific sleep-spindle oscillations. This evidence moves beyond the notion of sleep universally enhancing memories, and instead, suggests that sleep may be ecologically attuned to instructions present during learning while awake.
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0089

SLEEP SPINDLE ACTIVITY CORRELATES WITH INTEGRATION OF NEWLY LEARNED WORDS IN THE MENTAL LEXICON

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Introduction: When novel spoken words become integrated in the mental lexicon, they influence the recognition of similar familiar words (e.g., learning "cathedruke" will slow the recognition of the phonologically overlapping word "cathedral"). This lexical competition effect emerges preferentially after sleep. We examined aspects of sleep architecture associated with this effect.
Methods: Participants studied novel words in the evening (sleep group, n = 31) or in the morning (wake group, n = 31) and were then tested on three occasions: immediately, following a 10hr delay (across wakeful-

ness or a night of polysomnographically monitored sleep, depending on condition), and a week later at the same circadian time. We tested recall rates and recognition speed of the novel words, as well as the competition effect.

Results: Compared to immediate performance, free and cued recall rates increased across a night of sleep (P's ≤ .001), but remained unchanged or decayed across a day of wakefulness. Compared to performance at the 10hr delay, recall rates increased at the 1-week test in the wake group only (P's ≤ .001). Similar improvement patterns were seen in recognition speed. Novel words influenced recognition of neighboring existing words at the 10hr and 1-week delay tests (P's < .05). Most crucially, emergence of this competition effect in the sleep group was associated with sleep spindle activity. Low lexical competition at the immediate test was associated with higher spindle density during the post-learning night of sleep (r = -.52) and the magnitude of change in competition between the two times was positively correlated with spindle density (r = .57).

Conclusion: Sleep enhanced recall and recognition of novel words, while an equal time of wakefulness did not. Participants who initially showed little evidence of integration of newly learned words experienced more sleep spindles during the subsequent night. We argue that spindles are central for integrating new memories with existing memories, but may be less important for enhancing item recall.

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0090

SLOW WAVE ACTIVITY IN MOTOR AREAS DURING SLEEP AFTER TRAINING ON A MOTOR SEQUENCE TASK REVEALED BY A TECHNIQUE OF COMBINING MEG AND MRI

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Introduction: While a growing body of evidence suggests that sleep plays a key role in facilitatory action of memory and learning, the underlying neural mechanism has yet to be completely understood. Here, to better clarify the mechanism for the faciliatory action on motor sequence learning, we measured fine-scaled spatio-temporal neural activity during sleep after training on a finger-tapping motor sequence task using a multimodal neuroimaging technique that combines MEG and MRI. Since the motor sequence learning is associated with changes in the region of the primary motor area (M1) contralateral to the trained hand, specifically we tested whether this region is also involved in the facilitatory action during sleep on the motor learning.

Methods: Young and healthy participants underwent an MRI session followed by 4 nightly MEG sessions; 2 adaptation nights, pre-training sleep, and post-training sleep. Before and after the post-training sleep, a finger-tapping task was trained. Wavelet-transformed MEG during sleep was combined with high-resolution MRI to constrain the current locations to the cortical mantle individually. Based on the individual MRI, we localized motor related cortical areas including the primary motor area (M1), the supplementary motor area and the pre-supplementary motor area, as well as the primary visual cortex (V1) as a non-motor related area. Then we measured the strength of slow wave activity (SWA) in these localized areas.

Results: The results showed that SWA was markedly stronger bilaterally in M1 and the supplementary motor area during the post-training sleep than during the pre-training sleep. However, no significant change in the strength of SWA was observed in V1.

Conclusion: These results suggest that the broad cortical reorganization in the motor related areas, rather than changes confined to the contralateral side of M1, underlies the facilitatory action during sleep on motor sequence learning.

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0091

SLEEP LEADS TO QUALITATIVE CHANGES IN THE EMOTIONAL MEMORY TRACE: EVIDENCE FROM fMRI

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Introduction: After information is encoded into memory, it undergoes an offline period of consolidation that may occur optimally during sleep. The consolidation process not only solidifies memories but also changes them in ways that render them more useful and adaptive. In previous studies we demonstrated that sleep preferentially enhances emotional objects at the expense of their neutral backgrounds, suggesting that sleep produces qualitative changes in the memory representation that do not occur during wakefulness. Here, we provide neural evidence for this qualitative shift - demonstrating that distinct memory networks are associated with the retrieval of emotional object memories following a night of sleep vs. a day of wakefulness.

Methods: Subjects encoded negative and neutral objects embedded in neutral backgrounds, either in the morning (between 7-9am, n = 21) or evening (between 7-9pm, n = 21) and then attempted to retrieve these objects from memory 12hr later while undergoing an fMRI scan (following a day of wakefulness or a night of sleep).

Results: The hippocampus was activated during successful retrieval of negative objects following both time spent asleep and awake. However, while wakefulness led to engagement of a diffuse memory retrieval network - including widespread activity in the lateral prefrontal and parietal cortices, sleep led to activation of a more refined network of limbic regions - including the amygdala and ventromedial prefrontal cortex. Effective connectivity analyses revealed stronger connections among limbic regions following sleep than following wakefulness.

Conclusion: These data indicate that a night of sleep is sufficient to evoke qualitative changes in the emotional memory retrieval network, and suggest that sleep may profoundly influence the consolidation of emotional memories by modifying the neural architecture used for later retrieval.

0092

THE IMPACT OF SLEEP ON EMOTIONAL EPISODIC MEMORY PERFORMANCE

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Introduction: Post-learning sleep is beneficial for memory retention across a variety of tasks, facilitating the recall of procedural, declarative, emotional, and spatial information. Yet little is known about the impact of sleep on episodic memory for naturalistic events unfolding across space and time. Here, we examined the effects of post-training sleep on emotional episodic memory using a narrative slideshow task originally developed by Heuer & Reisberg (1990).

Methods: Participants viewed a series of 11 slides accompanied by narration, which depicted the story of a young boy who is struck by a car. Of these slides, four are classified as containing "emotional" content, while the remaining seven are classified as "neutral" slides (see Payne et

al., 2007). Wake participants (n = 29) viewed the slideshow at 9am, and were tested on their memory for the narrative 12hrs later at 9pm. Sleep participants (n = 34) viewed the slideshow at 9pm and were tested on their memory at 9am, following a night of sleep. To assess time-of-day effects on encoding and retrieval, Immediate Test control groups viewed the slideshow at either 9am (n = 18) or 9pm (n = 18), with a memory test administered 15min following learning. In addition to overall performance, dependent measures also assessed the recall of emotional vs. neutral information, and the recall of central vs. peripheral information.
Results: Memory performance was superior in the Sleep group, relative to the Wake group (P = .01). In contrast, performance was nearly identical in the 9am and 9pm Immediate Test control groups (P > .6), indicating that time of day did not significantly impact encoding or retrieval processes.
Conclusion: These data suggest that sleep is beneficial for the retention of episodic-like narrative information comprised of events unfolding across time. This effect cannot be attributed to time-of-day differences between groups, as 9am and 9pm Immediate Test groups exhibited similar memory performance.
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0093

POST-LEARNING SLEEP SELECTIVELY ENHANCES RETENTION OF EMOTIONAL MEMORIES: BOTH FULL AND HALF-NIGHT (REM) SLEEP DEPRIVATION INHIBITS THE ENHANCEMENT

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Introduction: Substantial evidence supports the role for sleep in memory consolidation.
Methods: Using a modified version of a well cited slide show varying only in emotionality with respect to the narrative in the middle phase of the show (neutral or emotional), a total of 57 participants (29 female, 28 male) were randomly assigned to six conditions: neutral (n = 10) and emotional (n = 10) full-night (8 hours) of sleep, neutral (n = 9) and emotional (n = 8) full-night (8 hours) of sleep deprivation, neutral (n = 10) and emotional (n = 10) half-night (4 hours) of late sleep deprivation. Standard polysomnography (EEG, EOG, EMG) was employed. Additionally, electrocardiography (ECG) was recorded to confirm physiological response to emotional stimuli. Participants were adapted to the laboratory a week prior to the experimental night, maintaining comparable sleep schedules. Subsequent to the experimental night, participants returned to the laboratory two days later, following a recovery night, for recognition testing.
Results: The findings confirm a selective enhancement of recognition memory (percentage of correct response) for the emotional middle phase in the emotional sleep group versus the emotional wake group (P = 0.001). There were no differences between full-night neutral sleep and neutral wake groups across all phases (P's > 0.05). As well, there was no difference between neutral and emotional half-night deprivation groups across all phases (P's > 0.05), including comparison with full-night deprivation groups. Subjective ratings of emotional reaction across two dimensions: (1) emotionality, and (2) valence were highly significant between neutral and emotional groups (P's < 0.0001). There was a significant ECG effect in the middle phase between the neutral and emotional groups (P < 0.05).
Conclusion: The results support three hypotheses: (1) sleep selectively enhances memories associated with emotional stimuli; (2) sleep deprivation inhibits the enhancement, and of most significant interest (3) half-night (REM) sleep deprivation appears to account for the impaired facilitation of emotional memories, suggesting an important functional role for REM sleep in memory storage processes.
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0094

THE EFFECT OF NORMAL SLEEP ON RULE-LEARNING IN AN AFFECTIVELY GUIDED DECISION-MAKING TASK: BEHAVIORAL RESULTS

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Introduction: Effects of sleep on rule-learning in the Iowa Gambling Task (IGT) is investigated.
Methods: 30 Harvard College undergraduates aged 18-24 (mean 20, SD 1.5) were assigned to Sleep (N = 18, 14 females) and Wake (N = 12, 8 females) groups. Sleep group testing began at 7:30 PM and 7:30 AM the following day, and Wake group at 7:30 AM and 7:30 PM of the same day. The computerized Iowa Gambling Task (IGT) used original (Bechara et al. 1994) win/loss amounts, schedule and instructions. Participants freely drew from 2 low-win/low-loss "advantageous" and 2 high-win/high-loss "disadvantageous" decks. Twenty draws were made during Session 1 and 80 in Session 2. Participants verbally evaluated each deck at the end of session 1 and after every 10 draws in session 2 (Maia and McClelland, 2004). Outcome (advantageous minus disadvantageous draws) was computed for Session 2 total and each 10- and 20-draw sequence.
Results: At Session 1, Sleep and Wake groups did not differ in outcome score (-3.3 and -1.5 respectively), number of losses and total amounts lost, won and net from disadvantageous decks (paired t-test), or percentage who drew the infrequent maximum loss card (Chi squared). Two-factor mixed ANOVA (between: Group, within: Session-2 Octile) of outcome showed a near trend for Group [F(1,28) = 2.4, P = 0.13] and highly significant Octile (P = .0003) main effects but no Group x Octile interaction. Wake's Session-2 outcome (41.5, SD 18.17) exceeded Sleep's (29.0, SD 23.6) due to 5 Sleep subjects who failed to improve during session 2 (outcomes -14 - +4), despite none of their Session 1 measures (see above) differing from the remaining 25 subjects.
Conclusion: After task exposure followed by sleep, a subset of individuals fail to show normative sustained IGT improvement. Sleep-mediated damping of emotion may diminish affective guidance on the IGT in such individuals.
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0095

LINKING SLEEP, COGNITION AND BEHAVIOUR IN CHILDHOOD − A META-ANALYSIS

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Introduction: Past research has shown that sufficient adult sleep is vital for daytime functioning, with sleep deprivation resulting in disrupted daytime performance. Less is known about the consequences of sleep loss in childhood. The recent years have seen an increased interest in childhood sleep and its relationship to daytime functioning, however results appear inconclusive. It therefore seems timely to aggregate all previous findings by meta-analysis to determine the status of, and gaps in, our current knowledge.
Methods: An extensive literature search was performed to find all research incorporating an objective measure of sleep, a measure of daytime functioning and a healthy childhood participant group. All relevant articles were objectively scored by two reviewers, and methodological and statistical aspects were imported into Comprehensive Meta-Analysis software. Independent effect sizes were calculated and split into 3 dimensions: Cognition, Behavioural Problems, or Sleepiness. Separate

meta-analyses, using random effect models, tested for the strength of a possible correlation between sleep duration and each of the three dimensions of daytime functioning.
Results: Eighty relevant studies were found. The meta-analyses revealed significant relationships between sleep and each of the 3 dimensions of daytime functioning. Sleep duration and cognitive performance were positively correlated, r = 0.090 (P < 0.001). Sleep duration and behavioural problems were negatively correlated, r = -0.075 (P < 0.001). Finally, sleep duration and daytime sleepiness showed a significant negative correlation, r = -0.093 (P < 0.001).
Conclusion: This - first ever - meta-analysis on sleep and daytime functioning in childhood conclusively reveals significant correlations between sleep, cognition and behaviour. Although the overall effect sizes are small, they confirm the existence of a previously disputed relationship. In light of the current results we would recommend ensuring that children obtain an adequate night's sleep duration.

0096

HIPPOCAMPAL-DEPENDENT LEARNING REQUIRES A FUNCTIONAL CIRCADIAN SYSTEM

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Introduction: The capacity for learning and memory have been shown to have a circadian rhythm. Many studies have also shown that sleep deprivation or disturbance can impair learning and memory. And, of course, there is strong circadian control over sleep. We asked whether the circadian system plays a role in learning and memory apart from its influence on sleep.
Methods: Siberian hamsters were rendered arrhythmic with a non-invasive light stimulation protocol which compressed their active phase on one day. Normal and arrhythmic hamsters were tested in two hippocampal-dependent learning tasks: novel object recognition and spontaneous alternation in a T-maze. Hamsters were subsequently treated with the GABA antagonist pentylenetetrazole (daily injections ip 1.0 mg/kg for 2 wks). One week and one month after drug treatment the behavioral tests were repeated. Prior experiments provided EEG scored sleep records on these animals.
Results: Control hamsters exhibited normal circadian modulation of performance in the learning and memory tasks. Arrhythmic animals could not discriminate a novel object from a familiar one only 20 or 60 min after training, nor could they maintain spatial working memory. Memory performance was not related to prior sleep history as sleep manipulations had no effect on performance. The GABA antagonist pentylenetetrazol restored learning in both tasks without restoring circadian rhythms.
Conclusion: We conclude that the circadian system is involved in memory function independent of its role in organizing sleep. Circadian influence on learning may be exerted via cyclic GABA output from the SCN to target sites involved in learning. Arrhythmic hamsters may have failed to perform this task because of chronic inhibitory signaling from the SCN that interfered with the plastic mechanisms that encode learning in the hippocampus
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0097

MINIMAL QUANTA OF SLEEP REQUIRED FOR MEMORY CONSOLIDATION

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Introduction: Sleep deprivation has been shown to impair memory consolidation, but is this a direct effect on a specific memory consolidation process or merely a consequence of disrupting neural processing of information in general? Is there a role for sleep integrity in the consolidation of memories?
Methods: We employed an in vivo optogenetics methodology to manipulate sleep/arousal control circuits in the brain and disrupt sleep integrity non-stressfully and without compromising total sleep duration. Using a lentivirus we transduced Hypocretin (Hcrt)/orexin neurons of C57Bl/6 mice with Channelrhodopsin-2 (ChR2). Applying light from a blue laser diode (20mW; 477 nm) we were able to stimulate the transfected Hcrt neurons with precise temporal resolution. Delivering trains of 10s stimuli (20Hz) at 30, 60, 120, or 240 sec intervals we induced micro-fragmentation of sleep in the experimental animals. The stimulations at intervals of 60 sec micro-fragmented sleep without sensory intervention and without compromising the overall duration of sleep or its general architecture. Using this method, we investigated whether interrupted integrity of sleep impaired memory consolidation in the novel object memory paradigm.
Results: Specific ChR2 stimulations for 4 h immediately after the training session resulted in a significant reduction in the performance on the test session of the novel object test 24 h later. These effects were specific to circadian phase and were Hcrt dependent as the reduction in memory performance was blocked when Hcrt receptor 1 antagonist (SB334867, 10 mg/kg ip) was injected prior to the stimulations. Longer intervals between stimulations (120 s and 240 s) had no effect on memory performance and a significant correlation was found between sleep integrity and memory performance, but not with sleep duration.
Conclusion: Results reveal a minimal quantal size of uninterrupted sleep episodes necessary for memory consolidation in rodents.

0098

GABA ANTAGONISTS DELIVERED DURING THE LIGHT PHASE, BUT NOT THE DARK PHASE, NORMALIZES LEARNING IN DOWN SYNDROME MICE

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Introduction: Down Syndrome is characterized by mild to severe cognitive impairment (IQ 20 - 80) with significant deficits in language, learning, and memory. The Ts65Dn mouse is an excellent rodent model of Down Syndrome, and shows poor performance in learning and memory tests. Working on the hypothesis that this learning and memory disability is due to over-inhibition, we tested the effects of GABA antagonists on these animals. In each case, adult mice were treated daily with low doses of the antagonists (picrotoxin, pentylenetetrazole, bilobilide, or flumazenil) for a period of 2 to 3 weeks. Weeks to months after treatment, the animals were tested for learning and memory abilities using the Novel Object Recognition (NOR) test. The drug treatments resulted in long-term normalization of learning and memory in the Ts65Dn mice.
Methods: Ts65Dn mice and WT controls were maintained on a 12:12 LD cycle. At 3 months of age they were trained and tested in the Novel Object Recognition test (NOR). The animals then received daily i.p. injections of pentylenetetrazole (0.3 or 3.0 mg/kg) for two weeks during the light phase or during the dark phase. Two weeks after the drug treatments ended, the animals were again trained and tested in the NOR.
Results: In baseline studies, the Ts65Dn mice were deficient in performance on the NOR. After 2 weeks of treatment with PTZ (.3mg/kg) delivered during the light phase, the Ts65Dn did not differ from the control mice in the NOR. However, mice that received their PTZ treatments during the dark phase showed no significant improvement on their NOR scores when subsequently tested.
Conclusion: We hypothesize that these results implicate circadian changes in GABA release from the SCN in the daily modulation of learning capacity. Thus, circadian phase must be taken into account in experiments exploring relationships between sleep and learning.

Support (If Any): Down Syndrome Research and Treatment Foundation, LeJeune Foundation; Fidelity Foundation; Stanford Institute for Neuroinnovation and Translational Neuroscience

0099

A MICE MODEL OF PTSD: PHYSICAL AND PSYCHOLOGICAL STRESS AND SLEEP AND BEHAVIORAL CHANGES

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Introduction: PTSD is an anxiety disorder that can develop after exposure to one or more terrifying events. Sleep disturbances such as difficulty falling asleep and nightmares are common symptoms of PTSD. The neurobiology underlying PTSD is largely unknown due to the lack of validated animal models of PTSD. We evaluated the sleep changes, anxiety levels, and serum corticosterone after single and repeated physical and psychological stress exposures using a unique communication box. Based on the results we found, we propose our psychological stress model as a new mice model of PTSD.
Methods: Mice (male, C57/BL6) with sleep headstage implantation were divided into three groups: electrical foot shock (FS), observation (OB), and cage control (CC) groups (n = 8 for each group). Physical and psychological stress was induced using a communication box, equipped with a metal floor grid. The box consisted of 8 compartments divided by non-transparent or transparent acrylic walls (with holes). A foot shock (2mA) was applied through the floor grid lasting for 10sec at 60sec intervals for 30 minutes for the FS mice. The OB mice could see the mice receiving the foot shock via transparent acrylic panels and perceive the sounds and smells. After the baseline sleep recording session (day 0), electric shock was applied to FS group (day 1, day 8 to 10, and day 15) and sleep was monitored for 6 hours from 10:00 am each experimental day. Anxiety was evaluated with elevated plus maze and marble burring tests.
Results: Both NR and REM sleep were significantly reduced in FS mice. Sleep changes in OB mice were different from those in FS mice, and REM sleep enhancement associated with reduction in NR was observed. These sleep changes in OB and FS mice lasted for 2 days. After 3 consecutive foot shock sessions, the sleep changes lasted longer. Furthermore, a single foot shock session on day 16 produced a much longer period (compared to the 1st session) of sleep changes. Corticosterone was significantly elevated in FS mice, but only modestly elevated in OB mice. In contrast, much higher and longer-lasting anxiety levels were observed in OB mice.
Conclusion: Sleep changes in the OB mice resemble those observed in human PTSD. REM sleep enhancement was associated with high anxiety,. The dose effects, and sensitization on the sleep and behavioral symptoms to the stress exposures were also observed.
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0100

THE IMPACT OF A POOR NIGHT SLEEP IN HEALTHY SLEEPERS: AN EVENT-RELATED POTENTIAL STUDY

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Introduction: In this study, we investigated cognitive performance following a subjectively good versus subjectively poor night sleep in healthy sleepers. In addition to reaction time, we investigated morning event-related potentials.
Methods: 23 healthy sleepers, aged between 18 and 28 years, participated. Thirteen subjects rated the sleep quality of the night before as acceptable (Good Night group) in comparison with their regular sleep quality (Brussels Indices of Sleep Quality). Seven subjects reported an unacceptably low sleep quality the previous night (Poor Night group). After completing the questionnaires in the morning, subjects performed a stop-signal task with simultaneous EEG recording. Maximal CNV, N1 and P2 amplitudes were determined at the Fpz, Fz, Cz and Pz location.
Results: A t-test showed that average reaction time did not differ between both groups ($t(11) = -1.041$; n.s.). A mixed 2 (Poor versus Good Night group) x 4 (location) repeated measures ANOVA indicated a significant interaction effect for N1 and P2 ($F(3,33) = 3,197$; $P < .05$ and $F(3,33) = 3,018$; $P < .05$ respectively). Post hoc tests showed that N1 at Fpz was marginally significantly larger in the Good Night than in the Poor Night group ($P < .10$). The amplitude of P2 at Fpz was significantly larger in the Poor Night than in the Good Night condition ($P < .05$).
Conclusion: Healthy volunteers who experienced a poor night sleep did not perform differently on a morning cognitive test from those who experienced a good night sleep in terms of reaction times. However, changes in the ERP components suggested that the underlying cognitive processes were affected in the way that a lower level of attention oriented towards imperative stimuli (smaller N1) was compensated by improved suppression of irrelevant information (larger P2) after a poor night as compared to a good night sleep.

0101

REGENERATION OF OVERNIGHT MEMORY CONSOLIDATION ABILITY IN CPAP PATIENTS

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Introduction: Obstructive sleep apnea (OSA) patients suffer from fragmented sleep and disrupted memory. Few studies have investigated the long-term memory abilities of OSA patients, and even fewer have compared memory performance in patients on and off CPAP. Here, we found that overnight picture memory consolidation was drastically improved in OSA patients using CPAP compared both to patients not using CPAP and controls.
Methods: 135 participants, ages 33-65 ($M = 54$; $SD = 10.6$) with BMIs ranging from 30-50 ($M = 34.1$; $SD = 7.4$), participated in a polysomnograph-monitored sleep study. They were divided into three groups: 1) control group ($n = 30$) who tested negative for sleep apnea; 2) baseline group ($n = 50$) diagnosed with OSA but not using CPAP and 3) experimental group ($n = 78$) diagnosed with OSA and using CPAP ≥ 3 weeks. All subjects viewed 20 photographs the night before the sleep study. The next morning, they were presented with 20 pairs of similar photographs and asked to identify which of each pair had been studied the previous night.
Results: There was no difference in the time spent in each sleep stage across experimental and control groups. Critically, however, the experimental group correctly identified more photographs after a night of sleep than both the control group ($P < .05$) and the baseline group ($P < .05$).
Conclusion: Patients receiving CPAP not only outperformed the baseline group (those with OSA but not yet on CPAP), but also the control group (those without OSA) in the overnight picture memory task. This suggests that CPAP is effective at recouping memory abilities that are impaired by OSA. More excitingly, because CPAP patients showed a performance increase over and above that seen in control subjects, CPAP use may be generally beneficial for the formation of long-term memories. This raises the question of whether forced oxygen flow allows for more efficient cognitive processing at night.

0102

SO YOU WANNA BE A ROCK STAR? SLEEP ON IT

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Introduction: A number of studies have demonstrated a beneficial effect of sleep for the consolidation of a variety of relatively simple motor

learning tasks. The purpose of the present study was to examine the benefit of sleep over wakefulness for a complex and ecologically-relevant motor learning task.
Methods: Participants were 15 university students (86.7% female; M age = 20, SD = 1.89 years). The complex motor learning task was Guitar Hero III (Activision). All participants completed both a wake (9AM to 9PM) and a sleep (9PM to 9AM) condition separated by 1 week. For each condition, participants played 1 of 2 songs. Participants had to reach a criterion of 50-75% of notes hit during acquisition. Participants performed two trials at retest. Both condition and song were counter-balanced across participants. A 2x2 repeated measures ANOVA with condition (wake vs. sleep) and session (acquisition vs. retest) was performed on the overall percentage of notes hit. A Pearson's correlation coefficient was computed between the total percent improvement across sleep and the duration of sleep, as determined by actigraphy.
Results: The repeated measures ANOVA revealed a significant condition by session interaction [$F(1,14) = 5.13$, $P = .04$]. Performance improved in the wake condition from 60.60% (SD = 9.41) to 62.80% (SD = 11.85) and in the sleep condition from 60.93% (SD = 9.60) to 68.10% (SD = 11.89). Sleep duration and the total percent improvement across sleep were significantly correlated [$r(13) = .52$, $P = .046$].
Conclusion: The results of this study suggest that sleep plays a role in the consolidation of a complex and ecologically-relevant motor learning task.
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0103
INTERACTIONS OF SLEEP AND WAKING WITH IMPLICIT AND EXPLICIT SEQUENCE LEARNING
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Introduction: Sleep has been reported to affect classic serial reaction time (SRT) sequence learning. Here we present data from an ongoing study of SRT learning in relation to both sleep and wakefulness.
Methods: In a sleep condition, sixteen participants have slept in the laboratory, each for one adaptation night and (one week later) one experimental night. On the experimental night the SRT sequence was learned either implicitly (n = 8) or explicitly (n = 8). After eight hours of sleep each participant was tested on both implicit and explicit SRT learning. In a wake condition, forty participants have learned the SRT sequence either implicitly (n = 16) or explicitly (n = 24). After an ecologically valid period of eight hours awake, each participant was tested on both implicit and explicit SRT learning.
Results: Sleep Condition: Reaction time (RT) to a novel sequence significantly exceeded RT to the learned sequence in the implicit group ($P = 0.009$), but not in the explicit group ($P = 0.41$). As shown by goodness of fit to the learned sequence, the explicit group could reconstruct the sequence ($P = 0.999$) and rate similarity to it ($P = 0.977$). The implicit group could not ($P = 0.00018$; $P = 0.001$) Wake condition: In the implicit group, RT to a novel sequence exceeded RT to the learned sequence ($P = 0.03$). This effect was weaker than in the sleep condition, and it disappeared in randomly selected subsamples size-matched (n = 8) to the sleep sample ($P = 0.16$; $P = 0.12$). In the explicit group, RT did not increase ($P = 0.528$). As shown by goodness of fit to the learned sequence, neither the explicit group ($P = 0.007$; $P = 0.01$) nor the implicit group ($P = 0.00005$; $P = 0.0001$) could reconstruct the sequence or rate similarity to it at a significant level.
Conclusion: Implicit SRT learning was sustained by sleep and, less strongly, by wakefulness. Explicit SRT learning was sustained by sleep but not by wakefulness. Sleep did not transfer implicit training to explicit knowledge.

0104
PERCEPTUAL LEARNING DIFFERENCES BETWEEN HABITUAL AND NON-HABITUAL NAPPERS
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Introduction: Napping habits vary across individuals. Although naps can improve performance, few studies have looked at differential benefits between habitual and non-habitual nappers. We asked whether habitual nappers receive more benefit in perceptual learning from a nap than non-habitual nappers.
Methods: Thirty-six healthy subjects kept a sleep diary for 7 nights. Subjects were categorized as habitual ((HN) n = 25, 15F, age = 20.4 ± 1.6yrs) if naps were recorded in diaries at least once during the seven days and non-habitual ((NN) n = 11, 6F, age = 21.9 ± 4.1yrs) if no naps were recorded. The texture discrimination task (TDT) was administered at 9:00 and 16:30. At 13:00, subjects took a 60 or 90min, PSG-recorded nap. TDT examined whether learning was vulnerable to interference by testing subjects on two different background orientations in either the same or different retinotopic location. Difference scores between AM and PM test sessions were analyzed.
Results: No differences were found in nap architecture, baseline TDT scores, or improvement on non-interference conditions of the task. In the interference condition, both groups showed resilience to interference, but HN showed significantly greater resilience than NN ($P = .003$). Furthermore, HN showed a correlation between nap architecture and performance in the interference condition: improvement after the nap was correlated with decreased stage1+2% ($r = -.423$) and increased REM% ($r = .526$). Nap architecture and performance was not correlated in NN.
Conclusion: We found that HN benefit more from a daytime nap than NH nappers. Specifically, HN are more resilient to perceptual interference. HN performance profiles are similar to prior studies reporting decreases in stage2 and increases in REM following TDT task administration. Taken together with prior studies of habitual nappers showing differences in nap architecture compared to non-habitual nappers, these data suggest that HN may reap more benefits to perceptual learning from a nap due to greater decreases in stage2 and subsequent increases in REM following TDT testing.
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0105
THE ROLE OF SOURCE AND ITEM MEMORY IN DECISION MAKING
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Introduction: Sleep deprivation affects some kinds of complex decisions including the Iowa Gambling Task (IGT). Emerging evidence has shown that sleep deprivation also interferes with memory encoding. The present study tests whether performance on IGT is partly a function of memory for choice outcomes over trails. If so, then sleep deprivation effects on decision making could be due to its influence on memory.
Methods: Healthy undergraduate students (n = 193) performed the IGT. The IGT requires subjects to choose from among four decks of cards. After a choice is made, a sum of money is either won or lost. The goal is to maximize winnings by choosing from the best decks. After 75 IGT trials, subjects were tested for item memory (which gains and losses were observed), and source memory (the deck associated with particular outcomes). Then subjects completed 25 additional IGT trials.
Results: Independent t-tests were used to contrast memory performance by good versus poor performers on the last 25 IGT trials. Hits and false alarms for item memory were unrelated to IGT performance ($P > 0.30$).

However, source memory was significantly better for subjects who performed well on the IGT (P = 0.01).
Conclusion: These results suggest that under non-sleep deprived conditions, source memory, which is associated with hippocampal functioning, is an important factor in complex decisions that involve accrual of information over trials. Further research is needed to determine if sleep deprivation effects on decision making are partially a function of impaired source memory.

0106

EFFECT OF SLEEP ON THE PERCEPTION OF COLOR

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Introduction: Sleep improves learning and consolidates memory. While this view is widely accepted, the notion that sleep can affect our perceptions, the way we view the world around us, has not yet been investigated. Here, we examine if sleep has an effect on visual perception, specifically on classification of stimulus color.
Methods: On a given trial, a full-field homogeneous stimulus of either slightly reddish or greenish hue was displayed. The observer had to judge if the stimulus was greener or redder than their internal percept of neutral gray. Across trials, the hue was varied using the method of constant stimuli. One pair of monocular tests was run just before the observer went to sleep overnight and the second pair immediately after the person woke up. Sleep duration was monitored with sleep diaries and actigraphy (7.7 hours on average).
Results: A comparison of pre- and post-sleep data (n = 5 observers) yielded a small but significant change: After sleep as compared to before, the stimulus was significantly less likely to perceptually take on a greenish tint (P < 0.01, bootstrapping statistics). A closer look at the results reveals that it is not sleep that causes gray to be classified as reddish, but prior wakefulness that causes gray to be classified as greenish and sleep restores perception to achromatic "equilibrium", i.e. following overnight sleep, physical gray is perceived as gray. Overnight full-field monocular stimulation of a flickering red ganzfeld failed to nullify the recalibrating sleep-induced effect: An achromatic stimulus was still less likely to be classified as greenish following sleep (n = 9), with no statistical difference in the magnitude of the recalibration in each eye. This suggests that recalibration is an obligatory, internal, sleep-dependent process that external stimulation cannot modulate.
Conclusion: Our tentative conclusion is that wakefulness causes color classification to drift away from neutrality and sleep restores it back.

0107

SLEEP AND EMOTIONAL SOURCE MEMORY CONSOLIDATION: A NAPPING STUDY

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Introduction: A growing body of literature indicates that emotional memories are preferentially consolidated during sleep. Here, we investigate how a four hour retention period containing either total wakefulness, or wakefulness with a two hour nap affects the retrieval of negatively valenced source information associated with a neutral cue.
Methods: Fifteen participants learned associations between emotionally negative or neutral background source pictures and neutral foreground object pictures. In an immediate retrieval test, participants were presented with learned object pictures and indicated whether the associated source picture had been emotionally negative or neutral. A second (delayed) retrieval test was administered following a retention period which contained wakefulness only, or wakefulness and a two hour nap.
Results: Behaviourally, a 2x2 ANOVA with retention type (nap/wake) and emotion (negative/neutral) as factors revealed considerably less forgetting (as calculated by immediate - delayed retrieval performance) in participants who napped during the retention interval (P < 0.001). Memory performance was comparable for items with emotional or neutral sources, and there was no interaction between factors. A Pearson correlation revealed a positive relationship between the percent of rapid eye movement sleep (REM) obtained during napping and the decay in neutral source memory across retention (R = 0.767, two tailed P = 0.04). However, no parallel correlation was found for emotional sources (R = 0.450, two tailed P = 0.31).
Conclusion: These findings support the hypothesis that sleep plays a role in the offline processing of newly formed declarative memories. The correlation between forgetting of neutral information and REM sleep is intriguing since previous research has indicated that REM may be involved in extracting the holistic properties or 'gist' of information while suppressing memory for the specific details of an experience. While we observed no evidence for preferential processing of emotional information across sleep, observation of this correlation for neutral, but not for emotional items does suggest that emotional valence interacts with consolidation processes during sleep. It is possible, for instance, that emotional salience disrupts REM based memory suppression.
Support (If Any): This research was funded by Unilever and the Engineering and Physical Sciences Research Council (EPSRC).

0108

THE EFFECTS OF TOTAL VS. PARTIAL SLEEP DEPRIVATION ON VISUAL WORKING MEMORY AND FILTERING

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Introduction: Effective working memory is essential for our ability to focus attention, maintain task instructions, and function successfully. The ability to both maintain relevant information and filter irrelevant information, is especially important for higher-order cognition. One prior study showed decreased VWM capacity after 24hrs total sleep deprivation. Here, we examine both VWM capacity and filtering efficiency following multiple types of sleep deprivation.
Methods: Subjects completed two computer-based VWM tasks in two sleep deprivation conditions: Partial Sleep Deprivation (PSD: 4 nights of 4hrs in bed/night, n = 15) and Total Sleep Deprivation (TSD: 22 hours awake, n = 14). The first task assessed overall VWM capacity, while the second probed the ability to filter out irrelevant distractor stimuli from the visual scene. Tasks were also completed by both groups after a well-rested period (6 nights of 9hrs in bed/night) in a counter-balanced order
Results: VWM capacity was not significantly affected by PSD or TSD, and PSD did not significantly affect filtering efficiency. However, TSD significantly impaired the ability to filter out irrelevant stimuli when distractors were most similar to targets (P = 0.25). On average, filtering efficiency fell by 62% during TSD.
Conclusion: Overall, neither 4 nights PSD nor 22hrs TSD decreased VWM capacity. Interestingly, TSD, but not PSD, impaired the ability to filter irrelevant but similar information from the visual field. Thus, while individuals can hold as many items on-line in VWM after total sleep deprivation, their ability to focus on the most valuable items may be compromised. Filtering efficiency is an important cognitive construct in many operational settings, particularly those requiring scanning of a vi-

sual scene. Future studies should examine the neural mechanisms of this differential sleep deprivation effect, as well as extend PSD to determine if PSD would eventually lead to impaired filtering efficiency.

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0109

COGNITIVE FLUCTUATIONS ARE ASSOCIATED WITH ABNORMALITIES IN RESTING-STATE FUNCTIONAL NETWORKS

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Introduction: Cognitive fluctuations, a core feature of Dementia with Lewy Bodies, recently have been described in Alzheimer's Disease, and are associated with worse clinical dementia rating and neuropsychological performance. Fluctuations may represent fragmentation of wakefulness, and thus be symptomatic of the instability of mechanisms separating sleep-wake states in neurodegenerative disease. Functional cortical networks characterized by correlated BOLD activity are preserved during wake and light sleep in controls, suggesting these networks maintain connectivity independent of state. However, many studies have shown that connectivity in these networks changes in cognitive pathology, reflecting abnormalities in cognitive processing. We evaluated three functional networks—Default Mode, Dorsal Attentional, and Executive Control—to assess whether fluctuations are associated with abnormalities in functional networks.

Methods: Subjects were recruited from a longitudinal study of memory and aging; the assessment included neuropsychological testing, resting state functional connectivity MRI and the Mayo Fluctuation Questionnaire. 15 subjects with high (3-4) fluctuation scores were compared with 16 age-matched controls.

Results: There was greater variability in intra-network connection strengths in participants who fluctuate compared with controls. Those with fluctuations had decreased connectivity in the Dorsal Attentional network, and increased connectivity in the Default Mode Network. There was decreased anti-correlation between these two networks. In the Executive Control network, participants who fluctuated had increased correlation between the left operculum and anterior cingulate cortex (ACC), and decreased correlation between the right operculum and ACC. Due to small sample size of this pilot, strong trends did not reached statistical significance.

Conclusion: Cognitive fluctuations are associated with several abnormalities in all three association networks examined, as well as with decreased anti-correlation between the Dorsal attentional and Default Mode networks, We propose that impairment of these functional networks in neurodegenerative disease leads to instability of sleep and wake states, resulting in cognitive fluctuations.

0110

PROSPECTIVE, RETROSPECTIVE, AND WORKING MEMORY ACROSS SLEEP AND WAKE DELAYS

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Introduction: Prospective memory refers to the ability to remember to execute intentions in the future, such as remembering to take one's medication with breakfast. Prospective memory may be contrasted with retrospective memory, which is memory for past events (such as a list of studied words). Research has demonstrated that sleep promotes retrospective memory consolidation, but the effect of sleep on prospective memory has yet to be investigated. Our primary goal was to examine whether sleeping after encoding a prospective memory intention would increase later prospective remembering.

Methods: Undergraduates (N = 121) were given a prospective memory task (remember to press the F1 key when you see a target stimulus during any experimental context), a retrospective memory task (syllable learning and recall), and a working memory task (reading span) at either 9 AM or 9 PM. Participants' were then given these tests again following a short delay (approximately 20 min), a 12-hr wake delay, or a 12-hr sleep delay.

Results: Prospective remembering was not only better following a 12-hr sleep delay than a 12-hr wake delay, but performance in the sleep condition did not differ significantly from performance in the short delay condition. Furthermore, the sleep-related prospective memory benefit was the greatest during a context that was weakly associated with the intention during encoding. Similar sleep-related benefits obtained for the retrospective memory test but not the working memory test.

Conclusion: The finding that sleep benefited prospective memory and retrospective memory, but not working memory, was consistent with the theory that hippocampus-dependent memories are consolidation during sleep. Furthermore, the results also suggest that sleep may promote associative binding, as evidenced by greater prospective remembering during an associated context only after a sleep delay. In a sense, sleep reinforced in memory a context in which the prospective memory intention was likely to be performed.

0111

THE RELATIONSHIP BETWEEN SLEEP VARIABLES AND IQ SCORES IN ADOLESCENTS

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Introduction: We have previously found that spindle activity and other sleep variables are correlated with IQ scores in young adults. This study was done to determine whether the same relationship also exists in adolescents.

Methods: Thirty-three adolescents (17 female and 16 male) between the ages of 12 and 19 years were recruited for the study. Participants were recorded for two consecutive nights in their home using the portable Suzanne system with Sandman software. EEG was recorded from C3, C4, FZ, and PZ leads as well as EOG and EMG. Approximately 1 week after the recording, participants were given the WISC-III (or WAIS) by a trained administrator.

Results: Pearson correlations were conducted on the proportion of time spent in each sleep stage vs. IQ scores. The percentage of time spent in slow wave sleep (SWS) was significantly related to Full Scale IQ ($r = .3746$, $P = .032$); it was specifically related to Verbal Comprehension ($r = .3587$, $P = .040$) and Perceptual Reasoning ($r = .4312$, $P = .012$). The percentage of time spent in REM sleep showed a negative trend with Full Scale IQ ($r = -.3073$, $P = .082$). The number of eye movements during REM (REMs) showed a significant negative relationship with Full Scale IQ ($r = -.4243$, $P = .014$); Subtests Verbal Comprehension ($r = -.3836$, $P = .028$) and Working Memory ($r = -.3386$, $P = .054$) showed the strongest relationships with REMs.

Conclusion: Sleep and IQ exhibit different relationships in adolescents than in adults, with the number of REMs actually being negatively related to IQ. In contrast, it seems that higher percentages of SWS are important in adolescence for optimal brain functioning. This is consistent with the high levels of slow wave sleep that occur in adolescence, suggesting its involvement in both brain development and functioning.

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0112

THE PREVALENCE OF SLEEP DISORDERS IN COLLEGE STUDENTS AND ASSOCIATION WITH ACADEMIC PERFORMANCE

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Introduction: Previous work has examined the prevalence of sleep disorders among adults, but the prevalence of sleep disorders among college students is unknown. The present study examined risk for sleep disorders in a large sample of college students. Given that some sleep disorders have been associated with some types of cognitive deficits, academic outcomes associated with risk for sleep disorders were also considered.
Methods: 1845 students at a large state university in southeastern United States completed the Sleep-50 survey (Spoormaker, Verbeek, van den Bout & Klip, 2005) during the 2007-2008 academic year. This survey has been validated against polysomnogram-based diagnoses. Current grade point average (GPA, as of the end of the semester when the survey was completed) was provided by the Registrar's Office. Sample demographics included: 70% White, 17% African American, 5% "Other," 4% each Asian and Latino; M age = 20.38 years; M GPA = 2.77.
Results: Over 500 students (27%) were at risk for at least one sleep disorder. The most commonly reported disorders were Narcolepsy and Insomnia, followed by Restless Legs Syndrome/Periodic Limb Movement Disorder, Circadian Rhythm Disorder (CRD), Affective Disorder, Obstructive Sleep Apnea (OSA), and Hypersomnia. Those not at risk for a sleep disorder had a higher GPA (M = 2.82, SD = .88) than did those who reported risk for at least one sleep disorder (M = 2.65, SD = .99), $F(1,1842) = 15.17$, $P < .01$. Students at risk for OSA, Insomnia, Narcolepsy, CRD, or at least one sleep disorder were over-represented among those with a GPA < 2.00.
Conclusion: If the findings reported here are representative, then sleep screening and treatment among college students may be of great benefit, particularly among individuals at risk for academic failure. Future research needs to demonstrate whether untreated sleep disorders are associated with retention and graduation rates, and whether treating a sleep disorder is followed by improved grades and better quality of life.

0113

THE ASSOCIATION OF BMI, NEUROPSYCHOLOGICAL AND BEHAVIORAL FUNCTIONING IN CHILDREN REFERRED FOR ADENOTONSILLECTOMY

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Introduction: The reported impact of pediatric obstructive sleep apnea (OSA) on daily functioning has been variable with limited studies examining the contribution of obesity on neuropsychological functioning in this group. The purpose of the present study is to examine the extent to which elevated BMI is associated with cognitive performance and behavioral symptoms in children, with or without measurable OSA on polysomnography.
Methods: Participants were part of a larger study on identification of sleep-disordered breathing in children (Washtenaw County Adenotonsillectomy Cohort II) including 147 children ranging in age from 3.0 -12.9 years (mean = 7.20 years) scheduled for clinically-indicated AT. Height and weights were measured prior to nocturnal polysomnography (PSG). Neuropsychological evaluations, including the Stanford Binet Intelligence Scale: Fifth Edition Abbreviated IQ and NEPSY Attention/Executive Functioning and Memory domains, were administered on the day following PSG. Parents completed the Pediatric Sleep Questionnaire (PSQ) and Conners' Behavioral Rating Scale-Revised: Long Version.
Results: ANOVAS examining the effect of age (3-5, 6-8, and > 8 years), presence (BMI+) or absence (BMI-) of BMI > 90th percentile, and the presence (OAI > .5) or absence of OSA on cognitive and behavioral functioning were computed. BMI+ was associated with poorer performance on the Stanford Binet Abbreviated IQ ($P = .04$) as well as the NEPSY Memory domain score ($P = .03$), but not NEPSY Attention/Executive functioning domain score (P = ns). The BMI+ group showed an increased parental report of PSQ Sleepiness ($P = .04$) and Conners' oppositionality symptoms ($P = .02$), but not Conners' hyperactivity symptoms (P = ns). Although age effects were seen for several variables, an age by BMI interaction was observed for NEPSY Memory, such that lower scores in the two younger groups for BMI+ were not evident for the oldest group.
Conclusion: Elevated BMI appears to be associated with poorer cognitive performance and higher ratings of problematic behavior in children scheduled for adenotonsillectomy, though for some variables age may modify this relationship.
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0114

COGNITION AND BEHAVIOR ONE YEAR AFTER ADENOTONSILLECTOMY IN CHILDREN WITH AND WITHOUT OSA AT BASELINE

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Introduction: Obstructive sleep apnea (OSA) is associated with childhood physiologic, cognitive, and behavioral problems, with a common treatment being adenotonsillectomy (AT). We previously reported that children scheduled for AT, whether they had OSA (AT/OSA+) or did not (AT/OSA-), presented with greater parental ratings of behavior problems and specific cognitive difficulties than did healthy controls, with the AT/OSA- group reflecting larger and more consistent problems than the AT/OSA+ group. We now examine one-year post-surgical changes in cognition and behavior.
Methods: Of the original participants, aged 5 to 12 years, in the Washtenaw County Adenotonsillectomy Cohort I, 94% (22 controls, 39 AT/OSA+, 38 AT/OSA-) returned one year after baseline pre-surgical evaluations for retesting with the original battery. Repeated measures analyses were used to compare the AT groups over time after adjusting for expected developmental changes based on control group performance.
Results: Following surgery, improvements were evident for Obstructive Apnea Index (AT/OSA+) and in both AT groups for Multiple Sleep Latency Test and parental snoring and sleepiness ratings (each $P < .001$). Both AT groups improved in sight reading ($P < .001$) and reading comprehension ($P < .01$), visual retention (Dot Recall, $P < .01$) and executive functioning (Category Test, $P < .01$). All Conners' parental ratings associated with hyperactivity and externalizing and internalizing behaviors demonstrated improvements ($P < .001$). In contrast, declines occurred across both AT groups in verbal abstraction (Similarities, $P < .001$) and initial verbal and visual learning (Word List, Dot Learning, $P < .05$).
Conclusion: Few studies have contrasted effects of AT in children with and without OSA. In our study, parents rated all AT children as significantly improved in sleep and behavior one year following surgery as compared to expectations based on healthy controls. Similar improvements occurred in some, but not all, neuropsychological and academic

areas. Identification of OSA before AT on standard polysomnography may not directly relate to post-AT improvement or further decline in neurobehavioral functioning.
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0115

MEASURES OF EEG AND EVOKED POTENTIALS DURING COGNITIVE PERFORMANCE IN CHILDREN WITH AND WITHOUT SLEEP DISORDERED BREATHING

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Introduction: Sleep disordered breathing (SDB) has been associated with impaired neurocognitive function in school aged children, but few data have been published that examine neurophysiological brain activity that occurs during the performance of cognitive tests. In this study, we recorded electroencephalographic (EEG) and evoked potential (EP) brain signals during three cognitive tests in children with and without SDB.
Methods: Eighty-six children ((mean ± SD)13.5 ± 1.5 years, 35 females) from the second cohort of the Tucson Children's Assessment of Sleep Apnea (TuCASA) study were administered the Sustained Working Memory Task (SWMT) developed by SAM Technology and the San Francisco Brain Research Institute. The SWMT tests spatial attention (SA), working memory (WM) and reaction time (RT). EEG power spectra and EP's were calculated based on established criteria and compared using Student t-tests on 43 pairs of children who were matched on age (1 year), gender, and IQ (10 points). Based on PSG ~5 years previously, SDB cases had RDI $\geq$ 6 while non-SDB controls had RDI $\leq$ 4.
Results: Performance and accuracy measures on all tests did not differ significantly between groups. The P300 EP (a marker of attention) had significantly larger amplitude during WM vs. RT tests only in the SDB group ($t(42) = -2.78$, $P < .01$). Slow wave EP amplitude, another marker of attention, did not differ significantly between groups. Alpha band EEG power (8-12 Hz) was larger in the non-SDB group during the RT, but not the SA or WM tests.
Conclusion: Few differences were observed between the SDB and non-SDB groups on EEG and EP measures. However, it remains possible that SDB results in subtle changes in long-term test cognitive test performance.
Support (If Any): HL 62373

0116

TEMPORAL LOBE EPILEPSY PATIENTS SHOW IMPAIRED SLEEP-DEPENDENT CONSOLIDATION ON A MOTOR SEQUENCE TASK

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Introduction: Previous studies demonstrated a vital role for sleep in learning and memory. Memory dysfunction is common in temporal lobe epilepsy (TLE), as is subjective and objective sleep disturbance. We examined whether patients with TLE demonstrate overnight improvement on a motor sequence procedural learning task known to undergo sleep-dependent improvement in healthy subjects.
Methods: Subjects underwent the finger tapping motor sequence test (MST), during which they were shown a numeric sequence of five numbers on a computer screen and asked to repeatedly press keys on a keyboard in a specific order, corresponding to the sequence displayed, using their left, non-dominant hand. Subjects completed twelve 30-second trials, with each trial scored for the number of correct sequences accomplished. To date, five patients (mean age 45 years, range 31-61) with probable or definite TLE and five control patients (mean age 47, range 28-62) underwent two MST sessions 24 hours apart to account for circadian effects. Testing took place between the hours of 8 AM and 4 PM. Performance was measured as the difference between the mean number of correct sequences completed in 30 seconds during the last 6 trials at baseline compared to the last 6 trials at retest, excluding any singular trial that was > 20% slower than the average for an individual.
Results: TLE patients demonstrated no significant improvement in their performance after a night of sleep (mean improvement 3.5%, sem 5.0%, $P = 0.503$), while controls demonstrated significant improvement (mean improvement 11.2%, sem 3.9%, $P = 0.022$). However, with this small n, no significant difference between groups was seen ($P = 0.26$).
Conclusion: These preliminary results suggest that TLE patients do not demonstrate overnight improvement on a sleep-dependent procedural learning task. Thus, there may be a failure of sleep-dependent memory processing in TLE patients. Further work in this area will help to confirm and elucidate these results.
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0117

EFFECTS OF CHRONIC SLEEP RESTRICTION ON SPATIAL LEARNING AND MEMORY IN RATS

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Introduction: Although previous studies have documented the deleterious effects of acute sleep disruption on memory processes, less work has examined the effects of chronic sleep restriction (CSR). This project was designed to determine the effect of 5d of CSR on the water maze performance of rats exposed to either 8h or 18h of total daily sleep deprivation (SD) placed immediately before, or after, the daily water maze acquisition training. We hypothesized that SD placed after the daily learning trials would impair memory consolidation more than would the SD placed prior to the daily learning trials.
Methods: Following two days of habituation to both the activity wheels (used to produce SD) and the water maze, 42 adult male Sprague-Dawley rats entered the CSR protocol and were trained daily for 4 days in the water maze task (8 acquisition trials/d with probe trials 30 min and 22h later to assess retention of the platform location).
Results: Acquisition: There was a tendency for rats receiving 8h SD after acquisition trials and wheel-control groups to show improved performance during acquisition trials towards the end of the experiment. Probe Trials: On day 4 the rats receiving 8h of daily SD after the acquisition training showed considerable memory for the platform location prior to training on the probe trial that preceded the daily acquisition trials. In contrast, the rats receiving 8h SD before the daily acquisition trials exhibited weaker memory on the day 4 probe trial. This finding contradicted our original hypothesis, and underscores the need for longer periods of SD in order to produce more robust impairments.
Conclusion: Since the size of all 8h SD-induced effects on learning and memory was modest, completion of the 18h/d CSR protocol is needed to provide more definitive conclusions.
Support (If Any): Dept. of Vet. Aff., NIH HL060292.

0118

BASELINE AND LEARNING-DEPENDENT CHANGES IN SLEEP SPINDLES PREDICT AVOIDANCE PERFORMANCE IN RATS

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Introduction: Sleep spindles may be involved in synaptic plasticity. Learning-dependent increases in spindles have been observed in both humans and rats. Not all rats learn to make avoidance responses in the 2-way shuttle avoidance task. The present study investigated if spindles predict whether rats are able to learn to make avoidance responses.
Methods: Baseline recordings were taken continuously for 24h prior to training on the shuttle task (50 trials/day) for two days followed by a 25 trial re-test on day 3. At re-test, rats were categorized into learners (n = 16) or non-learners (n = 21). The sleep architecture and spindle data were binned into 4h periods aligned to lights-on (1100h). All sleep stages were expressed as the percent total recording time within each 4h period, and spindle density as spindles/minute.
Results: Avoidance responses significantly increased over the training and re-test ($F(2,30) = 23.43$, $P < 0.0001$) in learning rats but not non-learning rats ($F(2,40) = 0.32$, $P = 0.73$). Groups did not differ in baseline duration of wake, REM, non-REM or spindle density. For combined groups, spindle density from 21-24h was negatively correlated (Bonferroni-corrected) with shuttle performance at re-test ($r(29) = -0.47$, $P = 0.007$), but not at any other period during the 24h baseline recording. Conversely, the learning-related change in spindle density from 21-24h, but not at any other time, was positively correlated with shuttle performance ($r(29) = 0.51$, $P = 0.003$).
Conclusion: Poorer performance was associated with a higher number of baseline spindles. Conversely, a learning-related change in spindles was positively correlated with shuttle performance. Thus, a high number of baseline spindles predict poor performance, whereas post-training increases in spindles predict performance improvements. Extreme spindle activity and high spindle density have been observed in humans with learning disabilities. Results suggest that while spindles may be involved in memory consolidation, in some cases, high levels of spindles prior to training may be maladaptive.
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0119

SPATIAL STRATEGIES UTILIZED BY SLEEP DEPRIVED RATS

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Introduction: Previous research has demonstrated that sleep disruption prior to training in a water maze task will disrupt learning in rodents. Additionally, hippocampal plasticity and proteins involved in learning and memory are altered following sleep loss. In the present study, a detailed analysis of the strategies utilized in a water maze was performed following total sleep deprivation. It is hypothesized that sleep deprivation will impair hippocampal function and therefore rats will choose a non-spatial strategy to escape from the water.
Methods: Sprague Dawley rats (N = 12) were randomly divided into a gentle handling sleep deprivation group and home cage control group. Immediately following 6 hours of manipulation, rats were trained in a hidden platform version of the water maze. Briefly, rats were given 3 blocks of 4 trials each, separated by 30 minutes between blocks. Rats were given a maximum of 60 seconds to locate the hidden platform. A computerized tracking system recorded the path each rat swam to the platform. An experimenter blinded to the group each rat was placed in judged each path and determined the rat to have utilized a A) spatial strategy, B) non-spatial systematic strategy, or C) repetitive looping strategy.
Results: There was a significant interaction between sleep deprivation and latency to find the platform over 12 trials ($F(11,110) = 2.03$, $P = .032$) where sleep deprived rats were slower in learning the task. However, there was not a robust difference between groups. Additionally, there were no differences observed in the frequency of strategy style chosen by rats in the sleep deprived group as compared to the cage control group ($\chi 2 = 3.73$, $P = .15$).
Conclusion: No differences were observed in the strategy rats utilized in solving a spatial task during initial testing. Further testing will be necessary to determine if increased sleep deprivation time or changes in task difficulty will alter the rodents' performance following sleep deprivation.

0120

REM SLEEP RESTRICTION AND REVERSAL OF SPATIAL LEARNING

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Introduction: The literature indicates that rapid eye movement (REM) sleep deprivation or restriction impairs spatial learning in the Morris water maze. However, it is not known how REM sleep restriction affects the reversal of this spatial learning.
Methods: After 2 days of visual acuity screening in the visual version of the Morris water maze, rats were trained in the spatial version of the Morris water maze for 12 training trials per day, for 6 days. The training was divided into two tasks: initial spatial learning (Days 1-4) and reversal learning (Days 4-6). Six hours of REM sleep deprivation was administered following training using the inverted flowerpot technique. We measured how REM sleep restriction altered spatial learning and/or reversal learning. Experiment 1 measured the effects of REM sleep restriction when given during reversal learning (n = 24). Side-effects of REM sleep restriction were controlled for by a REM sleep deprivation group deprived during a REM sleep insensitive learning window. Experiment 2 tested the effects of REM sleep restriction given during initial spatial learning on performance and on subsequent reversal learning when rats were no longer deprived (n = 17).
Results: Experiment 1: REM sleep restriction during reversal learning had no effect on performance ($P > 0.05$). Experiment 2: REM sleep restriction during initial spatial learning had no effect on initial performance ($P > 0.05$), and traditional measures for training and probe trials showed no group differences during subsequent reversal learning ($P > 0.05$). However, the more sensitive measure of average proximity showed that previously REM sleep restricted rats swam further from the reversal learning platform location than home cage controls ($P < 0.05$) during the probe trial.
Conclusion: Though REM sleep restriction had no immediate performance effects when 12 trials/day were administered, a nonstandard measure detected a latent performance deficit during the subsequent reversal learning.
Support (If Any): MH60670 NIH Dept. of Anesthesiology, University of Michigan

0121

PHARMACOLOGICALLY INDUCED DEEP SLEEP ENHANCES HIPPOCAMPUS-DEPENDENT MEMORY IN MICE

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Introduction: Human studies have found slow-wave sleep to facilitate declarative memory. Rodent studies have demonstrated reactivation of hippocampal place cells during NREM sleep and this neuronal replay has been implicated as a mechanism for memory consolidation. However, no studies to date has directly linked deep sleep (when compared to a natural waking control) to improved memory in rodents.

Methods: We trained animals on Pavlovian fear conditioning an hour prior to their main awake phase. Immediately post-training, we administered a high dose of zolpidem (8mg/kg, i.p.) or saline. We tested the animals for context (hippocampus-dependent) and cued (hippocamus-independent) memory 12 hours post-training (off drug).
Results: We found zolpidem-induced deep sleep to selectively enhance contextual fear and not cued memory.
Conclusion: Our findings show for the first time, a direct link between deep sleep and hippocampus-dependent memory consolidation in rodents. We encourage the use of this novel paradigm to study the neural mechanism underlying sleep-dependent consolidation.
Support (If Any): UCSD Interdisciplinary Collaboratories Grant (DJC)

0122

A CRITICAL TIME WINDOW FOR SLEEP TO STABILIZE HIPPOCAMPUS-DEPENDENT MEMORIES IN MICE

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Introduction: We have previously reported sleep to facilitate consolidation of hippocampus-dependent memory in mice. In a prior study, we found post-training sleep to enhance contextual fear memory, regardless of whether it occurred immediately post-training or 12 hours later. In the current study, we asked if weaker memories have a more immediate critical window within which sleep must occur.
Methods: We trained mice on a Pavlovian fear conditioning task (1 tone-shock pairing) immediately prior to their main sleep or awake phase. We tested animals 12 or 24 hours later for their contextual (hippocampus-dependent) and cued (hippocampus-independent) memory.
Results: We found sleep to enhance contextual fear memory only when it occurred immediately post-training. The benefit of sleep was only observed for contextual and not cued memory.
Conclusion: The strength of the memory formation (manipulated by the difficulty of the training protocol) interacts with the critical time window in which sleep needs to occur. For weaker formed memories, sleep must occur soon after training. Whereas for stronger formed memories, sleep may occur at a later time after training.

0123

SLEEP IS REQUIRED FOR THE FORMATION OF LOCOMOTOR SENSITIZATION, A NON-ASSOCIATIVE LEARNING PROCESS IMPLICATED IN DRUG ADDICTION

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Introduction: We have previously reported that fear memories require sleep. Recent theories of addiction have linked learning mechanisms with the behavioral and cellular changes induced by drugs of abuse. Thus, we sought to test the role of sleep in the formation of locomotor sensitization, a non-associative learning process implicated in drug addiction.
Methods: Mice were trained with an initial injection of cocaine (15 mg/kg) immediately prior to their main sleep or awake phase. Locomotor sensitization was assessed by administering a second injection of cocaine 12 or 24 hours after training. Locomotor sensitization was measured as an increase in the locomotor stimulant properties of a drug after repeated administration.
Results: After 12 hours, only mice that were trained immediately before the main sleep phase demonstrated locomotor sensitization. After 24 hours, all mice showed locomotor sensitization.
Conclusion: Locomotor sensitization was induced only after having a sleep phase. Sleep, therefore, is required for the formation of this non-associative process implicated in addiction.
Support (If Any): NIDA DA020041 (SGA)

0124

ANTAGONIZING CORTICOTROPIN RELEASING FACTOR (CRF) 1 RECEPTORS IN THE BASOLATERAL AMYGDALA (BLA) ATTENUATES THE EFFECT OF FOOTSHOCK TRAINING ON SLEEP IN RATS

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Introduction: We have demonstrated that fear conditioning (shock training (ST) and fearful context alone (FC)) is followed by significant reductions in REM. CRF plays a major role in stress-induced alterations in sleep including those produced by fear conditioning. BLA contains a high density of CRF1 receptors; however, their role in fear conditioning is poorly understood. The role of BLA in sleep and arousal following fear conditioning also has not been delineated. Here, we examined the effects of microinjections of the CRF1 antagonist, antalarmin (ANT), into BLA prior to ST on subsequent sleep. We also examined the "lasting" effects of these infusions on sleep after FC.
Methods: Wistar rats (n = 19) were implanted with electrodes for recording sleep and with cannulae aimed bilaterally into BLA. After recovery the animals were habituated to the injection procedure (handling) over 2 consecutive days and baseline sleep following handling was recorded. On experimental day 1, the rats were injected (0.5uL) with either ANT (4.82mM; n = 10) or vehicle (dH2O, n = 9) prior to ST (20 footshocks, 0.8mA, 0.5s duration, 60s ISI). On day 6, the animals experienced FC. Sleep was recorded for 20h post-experiment (8h light, 12h dark) and scored for NREM, REM, and wakefulness.
Results: Compared to baseline, rats receiving vehicle showed reduced REM after ST and FC. Rats receiving ANT did not show differences in light period REM across recording days whereas dark period REM after ST was increased compared to baseline and FC. Also, compared to vehicle, ANT prior to ST resulted in significantly increased light period REM. After FC, vehicle and ANT treated rats did not significantly differ in the light period, but vehicle treated rats showed more dark period REM.
Conclusion: CRF1 receptors within the BLA play a role in the reduction of REM observed following ST phase of fear conditioning and may modulate memory of the fearful experience.
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0125

EFFECTS OF CORTICOTROPIN RELEASING FACTOR (CRF) ON SLEEP FOLLOWING PREDICTABLE CONTROLLABLE AND UNCONTROLLABLE STRESS IN MICE

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Introduction: CRF plays a major role in neurobiological responses to stress including stress-induced alterations in sleep. Predictability and controllability are important in the persisting effects of stress, and are factors in the effects of stress on sleep. We administered CRF and astressin (AST), a non-specific CRF antagonist, to mice trained with signaled, escapable shock (SES) and with signaled, inescapable shock (SIS) to assess the role of CRF in regulating changes in sleep induced by predictable stressors.
Methods: Male BALB/cJ mice were implanted with transmitters (DataSciences ETA10-F20) for recording EEG and activity by telemetry. After baseline sleep recording, the mice were presented tones (90 dB, 2 kHz) that started 5.0 sec prior to and co-terminated with footshock (0.5 mA; 5.0 sec maximum duration). SES mice (n = 9) always received shock but could terminate it by moving to the non-occupied chamber in a shuttlebox. Yoked SIS mice (n = 9) were treated identically except that they could not alter shock duration. Training with SES

or SIS was conducted for two days without drug administration to stabilize responses. Afterwards, the mice were administered saline, CRF or AST prior to SES or SIS. Sleep was analyzed over 20 h post-stress recordings.

Results: After ICV administration of saline, REM was significantly greater in SES mice than in SIS mice ($P < .04$). ICV administration of CRF significantly reduced REM in SES mice ($P < .002$), but not in SIS mice. By comparison, ICV administration of AST enhanced REM in SIS mice ($P < .04$) but not in SES mice. Total 20 h NREM did not vary across condition or group.

Conclusion: SES and SIS produce directionally different alterations in REM that are differentially altered by ICV administration of CRF and AST. These findings indicate a role for CRF in mediating sleep after predictable controllable and predictable uncontrollable stress.

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0126

EFFECTS OF STRESSOR PREDICTABILITY AND CONTROLLABILITY ON SLEEP IN MICE

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Introduction: We have demonstrated that controllable and uncontrollable footshock stress produce directionally different alterations in post-stress rapid eye movement sleep (REM). Predictability is also important in the persisting effects of stress. We trained mice with signaled, escapable shock (SES) and with signaled, inescapable shock (SIS) to determine whether predictability can be a significant factor in the effects of stress on sleep.

Methods: Male BALB/cJ mice were implanted with transmitters (Data-Sciences ETA10-F20) for recording EEG and activity by telemetry. After recovery from surgery, baseline sleep recordings were obtained for 2 days. The mice were then randomly assigned to SES ($n = 9$) and SIS ($n = 9$) conditions. The mice were presented tones (90 dB, 2 kHz) that started 5.0 sec prior to and co-terminated with footshock (0.5 mA; 5.0 sec maximum duration). SES mice always received shock but could terminate it by moving to the non-occupied chamber in a shuttlebox. Yoked SIS mice were treated identically except that they could not alter shock duration. Twenty tone-shock pairings (1.0 min interstimulus intervals) were presented on two days (ST1 and ST2). Sleep was analyzed over 20 h post-stress recordings.

Results: Shock duration per trial was greater on ST1 (2.4 ± 0.85 sec) than on ST2 (1.4 ± 0.62 sec), $P < .006$. Compared to SIS mice, SES mice showed significantly increased REM after ST1, $P < 0.0001$, and ST2, $P < 0.0006$. Compared to baseline, SES mice showed greater REM after ST1, $P < 0.001$, and ST2, $P < 0.0002$, whereas SIS mice showed significantly decreased REM after ST1, $P < 0.007$, but not ST2. Compared to SES mice, SIS mice also showed increased NREM after ST1, $P < 0.04$, and ST2, $P < 0.02$.

Conclusion: Even though both groups of mice received equal amounts of footshock, SES was followed by increased REM on both ST days whereas SIS produced a decrease in REM on ST1 that was attenuated on ST2. These findings suggest that predictability as well as controllability can play a significant role in the effects of stress on sleep.

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0127

DEFICIENCY OF SYNAPTIC CELL-ADHESION MOLECULE, NEUREXIN-3, AND WAKE-PROMOTING RESPONSE TO AMPHETAMINE

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Introduction: Neurexins and neuroligins are synaptic cell-adhesion molecules that connect presynaptic and postsynaptic neurons at synapses; mediate signaling across the synapse; and shape the properties of neural networks by specifying synaptic functions. Alterations in genes, encoding neurexins or neuroligins, have recently been shown to be implicated in autism and alcohol dependences. A recent animal experiment also suggests a link between neurexin-3 (NRXN3), one of the neurexins, and cocaine addiction. Since neurexin-3 is enriched in dopamine (DA) neurons and DA is involved in stimulant abuse and stimulant induced wakefulness, we generated the NRXN3 KO (specific to DA neurons) mice and evaluated sleep phenotype and response to wake-promoting DA compounds in these mice.
Methods: The mice lacking NRXN3 expression in DA neurons (NRXN3/DA cKO) are generated by crossing neurexin-3 α/β common exon floxed mice to dopamine transporter cre knock-in mice, and 6 NRXN3/DA KO mice and 6 wild type (WT) littermate mice are used. The mice were surgically prepared for cortical EEG and neck EMG recordings. Following the recovery, 24 hour baseline sleep recordings as well as 6 hour sleep deprivation (SD) were made, and sleep phenotypes were compared between two genotypes. We also administered d-amphetamine, d-methamphetamine (DA release enhancers), GBR12909 (a DA uptake inhibitor) and modafinil and examined the wake-prompting effects between genotypes.
Results: There was no difference in wake, NREM and REM sleep amounts, their diurnal distributions or sleep architectures between NRXN3/DA KO and WTmice. Likewise, there was no difference in recovery sleep after the SD between genotypes. However, NRXN3/DA KO mice are more sensitive to amphetamine and methamphetamine, and significantly larger amounts of wakefulness ware observed in NRXN3/DA KO after the drug administrations. By contrast, GBR12909 and modfinil produced the same amounts of wakefulness in both genotypes.
Conclusion: NRXN3 in DA neurons may be involved in DA release, and altered function of this mechanism may explain the enhanced wake-promoting responses to amphetamine and susceptibility of cocaine abuse. Further research is warranted to evaluate roles of NRXN3 in the regulation if DA neurotransmissions in health and disease.
Support (If Any): This study was supported by NIH Grants(R01MH072525 and R03MH079258)

0128

EFFECTS OF SLEEP DEPRIVATION ON SINGLE UNIT ACTIVITY IN THE RAT LATERAL PREOPTIC HYPOTHALAMUS

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Introduction: The preoptic hypothalamus plays a critical role in the regulation of nonREM and REM sleep. Immunohistochemical and electrophysiological studies have identified sleep-active neurons in this region and it is hypothesized that these neurons have sleep regulatory functions. However, the effects of increased homeostatic pressure for sleep on the discharge of preoptic neurons are unknown. We examined the activity of lateral preoptic (LPO) neurons during spontaneous sleep-wake, during short term sleep deprivation (SD) and during recovery sleep (RS).
Methods: Sprague Dawley rats were prepared with EEG and EMG electrodes for recording of sleep-wake states and with bundles of microwires in the LPO for recording extracellular neuronal activity. After baseline sleep-wake profiling, neuronal activity was continuously recorded during 2-3h of SD achieved with gentle handling. This was followed by continuous recording during 2h RS. The experiments were conducted during light phase and SD was initiated within 2h of light onset.
Results: We have identified 18 state-indifferent, 10 wake-active, 40 wake-REM active, 18 nonREM sleep active and 21 REM sleep active neurons (total = 107). We have documented responses of 78 neurons during SD and RS. Wake-active neurons (n = 5), wake-REM active neurons (n = 17) and state-indifferent neurons (n = 13) did not exhibit changes in discharge rate during SD or RS compared to baseline. REM sleep related neurons (n = 17) exhibited increases in discharge rate during SD compared to baseline waking (7.13 ± 2.2s/s versus 5.2 ± 1.6s/s) and during nonREM sleep during RS versus baseline (6.7 ± 2.1s/s versus 4.2 ± 1.5s/s). Responses of nonREM sleep-related neurons to SD (n = 10) were heterogeneous, but mean discharge rates were unchanged in response SD and RS.
Conclusion: Within the LPO, neurons with REM sleep-related discharge may be the most responsive to short-term SD. Increased activity of these neurons in response to SD may promote sleep onset and promote the occurrence of REM sleep during RS
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0129

PREDICTING THE INFLUENCE OF SOUND ON SLEEP

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Introduction: Sleep spindles are thought to affect the neural processing of sensory information during non-REM sleep and mitigate the disruptive effects of ambient noise. Variation in spindle quantity might thus signal differential protection from arousal during sleep. We hypothesized that individual spindle density is related to the mean sound intensity required to evoke a cortical arousal during non-REM sleep.
Methods: Thirteen healthy subjects (median age 23) were polysomnographically recorded for three consecutive nights in the laboratory. Spindles on the first night were counted off-line by applying an automatic detection algorithm to one centrally-derived EEG channel. During the 2nd and 3rd nights, fourteen stereotypical hospital sounds (e.g. IV alarm, toilet flushing), each 10 seconds in duration, were delivered during stable bouts of stages N2, N3 of non-REM sleep, and REM sleep. Sounds were initiated at 40 dB and presented every minute, in 5 dB increments, until a cortical arousal occurred or 70 dB was achieved.
Results: We found a significant positive correlation between spindle density during stage N2 of the 1st night and the mean intensity required to induce an arousal during stage N2 of the 2nd and 3rd nights ($R = 0.63$; $P = 0.02$).
Conclusion: Our data show that the disruptive effects of sound during non-REM sleep can be predicted by the density of spindles on a previous night. Sleep spindle quantity might thus be regarded as a biological signature of individual resistance to external interference during sleep.
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0130

OVERNIGHT INCREASES IN MEDIAL TEMPORAL LOBE RESPONSE DURING EMOTIONAL MEMORY

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Introduction: A growing literature suggests that emotional memories are preferentially consolidation across sleep. This has been indexed by stronger hippocampal responses and connectivity as well as behavioural benefit for emotional, as compared to neutral memories during retrieval post-sleep. Here, we use functional magnetic resonance imaging (fMRI) to examine brain responses during emotional memory after a 12 hour retention interval across wake or sleep. Because cognitive set modulates hippocampal responses and connectivity at recognition, we also examine the impact of two distinct retrieval tasks.
Methods: 22 participants encoded 160 object/source image pairs incorporating neutral objects and negative/neutral sources containing people/no-people in a counterbalanced manner. 12 +/- 1 hours later, during fMRI scanning, learned objects were presented and participants indicated if the source had been emotional (emotion-relevant task), or if it had contained people (emotion-irrelevant task). Retention included a night of sleep (Sleep group) or a day awake (Wake group).
Results: Behaviourally, a 2x2 ANOVA with valence and group as factors revealed greater source memory for negative items ($P < 0.001$), and greater source memory after wake than after sleep ($P = 0.003$), but no interaction. Functionally, there was an interaction between sleep and valence, with left amygdala and right rhinal cortex more active during emotional memory after sleep (s.v.c. $P < 0.05$). Interestingly, these responses were significantly stronger in the emotion-relevant condition. There was also greater connectivity between right rhinal cortex and amygdala bilaterally during emotional memory after sleep (s.v.c $P < 0.05$), however this did not differ across tasks.
Conclusion: These findings demonstrate that the neural representations of recalled emotional memories change across a brief retention interval of just 12 hours. Furthermore, this offline modulation depends not only upon retention time, but also upon brain-state during that time. Finally, cognitive set determines the extent to which resources that have become available across a night of sleep are actively recruited at subsequent recall.

0131

FUNCTIONAL MRI CORRELATES OF SELF-REPORTED DAYTIME SLEEPINESS

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Introduction: An emerging model of brain function suggests that there exists a stable pattern of activation within the awake resting brain. When not engaged in task-relevant processing, individuals show activation of midline cortical structures including the posterior cingulate, precuneus, and medial prefrontal cortex—a system known as the Default Mode Network (DMN). This pattern of activation appears to be related to self-relevant cognition, mind wandering, and daydreaming. Sleepy individuals often complain of difficulty concentrating and daydreaming, yet it is currently unknown whether DMN activity during cognitive processing is related to daytime sleepiness. We examined the relationship between self-reported daytime sleepiness and DMN activation during a cognitively engaging task.
Methods: Sixteen healthy adults (8 male; 8 female; Mean age = 47, SD = 5) underwent fMRI scanning (3T) while engaged in an appetitive-processing task shown to activate a cortico-limbic network (i.e., viewing images of high fat/calorie rich foods versus control stimuli of flowers, rocks, and trees). Responses to the question "I feel sleepy during the daytime" were rated on a 10-point scale ranging from "not at all" to "always feel severe sleepiness." Scores on the daytime sleepiness scale were entered into a linear regression analysis in SPM99 to predict functional brain responses during the appetitive task.
Results: Self reported sleepiness was low to moderate (M = 3.25, SD = 1.5, range 1-6). Greater daytime sleepiness was positively correlated with activation within the "default mode network," including the medial prefrontal cortex, cingulate gyrus, and precuneus ($P < .005$, uncorrected). In contrast, activation within the hypothalamus and amygdala was negatively correlated with daytime sleepiness ($P < .005$, uncorrected).
Conclusion: During an engaging visual task, higher self-reported daytime sleepiness was associated with greater activation within the DMN and lower activation within regions involved in homeostatic regulation, motivation, and emotional arousal and orienting responses. Findings suggest a functional brain signature that may be associated with daytime sleepiness.
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0132

COMPLEMENTARY AND SYNERGISTIC CONTROL OF WAKEFULNESS BY HISTAMINE AND OREXINS, DEMONSTRATED USING A DOUBLE KNOCKOUT MOUSE MODEL

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Introduction: We have previously shown that mice lacking histamine (HA) synthesis are characterized by an EEG and behavioral somnolence. Indeed, these mice show a deficiency of wakefulness (W) when high vigilance is required such as lights-off or a new environment; whereas orexin (Ox) knockout (KO) mice are distinguished by a W deficit faced with a motor challenge. We then suggested that HA and Ox exert a distinct, but complementary control of W. To access the synergies of the two waking systems, we have characterized the sleep-wake phenotypes of KO mice lacking HA and Ox.
Methods: The double KO mice were obtained by crossing KO mice lacking HA-synthesis and those lacking prepro-orexin. The mouse model was validated by PCR and immunohistochemistry showing the deletion of HA-synthesizing and prepro-orexin genes and the absence of HA and Ox neurons in the posterior hypothalamus. Cortical EEG and sleep-wake recordings were performed in adult mice under baseline conditions and following behavioral or/and pharmacological tests.
Results: Our double KO mice were characterized, on the one hand, by a somnolent phenotype more severe than that seen with KO mice lacking HA alone, i.e., 1) significant decrease in W (during darkness and over 24h), sleep latencies and cortical EEG ratio between slow wave sleep and W; 2) unable to remain awake faced with a new environment. This somnolence was abolished by modafinil but not by H3-receptor inverse agonists suggesting absence of functional HA. On the other hand, these mice showed phenotypes characteristic of Ox KO mice, i.e., direct REM sleep onset (DREMs) and W deficit faced with a motor challenge, both being rescued by central Ox-A dosing. Finally, these double KO mice displayed aggravated sleep fragmentation and obesity as well as phenotypes never seen with simple KO mice lacking HA or Ox, such as cortical EEG hypersynchronization during W and cataplexy, defined

as sudden loss of muscle tone during W and characteristic of human narcolepsy.
Conclusion: Our data suggest that HA- and Ox-neurons exert a distinct but complementary and synergistic control over W, the amine being mainly responsible for cortical (EEG) arousal and cognitive activities during W and the neuropeptide being more involved in the behavioral activities during W. They could be co-responsible for narcolepsy: Ox deficiency is likely the direct cause of DREMs and cataplexy, whereas a decreased HA neurotransmission could account for the excessive somnolence seen in this disease and other sleep disorders.
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0133

ENHANCED REM SLEEP AND RESISTANCE TO ANTIDEPRESSANTS IN MICE LACKING THE RELAXIN-3 PEPTIDE

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Introduction: Relaxin-3 is an insulin-like peptide transmitter that is produced only in the nucleus incertus, and was found to activate a novel G-protein coupled receptor, RXFP3, expressed in brain regions associated with stress and information processing. Relaxin-3 function is hypothesized to control appropriate level of central behavioral activation with consequent possible links to disorders associated with stress and cognition. This led us to examine sleep-wake patterns in relaxin-3 deficient mice and the sleep response to pharmacological inhibition of RXFP3 in rats.
Methods: Sleep experiments were conducted in mice and rats implanted with telemetric devices for recording of EEG/EMG signals. In male adult relaxin-3 knock-out (KO) and wild-type (WT) C57Bl/6 mice, sleep was recorded under baseline conditions. In male Sprague-Dawley rats implanted with a lateral icv cannula, sleep was analyzed after infusion of the RXFP3 antagonist R3(B delta 23-27)R/I5 (10 ug) at the onset of the dark phase. The tail suspension test (TST) was used to determine the depressive-like behavior in response to the antidepressants fluoxetine and desipramine (30 mg/kg ip) in both mouse genotypes.
Results: Under baseline conditions, relaxin-3 KO mice exhibited more frequent REM sleep episodes resulting to a specific enhancement in REM sleep duration over the entire light-dark cycle, relative to WT mice. Consistent with this observation, the RXFP3 antagonist also produced a significant prolongation of REM sleep time during 6h following its administration in rats. Interestingly, in the TST the decrease in immobility time induced by fluoxetine and desipramine was evident in WT but not in relaxin-3 KO mice.
Conclusion: The present data indicate a potential role of relaxin-3 in the control of REM sleep. The finding that mice lacking the relaxin-3 peptide exhibit excessive episodes of REM sleep associated with a resistance to antidepressants indicates that these mice may represent a new genetic model for depression with sleep abnormalities that parallel those observed in depressed patients.

0134

CIRCADIAN DISTRIBUTIONS OF WAKE, NREM AND REM SLEEP OF DEC2-P385R TG MICE

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Introduction: We have recently shown that a mutation in a transcriptional repressor (hDEC2-P385R) is associated with a human short sleep phenotype. Sleep recordings of transgenic mice carrying this mutation showed increased wake time and less sleep time than control mice in a zeitgeber time- and sleep deprivation-dependent manner. In order to evaluate the primary component influences the sleep changes (sleep need vs. circadian timing program), we evaluated distributions of wake, NREM and REM sleep amounts in hDEC2-P385R TG and their littermate wild type (WT) mice under constant darkness.
Methods: hDEC2-P385R mice (n = 7) and their littermate WT mice (n = 6) were used. The mice were surgically prepared for EEG (bilateral motor cortex and visual cortex) and neck EMG recordings with a headstage attached to a thin cable recorder that allows the animal free movement. A telemetry transmitter for activity and core body temperature was also implanted in the abdominal cavity. Following the recovery in the 12:12 hour light-dark cycle, a 24 hour baseline sleep recording was made under the LD 12:12 cycle. The mice were then put in the constant dark (DD), and a 24 hour recording (from the activity onset of each mouse) was carried out. Each 10-second epoch was scored visually as wake, REM or NREM sleep and amounts of each state across 24 hour were compared under LD and DD conditions. The activity onset was determined with vital view software.
Results: As previously demonstrated, hDEC2-P385R TG mice period in 12:12 LD cycle exhibited an intact diurnal rest-activity pattern, but increased wake, reduced NREM and REM sleep (compared to their littermate WT mice) were observed during the light period. The circadian period (evaluated with rest activity rhythm under DD cycle) of hDEC2-P385R TG mice (23.48 ± 0.03 hr) did not differ from that of WT mice (23.46 ± 0.03 hr). We found that the distribution of amounts of wake, NREM and REM sleep in DD was almost identical to those during LD, and a significant increase in wake and a decrease in NREM was evident (predominantly during subjective light period).
Conclusion: These results, taken together with the fact that sleep recovery after the sleep deprivation was slow and not complete, suggest that an altered sleep phenotype seen in hDEC2-P385R TG mice is characterized as a change in sleep need, and no obvious disturbance of circadian timing program was found.

0135

GLYCINE DECREASES CORE BODY TEMPERATURE AND INCREASES CUTANEOUS BLOOD FLOW VIA NMDA RECEPTOR LOCATED IN THE RAT SUPRACHIASMATIC NUCLEUS

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Introduction: Glycine is a non-essential amino acid that has either excitatory or inhibitory neurotransmission via N-methyl-D-aspartate type glutamate receptor (NMDAR) or glycine receptor, respectively. We recently reported that glycine ingestion before sleeping significantly improved objective and subjective sleep quality among persons bearing insomniac tendency. Oral administration of glycine in rats was found to increase the glycine concentrations in plasma and cerebrospinal fluid (CSF), and to increase c-fos immunopositive cells in the suprachiasmatic nucleus (SCN), a major circadian center in hypothalamus. Simultaneously, core body temperature was decreased, associating with cutaneous hyperemia. The objectives of the present study are to identify the receptors and the nuclei on which glycine acts in the brain and is responsible for cutaneous hyperemia.
Methods: Rats were implanted the stainless cannulae into lateral ventricle or SCN. Under the isoflurene anesthesia, drugs were administered via cannulae into lateral ventricle or SCN, and cutaneous blood flows were recorded by laser-doppler flowmetry (Periscan PIM-II, PERIMED).
Results: The cutaneous hyperemia was induced by intracerebroventricular injection of glyine, which was inhibited by pretreatment with NMDAR antagonists. Furthermore, the bilateral injection of glycine into the SCN significantly increased cutaneous blood flow, which was also attenuated by pretreatment with NMDAR antagonists.
Conclusion: Oral administration of glycine induces hypothermia and hyperemia via NMDAR in the SCN.

0136

GABAergic BRAINSTEM PROJECTIONS TO THE DORSAL RAPHE NUCLEUS IN GAD67-GFP KNOCK-IN MICE: IMPLICATIONS FOR REM SLEEP REGULATION

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Introduction: Several midbrain/brainstem regions rich in serotonin (5-HT), including the dorsal raphe nucleus (DR), are involved in vigilance state regulation. Serotonergic DR neurons have been described as "wake-on/REM-off", counteracting the "REM-on" neuronal activity of the cholinergic laterodorsal tegmental/pedunculopontine tegmental nuclei (LDT/PPT). Recent models propose that several GABAergic brainstem populations, in particular those in the ventrolateral periaqueductal gray (vlPAG) and neighboring lateral pontine tegmentum (LPT), may inhibit DR neuronal activity during REM sleep. Here, we investigated the prominent GABAergic brainstem projections to DR, employing retrograde tracer injections in mice expressing green fluorescent protein in brainstem GABAergic neurons.
Methods: The retrograde tracer tetramethylrhodamine detxran amine (1%) was pressure injected into DR of GAD67-GFP knock-in mice. After a recovery period of 5 days, brains were removed, and sectioned. GABAergic neurons were identified by their intrinsic GFP fluorescence. Single- and double-labeled neurons were schematically plotted using Neurolucida, and illustrated with photomicrographs. Whole-cell recordings were made from GFP-positive neurons in brain slices prepared from young (10-14 d) animals in regions identified as projecting to DR.
Results: A large number of retrogradely labeled GABAergic neurons were located in DR, vlPAG, and neighboring LPT regions. Intermediate double labeling was observed in the lateral vestibular nuclei. Sparse double labeling was evident in the lateral parabrachial nucleus, pontine oralis (PnO) and caudalis, and in the vicinity of raphe magnus and the ventral gigantocellular fields of the medulla. Our recordings indicate that a subset of GFP-positive neurons in vlPAG/LPT and PnO are excited by the cholinergic agonist carbachol, suggesting that they are REM-on.
Conclusion: The brainstem projections to DR may be involved in REM sleep regulation. In particular, carbachol-excited GABAergic neurons in the vlPAG/LPT and PnO may provide inhibitory input to the serotonergic DR, allowing the expression of REM sleep.
Support (If Any): Dept. of Vet. Aff., NIH MH039683, Grants-in-Aids for Scientific Research from MEXT and MHLW, Japan (to Y.Y.)

0137

GAD67-GFP KNOCK-IN MICE AS A MODEL SYSTEM FOR INVESTIGATION OF GABAergic NEURONS INVOLVED IN BEHAVIORAL STATE CONTROL

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Introduction: We here describe validation of a novel genetic model for investigation of GABAergic neurons involved in sleep-wake regulation, namely GAD67-GFP knock-in mice in which green fluorescent protein (GFP) is expressed under control of the promoter region of the Gad1(GAD67) gene. In the brainstem and basal forebrain of these mice we examined: (i) whether GFP is located in all GABA neurons, including those containing parvalbumin; (ii) whether ectopic expression of GFP occurs; (iii) if GFP is expressed in cholinergic/aminergic neurons; and (iv) whether the distribution of GFP/GABA neurons matches that previously reported in the rat.
Methods: Fluorescent immunohistochemical staining for GABA quantified the amount of co-localization with GFP (in basal forebrain colchicine was used to enhance staining). We stained the basal forebrain for choline acetyltransferase (ChAT, cholinergic neurons) or parvalbumin and the brainstem for ChAT, tryptophan hydroxylase (serotonergic neurons), or tyrosine hydroxylase (catecholaminergic neurons). Labeled cells in both regions were mapped onto mouse atlas templates using Neurolucida.
Results: In both regions, ~90-95% of GFP-Pos cells were co-labeled with GABA. Conversely, ~85% of GABA neurons were co-labeled with GFP. GFP was not co-localized with ChAT, tryptophan hydroxylase, or tyrosine hydroxylase. Ectopic expression of GFP was not observed. In the basal forebrain, ~85% of parvalbumin-positive neurons were also labeled with GFP. The distribution of GFP-positive neurons was broadly similar to that previously reported in the rat, surrounding the core of regions with high densities of cholinergic or aminergic neurons.
Conclusion: GFP faithfully labels GABAergic neurons in all sleep-wake controlling brain regions so far investigated in the GAD67-GFP knock-in mouse. Moreover, we previously reported that mice have a normal sleep phenotype. We conclude this mouse model is a valuable tool to investigate the role of GABAergic neurons in sleep/wake regulation.
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0138

CHANGES IN SLEEP MAINTENANCE QUANTIFIED USING SURVIVAL ANALYSES OF SLEEP AND WAKE BOUTS IN RATS AFTER VLPO LESIONS

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Introduction: A small cluster of cells in the preoptic region, known as ventrolateral preoptic nucleus (VLPO) is critical for the regulation of sleep. Lesions of the VLPO resulted in severe insomnia and sleep fragmentation in rats. We used survival analyses of sleep and wake bout lengths to quantify changes in sleep maintenance in the VLPO-lesioned animals during lights-off (habitual wake) and lights-on (habitual sleep) times.
Methods: Under anesthesia, adult male Sprague Dawley rats (n = 18) were injected with orexin-saporin (VLPO lesions) or saline (control) into the VLPO and implanted with the electrodes for the recording of electroencephalogram (EEG) and electromyogram (EMG). 2-weeks after injections, EEG/EMG recordings were performed for 48 continuous hours and were scored off-line in 12-sec epochs as Wake, non rapid eye movement sleep (NREM) and rapid eye movement sleep (REM). Cox Proportional Hazard Regression Models for clustered data using R Software were performed for wake, Sleep (NREM+REM), NREM and REM bouts (minimum bout length 24 sec) during lights-on and lights-off periods in both control and VLPO-lesioned animals.
Results: There was a non-normal distribution of bout lengths for Wake, Sleep, NREM sleep and REM sleep. Both groups had significantly longer "survival" in Wake and shorter "survival" in Sleep, NREM sleep and REM sleep during lights-off than lights-on period. VLPO-lesioned animals had significantly longer "survival" in Wake and shorter "survival" in Sleep and NREM sleep during both lights-on and lights-off periods and in REM sleep during lights-on than control animals. The survival characteristics were not dependent on the next state: NREM-

to-REM and NREM-to-Wake were similar to each other, as were REM-to-NREM and REM-to-Wake. VLPO-lesioned animals had more frequent transitions than the control animals.
Conclusion: Survival based analyses provide additional evidence for the previously proposed 'flip-flop switch' model of sleep control by VLPO.
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0139

ANTILOCK ANALGESIA & AROUSAL: A NEW MODEL FOR BRAINSTEM SLEEP/WAKE STATE MODULATION OF PAIN

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Introduction: The nucleus of the medullary raphe magnus (RM) is a critical brain locus for analgesia. Although most work has been performed in anesthetized animals, it is believed that sustained excitation of OFF neurons and inhibition of ON neurons participates in sleep/wake state pain modulation.
Methods: To determine how both ON and OFF neurons respond to pain, morphine and sleep/wake states in unanesthetized mice, we trained mice to permit the introduction of recording electrodes into RM through a chronically implanted recording chamber that was stabilized within a stereotaxic apparatus. RM neurons were characterized by their response to noxious tail heat and then recorded before and after systemic morphine administration (1 mg, s.c.) which depressed withdrawal reactions to noxious heat.
Results: ON cells had a higher firing during wakefulness and OFF cells were most excited during sleep. Tonic activity of RM neurons was also altered during sighs and bradycardia, but not by morphine administration. Noxious stimulation excited ON neurons and inhibited OFF neurons prior to morphine administration, but neuronal responses to noxious stimulation were eliminated during morphine analgesia.
Conclusion: RM contributes to sleep/wake state dependent mechanisms of analgesia by inhibiting spinal nociceptive circuitry exclusively during the application of a noxious stimulus. Within the context of the broad and critical roles that RM plays in homeostatic regulation, the restriction of RM-mediated analgesia to focal periods of noxious stimulation may allow RM to balance the preservation of homeostasis and pain management by appropriately multiplexing sensory-modulating and homeostatic-regulating roles. We propose that RM only inhibits nociception when needed, in a pulsatile fashion resembling the engagement of vehicular anti-lock brakes which occurs only during periods of perceived traction.
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0140

ACTIVITY OF MIDBRAIN LOCOMOTOR REGION (MLR) NEURONS DURING SLEEP-WAKE CYCLE AND RESPONSE TO SPINAL CORD STIMULATION

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Introduction: In addition to cortical EEG, motor activity also changes from a very high during wake to low (during sleep) and to its complete loss during REM sleep. The midbrain locomotor region (MLR) consists of non-cholinergic and glutamatergic spinal projecting neurons and is considered a major node for motor control. Therefore, firstly, we aim to record single neuronal activity in the MLR and classify the neurons based on their firing pattern during sleep-wake. Secondly, an antidromic stimulation of the spinal cord determines if these neurons project to spinal cord.
Methods: Male Sprague-Dawley rats were implanted with electrodes to record sleep-wake behavior and a microwire assembly to record single neurons from the midbrain locomotor region (MLR). A bipolar stimulation electrode was implanted in the spinal cord at the level of C8-T1. After post-surgery recovery and habituation, activity of single neurons (3:1 signal: noise) was recorded in freely-behaving rats over multiple episodes of sleep-wake and their response to spinal cord stimulation was studied.
Results: Activity of 25 neurons in the MLR during sleep-wake cycles has been analyzed. Most (16/25; 64%) of these neurons were highly active during active wake (AW) and REM sleep; but relatively inactive during quite wake and NREM sleep, these are AW-REM active neurons. Ten (62%) of these neurons showed antidromic activation while the rest (n = 6) showed no response to spinal cord stimulation. These ten neurons showed burst firing that correlated with higher muscle tone during AW while a sustained firing during REM sleep. Interestingly nine neurons (9/25; 36%) were selectively active during REM sleep, but all of these (n = 9) showed no response to spinal cord stimulation.
Conclusion: Our results suggest that the AW-REM active neurons in MLR that are antidromically excited by the spinal cord stimulation are the ones that may be involved in motor control during wakefulness. During REM sleep, these MLR neurons may be involved in driving phasic activity of postural muscles, which is mostly suppressed by the sublaterodorsal nucleus (SLD).
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0141

MUSCIMOL INACTIVATION OF THE PARABRACHIAL/ PRECOERELEAN REGION INCREASES SLEEP IN THE RAT

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Introduction: Millions of Americans suffer from obstructive sleep apnea, a disorder in which frequent arousals from sleep interfere with the architecture of sleep, reduce deep sleep, and impair the restorative/cognitive benefits of sleep. Therefore, it is important to understand the neural pathways that mediate the arousals of sleep apnea. Recent work using anatomical methods has led to the hypothesis that activation of a specific brainstem region, the parabrachial/precoerelean nuclei (PB/PC), is important for both cortical electroencephalographic (EEG) activation and wakefulness. In this study, muscimol (a GABA-A agonist) was delivered directly into the PB/PC, in order to pharmacologically inactivate the region, followed by an evaluation of the changes in sleep and wakefulness.
Methods: Doses of 1, 3, and 10 μM of muscimol were administered for two hours by means of reverse microdialysis infusion into the PB/PC region of rats outfitted for EEG/EMG recording to allow determination of vigilance states (wake, NREM, and REM sleep). NREM episode duration and delta power were also measured.
Results: Bilateral microdialysis probes were histologically located in PB/PC target region. Microdialysis infusion of 1 μM muscimol into the PB/PC caused minimal fluctuation of vigilance state amounts. 3 μM of muscimol increased sleep for the entire two hour period of drug infusion, and led to an increase of NREM episode duration. 10 μM of muscimol produced an increase in wakefulness, presumably due to diffusion of the drug beyond the target region, a hypothesis that will be tested using a fluorescently tagged version of muscimol to assess diffusion.
Conclusion: Reversible pharmacological inactivation of the PB/PC, by local infusion of 3 μM of muscimol, led to an increase of sleep time and NREM bout duration. Understanding the neural control mechanisms that underlie spontaneous & pathological arousals from sleep may provide a rational basis for the development of therapies aimed at reducing pathological arousals from sleep.
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0142

MATURATION OF SLEEP HOMEOSTASIS IN RATS DURING THE FOURTH POSTNATAL WEEK

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Introduction: Present study examined sleep architecture, compensation of sleep deprivation and maturation of preoptic area (POA) sleep-regulating neurons in Sprague Dawley rats, at postnatal days 21-30 (P21-P30).
Methods: Experiment 1; Spontaneous sleep-wake organization was studied in rats (n = 4) at P21 and P29, and homeostatic responses to 2h sleep deprivation (SD) were studied in these same rats at P22 and P30. Experiment 2; P22 (n = 4) rats were subjected to 2h-SD and perfused immediately after SD. Additional 4 P22 rats were allowed 1h-recovery sleep (RS) after 2h-SD. Control P22 rats (n = 8) slept spontaneously for either 2h or 3h prior to sacrifice. Groups of P30 rats were subjected to the same procedures. Brain tissue was processed for c-Fos and glutamic acid decarboxylase (GAD) immuohistochemistry.
Results: Experiment 1; At P21, rats exhibited higher %REM-sleep (25.9 ± 1.2 vs. 15.2 ± 2.8), lower %NREM-sleep (54.7 ± 2.1 vs. 66.6 ± 3.5) and similar %Wakefulness (19.4 ± 1.2 vs. 18.2 ± 2.7), compared to P29. At P22 and P30, these same rats exhibited increased sleep pressure during 2h-SD, increased %NREM-sleep and increased delta-power during RS, compared to baseline. However, the level of sleep consolidation in RS versus baseline, defined by the number of awakenings from sleep (18 ± 4.5 vs. 9.2 ± .8), number (16.5 ± 2.6 vs. 11.2 ± 0.9) and mean duration (2.5 ± 0.4min vs. 4.3 ± 0.8min) of NREM-bouts, was increased in rats only at P30. Experiment 2; Fos+ cell counts in the median preoptic nucleus (MnPN) were elevated in all SD rats, compared to controls (P22:58 ± 5.2 vs. 38.7 ± 3.3; P30:87 ± 1.7 vs. 46 ± 0.8). Numbers of MnPN Fos/GAD+ cells in P22 rats were low in all experimental conditions, while P30 SD versus control rats manifested higher numbers of MnPN Fos/GAD+ cells (31 ± 1.6 vs. 20 ± 1.5). Cell counts in ventrolateral preoptic area (VLPO) of P22 rats did not differ across experimental conditions. P30 rats expressed elevated numbers of VLPO Fos/GAD+ cells in the condition of RS, compared to baseline (VLPO cluster: 20 ± 1.5 vs. 12 ± 1.3; extended VLPO: 20.3 ± 0.3 vs. 13.7 ± 2.0).
Conclusion: These findings suggest that maturation of POA GABAergic sleep-regulatory neuronal circuits contributes to sleep consolidation across postnatal days P20-P30 in rats.
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0143

CREB IS REQUIRED IN THE FOREBRAIN TO MAINTAIN WAKEFULNESS

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Introduction: Sleep/wake regulation at the systems level has been well characterized over the past 50 years. However, little is known about the molecular and intracellular signaling processes that control sleep/wake states. Studies in flies and rodents suggest that the cyclic-AMP response element binding protein (CREB), an activity-dependent transcription factor, is required for the maintenance of wakefulness. Here, we show that deletion of CREB in forebrain neurons decreases wakefulness.
Methods: We used the cre/loxP system to delete CREB in forebrain neurons of mice and examined sleep/wake states using polysomnography. Animals were kept on a 12:12 light cycle, and sleep was recorded for a total of 48 hours. Baseline sleep was recorded for the first 24 hours, followed by 6 hours of sleep deprivation and 18 hours of recovery. We also used a beam-splitter based activity monitoring system to assay locomotion and activity of mutant and control animals.
Results: Conditional CREB knock out (CREB cKO) mice showed decreased wakefulness and increased NREM sleep. Sleep microstructure analysis revealed an increased number of wake to NREM and NREM to wake transitions in mutant mice compared to wild-type littermates. In addition, CREB cKO mice had fragmented wakefulness but normal NREM and REM sleep architecture, suggesting that CREB is required for the maintenance of wakefulness. Another possibility is that CREB serves a restorative function during NREM sleep. To test this hypothesis, we examined rebound sleep following a brief period of sleep deprivation. CREB mutant animals had normal REM sleep and decreased NREM sleep rebound following sleep deprivation. The lack of increased recovery sleep in CREB cKO suggest that CREB is not required for the restorative function of sleep.
Conclusion: Taken together, these results suggest that CREB is required in forebrain neurons to maintain wakefulness.
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0144

WORKLOAD EFFECT IN A SLEEP/WAKE HOMEOSTASIS-BASED MODEL OF COGNITIVE PERFORMANCE

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Introduction: Cognitive workload appears to affect the build-up of homeostatic pressure during wakefulness. Mathematical models have provided only ad-hoc accounts of this workload effect. We recently published a model of the homeostatic regulation of cognitive performance based on the dynamic interplay of two biological systems, tentatively assumed to represent changes in extracellular adenosine and adenosine receptors and potentially reflecting brain metabolic processes. In this differential equation model, the homeostatic process is modulated by circadian rhythm through a nonhomogeneity, effectively providing a driving force that varies over time. We postulated that workload may similarly be implemented as a (time-varying) nonhomogeneity modulating the homeostatic process. We evaluated this with data from a laboratory study designed to measure the workload effect on cognitive function.
Methods: 21 healthy subjects (age 28.5 ± 5.5; 11f) underwent three 36h total sleep deprivations separated by two recovery days. Every 2h during deprivation, subjects completed a cognitive test battery. They underwent moderate workload (0.5h battery with 10min PVT every 2h) during two deprivations, and high workload (1.0h battery with 20min PVT every 2h) during one deprivation, in randomized counterbalanced order. Between test bouts, only nonvigorous activities were allowed. To quantify the workload effect, lapses (RTs > 500ms) during the 10min PVT in the moderate workload conditions were compared to lapses during the first 10min of the 20min PVT in the high workload condition. As reported previously, PVT lapses were increased in the high compared to the moderate workload conditions, with the difference growing over time awake.
Results: We fitted our model to the data assuming high waking activity (modeled as offset H in the nonhomogeneity) across time during test bouts, and low waking activity (modeled as offset L) across time between test bouts. Model parameters (± s.e.) were assessed using Markov Chain Monte Carlo estimation, yielding L = 0.31 ± 0.08 and H = 1.19 ± 0.14. The fitted model tracked PVT performance in the different conditions better (F = 19.9, P = 0.001) than the original model which could not differentiate based on workload.

Conclusion: A theory-driven account of the effect of cognitive workload on the build-up of cognitive impairment during sustained wakefulness was proposed. The account suggests that elevated workload accelerates the build-up of homeostatic pressure over time awake by intensifying brain metabolism.
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0145

SLEEP ONSET REM PERIOD (SOREMP) DURING ROUTINE EEG

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Introduction: To determine the incidence and significance of Sleep Onset REM Periods (SOREMP) during routine electroencephalography (EEG) at a tertiary referral center.
Methods: We retrospectively reviewed all outpatient and inpatient EEGs performed at Tampa General Hospital, a tertiary referral center, over a four month period. Only patients older than 16 were included in the study. All EEGs were reviewed by an attending epileptologist (SRB & AMB). When SOREMP was identified, the chart was reviewed to identify the most likely etiology.
Results: 449 EEGs were reviewed between August 10th, 2009 and December 9th, 2009. 106 were outpatient EEGs and 343 were inpatient EEGs. There were 7 EEGs with SOREMP, 6 from inpatients EEGs and 1 from an outpatient EEG. The most common reason for SOREMP was severe sleep deprivation. Four of the seven patients with SOREMP reported severe sleep deprivation, two were possibly withdrawing from alcohol and REM suppressing medications, and one that we did not clearly indentify a cause.
Conclusion: The incidence of SOREMP during routine EEG was 1.6% and 6 of 7 were inpatient EEGs. This suggests that sleep deprivation associated with hospitalization may be the most common cause. At our institution the most prevalent cause of SOREMP was sleep deprivation. Our findings suggest that despite the common association of SOREMP with narcolepsy, the highest incidence of SOREMP by far is sleep deprivation, drug or substance withdrawal rather than narcolepsy. These findings raise the concern of how much the inpatient setting alters the quality and architecture of sleep.

0146

MUSCLE PHENOTYPE PREDICTS THE DEGREE OF MUSCLE TONE SUPPRESSION IN SLEEP

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Introduction: Skeletal muscle tone is generally reduced during sleep; however, the pattern of sleep-related muscle suppression varies between functionally-distinct muscle groups (e.g. respiratory vs. non-respiratory muscles). One phenotypic property that distinguishes various muscles is fiber-type composition, which spans a spectrum between slow- and fast-twitch fiber populations. It is currently unknown whether the fiber-type composition of a muscle can predict the degree of its suppression across the sleep-wake cycle.
Methods: To monitor sleep-wake states, we instrumented male, Sprague-Dawley rats (n = 6) with both EEG and EMG electrodes. To determine whether there is a correlation between fiber-type composition and the degree of muscle suppression during non-REM and REM sleep, we recorded EMG activity from fast-twitch (masseter), slow-twitch (soleus) and mixed fiber-type (trapezius) muscles. Sleep-wake behaviour and muscle tone were recorded and analyzed across a 12-hr period during the light phase.
Results: We found that waking levels of masseter muscle (fast-twitch) activity were strongly suppressed during both non-REM ($P = 0.022$) and REM sleep ($P = 0.010$); in contrast, soleus muscle (slow-twitch) tone was not significantly reduced during either sleep state ($P > 0.05$). Trapezius muscle (mixed fiber-type) tone was significantly suppressed during both non-REM ($P = 0.039$) and REM ($P = 0.049$) sleep, although the degree of sleep-related suppression was less potent than in the masseter.
Conclusion: We demonstrate that muscle fiber phenotype appears to predict the magnitude of muscle tone suppression in sleep. Specifically, we show that while slow-twitch muscle tone is not reduced during sleep, fast-twitch muscle tone is potently suppressed. How and why sleep differentially suppresses slow- versus fast-twitch muscle tone is unknown; however, it suggests that motor suppression in sleep could play a functional role in normal muscle physiology.
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0147

OPTIMAL AIR TEMPERATURE AT SUMMER SLEEP ENVIRONMENT IN REM SLEEP

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Introduction: The purpose of this paper is to clarify the effects of air temperature at summer sleep environment. The experiment is conducted in summer season at night time.
Methods: The subjects are exposed to the following conditions with polysomnogram: 26 degrees and control the variety temperatures at REM (Rapid eye movement) stages. Experiment condition maintains constant temperature condition before and after REM stage. While REM stage, the temperature were reduced by 1 degree. The following results are obtained
Results: Lower 1 degree at REM stage was rised sleep efficiency 95.65~96.43% more than constant condition. Lower 2 degree at REM stage was rised sleep Efficiency 98.10 %. Additional, number of awakening was decreased from 7.09 to 2.25.
Conclusion: This study showed that the temperature control affected sleep efficiency and REM sleep percentage. This temperature changing environment while in REM sleep improved sleep quality compared to constant temperature environment.
Support (If Any): LG electronic company

0148

PONTINE GLUTAMATERGIC CIRCUIT CONTROLS RAPID-EYE-MOVEMENT SLEEP

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Introduction: We have previously shown that glutamatergic neurons in the sublaterodorsal nucleus (SLD) project to glycinergic/GABAergic interneurons in the spinal cord layers VII-VIII. Cell-body lesions of the SLD alone produce behaviors similar to human REM sleep behavior disorder (RBD) without affecting REM sleep time in rat. On the other hand, cell-body lesions including the caudal laterodorsal tegmental nucleus (cLDT) and SLD reduce REM sleep by a half with more transitions into REM sleep and shortened REM sleep episodes as well as RBD. We also made lesions in the LDT and did not see significant changes in REM sleep. Based on these results, we hypothesized that (1) glutamatergic spinal-projecting neurons in the SLD are responsible for control of phasic activity of postural muscles during REM sleep,

and (2) REM sleep executive cells in the cLDT and SLD control REM sleep time.
Methods: To delineate the role of GABA and glutamate in REM-on region, we eliminated glutamate or GABA transmissions by conditionally deleting vesicular glutamate transporter 2 (VGLUT2) or vesicular GABA transporter (VGAT) in caudal LDT and SLD by directly injecting adeno-associated virus containing Cre-recombinase (AAV-Cre) in flox-VGLUT2 and flox-VGAT mice respectively.
Results: We found that deletion of VGLUT2 in the caudal LDT plus SLD produced RBD like behavior with jerking, kicking and flying, similar seen in rats and human. Furthermore, VGLUT2 deletion in the cLDT and SLD shortened REM sleep duration and fragmented REM sleep, and reduced total REM sleep by 40%. There was a significant umber of REM sleep episodes shorter than 10 seconds. In contrast, VGAT knockout in the caudal LDT and SLD did not have significant effects on REM sleep time and muscle activity.
Conclusion: These results indicated that glutamatergic neurons in the SLD and cLDT-SLD regulate phasic activity of atonia and REM sleep time respectively. In contrast to our original hypothesis, GABA in the cLDT-SLD did not appear to be critical for regulation of REM sleep time. We hypothesized that REM-executive glutamatergic neurons in the cLDT-SLD activate spinal projecting glutamatergic neurons in the SLD and ascending projecting glutamatergic neurons in the parabrachial and pre-coeruleus nuclei that regulate the basal forebrain corticopetal neurons.
Support (If Any): NS 061841 and NS 062727

0149

TIME COURSE OF CHANGES IN ADENOSINE, NITRIC OXIDE (NO) AND INDUCIBLE NO SYNTHASE (iNOS) DURING PROLONGED SLEEP DEPRIVATION IN THE BASAL FOREBRAIN AND CORTEX

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Introduction: Short-term sleep deprivation (SD) (3h) in rats results in selective increases in adenosine (AD) and iNOS-dependent NO production in the cholinergic basal forebrain (BF), which promotes a homeostatic sleep response. iNOS inhibition in the BF prevents AD increase, suggesting iNOS-mediated NO production precedes the AD increase. Our recent data show that iNOS is induced in the frontal cortex (FC) after longer-term SD, however it is not clear whether it is followed by AD release. In the present study we investigated the time course of iNOS induction, NO and AD release in the BF and FC following varying durations of SD by examining changes in iNOS mRNA/iNOS protein, nitrate-nitrite (NOx) and AD levels.
Methods: One set of male rats (n = 6) were chronically implanted with microdialysis cannula targeting the BF, FC and cingulate cortex (CC). They were sleep-deprived for 11h, samples were collected hourly and used for AD/NOx measurements. Another set of rats were sleep-deprived for 1h, 3h, 5h, 6h or 11h (n = 8/time point) and sacrificed with their time-matching undisturbed controls. Brain tissue samples, collected from the BF, FC and CC, were used for iNOS mRNA and iNOS protein measurements.
Results: iNOS mRNA, iNOS protein and NOx were significantly increased in the BF after 1hSD. In contrast, in the FC all three measures were increased only after 5hSD. We observed the onset of an increase in AD level in the BF after 2hSD and, in the FC, only after 6hSD. In CC, no changes were observed in iNOS or in AD levels.
Conclusion: Our data show that iNOS induction and NO release precede the release of AD both in the BF and FC. We conclude that SD-induced iNOS-mediated NO production and AD release follow a specific temporal and spatial pattern with the BF being the first to respond to SD followed by changes in cortex. Triggering of this cascade in the FC might be implicated in cognitive performance deficit after prolonged SD.
Support (If Any): Department of Veterans Affairs Medical Research Service Award, SRSF Christian Gillin Research Award, the National Institute of Mental Health Grant(NIMH39683), Academy of Finland

0150

ALTERATIONS IN ADENOSINERGIC AND ADRENERGIC RECEPTOR mRNA LEVELS OBSERVED IN RESPONSE TO CHRONIC SLEEP RESTRICTION IN RATS

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Introduction: When sleep is restricted for several consecutive days, animals fail to express compensatory responses in total sleep time and sleep intensity (as measured by NREM EEG delta power). These "adaptive" sleep responses to chronic sleep restriction (CSR) have been shown in both humans and rodents. Previously, we reported that during CSR, animals continuously experience sleepiness, which can be considered a "non-adaptive" sleep response. Here, we investigated adenosinergic and noradrenergic systems to examine if they may mediate the adaptive and non-adaptive homeostatic sleep responses observed in CSR.
Methods: Rats were allowed to sleep only 6h per day for 5 consecutive days (SR1 to SR5), followed by 3 unrestricted recovery sleep days (R1 to R3). The 6h sleep opportunity was given during the first 6h of the light period. RT-PCR methods were used to measure receptor mRNA levels.
Results: 1) Adenosine A1 receptor (A1R) mRNA levels were increased in the basal forebrain from SR1 to R1 (+29 to +49%). 2) Adenosine A2a receptor (A2aR) mRNA levels were decreased in the frontal cortex from SR1 to R1 (-28 to -41%). 3) Beta-adrenergic receptor (AR) mRNA levels were decreased in the anterior cingulate cortex only on SR1 (-22%) and returned to the baseline level from SR3.
Conclusion: 1) The continuously altered levels in basal forebrain A1R and the frontal cortex A2aR mRNA resemble the time pattern of sleep latency changes observed in CSR. 2) The transitional change in the anterior cingulate cortex beta-AR mRNA levels resembles the time pattern of sleep time and sleep intensity changes during CSR. 3) Our findings suggest the possibility that changes in the basal forebrain A1R and the cortical A2aR tone may mediate sleepiness, whereas the cortical beta-AR receptor tone may mediate sleep time and intensity.
Support (If Any): The Department of Veteran Affairs and NHLBI - T32 HL07901.

0151

ADENOSINE INHIBITS THE GLUTAMATERGIC INPUT TO BASAL FOREBRAIN CHOLINERGIC NEURONS

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Introduction: Adenosine has been proposed as an endogenous homeostatic sleep-factor that accumulates during waking and inhibits wake-active neurons to promote sleep. In basal forebrain (BF) adenosine decreases waking, promotes recovery sleep, and directly inhibits wake-active neurons. We previously reported that adenosine directly inhibits the cholinergic neurons of the magnocellular preoptic and substantia innominata (MCPO/SI) nuclei. This effect was mediated through post-synaptic A1 receptors and by the activation of an inwardly rectifying potassium conductance. In the current study we examined how adenosine affects the glutamatergic input to the MCPO/SI cholinergic neurons.
Methods: We performed patch-clamp recordings on MCPO/SI cholinergic neurons in in vitro slices of mice. MCPO/SI cholinergic neurons were labeled in vivo, by intracerebroventricular injections of Cy3-p75-IgG. One to three day after these injections the mice were used for slice recordings and cholinergic MCPO/SI neurons were identified under

fluorescence microscope by the presence of internalized Cy3-p75-IgG. Immunoreactivity for choline acetyltransferase confirmed that MCPO/SI neurons that internalized Cy3-p75-IgGs were cholinergic. Evoked glutamatergic excitatory postsynaptic currents (evEPSCs) were induced by local stimulation in the MCPO/SI region.

Results: Adenosine reduced the amplitude of AMPA-mediated evEPSCs in MCPO/Si cholinergic neurons. This effect was mediated by A1 but not A2 receptors and was mediated by presynaptic reduction of glutamate release probability. Application of the A1 antagonist DPCPX increases evEPSC amplitude suggesting that glutamatergic inputs to the MCPO/SI cholinergic neurons were under A1-mediated inhibitory tone by endogenous adenosine. In addition we found that adenosine through A1 receptor activation also reduced the frequency of spontaneous EPSCs.

Conclusion: The reduction of the glutamatergic input provides an additional mechanism by which adenosine inhibits BF cholinergic neurons. Thus direct inhibition of BF cholinergic neurons and the presynaptic inhibition of the excitatory input can synergistically contribute in the adenosine sleep-promoting effects in BF.

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0152

CENTRAL ADMINISTRATION OF ADENOSINE A2a RECEPTOR AGONIST ACTIVATES GABAERGIC NEURONS IN THE RAT PREOPTIC HYPOTHALAMUS

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Introduction: Adenosine is hypothesized to promote sleep in part by activating sleep regulatory neurons in the preoptic area via A2a receptors. The effect of A2a agonist on c-fos expression in GABAergic neurons in the Median Preoptic Nucleus (MNPN) and Ventrolateral Preoptic Area (VLPO) have not been examined. We compared the patterns of sleep and Fos-Immunoreactivity evoked by microinjection of CGS21680 into the lateral ventricle (ICV) and the subarachnoid space (SA).

Methods: In Experiment 1, three groups of rats were administered either with vehicle (n = 7) or two doses of CGS-21680 (8nmol; n = 7 or 24nmol; n = 7) into the lateral ventricle. For experiment 2, groups of rats were administered either with vehicle (n = 7) or CGS-21680 (8 nmol; n = 7) into the subarachnoid space. For both experiments, injections were delivered at 14:00 hr, i.e. 8 hours after lights on. Rats were left undisturbed for 2 hours while EEG and EMG were continuously recorded. Animals were sacrificed at the end of recording and brain tissue was immunostained for c-Fos protein and glutamic acid decarboxylase (GAD).

Results: Subarachnoid administration of CGS-21680 increased percent total sleep time at a lower dose compared to ICV (Vehicle, 49.54 ± 3.85; 8 nmol SA, 72.80 ± 1.23; 8 nmol ICV, 41.52 ± 4.50; 24 nmol ICV, 62.27 ± 2.55: $F = 21.15$; $P < 0.001$). Subarachnoid administration of CGS-21680 increased Fos expression in GAD+ neurons of the MnPN at a lower dose compared to ICV (Vehicle, 7.37 ± 1.17; 8 nmol SA, 17.93 ± 2.55; 8 nmol ICV, 9.00 ± 1.01; 24 nmol ICV, 15.91 ± 2.22: $F = 7.35$; $P = 0.005$). Significant increases in the Fos expression were also observed in GABAergic neurons of VLPO (Vehicle, 9.28 ± 0.84; 8 nmol SA, 21.10 ± 1.50; 8 nmol ICV, 15.01 ± 1.32; 24 nmol ICV, 24.65 ± 3.57: $F = 12.33$; $P < 0.001$).

Conclusion: Subarachnoid delivery of A2a agonist yields stronger activation of GABAergic neurons in MNPN and VLPO, which could account for lower threshold dose for sleep induction, compared to ICV injections.

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0153

WAKE PROMOTING EFFECTS OF SELECTIVE ADENOSINE RECEPTOR ANTAGONISTS IN OREXIN/ATAXIN-3 NARCOLEPTIC MICE

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Introduction: Caffeine, a xanthine derivative from plants, is the world's most widely consumed psychoactive stimulant. The wake-promoting potency of caffeine is, however, often not strong enough for treating pathological sleepiness. The wake-promoting effects of caffeine are believed to be mediated by antagonism of adenosine A1 and A2A receptors, but caffeine's primary mode of action has been debated. In order to evaluate the roles of adenosine receptor antagonism for wake-promotion and the possible therapeutic application of receptor subtype selective adenosine receptor antagonists for hypersomnia, we have evaluated wake-promoting effects of several selective A1 and A2 antagonists in the mice model of narcolepsy, a prototypical disease model of hypersomnia.

Methods: Orexin/ataxin-3 TG mice (N9, backcrossed to C57BL/6) and their littermate wild type (WT) mice were used (n = 8 each group). The mice were surgically prepared for EEG and EMG recording. A telemetry transmitter for activity and core body temperature was also implanted in the abdominal cavity. Following 3 weeks of recovery, the mice were subjected to i.p. administration at ZT 2 of three doses of DPCPX (A1 selective, up to 8mg/kg), ZM241385 & SCH58261 (A2A selective, up to 20 mg/kg and 6.4 mg/kg, respectively), alloxazine (A2B selective, up to 16 mg/kg) and caffeine (up to 20 mg/kg) and of respective vehicle. Six-hour post drug data were analyzed, and each 10-second epoch was scored visually as wake, REM, or NREM sleep.

Results: Caffeine and an A1 antagonist, DPCPX, significantly increased wake and reduced NREM and REM sleep in both narcoleptic and WT mice in a dose dependent manner, while none of the A2A and A2B antagonists significantly increased wake amount, suggesting the dominant role of A1 antagonism for the wake-promoting effects of adenosine receptor antagonists. In order to evaluate any additive effects of A2A and A2B antagonism on wake-promoting effects by A1 antagonism, effects of coadministrations of DPCPX (8mg/kg) and ZM241385 (20mg/kg), SCH58261 (6.4 mg/kg) or alloxazine (16mg/kg) were carried out, but none of these compounds modified the wake-promoting effects of DPCPX.

Conclusion: Our results clearly demonstrate the importance of A1 receptor antagonism for mediating wake-promotion by adenosine receptor antagonism. Further evaluations of the therapeutic applications of synthetic A1 antagonists for hypersomnia are warranted.

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0154

LOCAL PERFUSION OF ESZOPICLONE INTO THE PERIFORNICAL LATERAL HYPOTHALAMUS PROMOTES SLEEP IN RATS

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Introduction: We have previously shown that systemic administration of eszopiclone (ESZ) or local perfusion of ESZ into the perifornical lateral hypothalamus (PFLH) in rats suppresses c-Fos expression in hypocretin (HCRT) neurons (Kumar et al, Sleep 31:A21, 2008). Here we determined if bilateral microdialysis perfusion of ESZ into the rat LH was sufficient to induce sleep. Effects of ESZ were compared to zolpidem (ZOL). Methods: Adult rats were prepared with EEG and EMG

electrodes and with bilateral microdialysis guide cannulae directed at the PFLH. In a repeated measures design, rats were perfused with vehicle and two concentrations of ESZ and ZOL for a 2 hr period beginning 2 hrs after lights off. We report findings on 6 rats with histologically confirmed, bilateral placement of microdialysis probes into the PFLH.

Methods: Adult rats were prepared with EEG and EMG electrodes and with bilateral microdialysis guide cannulae directed at the PFLH. In a repeated measures design, rats were perfused with vehicle and two concentrations of ESZ and ZOL for a 2 hr period beginning 2 hrs after lights off. We report findings on 6 rats with histologically confirmed, bilateral placement of microdialysis probes into the PFLH.

Results: Perfusion of ESZ at 50 μM produced significant reductions in percent time awake (Vehicle, 69.88 ± 2.26%; ESZ, 57.14 ± 2.27%; Zol, 64.22 ± 2.39%: $F = 9.84$; $P = 0.004$) and increased percent time in nonREM sleep (Vehicle, 27.31 ± 1.93%; ESZ, 38.40 ± 2.02%; Zol, 32.40 ± 2.28%: $F = 9.81$; $P = 0.004$) compared to both vehicle and 50 μM ZOL. Both ESZ and ZOL at 500 μM decreased time awake (Vehicle, 69.88 ± 2.26%; ESZ, 47.27 ± 2.70%; Zol, 53.57 ± 3.71%: $F = 20.75$; $P < 0.001$) and increased time spent in nonREM sleep (Vehicle, 27.31% ± 1.93; ESZ, 46.78% ± 2.75; Zol, 42.02 ± 3.99%: $F = 15.45$; $P < 0.001$) compared to vehicle.

Conclusion: These results demonstrate that bilateral perfusion of 50 μM ESZ into the rat PFLH is sufficient to promote sleep. Given our previous findings that perfusion of 50 μM ESZ selectively suppresses c-Fos in HCRT neurons (Kumar et al., 2008), the current findings support the hypothesis that suppression of HCRT neuronal activity is a mechanism underlying the sleep-promoting effects of ESZ.

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0155

ROLE OF HISTAMINE IN DISRUPTED SLEEP

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Introduction: The histamine (HA) containing neurons in the posterior hypothalamus (PH) project widely throughout the nervous system. Histamine neuronal activity is high during waking and is reduced or absent in sleep states. We hypothesize that anxiety and stress increase waking and produce poor quality sleep due to increased activity of HA neurons.

Methods: Experiments were conducted on adult male Sprague-Dawley rats (275-350g). Five-minute microdialysis samples were collected from PH across spontaneous S-W states, short-term sleep deprivation (STSD) and cage change induced waking and analyzed for HA using HPLC.

Results: Histamine levels were reduced in both NREMS and REMS compared to AW under baseline conditions. Two hour sleep deprivation (using gentle handling) increased levels of HA throughout the deprivation period (percentage of basal AW level: 220 to 244 %; $F(3,36) = 9.6$, $P < 0.0001$, ANOVA). Rats placed in a cage previously occupied by another male for five days showed prolonged waking followed by a disrupted sleep pattern, with brief sleep bouts and frequent waking. Histamine levels in rats exposed to used cage were higher than basal HA levels, and this effect was time dependent (percentage of basal; 273.2 ± 49.3%, $P < 0.01$, Fisher's LSD and 146 ± 33.6% in 30 and 60 min post exposure respectively). Histamine levels also increased after new cage change compared to spontaneous waking (percentage of basal; 215 ± 43 %, $P < 0.01$ and 167 ± 47 %, $P < 0.01$, Fisher's LSD in 30 and 60 min post exposure respectively). The percentage of waking, during the sampling period was positively correlated with the level of HA in the PH ($r = 0.72$; $P < 0.01$). We further observed a trend of increased level of HA with decreased NREMS delta power.

Conclusion: This is the first study of HA level changes with behavioral challenges that disrupts sleep. These studies support our hypothesis that increased HA level is linked to poor quality sleep.

0156

PROJECTIONS FROM THE CENTRAL NUCLEUS OF THE AMYGDALA TO NEURONS IN THE NUCLEUS PONTIS ORALIS: AN INTRACELLULAR STUDY

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Introduction: The present study was designed to elucidate the neuronal circuitry which is responsible for the control of active (REM) sleep by the amygdala. This circuitry, we propose, involves the activation, by the central nucleus of the amygdala (CNA), of neurons in the nucleus pontis oralis (NPO) that are responsible for the generation and maintenance of active sleep. Accordingly, the responses of neurons, recorded intracellularly in the NPO, were examined following stimulation of the CNA.

Methods: Experiments were performed on adult male Sprague-Dawley rats (250-400g). The animals were anesthetized with urethane (1.4 g/kg, i.p.). Electrical stimulation (50 to 400 μA) of the CNA was carried out with a stainless steel electrode. NPO neurons were recorded, intracellularly, with glass micropipettes filled with 3 M KCl in conjunction with stimulation of the CNA.

Results: Stimulation in the CNA with a single pulse produced an early, fast depolarizing potential (EPSP) in neurons within the NPO. The mean latency to the onset of these EPSPs was 3.52 ± 0.20 ms. A late, small-amplitude IPSP was present following each EPSP in the majority of the cells that were recorded in the NPO. Stimulation of the CNA with a train of 10 pulses resulted in a sustained depolarization (5 to 10 mV) of the resting membrane potential, which lasted approximately 50 ms. When subthreshold intracellular depolaring current pulses were delivered to NPO neurons, CNA stimulation-induced EPSPs were sufficient to promote the discharge of these cells.

Conclusion: The present results demonstrate that amygdalar projections exert a powerful excitatory postsynaptic drive that is capable of activating neurons in the NPO, which we believe comprise the Active Sleep-Generator. Therefore, we suggest that the amygdala is capable of inducing active sleep via direct projections to executive active sleep-on neurons in the NPO.

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0157

GLUTAMATERGIC NEURONS IN THE CENTRAL NUCLEUS OF THE AMYGDALA PROJECT DIRECTLY TO THE NPO

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Introduction: We hypothesize that the central nucleus of the amygdala (CNA) is capable of directly inducing active sleep by exciting neurons in the nucleus pontis oralis (NPO). Accordingly, the present study was designed to explore the morphological projections of neurons in the CNA to cells in the NPO.

Methods: Cholera toxin B subunit (CTB), a retrogradely transported neuronal tracer, was iontophoresed (+5 uA, 7s on and 7s off for a duration of 20 min) into the NPO in the region that contains neurons that are involved in the induction of active sleep. The animals were allowed to survive for 5 days. They were then euthanized with an overdose of pentobarbital and perfused transcardially with a standard fixative. Sections of the NPO and CNA which were immunostained with antibodies against CTB were examined with light microscopy. In addition, in order to identify the phenotype of CTB-labeled neurons in the CNA, a double immunohistochemical technique was employed with antibodies against CTB and the vesicular glutamate transporter (a biomarker for glutamatergic neurons).

Results: Large numbers of neurons were retrogradely labeled in the CNA ipsilateral to the CTB injection site in the NPO. No labeled neurons were observed in the CNA on the contralateral side. Within the

CNA, the majority of labeled neurons were present in the medial division of the nucleus; the central and lateral divisions of the CNA contained only a small number of labeled cells. Light microscopic analysis also revealed that approximately 25% of all CTB-labeled neurons in the CNA were double-stained.
Conclusion: These data indicate that glutamatergic neurons in the amygdala project directly to the NPO. This morphological study therefore supports our hypothesis that neurons in the NPO that initiate and maintain active sleep are under the direct control of glutamatergic neurons in the CNA.
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0158

NATURE OF CHOLINERGIC INNERVATION OF THE CAUDAL, ORAL PONTINE RETICULAR FORMATION IN THE RAT

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Introduction: The caudal, oral pontine reticular formation (PnOc) in rat is an area in which the local application of muscarinic receptor agonists can induce REM sleep. The PnOc is one region supplying a GABAergic afference to another REM sleep induction zone, the sublaterodorsal nucleus (SLD). Blockade of GABAA-receptors in SLD results in REM sleep induction. A high proportion of GABAergic neurons in the PnOc are inhibited by cholinergic agonists. Taken together, these findings support the possibility that cholinergic REM sleep induction in PnOc is through inhibition of a GABAergic afference to SLD. Here, we sought to obtain evidence for a cholinergic innervation of GABAergic neurons in PnOc.
Methods: Frozen coronal sections (20 um) were obtained through the PnOc and immuno-labeled for the vesicular acetylcholine transporter (VAChT) with the immuno-peroxidase method (nickel DAB) to visualize cholinergic axon fibers and varicosities utilizing bright-field microscopy. Alternate sections were additionally either counter-stained with neutral red or immuno-labeled (DAB) for glutamic acid decarboxylase-67 (GAD) to identify GABAergic neurons. Work in progress, is micro-injecting the orthograde tracer biotinylated dextran amine, 3k MW (BDA), into the SLD combined with labeling VAChT and GAD. Fluorescence, scanning confocal microscopy will be used to detect cholinergic varicosities apposed to membranes of GABAergic neurons projecting to SLD.
Results: The PnOc contains a moderate density of fine caliber fibers labeled with VAChT. Periodic swellings appear along the course of the axon fibers. A very small proportion of these varicosities are observed apposed to perikaryal membrane in either the GAD or neutral red labeled material. Inasmuch as dendritic processes are unlabeled, these may be the predominant sites of synaptic contact.
Conclusion: Cholinergic innervation of PnOc may be axo-dendritic or involve no synaptic contact. Use of BDA should result in filling dendrites and may permit tentative identification of synapses on dendrites of GABAergic neurons projecting to SLD.
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0159

GLYCINERGIC/GABAA-MEDIATED INHIBITION OF TRIGEMINAL MOTONEURONS IS DIFFERENTIALLY REGULATED DURING INDIVIDUAL REM SLEEP EPISODES

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Introduction: Motor control in REM sleep is unique because it is characterized by intermittent muscle twitches that punctuate muscle atonia. Previously, we reported a phasic glycinergic/GABAA-mediated inhibitory drive onto trigeminal motoneurons that functions to suppress muscle twitches during REM sleep. The aim of this study was to determine how this inhibition contributes to the temporal pattern of twitches across individual REM episodes.
Methods: Rats (n = 15) were instrumented with EEG and EMG (masseter and neck) electrodes to identify sleep-wake states. A microdialysis probe was implanted into the trigeminal motor pool to pharmacologically block glycine and GABAA receptors on trigeminal motoneurons.
Results: To quantify the temporal pattern of phasic twitch activity in REM sleep, each REM episode was divided into quarters. We found that muscle twitch frequency increased across individual REM episodes, with the number of twitches more than doubling from the first to the last quarter ($P < 0.001$). To determine how this pattern of twitch activity is regulated, GABAA and glycine receptors were blocked (via 0.1mM bicuculline and strychnine). Removal of this inhibitory drive not only resulted in an overall increase in the number of twitches ($P = 0.010$), there was also a change in the temporal pattern of activity, with a disproportionate increase in the number of twitches occurring in the first quarter of REM sleep.
Conclusion: We demonstrate that twitches are not uniformly distributed during individual REM periods, but gradually increase in frequency toward the end of REM episodes. When the endogenous inhibitory drive onto motoneurons is removed, there is a disproportionate increase in the frequency of twitches at the beginning of REM periods. Thus, inhibition appears to regulate the pattern of twitch activity by suppressing twitches more strongly in the earlier stages of REM sleep. We conclude that glycinergic/GABAA-mediated inhibition of trigeminal motoneurons is differentially regulated during individual REM sleep episodes.

0160

AN INVESTIGATION OF SPONTANEOUS CORTICAL SLOW OSCILLATIONS USING 256-CHANNEL EEG

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Introduction: Cortical slow oscillations (CSO) (< 1Hz) are generated by the neocortex during non-REM sleep. CSO exist within in-vivo cortical slices after thalamectomy. These cortical oscillations affect the excitability of neocortical networks with a "down" and "up" state. The "down" state reflects a hyperpolarization and neuronal quiescence of the neocortical cells while the "up" state reflects depolarization and a heightened activity of the neocortical cells. Using dense-array EEG, we attempt to identify the cortical sources for spontaneously generated CSO during slow-wave sleep (SWS).
Methods: We acquired sleep EEG from 20 participants using a 256-channel sensor array. Sleep stages were identified and CSO were scored during SWS from the first sleep cycle. CSO were evaluated in source space using a realistic head model with linear-inverse method using different regularization constants. Statistical analyses were performed on the CSO source waveforms.
Results: We found considerable variability between subjects related to CSO source analysis. However, there are shared regions of cortical source activity within Brodmann area 30 & 31 (Posterior Cingulate & Precuneus) and Brodmann area 18 (Lingual Gyrus).
Conclusion: From these results, we can conclude that the cortex is utilizing the synchronous nature of the CSO "up" and "down" states to regulate different cortical regions during sleep. This may be a way to coordinate neuronal activity such as synaptic plasticity during sleep.

0161

THE ANTI-NEUROINFLAMMATORY AGENT, MINOCYCLINE, SUPPRESSES SLEEP AND ELECTROENCEPHALOGRAPHIC SLOW WAVE ACTIVITY IN MICE

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Introduction: Sleep loss has pro-inflammatory effects, but the degree to which these effects occur in the brain and influence the electroencephalogram have not been delineated. We assessed the effect of sleep loss on the electroencephalogram and markers for neuroinflammation. We also measured the modulation of these effects by minocycline, a molecule known to attenuate neuroinflammatory events.
Methods: Adult male CD-1 mice (25-35 g) obtained from an in-house breeding colony were subjected to electroencephalographic and electromyographic recordings in a rodent neurobiology research facility. Minocycline was administered in a chronic daily regimen (2 weeks) at a dose known to attenuate neuroinflammatory reactions to cerebral insults. Mice were subjected to electroencephalogram and electromyogram data collection in undisturbed baseline conditions and after sleep deprivation (SD) sessions of 1, 3 and 6 hrs in duration. Following EEG studies, mice were euthanized for measurement of brain RNAs and proteins, either at the end of a 3 hr-SD or as time of day controls. Transcripts related to neuroinflammation (tnfα, il-1β, il-6, cd11b, pbr and tlr4) and a positive control for SD effects (c-fos) were measured by real-time polymerase chain reaction and proteins (Fos, CD11b) by Western blot.
Results: Minocycline administration at the onset of light in the baseline condition induced a transient decrease in sleep as a percentage of recording time. The elevation of EEG in response to SD was attenuated in animals subjected to chronic minocycline administration. SD increased expression of the immediate early gene c-fos and decreased the expression of tnfα, pbr and cd11b at the mRNA level. However, the EEG effect of minocycline was not accompanied by a significant change in these biochemical responses to SD.
Conclusion: The attenuation of SD-induced slow wave activity by minocycline is compatible with the concept that neuroinflammatory events mediate, in part, the effects of sleep loss on the electroencephalogram.
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0162

SLEEP DEPENDENT ABNORMAL EEG PATTERN IN Ts65Dn MOUSE MODEL OF DOWN SYNDROME

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Introduction: Patients with Down syndrome (DS) show a higher incidence of seizures than do people without DS: approximately 8% people with DS have a seizure disorder, of which 47% develop partial seizures, 32% infantile spasms and 21% generalized tonic-clonic seizures. Recent reports indicate that Ts65Dn mice, a widely used mouse model of DS, at ages younger than 2 months show bilateral spontaneous spike and slow wave EEG discharges (SWD) associated with epileptic extensor spasms - features characteristic consistent with the infantile spasms seen in human DS. These seizures are made worse by GABAB agonists. In order to further characterize these seizures and their relation to GABAergic neurotransmission, we evaluated adult Ts65Dn mice during the normal sleep and wake cycle and after sleep deprivation (SD).
Methods: Ts65Dn mice and their littermate wild-type mice were used (6 months of age, n = 4 each group). The mice were surgically prepared for EEG (bilateral motor cortex and visual cortex) and neck EMG recordings with a headstage attached to a thin cable recorder that allowed the animal free movement. Following the recovery, recordings of 24 hours baseline sleep as well as 6 hours SD were made. The durations of SWD and the relationships between SWD and their sleep stages at the baseline and after SD were analyzed in Ts65Dn and WT mice.
Results: We found that adult Ts65Dn mice were also more prone to exhibit SWD, characterized by bilateral 6-9 Hz synchronization and 0.5-3 sec duration. These SWD were not associated with tonic-clonic seizures or spasms, both of which are known characteristics of absence seizures in this species. SWD were observed most frequently during wakefulness, less often during NREM and seldom during REM sleep. However, the difference in the SWD occurrences between Ts65Dn and WT was more significant in NREM than during wakefulness. Furthermore, the differences were more enhanced during NREM sleep rebound after SD.
Conclusion: Adult Ts65Dn are susceptible to SWD, especially during NREM sleep. Considering the fact that central GABAergic tone is enhanced during NREM sleep, the SWD seen in Ts65DS are likely under the influence of GABAergic neurotransmission. Further characterization, by polygraphic, behavioral and pharmacological evaluations of abnormal EEG activity, are in progress.

0163

GAMMA BAND POPULATION ACTIVITY IN THE PARAFASCICULAR NUCLEUS - EFFECTS OF CARBACHOL

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Introduction: Parafascicular (Pf) neurons receive cholinergic input from the pedunculopontine nucleus, part of the reticular activating system that is active during waking and REM sleep. We recently reported that Pf neurons were inhibited (55%), excited (31%) or both (7%) by the nonspecific cholinergic agonist carbachol (CAR). The studies described tested the hypothesis that population responses of Pf neurons are capable of generating gamma band frequency activity when activated by cholinergic input. We used the nonspecific cholinergic agonist carbachol (CAR) to activate cholinergic input to the Pf.
Methods: Population responses were recorded using extracellular microelectrodes in an interface chamber on 9-20 days old rat brainstem slices. Power spectra of activity were compared between control and after perfusion with CAR at 10, 30 and 50 uM.
Results: Population responses in the Pf showed that CAR induced dose-dependent peaks of activation in the theta and gamma band range, but not overall increases in level of activity.
Conclusion: Gamma band activity appears to be part of the intrinsic membrane properties of Pf neurons, and the population as a whole generates gamma band activity under the influence of the nonspecific cholinergic receptor agonist CAR. CAR induced specific peaks of activity in the gamma band range. Given sufficient cholinergic excitation, the Pf may impart gamma band activation on its targets.
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0164

GAMMA BAND POPULATION ACTIVITY IN THE PARAFASCICULAR NUCLEUS - EFFECTS OF NMDA AND KAINIC ACID

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Introduction: Parafascicular (Pf) neurons receive glutamatergic input from the cortex and from the pedunculopontine nucleus, part of the reticular activating system that is active during waking and REM sleep. The studies described tested the hypothesis that population responses of Pf neurons are capable of generating gamma band frequency activity when activated by specific glutamatergic receptor agonists. We used the specific glutamatergic receptor agonists n-methyl-d-aspartic acid (NMDA) and kainic acid (KA) to activate glutamatergic input to the Pf.

Methods: Population responses were recorded using extracellular microelectrodes in an interface chamber on 9-20 days old rat brainstem slices. Power spectra of activity were compared between control and after perfusion with NMDA at 1, 5 and 10 uM, or KA at 0.2, 1 and 2 uM.
Results: Population responses in the Pf showed that NMDA induced a dose-dependent overall increase in activity at theta and gamma frequencies. On the other hand, KA induced an increase in overall levels to a lesser extent but with higher peaks of activation in the gamma band range.
Conclusion: Gamma band activity appears to be part of the intrinsic membrane properties of Pf neurons, and the population as a whole generates gamma band activity under the influence of specific glutamatergic receptor agonists, although in different patterns. Given sufficient glutamatergic excitation, the Pf may impart gamma band activation on its targets.
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0165

RESPONSE OF PEDUNCULOPONTINE NEURONS TO N-METYL-D-ASPARTIC ACID

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Introduction: The pedunculopontine nucleus (PPN) is involved in the activated states of waking and paradoxical sleep, forming part of the reticular activating system (RAS). The PPN receives glutamatergic input from local and external nuclei, and activation of specific glutamatergic receptor subtypes is thought to underlie the differential control of waking vs. REM sleep. Furthermore, the presence of REM-on and Wake/REM-on neurons in the PPN indicates that cells in the PPN may be differentially regulated by glutamate receptor subtypes. These studies tested the hypothesis that cells in the PPN respond differently to the glutamatergic receptor agonist n-methyl-d-aspartic acid (NMDA), indicating distinct populations of REM-on and Wake/REM-on cells.
Methods: Single cell responses were recorded using whole cell patch clamp electrodes in an immersion chamber on 9-17 day old rat brainstem slices. NMDA (4 μM) was superfused with and without TTX (1 μM) in order to determine the direct, postsynaptic effects.
Results: All cells in the PPN (type I, II, III and excited, inhibited, biphasic response to carbachol-CAR) were excited by NMDA. Furthermore, there was no difference in the level of excitation between these cell types.
Conclusion: Our results suggest that cells in the PPN do not respond differentially to NMDA, with all cells exhibiting robust responses. If waking vs. REM sleep is determined by activation of different populations of cells, any differences may be downstream from the postsynaptic NMDA receptor activation.
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GAMMA BAND POPULATION ACTIVITY IN THE PEDUNCULOPONTINE NUCLEUS - EFFECTS OF CARBACHOL

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Introduction: The pedunculopontine nucleus (PPN) is involved in the activated states of waking and paradoxical sleep, forming part of the reticular activating system (RAS). Major cholinergic inputs to the PPN arise in the contralateral PPN and both laterodorsal tegmental nuclei. The studies described tested the hypothesis that population responses of PPN neurons are capable of generating gamma band frequency activity when activated by cholinergic input. We used the nonspecific cholinergic agonist carbachol (CAR) to activate cholinergic input to the PPN.
Methods: Population responses were recorded using extracellular microelectrodes in an interface chamber on 9-20 days old rat brainstem slices. Power spectra of activity were compared between control and after perfusion with CAR at 10, 30 and 50 uM.
Results: Population responses in the PPN showed that CAR induced dose-dependent peaks of activation in the gamma band range, but not overall increases in level of activity.
Conclusion: Gamma band activity appears to be part of the intrinsic membrane properties of PPN neurons, and the population as a whole generates gamma band activity under the influence of the nonspecific cholinergic receptor agonist CAR. CAR induced specific peaks of activity in the gamma band range. Given sufficient cholinergic excitation, the PPN may impart gamma band activation on its targets.
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0167

GAMMA BAND POPULATION ACTIVITY IN THE PEDUNCULOPONTINE NUCLEUS - EFFECTS OF NMDA AND KAINIC ACID

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Introduction: The pedunculopontine nucleus (PPN) is involved in the activated states of waking and paradoxical sleep, forming part of the reticular activating system (RAS). The PPN receives glutamatergic input from local and external nuclei, and activation of specific glutamatergic receptor subtypes is thought to underlie the differential control of waking vs REM sleep. These studies tested the hypothesis that population responses of PPN neurons are capable of generating gamma band frequency activity when activated by glutamatergic inputs. We used the specific glutamatergic receptor agonists n-methyl-d-aspartic acid (NMDA) and kainic caid (KA) to activate these receptors.
Methods: Population responses were recorded using extracellular microelectrodes in an interface chamber on 9-20 days old rat brainstem slices. Power spectra of activity were compared between control and after perfusion with NMDA at 1, 5 and 10 uM or KA at 0.2, 1 and 2 uM.
Results: Population responses in the PPN showed that NMDA induced a dose-dependent overall increase in activity at theta and gamma frequencies. On the other hand, KA induced an increase in overall levels to a lesser extent but with higher peaks of activation in the gamma band range.
Conclusion: Gamma band activity appears to be part of the intrinsic membrane properties of PPN neurons, and the population as a whole generates gamma band activity under the influence of specific glutamatergic receptor agonists, although in different patterns. Given sufficient glutamatergic excitation, the PPN may impart gamma band activation on its targets.
Support (If Any): Supported by NIH awards NS20246 and RR20146

0168

GAMMA BAND POPULATION ACTIVITY IN THE SUBCOERULEUS NUCLEUS - EFFECTS OF CARBACHOL

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Introduction: Subcoeruleus nucleus (SubC) neurons are thought to promote REM sleep signs under the influence of cholinergic input from the pedunculopontine nucleus. The studies described tested the hypothesis that population responses of SubC neurons are capable of generating gamma band frequency activity under the influence of cholinergic input. We used the nonspecific cholinergic agonist carbachol (CAR) to activate cholinergic input to the SubC.
Methods: Population responses were recorded using extracellular microelectrodes in an interface chamber on 9-20 days old rat brainstem

slices. Power spectra of activity were compared between control and after perfusion with CAR at 10, 30 and 50 uM.
Results: Population responses in the SubC showed that CAR induced dose-dependent peaks of activation in the gamma band range, but not overall increases in level of activity.
Conclusion: Gamma band activity appears to be part of the intrinsic membrane properties of SubC neurons, and the population as a whole generates gamma band activity under the influence of the nonspecific cholinergic receptor agonist CAR. CAR induced specific peaks of activity in the gamma band range. Given sufficient cholinergic excitation, the SubC may impart gamma band activation on its targets.
Support (If Any): Supported by NIH awards NS20246 and RR20146

0169

GAMMA BAND POPULATION ACTIVITY IN THE SUBCOERULEUS NUCLEUS - EFFECTS OF NMDA AND KAINIC ACID

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Introduction: Subcoeruleus nucleus (SubC) neurons are thought to promote REM sleep signs under the influence of cholinergic input from the pedunculopontine nucleus, and glutamatergic input from a number of sources. The studies described tested the hypothesis that population responses of SubC neurons are capable of generating gamma band frequency activity under the influence of glutamatergic input. We used the specific glutamatergic receptor agonists n-methyl-d-aspartic acid (NMDA) and kainic acid (KA) to activate glutamatergic input to the SubC.
Methods: Population responses were recorded using extracellular microelectrodes in an interface chamber on 9-20 days old rat brainstem slices. Power spectra of activity were compared between control and after perfusion with NMDA at 1, 5 and 10 uM, or KA at 0.2, 1 and 2 uM.
Results: Population responses in the SubC showed that NMDA induced a dose-dependent overall increase in activity at theta and gamma frequencies. On the other hand, KA induced an increase in overall levels to a lesser extent but with higher peaks of activation in the gamma band range.
Conclusion: Gamma band activity appears to be part of the intrinsic membrane properties of Subc neurons, and the population as a whole generates gamma band activity under the influence of specific glutamatergic receptor agonists, although in different patterns. Given sufficient glutamatergic excitation, the SubC may impart gamma band activation on its targets.
Support (If Any): Supported by NIH awards NS20246 and RR20146

0170

HOMEOSTASIS OF A C. ELEGANS SLEEP-LIKE STATE

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Introduction: The molecular processes that change with sleep deprivation and the genetic mediators of the behavioral response to sleep deprivation are poorly understood. We studied the homeostatic response to sleep deprivation of lethargus, a sleep-like state that occurs during *C. elegans* larval stage transitions.
Methods: Amplified cDNA synthesized from RNA collected from 5 groups of 100 whole worms forced to swim for 40 minutes during lethargus was compared to 5 groups of 100 lethargus worms that were allowed to remain quiescent for 40 minutes using Affmetrix whole genome microarray chips. A total of 3544 probe sets were differentially expressed between groups, but not changed by swimming in awake adults at an FDR significance level of 5%. Genes mapped from these probe sets were considered to represent "DEP" genes.
Results: Among DEP genes, several genes previously shown to be regulated by the insulin-signaling pathway FOXO transcription factor DAF-16 were changed. In addition, 8 genes encoding insulin-like peptides were up-regulated while 1 insulin-related gene was down-regulated, suggesting that insulin signaling changes occur in response to sleep deprivation. We tested whether DAF-16 moves into the nucleus in response to sleep deprivation, as would be predicted with a reduction in insulin signaling. We found that in multiple tissues, GFP::DAF-16 fusion proteins becomes more nuclear following forced locomotion during lethargus. This change in insulin signaling is important for the response to sleep deprivation since we found that 3 independent daf-16 alleles show a defective homeostatic response to sleep deprivation.
Conclusion: The molecular response to sleep deprivation in C. elegans is complex, a result that is consistent with observations in other species. Insulin-like growth factor signaling is reduced by deprivation and this reduction appears to play a role in the behavioral response to sleep deprivation. These findings are relevant to clinical observations that sleep deprivation can reduce insulin signaling in humans.
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0171

NEURONAL ACTIVITY IN MACAQUE BASAL FOREBRAIN RELATED TO AROUSAL STATES AND COGNITIVE PERFORMANCE

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Introduction: The basal forebrain is thought to be important for regulation of arousal states. However, many studies on the functional role of this region were performed in rodents and little is known in primates at the cellular level. In this study we recorded neuronal activity in the basal forebrain of behaving macaques to examine its relationship to level of arousal and cognitive performance.
Methods: Action potentials and local field potentials (LFPs) were simultaneously recorded from the basal forebrain and the ventral pallidum of two head-restrained macaques (Macaca mulatta). The recording was made while animals were performing a task or sitting still in the darken room. The task was to detect change in luminance in one of four disks on the computer monitor and animals were asked to saccade to the target disk.
Results: Forty-one out of 83 neurons showed significant difference in firing rate between wakefulness and sleep ($P < 0.01$). Twenty eight of 41 showed higher firing rate during sleep and some of the responses preceded the closure of eyes by 5 s. While animals were sleeping or showed slow-rolling eye movements, the power of LFPs tended to become higher at lower frequency ranges. Of 57 neurons recorded during the task, 21 showed significant difference in activity depending on whether the trials ended in success or not, and 11 of them were selective for arousal states ($P < 0.01$).
Conclusion: We have found the macaque basal forebrain neurons which were related to both arousal states and behavioral performance. This arousal-performance relationship in the basal forebrain may imply dynamic change of cortical states that affects accuracy of behavior at a given moment, therefore, responses of the basal forebrain neurons may predict the future cognitive performance.

0172

NEURAL AND NON-NEURAL SUPRACHIASMATIC INFLUENCES ON SLEEP AND WAKEFULNESS IN INFANT RATS

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Introduction: The suprachiasmatic nucleus (SCN) controls circadian rhythms in mammals. Output signals from the SCN reach target re-

gions via neural efferents and diffusible signals, but the development of these influences on sleep and wakefulness has not been studied. Here we examine this issue in rats during the first postnatal week at a time when day-night differences in sleep and wakefulness are detectible.

Methods: To remove neural efferents from the SCN to downstream brainstem structures, we performed precollicular transections at P2 and P8 during the day and night (n = 6 in each group). In an additional experiment, we lesioned the SCN in P1 littermates and tested them at P2 during the day and night. Sham transections and lesions were also performed. In all experiments, sleep and wakefulness were monitored by measuring nuchal muscle activity.

Results: Precollicular transections at P2 did not alter day-night differences in sleep and wakefulness, suggesting that neural factors from the SCN to downstream brainstem nuclei are not responsible for circadian differences at this age. However, at P8, precollicular transections eliminated day-night differences in sleep and wakefulness, suggesting that by this age neural efferents from the SCN are influencing brainstem nuclei involved in sleep and wakefulness. In contrast with transections, SCN lesions eliminated day-night differences in sleep and wakefulness at P2.

Conclusion: These results suggest that the SCN exerts its effects on newborn sleep and wakefulness by releasing a diffusible signal that influences brainstem structures. Over the first postnatal week, neural outputs from the SCN appear to gain control. In future experiments, we will investigate potential diffusible signals (e.g., transforming growth factor-alpha, prokineticin 2) and assess changes in neural outputs from the SCN across the first postnatal week.

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0173

EFFECTS OF SHORT LIGHT-DARK CYCLES ON SLEEP AND WAKING IN ALBINO MICE WITH RETINAL DEGENERATION

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Introduction: Short light-dark cycles (LDc) have been found to induce redistribution of paradoxical sleep (PS) being more in the dark than in the light period in albino rats. The eyes are necessary for the effect of short LDc on PS distribution. This study aimed at confirming the short LDc effect on PS in albino mice and clarifying whether the rod and cone photoreceptive system is needed for the short LDc effect on PS.

Methods: Five adult male CD-1 (ICR) mice (11 weeks old) and eight adult male FVB/NJNarl mice (11 (n = 4)and 21 (n = 4) weeks old), which carried rd/rd mutation and lose rods and most cones after maturity, were implanted with electrodes for standard electrophysiological recordings performed during baseline, experimental, and recovery periods, each lasted for two days. During the experimental period, 5 min-5 min LDc were applied for 4 hours in the mid-period of both the inactive and active circadian phases.

Results: No significant differences in daily activity rhythm between the two mice strains ($P = 0.840$). PS was more in the 5 min dark periods than in the 5 min light periods in both the FVB ($P < 0.001$) and ICR ($P < 0.001$) mice.

Conclusion: The results of this study confirm that short LDc induce redistribution of PS being more in the dark than in the light in the albino mice. Severe loss of the rod and cone photoreceptive system did not affect the short LDc effect on PS, which suggests that the non-rod, non-cone photoreceptive system, e.g., melanopsin-containing retinal ganglion cells, may be responsible for the short LDc effect on PS.

0174

UNDERSTANDING INTERNAL DESYNCHRONY AND THE PHYSIOLOGICAL EFFECTS OF SELF-SELECTED SCHEDULES USING A QUANTITATIVE MODEL OF SLEEP PHYSIOLOGY

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Introduction: Early attempts to ascertain free-running circadian period in humans reported two unusual results: (1) Periods of 25 hours with sleep initiated at later circadian phases than during entrainment; (2) Internal desynchrony of sleep/wake and circadian rhythms, with the former free-running with an observed period of 30-60 hours. (1) was explained by subjects preferentially choosing light exposure during the delay portion of the phase response curve, although the reason for this behavior is unknown. (2) was reproduced by Kronauer (1982, Am. Physiol. Soc.) using two coupled mathematical oscillators, but the physiological basis remained unclear. We demonstrate that a physiologically based model reproduces both observations, and explains the "long" sleep/wake cycle.

Methods: The model includes the mutually inhibitory ventrolateral preoptic area (VLPO) and monoaminergic nuclei (MA), and circadian, homeostatic, and cholinergic/orexinergic drives (Phillips, 2008, J. Theor. Biol; St. Hilaire, 2007; J. Theor. Biol.). We hypothesized that delayed sleep times indicate an additional wake-promoting drive of psychological origin, associated with removal of schedules and instructions given to the subject, which we model by increasing cholinergic/orexinergic input to MA during wake.

Results: Increased cholinergic/orexinergic tone during wake reproduces the observed period lengthening. Additionally, if circadian input to VLPO is weakened, internal desynchrony results. Sleep/wake rhythms are then driven purely by sleep homeostasis, with the period dictated by homeostatic clearance rate, potentially providing a new means of measuring homeostatic kinetics. The model predicts a free-running period of 28 to 67 hours, using the previously constrained range for homeostatic clearance rate.

Conclusion: We hypothesize that during self-selected schedules, the circadian signal is down-regulated by the dorsomedial hypothalamus (DMH), which acts as an intermediary between the suprachiasmatic nucleus and VLPO and responds to environmental factors such as meal timing. The results also suggest that increased cholinergic/orexinergic activity is a plausible mechanism for choosing to sustain wakefulness at high homeostatic pressure. In a society where daytime is selected at the flick of a switch, understanding the physiological and behavioral implications of self-selected schedules has wide-reaching consequences.

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0175

HYPOCRETIN/OREXIN NEURONS CONTRIBUTE TO RESPIRATORY MUSCLE TONE CONTROL IN MICE

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Introduction: Ampakines are AMPA receptor potentiators that have clinical relevance because they have been shown to increase alertness and alleviate opioid-induced respiratory motor suppression. Hypocretin neurons project to brain regions that modulate arousal and respiratory motor control including respiratory motoneurons. The aim of this study was to determine whether ampakines can specifically activate hypocretin neurons and thereby modulate respiratory muscle tone.

Methods: We used neuro-pharmacological, electrophysiological and histological techniques to determine whether hypocretin neurons modulate the respiratory activity of genioglossus muscles in anaesthetized mice.

First, we applied ampakine (0.5mM CX546) onto hypocretin neurons while monitoring genioglossus EMG activity in wild-type or hypocretin knockout mice. Second, we blocked hypocretin-1 and -2 receptors on hypoglossal motoneurons while monitoring genioglossus EMG tone.
Results: In wild-type mice (n = 7), application of ampakine CX546 onto hypocretin cells increased both expiratory and inspiratory genioglossus muscle tone by 29 ± 8% (P = 0.03) and 38 ± 18% (P = 0.018) above baseline levels. Ampakine application had no effect on respiratory rate (P > 0.05). However, ampakine application in hypocretin knock mice (n = 4) had no effect on either expiratory (P = 0.938) or inspiratory (P = 0.426) genioglossus muscle tone. Simultaneous blockade of both hypocretin-1 and -2 receptors on hypoglossal motoneurons suppressed inspiratory genioglossus tone by 25 ± 4% below baseline levels (P = 0.01) in wild-type mice (n = 7). This intervention had no effect on either expiratory tone (P = 0.253) or respiratory frequency (P = 0.163).
Conclusion: We suggest that ampakines amplify a prevailing glutamatergic drive onto hypocretin neurons, which project to and activate hypoglossal motoneurons thereby increasing genioglossus tone. Our data also show there is an endogenous hypocretin drive onto hypoglossal motoneurons because blockade of hypocretin receptors reduces genioglossus muscle tone and ampakine effects are lost in hypocretin knockout mice. Together, these data show that hypocretins contribute to regulation of respiratory muscle tone.

0176

MICE EXPOSED TO CHRONIC INTERMITTENT HYPOXIA (CIH) ARE CHARACTERIZED BY INCREASED OXIDATIVE STRESS AND IMPAIRED RESPIRATORY FUNCTION IN CORTICAL AND HIPPOCAMPAL MITOCHONDRIA

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Introduction: Obstructive sleep apnea is associated with increased oxidative stress in the brain and neurocognitive dysfunction. We have shown that CIH increases mitochondrial content of reactive oxygen species (ROS) and causes neuronal-specific apoptosis in the cortex and the hippocampus. However, the effects of CIH on mitochondrial metabolic functions remain unclear.
Methods: C57BL/6 mice were exposed to CIH (alternating 5.7% and 21% O2 every 90 seconds 12 hours/day for 3 months). Mitochondria from various brain regions were isolated for assessment of H2O2 release, oxygen consumption, complex activities, and membrane potential.
Results: CIH caused a significant increase in ROS content in mitochondria isolated from the cortex and the hippocampus. CIH also increased the kinetic release of H2O2 from these mitochondria when respiration was supported by a complex II substrate (succinate), which was abolished by rotenone, a complex I inhibitor. Conversely, CIH had little effect on H2O2 release when respiration was supported by complex I substrates (glutamate+malate). These data suggest that CIH-induced increase in ROS production is mainly due to electron drop from complex I through the reverse electron flow. In accordance with these changes, CIH impaired complex I, but not complex II, enzymatic activities. Moreover, CIH reduced the rate of oxygen consumption, especially during state 3 respiration, and reduced the phosphorus:oxygen ratio, indicating a sluggish electron transport chain (ETC) and a lower oxygen efficiency in these mitochondria. Consequently, the membrane potential of these mitochondria was at < 60% of that measured in mitochondria from control mice.
Conclusion: We conclude that CIH impairs the ETC, especially complex I, resulting in increased ROS production, decreased electron transport rate, decreased oxygen efficiency, and eventually, decreased membrane potential in cortical and hippocampal mitochondria. These adverse changes in mitochondrial metabolic functions may represent a mechanism whereby CIH induces neuronal cell death and neurocognitive dysfunction.
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0177

LONG-TERM INTERMITTENT HYPOXIA (IH) INCREASES PRODUCTION OF REACTIVE OXYGEN SPECIES IN CORTICAL AND HIPPOCAMPAL MITOCHONDRIA AND INDUCES NEURONAL APOPTOSIS IN MICE

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Introduction: IH during sleep is a constitutive component of obstructive sleep apnea and leads to neurocognitive dysfunction. Although increased oxidative stress occurs in brain regions of rodents exposed to IH during sleep, the source of IH-induced reactive oxygen species (ROS) and their cellular and subcellular targets remain unclear.
Methods: C57BL/6 mice were exposed to IH for 3 months (alternating 5.7% and 21% O2 every 90 seconds 12 hrs/daylight). Mitochondria from various brain regions were isolated for ROS content using flow cytometry. Tissue homogenates were prepared for measurement of oxidative damage and for Western blotting analyses. The FLIVO reagent was used for in vivo detection of apoptosis.
Results: IH elicited significant increases in ROS content in mitochondria isolated from the cortex and the hippocampus. Consequently, oxidative cellular damage was apparent in these brain regions, as shown by increased lipid peroxidation (malondialdehyde content) and protein oxidation (protein carbonyl content) in total tissue homogenates. In contrast, mitochondria isolated from the cerebellum and the brain stem exhibited no evidence of detectable increases in ROS content and only minor increases in oxidative cellular damage. Furthermore, activated caspase 3 and poly(ADP-ribose) polymerase were detected in cortical and hippocampal homogenates, but not in brain stem tissue homogenates. Analysis of in vivo apoptosis showed increased apoptosis in the cortex and the hippocampus. Co-labeling studies further revealed that fluorescent signals of active caspases almost exclusively co-localized with neurons but were rarely present in astroglia.
Conclusion: Cortical and hippocampal mitochondria are vulnerable to chronic IH insults, and are a major source of IH-induced ROS production. These findings also suggest that mitochondria in these brain regions, especially those in neuronal cells within the cortex and hippocampus, may constitute specific targets of increased oxidative stress, and that mitochondrial damage consequently leads to apoptotic cell death, and ultimately to neurocognitive impairment.
Support (If Any): Supported by NIH grants HL-074369 and HL-086662

0178

INCREASED DOPAMINE SIGNALING DELAYS FUNCTIONAL SENESCENCE IN BEHAVIORAL AND STRUCTURAL PLASTICITY

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Introduction: Sleep disruptions, such as those which occur commonly during normal aging, are associated with structural and functional changes in the brain. Interestingly, while sleep plays an important role in memory consolidation in younger adults, older adults may not improve following sleep. Although these results suggest that sleep-dependent memory consolidation is diminished with age the underlying mechanisms are unknown. Thus, we have examined the relationship between aging and plasticity in the genetic model organism Drosophila.
Methods: Female Cs flies were exposed to social isolation (n = 1) or social enrichment (n = 35-45) for five days when they were 5, 10, 15 and 20 days old. The response to social enrichment was evaluated by

monitoring both subsequent sleep and the number of synaptic terminals in projections from the large ventral lateral neurons (LNV).
Results: Young (3-5 day old) flies exhibit increased sleep following social enrichment. However, by 20 days of age female Cs flies are not capable of responding to an enriched social environment with an increase in sleep. The failure of old flies to respond to social enrichment could not be attributed to a reduction of group activity or a decline in fecundity. Importantly, the failure of older flies to increase sleep in response to social enrichment was accompanied by the absence of structural plasticity as measured by alterations in the synaptic terminals LNV. The age-related impairment in plasticity induced sleep as well as the deficits in structural plasticity in the LNvs could be prevented pharmacologically by administering L-DOPA to 20-day old Cs females during social enrichment or genetically by expressing the dopamine D1-like (dDA1) receptor in the LNvs.
Conclusion: Flies, like humans, display age-dependent declines in sleep-dependent plasticity. In flies, functional senescence in sleep and structural plasticity is mediated, in part, through degradation of dDA1 signaling which can be delayed using both pharmacological and genetic manipulations.

0179

EARLY LIFE REM SLEEP DISTURBANCE AFFECTS HIPPOCAMPAL SYNAPTIC PLASTICITY IN YOUNG ADULT RATS

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Introduction: In early life, synaptic plasticity participates in correct development of the CNS. Synaptic plasticity can be compromised during development, however, by insults such as hypoxia, drugs and deficiencies of sleep. REM sleep has a significant role in brain development, and its restriction during early life leads to: altered size of cells in the lateral geniculate nucleus, extension of visual cortical plasticity beyond the usual developmental phase, and delayed maturation of LTP-stability and glutamatergic signaling proteins in hippocampus. The latter changes were observed in rats that were REMS-deprived when very young and allowed up to a week of recovery before LTP-stability was examined. The present study attempted to determine whether very early-life REM sleep restriction affects hippocampal synaptic plasticity in adults.
Methods: Rats were REM sleep-deprived for 5 h (9:00 - 13:00 h) on each day between postnatal day (P) 16 - 19. Following published protocols, at P50-54 rats were anesthetized (isoflurane) prior to brain removal. Several coronal hippocampus slices (400 μm) were obtained and transferred to an interface chamber. The slices were maintained in oxygenated ACSF at 31° C for at least 2h prior to placement of a stimulating electrode in the Schaffer collaterals in CA3 and a recording electrode in the CA1 region. A 25 min baseline was recorded, using the half-maximal stimulus delivered once a minute. Then LTP was induced by means of TBS for 2s at the same stimulus intensity. Recording continued for 30 min with one stimulation each minute at the identical intensity.
Results: In normal animals, LTP was produced in 11 of 16 attempts. In contrast, animals deprived of REM sleep just after the second week of life were less likely to produce LTP (5 / 15 attempts, Fisher's Exact, two-tailed, P = 0.032). Further, the level of LTP, when exhibited in the deprived group, was much lower (129 vs 148% increase over baseline.
Conclusion: These preliminary data extend into adulthood our previous findings that early REM sleep deprivation has persistent effects on hippocampal synaptic plasticity. The hippocampus is involved in memory, learning and major depression. Unperturbed REM sleep in the first weeks of life appears to be essential for correct brain development and affective processes. Current studies are examining the effects of early life REM sleep restriction on behavioral measures of anxiety and also on neuroproteins known to have roles in synaptic plasticity and human depression.
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0180

REM SLEEP PLAYS A ROLE IN OCULAR DOMINANCE PLASTICITY CONSOLIDATION

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Introduction: Sleep has been hypothesized to play a role in plasticity consolidation, but the underlying mechanisms in this process are unknown. Ocular dominance plasticity (ODP) in the cat primary visual cortex (V1) is a canonical form of in vivo plasticity induced by monocular deprivation (MD), and is consolidated by sleep. This requires the activation of NMDA receptors and downstream kinases during post-MD sleep. However, the respective contributions of NREM and REM sleep in ODP consolidation and kinase activation are unknown. NREM and REM are characterized by distinct neuromodulatory tone and cortical activity patterns, suggesting that these states may play separate but complementary roles in consolidation.
Methods: Cats in the critical period for ODP were implanted with electrodes for polysomnography recording, and then underwent MD for 6 hours to induce cortical remodeling. MD was followed by 1 hour of normal sleep, REM sleep deprivation (RSD), or NREM-fragmented sleep. NREM fragmentation served as a control for the nonspecific effects (increased wake time, suppression of delta power, and decreased sleep continuity) of RSD. Immediately following these manipulations, ODP was assessed using optical imaging of intrinsic cortical signals and single unit recording in V1. Another set of animals was subjected to the same sleep-wake manipulations, after which V1 tissue was collected for Western blot analysis of ERK1/2 and CaMKII alpha/beta, kinases known to be activated in post-MD sleep.
Results: Optical imaging and unit recording showed that plasticity induced by MD was reduced by subsequent RSD relative to normally sleeping animals and NREM-fragmentation controls. Furthermore, ERK1/2 and CaMKII alpha/beta phosphorylation levels in V1 were reduced when MD was combined with subsequent RSD. These data suggest that the activation of these kinase cascades requires REM sleep.
Conclusion: These results support a role for REM sleep in the activation of biochemical signaling cascades that lead to ODP consolidation.

0181

SLEEP-RELATED SPONTANEOUS ACTIVITY AND RECOVERY OF FUNCTION IN THE SOMATOSENSORY CORTEX OF INTACT AND CALLOSOTOMIZED INFANT RATS

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Introduction: The corpus callosum modulates spontaneous sleep-related cortical activity in the form of spindle bursts (SBs) in rats during the early postnatal period. SBs are brief 5-40 Hz oscillations that are produced in response to sensory feedback from active sleep-related myoclonic twitches and can also be evoked by peripheral stimulation. SBs have been suggested to play a role in the development of somatotopic cortical maps. We have previously shown that acute transection of the corpus callosum (callosotomy) before, but not after, postnatal day (P)7 disinhibits spontaneous SB activity in the forepaw region of somatosensory cortex and reduces the reliability of evoked responding to stimulation of the contralateral forepaw. Here we test the hypothesis that disinhibition of SB activity is related to cortical plasticity by performing callosotomies at P1 and P8 and examining recovery of function over the ensuing week.

Methods: Callosotomies and sham surgeries were performed at P1 or P8. Littermates that received a callosotomy at P1 were tested at P1, 2, 4, 6, or 8 (n = 6 per group). Littermates that received a callosotomy at P8 were tested at P8, 9, 12, or 15 (n = 6 per group). All surgeries were conducted under anesthesia and the recording of neurophysiological and behavioral activity was conducted in unanesthetized head-fixed infant rats.

Results: Callosotomies performed at P1 resulted in the initial disinhibition of spontaneous SBs and a gradual decrease in spontaneous activity over the ensuing week. The response to stimulation of the contralateral forepaw, initially reduced after callosotomy, recovered to sham levels by P8. This recovery of function was not seen in pups callosotomized at P8 and tested at P15. An additional series of pups callosotomized at P6 exhibited disinhibition of spontaneous SBs and complete recovery of function over the ensuing week, similar to the pups callosotomized at P1.

Conclusion: We conclude that there exists a period of somatosensory cortical plasticity during the first postnatal week that terminates between P6 and P8. The period of plasticity is associated with high rates of myoclonic twitching and disinhibitory responses to callosotomy. We hypothesize that sleep-related myoclonic twitches and their associated sensory feedback contribute to somatosensory cortical organization and recovery of function after damage to cortical circuitry.

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0182

EFFECTS OF EXOGENOUS MELATONIN ON RESTING METABOLIC RATE IN HUMANS

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Introduction: Exogenous melatonin has been shown to improve daytime sleep. These improvements in sleep are thought to be partly mediated by melatonin induced thermoregulatory changes in core body temperature and cutaneous heat loss. It is also possible that melatonin may facilitate daytime sleep by reducing resting metabolic rate (RMR). Therefore, we tested the hypothesis that exogenous melatonin (5mg) would acutely decrease RMR as assessed by volume of oxygen consumption (VO2), and calculated energy expenditure (EE) when compared to placebo.
Methods: Eighteen healthy adults (7 females), BMI (22.5 ± 1.7 kg/m^2) aged (22 ± 5 yrs) participated in a randomized, double-blind, placebo-controlled study. Participants were deemed healthy based on physical exam, sleep and psychological history, and blood chemistries. Urine toxicology and alcohol breath testers verified that participants were drug free. The laboratory visit was preceded by one week ~8h consistent sleep-wakefulness schedules verified by call-ins to a time stamped recorder, actigraphy (Actiwatch-L, Mini Mitter Respironics) and sleep logs. Participants were studied under modified constant routine conditions to control for influences of activity, posture, and lighting. Melatonin/placebo was administered 1.25h after awakening from a 5h daytime sleep opportunity while in the fasted state. Resting VO2 was assessed using indirect calorimetry (Truemax, Parvomedics) just prior to pill administration, and twice after (60 and 90 min). Additionally, EE expressed as kilocalories per minute (kcal/min) was calculated for each test. Changes in metabolic measures were calculated as differences from baseline and analyzed by repeated measures ANOVA.
Results: As hypothesized, exogenous melatonin significantly decreased VO2 (ml/kg/min) and EE (kcals/min) ($P < 0.05$).
Conclusion: Exogenous melatonin (5mg) decreased resting VO2 and EE when compared to placebo. Together with previous research findings that have shown thermoregulatory effects of melatonin on CBT and skin temperatures these findings suggest that melatonin, may also facilitate sleep through reductions in RMR.
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0183

ADVANCING CIRCADIAN RHYTHMS WITH AFTERNOON MELATONIN AND A GRADUALLY ADVANCING SLEEP/DARK SCHEDULE

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Introduction: We previously tested a gradually advancing sleep/dark schedule with morning bright light exposure plus afternoon melatonin, and with morning bright light alone (Burgess et al., JBR 2003; Revell et al., JCEM 2006) to advance human circadian rhythms. We currently examine how much circadian rhythms advance with this sleep pattern and afternoon melatonin alone.
Methods: Eight young healthy adults (5 male) completed this ongoing within-subjects placebo-controlled counterbalanced study. Following 6 nights of "stabilization" (fixed 8-hour sleep) we sample saliva in the laboratory every 30 minutes to determine the baseline dim light melatonin onset (DLMO), a circadian phase marker. After another 3 days of stabilization, we advance sleep/dark by 1 h/night for 3 consecutive nights in the laboratory. Participants ingest 3mg melatonin or placebo 7 hours before their stabilization bedtime on the first laboratory night and 1 hour earlier each day. Participants remain in room light (< 120 lux) in the morning. Saliva sampling to determine the final DLMO follows. We computed a 2 (time: baseline vs. final DLMO) x 2 (condition: melatonin vs. placebo) repeated measures ANOVA.
Results: As expected, DLMO advanced in both conditions [time effect: $F(1,7) = 75.3$, $P < .001$], which is attributed to the advancing sleep/dark schedule. The phase advance with evening melatonin (mean = 82, sd = 10 mins) was larger than with placebo (mean = 42, sd = 36 mins) [time-by-condition interaction: $F(1,7) = 8.8$, $P = .021$].
Conclusion: Thus far, adding afternoon melatonin to the gradually advancing sleep pattern doubles the average phase advance compared to placebo. This is similar to the effect of bright light in our previous studies, which showed about twice the average phase advance shift with morning intermittent bright light compared to room light. Based on our series of studies, the combination of morning intermittent bright light, afternoon melatonin and gradually advancing sleep/dark produces the largest average phase advance (156 minutes, or about 1 hour/day).
Support (If Any): R01 NR007677 to C. Eastman

0184

ONGOING GOLITE (BLUE LIGHT) PHASE RESPONSE CURVE IN HUMANS

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Introduction: We generated phase response curves (PRCs) to 3.0 mg melatonin (Burgess et al, J. Physiol, 2008), 0.5 mg melatonin and a partial PRC to white fluorescent light, 2 hour pulses of ~3500 lux (Revell & Eastman, JBR, 2005). We are currently generating a PRC to blue light.
Methods: So far 20 young subjects have completed two 5-day laboratory sessions preceded by 7-9 days of fixed home baseline sleep. Each laboratory session consists of a baseline phase assessment (30 min saliva samples) to measure the dim light melatonin onset (DLMO), 3 days in an ultradian wake-sleep, light (< 150 lux)-dark cycle (LD 2.5:1.5), followed by a final phase assessment. Subjects are exposed to daily blue light (same clock time on each of the 3 ultradian days) during one laboratory session and no additional light during the other (counterbalanced). Each individual's phase shift to blue light is corrected by subtracting their phase shift from the other session (the free-run); Each subject contributes one point to the PRC. The blue light is provided by goLITEs (14x14x2.5 cm) which contain relatively narrowband LEDs that peak at 467 nm. The blue light is ~85 lux (eyes ~50 cm from light) with an intermittent pattern: Three 30 min pulses separated by 15 min in room light.
Results: The phase delay portion starts around the time of baseline bedtime and ends around baseline wake time. The advance portion peaks several hours after wake time. The largest phase shifts were about 3 hours.
Conclusion: So far the blue light PRC is phase delayed relative to our white light PRC, but we do not know if this is due to wavelength or the small N (7) for our white light PRC. The magnitude of the phase shifts with blue light is similar to those produced with melatonin.
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0185

SLEEP DEPRIVATION REDUCES PHASE SHIFTS TO LIGHT IN HUMANS

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Introduction: Studies in mice and hamsters suggest that sleep deprivation reduces phase shifts to light. However, this has not been previously investigated in humans. Here we examined the effect of sleep deprivation on phase shifts to light in humans, while controlling for changes in the light-dark cycle.

Methods: Thirteen young healthy subjects (8 males, 5 females) participated in a within-subjects counterbalanced design. In both conditions subjects followed their habitual sleep schedule at home for 6 nights before a phase assessment in the laboratory to determine their dim light melatonin onset (DLMO). Subjects returned to sleeping at home for a week before a 4-day laboratory session. During the 4-day laboratory session, subjects underwent a 3-day advancing protocol (3.5 hours of bright light each morning, starting 8 hours after the DLMO), followed by another phase assessment. In one condition (no sleep deprivation) subjects had an 8 hour sleep opportunity during each day of the advancing protocol. In the other condition (partial sleep deprivation) subjects were kept awake for 4 hours in darkness, and then had a 4 hour sleep opportunity during each day of the advancing protocol.
Results: Ten of thirteen subjects showed reduced phase advances when they were sleep deprived compared to when they were not sleep deprived. The reduction in phase advance ranged from 0.2 to 1.2 hours (mean = 0.6 hours, paired t-test $P < 0.03$).
Conclusion: These results show for the first time that sleep deprivation per se (and not just the associated light-dark cycle changes) can reduce circadian responsiveness to light. These results also provide further evidence of the complex interaction between the sleep and circadian systems. This finding has significant implications for the sleep deprived general population, and for treating circadian rhythm sleep disorders such as shift work and delayed sleep phase type.
Support (If Any): NHLBI RO1 HL083971 to HJB.

0186

SLEEP DURING A 24 HOUR BI-PHASIC WORK/REST SCHEDULE IN AMERICAN WATERWAYS OPERATORS

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Introduction: Crew in the United States inland waterways towboat barge industry often show a bi-phasic sleep behavior that is necessitated by a unique work schedule of 6 hours work followed by 6 hours off resulting in 2 rest/sleep and 2 work intervals per 24 hour period. Crewson such a schedule often maintain the 6:6:6:6 schedule for extended periods of time (e.g. 14-28 days). The aim of this study was to examine sleep-wake behavior in American Waterways Operators during normal operations.
Methods: Rest-activity cycles were recorded using both wrist activity monitors and sleep diaries for 10 consecutive days. The participating crew were divided into two groups: Front Watch (n = 11, mean age 42.1) working from about 6am-12pm and 6pm-12am and the Back Watch (n = 7, mean age 38.8) working from 12am-6am and 12pm-6pm. All participants were volunteers and gave informed consent.
Results: In a 24 hour period crew on the Front Watch obtained about 6.4 hours of sleep with 8.1 hrs time in bed. During the 12am-6am rest period Front Watch crew only slept an average 3.7 hours with 4.5 hours time in bed (TIB). Crew on the Back Watch obtained about 6.2 hours total sleep time with 7.8 hrs TIB and during the morning rest period obtained 3.6 hours of sleep with 4.4hrs TIB .
Conclusion: Even when sleeping at an optimum circadian phase crew on the front watch only slept 3.7 hours. On a continuous bi-phasic rest schedule, sleep intervals are shortened even for those sleeping at night. It has been suggested that a schedule change to 7:7:5:5 or 8:8:4:4 would enable crew to obtain 7-8 hours of sleep during the major/anchor sleep period. However our data suggests that even with extended sleep opportunities crews will not be able to obtain 7-8 hours of sleep, demonstrating the need for an anchor sleep/nap strategy for operations under a 24 hour split schedule.
Support (If Any): The study was supported by a consortium of the barge industry.

0187

RING THE BELL FOR MATINS: CIRCADIAN ADAPTATION TO SPLIT SLEEP IN MONKS

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Introduction: Clustered monks follow during their lifelong a ten-century old regular circadian rhythm with a common zeitgeber, including a night-time sleep split by a 2-3 hours mass, the Matins. How the circadian clock adapts to this rhythm is unknown. We studied the circadian rhythm of rest-activity, temperature, and sleep in these monks.
Methods: Ten monks (5 men, 5 women) from two monasteries of the same clustered Catholic order and 10 age- and sex-matched controls underwent a body examination, a sleep questionnaire, a sleep agenda, an actigraphy during a week, and a 48-hour long measure of core body temperature.
Results: Compared to controls, the monks went to bed earlier (at 08:14 PM vs. 11:37 PM, had a longer sleep onset latency (39 ± 48 min vs. 8 ± 4 min), a shorter sleep time (6.3 ± 0.9 hr vs. 7.2 ± 0.9 hr),woke up earlier (at 06:28 AM vs. 07:37 AM), and tended to be sleepier during daytime (Epworth score 8.6 ± 4.6 vs.5.8 ± 4.3). They scored higher at the Pittsburgh Sleep Questionnaire Inventory, had more frequently occasional hypnagogic hallucinations and nightmares, but no more sleep paralysis. In contrast to their wove of silence during daytime, they had frequent conversations in their dreams, acts of piety, but rarely true prayers. A specific biphasic temperature rhythm was found in monks, including an early decrease at 6:00 PM (± 126 min), a plateau or rise of temperature at 10:40 PM (± 24 min), lasting 286 ± 64 min, followed by a second decrease after the mass (temperature nadir at 5:50 AM ± 47 min) and a morning classical rise. Although they needed several alarm clocks to wake up for Matins at midnight, the rise of temperature anticipated the nocturnal awakening by 75 ± 25 min (42-110 min), while they were still asleep.
Conclusion: The biphasic circadian temperature rhythm in monks suggests that the human clock can adapt and even anticipate regular nocturnal awakenings.
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0188

EFFECT OF CHRONOTYPE ON PERCEIVED SLEEP NEED AND WEEKDAY AND WEEKEND SLEEP DURATION

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Introduction: Although it is commonly recommended for adults to get 7-9 hours of sleep per night, there are individual differences in self-reported sleep need. To compensate for sleep deficits, people often alter their sleep patterns on the weekend in accordance with changes in social demands. Each individual's chronotype (preference for early or late sleep timing) may affect his/her ability to get as much sleep as needed during the week and influence sleep patterns between the week and the weekend. The aim of this study was to assess perceived sleep need and how actual sleep duration during the week and weekend deviate from self-assessed sleep need in morning and evening types.
Methods: One hundred forty-six adults (mean ± SD 36.11 ± 12.40 years, 91F, 55 M) were recruited from visitors to the Museum of Science in Boston, Massachusetts to participate in a questionnaire study. The questionnaire included general sleep habits and preferences questions as well as the Horne-Östberg morningness-eveningness questionnaire (MEQ). Standard scores on the MEQ were used to categorize subjects, and comparisons of self-reported sleep need and weekday and weekend sleep duration between "morning types" (M) and "evening types" (E) were performed.

Results: E types (n = 23) had a significantly longer self-assessed sleep need (8.17 ± 1.04h) than M types (n = 34, 7.56 ± 1.18h; P = 0.05). During the week, E types reported 1.2 ± 1.73h less sleep each night than their perceived need, while M types reported 0.5 ± 1.13h less than their perceived need (P = 0.08). On the weekend, both groups reported extending their sleep duration significantly (P < 0.001). However, the amount by which weekend sleep duration exceeded self-reported need was significantly different between the groups (E types: 0.9 ± 1.63h; M types: 0.05 ± 1.25h; P = 0.025). Together, these data imply that E types accumulate a weekly sleep debt of nearly 7h, while M types accumulate a weekly sleep debt of ~ 2.5h.
Conclusion: Both M and E type subjects reported getting less sleep than they need during the week, and extending their sleep duration on weekends. E type subjects extended their weekend sleep duration more than M type subjects by sleeping later in the morning. However, neither group 'made up' all the lost weekday sleep on weekends, with the E types accumulating a greater weekly sleep loss than the M types. This greater accumulated sleep debt in E types may contribute to their longer perceived sleep need.
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0189

CIRCADIAN VARIATION OF ENERGY EXPENDITURE IN HUMANS

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Introduction: One of the proposed functions of the circadian timekeeping system is to modulate metabolic physiology so that the organism is biologically prepared for adaptive physiological and behavioral responses at appropriate environmental times of day. Very little research has been performed on humans to examine the circadian variation of energy expenditure. Therefore, the primary aim of the current study was to examine the circadian variation in energy expenditure in humans.
Methods: Seventeen subjects (12 men and 5 women), who were aged 23.0 ± 2.1 years (mean ± SD) and screened for medical, sleep and psychological disorders participated. Subjects maintained an ~8h per night sleep schedule for one week at home prior to the laboratory visit, as verified by wrist actigraphy recordings. Following an 8h in laboratory sleep opportunity at the subjects' habitual sleep time, subjects were studied under constant routine conditions (constant wakefulness, bed rest, dim light ~1.5 lux, hourly nutrition intake) for at least 28h. Energy expenditure (kjoules/min) was determined by indirect calorimetry every four hours and core body temperature (CBT) was assessed every minute. Energy expenditure data were linearly interpolated to align with the fitted minimum of the CBT rhythm as determined by dual-harmonic regression analysis. Repeated measures ANOVA was used to test for significant effects of circadian phase.
Results: Energy expenditure showed significant circadian variation (P < 0.05). Energy expenditure levels declined across the biological day, were lowest near habitual bedtime, and increased across the biological night peaking near habitual waketime.
Conclusion: The finding of low energy expenditure near the beginning of the biological night supports a role for the circadian clock in promoting energy conservation at night in humans. Whereas, the finding of a rise in energy expenditure across the night, with peak expenditure near habitual waketime, may represent a circadian drive to prepare for subsequent wakefulness.
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0190

THE DEVELOPMENT OF DAY-NIGHT DIFFERENCES IN SLEEP-WAKE BEHAVIOR AND FOS-IMMUNOREACTIVITY IN DIURNAL NILE GRASS RATS AND NOCTURNAL NORWAY RATS

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Introduction: Whereas progress has been made in our understanding of the development of sleep-wake rhythms in nocturnal Norway rats (Gall et al., 2008), less is known about their development in diurnal species. Here we analyzed the development of sleep-wake processes in the diurnal Nile grass rat (Arvicanthis niloticus) and compared them to that of Norway rats. Developmental analyses of Fos-immunoreactivity (IR) allowed us to compare the neural substrates of sleep-wake processes between diurnal and nocturnal species.
Methods: Sleep and wakefulness were recorded during the day and night for grass rats at postnatal days (P)2, P5-7, and P15 (n = 6 for each group). Data were compared to those from a similar study examining circadian patterns of sleep and wakefulness in Norway rats (Gall et al., 2008). In additional animals, P5-7 and P15 grass rats and P8 and P15 Norway rats were sacrificed in the middle of the day or night and c-Fos immunohistochemistry was performed (n = 6 for each group).
Results: As expected, both species exhibited higher Fos-IR in the suprachiasmatic nucleus (SCN) during the day. Grass rats expressed diurnal wakefulness as early as P2; however, by P15, they exhibited a dramatic increase in daytime wake bout durations that was mirrored by increased nighttime Fos-IR in the ventral subparaventricular zone (vSPVZ). In contrast, Norway rats developed nocturnal wakefulness at P15 that was mirrored by a significant increase in daytime Fos-IR in the vSPVZ.
Conclusion: Whereas Fos-IR in the SCN is higher during the day regardless of diurnality or nocturnality, the vSPVZ is more active during a species' inactive photoperiod. Our results indicate that vSPVZ activity mirrors the developmental emergence of diurnality and nocturnality in grass rats and Norway rats, respectively. The different patterns of activation in the vSPVZ of these species may reflect differences in its connectivity with the SCN. Future work will investigate the developmental mechanisms underlying species differences in circadian sleep-wake behavior.
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0191

IN VIVO PHOTIC PHASE-RESETTING OF THE MOUSE CIRCADIAN CLOCK IS ATTENUATED BY ACUTE ETHANOL ADMINISTRATION

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Introduction: Brain systems mediating alcoholism and alcohol abuse are closely and reciprocally tied to the circadian timing system. To study this, we assessed acute ethanol effects on in vivo photic phase-resetting of the mouse circadian clock.
Methods: Male C57BL/6J mice were outfitted with a microdialysis probe stereotaxically aimed at the lateral margin of the suprachiasmatic nucleus (SCN). General circadian locomotor activity was analyzed through infrared sensors wired to a computerized data acquisition system. In the first experiment, ethanol pharmacokinetics within the SCN were characterized. Artificial cerebral spinal fluid (ACSF) was perfused into the SCN 1 hr. preceding an i.p. of 2.0 g/kg (high), 1.0 g/kg (moderate), or 0.5 g/kg (low; n = 3, for each dose). Dialysate samples were collected every 20 min. In a second experiment using reverse microdialysis, a SCN perfusion of ACSF or ethanol (500 mM) in ACSF commenced 30

min before a 30 min light (25 lux) or no pulse during the delay portion of the mouse photic phase response curve (zeitgeber time 14; n = 4, for each treatment).
Results: Independent of dose, intra-SCN ethanol levels peaked 40 min post-injection (P > 0.05). In the first experiment, peak intra-SCN ethanol concentrations were dose-dependent with the highest dose reaching 57.67 +/- 5.89 mM (P < 0.01). Peak intra-SCN ethanol concentrations for the moderate and low dose were 20.17 +/- 3.03 mM and 8.75 +/- 1.46 mM, respectively. In the second experiment, an intra-SCN perfusion of ethanol significantly attenuated photic phase delays by ~1.25 hr (ACSF: 2.00 +/- 0.13 hr; EtOH: 0.77 +/- 0.11 hr; P < 0.01).
Conclusion: These experiments illustrate that ethanol can markedly affect photic-resetting of the circadian clock in this mammalian model. In humans, acute ethanol exposure thus could possibly affect re-entrainment to novel photocycles associated with shift work or jet lag.
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0192

SLEEP CHANGES DURING RE-ENTRAINMENT: RESPONSES TO CHRONIC PHASE ADVANCES

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Introduction: Experimentally induced jet-lag protocols have adverse effects on health in rodents. Notably, repeated six-hour advances of the light-dark cycle increase mortality in aged mice. The mechanism involved in the effects of experimental jet-lag on rodents is unknown. One hypothesis is that the effects are due to sleep loss during the repeated phase shifts. However, sleep has not been comprehensively characterized in rodents during repeated phase-advances.
Methods: We examined sleep in C57BL/6J mice (6 - 9 mos.) during repeated six-hour phase advances of the light cycle (12L:12D). Advances were repeated once every seven days for at least eight weeks. Polysomnographic data was recorded in 24-hour segments by telemetric transponders. Vigilance states were hand scored in ten second epochs as wake, non-rapid eye movement (NREM) or rapid eye movement (REM) sleep. Sleep records for the day prior to the start of shifting and the first and sixth day following shift one, four and eight were analyzed.
Results: We detected a significant 27% increase (P = 0.034) in total REM sleep amount on day one of the fourth shift. When analyzed in two-hour intervals, REM sleep increases were also detected on day six of shift four. These differences were found at two points near the light-dark transition (50% increase, P = 0.021; 114% increase, P = 0.049). Day one of shift four also had a significant 36% increase (P = 0.022) in fragmentation, as measured by brief arousals. These effects at shift four appear to be transient. Sleep/wake amount showed no significant change at shift eight or any other analysis days in the paradigm. Neither net loss of sleep nor significant impairment in NREM delta power (spectral density) was detected.
Conclusion: These results suggest that phase advances in the light-dark cycle alone are not sufficient to cause major disruptions in the sleep/wake cycle of mice.
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0193

THE CIRCADIAN EXPRESSION OF PER1 PROTEIN WITHIN THE SUPRACHIASMATIC NUCLEUS OF TEMPORAL LOBE EPILEPSY (TLE) RATS

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Introduction: Suprachiasmatic nucleus (SCN) of hypothalamus is the mammalian pacemaker controlling circadian rhythm. A number of transcription factors being molecular components in the SCN have been identified. Those mammalian clock proteins show circadian rhythms. Circadian oscillation of Per1 peaks at subjective day and in antiphase to Bmal1 expression, which peaks at subjective night. Per2 and Crys peak at subjective dusk. In addition, daytime somnolence and insomnia at night are common among patients with epilepsy, which implies the influence of epilepsy on circadian rhythm. However, knowledge about this interaction is very rare. Amygdala kindling-induced temporal lobe epilepsy (TLE) was used in current study to investigate the different expression of PER1 in the SCN between the normal and TLE rats. This experiment was designed to elucidate the phase-shifting of PER1 expression when rats kindled at different circadian time points.
Methods: Male Sprague-Dawley rats were housed in a 12:12-hour light:dark cycle. The kindling stimuli is a train of biphasic pulses (1 ms duration) of 20 Hz for 10 s, the interval for each stimulating pulse is 5 min, and the whole kindling protocol lasts for 2 days with stimuli of 5 hrs per day. The intensity of stimulus ranges from 100-300 μA. After the full-blown seizure developed, rats received a single stimulus either at the midpoint of the light period (circadian time 6; CT6) or the dark period (CT8). Immunohistochemistry detection of PER1 was determined every 6 hr after kindling.
Results: The experiment is still ongoing and brain slices have been collected. Preliminary results have shown that expression of PER1 in the SCN, which receives non-photic input from the limbic system and the hypothalamus, differs between normal and TLE rats.
Conclusion: This result suggests that epileptic activity indeed shifts the oscillation of PER1 and subsequently alters sleep-wake activity.

0194

ASSOCIATION OF CIRCADIAN GENE POLYMORPHISMS WITH SLEEP CHARACTERISTICS IN JAPANESE POPULATION

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Introduction: A system of self-sustained biological clocks controls 24-hour (h) rhythms of behavioral and physiological processes such as the sleep-wake cycle, body temperature and hormonal secretion. The circadian clock system is regulated by transcription and translation feedback loops of multiple clock genes. Polymorphisms in the circadian clock genes have been reported to correlate with disordered sleep phenotypes. For example, PER2 functional polymorphisms show strong association with familial advanced sleep phase syndrome (FASPS), and a variable number tandem repeat (VNTR) and a haplotype in PER3 influence diurnal preference and susceptibility to delayed sleep phase syndrome (DSPS).
Methods: 925 Japanese people (274 males, 651 females, average age 36.45 years) were surveyed by two self-rating questionnaires; Horne-Östberg morningness-eveningness questionnaire (MEQ) and Pittsburgh Sleep Quality Index (PSQI). Blood samples were collected from all the subjects and polymorphisms in the circadian clock genes, PER1, PER2, PER3, TIM, CLOCK, NPAS2, CRY2 and OPN4 were determined. These clock gene polymorphisms were tested for association with chronotype (morningness-eveningness preference) and multiple sleep parameters including sleep onset time, wake time and sleep quality indices. The subjects' chronotypes were determined by their MEQ scores according to Horne and Östberg's criteria. PSQI total score > 5 was considered to be indicative of poor sleep quality.
Results: Sleep onset time was associated with polymorphisms in PER3, CLOCK and OPN4, and wake time with polymorphisms in CLOCK and NPAS2. The PER3 haplotype which has been reported to be associated with DSPS was not linked to any sleep characteristics in

this study population. In contrast, another PER3 haplotype correlated with evening preference and poor sleep quality.
Conclusion: The current study demonstrates that circadian clock gene polymorphisms are significantly associated with sleep timing and sleep quality. Further analysis of gene-gene interactions will provide new insights into the mechanism for circadian influences on sleep regulation.

0195

THE ROLES OF A MORNING BLUE-LIGHT INTERVENTION AND AN EARLIER SLEEP SCHEDULE IN PHASE ADVANCING DIM LIGHT MELATONIN ONSET (DLMO) OF YOUNG ADULTS

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Introduction: Many young adults show delayed sleep/wake schedules relative to their school/work obligations. We examined salivary dim light melatonin onset (DLMO) before and after one week on a fixed, phase-advanced sleep/wake schedule with and without a morning blue-light intervention.
Methods: 25 young adults (mean age (SD) = 21.8 (3) years; 13 women) with obligatory morning commitments requiring them to wake 1-2.5 hours earlier than their average reported wake times at least one day per week participated. We estimated baseline DLMO and the schedule necessary to align participants' sleep schedules to their earliest commitment with the Burgess and Eastman algorithm (Journal of Sleep Research, 2005). After a baseline week, participants kept fixed, individualized 7.5-hour sleep schedules for 1 week. Schedules allowed for blue light exposure during the first hour after waking and for participants' on-time arrival at their earliest commitments. Participants were randomly assigned to "blue-light" group (Apollo P2 GoLite, 24" from cornea at 50% maximum brightness) or "dim-light" group (GoLite perpendicular to face at 10% maximum brightness). Daysimeters measured light/dark exposure; wrist actigraphs confirmed compliance. DLMO (threshold = 4 pg/ml) was measured at the end of each week and examined with repeated measures, two-factor (light group by week) ANOVA.
Results: Average pre-study reported bedtime (SD) was 1:55 am (53 min) and wake time (SD) was 9:52 am (50 min). Mean scheduled bedtime (SD) was 11:55 pm (40 min) and mean scheduled wake time was to 7:24 am (41 min). Average DLMO shifted from 11:25 pm at baseline to 9:58 pm after schedule, a significant main effect of week ($F(1, 23) = 55.2$, $P < 0.001$). Neither group nor group by week effects were significant. Daysimetry showed greater light exposure during the first 4 hours of wakefulness for the "blue-light" group, but there was no significant difference in total light exposure across weeks or between groups.
Conclusion: DLMO phase advanced nearly 1.5 hours following one week on an advanced sleep/wake schedule. The light intervention did not differentially affect phase. We conclude that the pattern of light/dark induced by the earlier sleep schedule was sufficient to advance circadian phase in this sample of young adults irrespective of the light intervention.
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0196

DIGITAL SYMBOL SUBSTITUTION TASK PERFORMANCE AND CIRCADIAN PHASE IN ADOLESCENTS

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Introduction: Many studies have examined the effects of sleep on cognitive performance; however, circadian phase has received limited study. Here we examine a cognitive performance task requiring attention and working memory in adolescents. We expected to see improved performance over time and an effect of circadian phase.
Methods: Twenty-seven participants (ages 10 to 16 yrs; 12 male) performed a 90-second Digit-Symbol Substitution Task (DSST) during three 24-hr Cycles living on a 4-hr Day (1.5 hr sleep). Dim Light Melatonin Onset phase (DLMO) was computed from saliva samples across 5 cycles, and period was estimated with a linear fit for each participant. The first task occurred within the circadian phase bin before DLMO on Cycle 1 after a short (5 hr) night of sleep.
Results: Average time of DLMO on the first day was 2107 (range = 1839-2328), average period was 24.33 hr (range = 23.7 hr-24.9 hr). Participants achieved over 90% accuracy across all trials. Repeated measures ANOVA was used to examine number of correct responses at 6 Circadian Phase bins for each of 3 Cycles, with Phase bin 2 including DLMO. The analysis showed a main effect of Cycle ($F(2,52) = 17.6$, $P < 0.001$; Means: Cycle 1 = 51.6, Cycle 2 = 53.3, Cycle 3 = 55.4) and significant main effect of Phase ($F(5,130) = 4.42$, $P = 0.006$; Means: Phase bin 1 = 54.3, Phase bin 2 = 53.8, Phase bin 3 = 53.0, Phase bin 4 = 52.4, Phase bin 5 = 52.8, Phase bin 6 = 54.7), and no interaction of Cycle and Phase ($F(10,260) = 1.02$, $P > 0.05$).
Conclusion: As expected, these results indicate that with repeated administration of the DSST, performance improves across Cycles and varies within Cycles according to circadian phase. Circadian factors should be taken into consideration when examining cognitive performance in repeated tasks. Future analysis will examine the effect of sleep and age.
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0197

EFFECT OF SIMULATOR DRIVING ON SUBSEQUENT PSYCHOMOTOR VIGILANCE PERFORMANCE

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Introduction: Neurobehavioral performance is a function of time awake, time of day (circadian rhythm), and time on task. However, relatively little is known about the effect of prior activities on neurobehavioral performance. We examined the effect of a 30min driving session in a high-fidelity driving simulator on subsequent performance on a psychomotor vigilance test (PVT).
Methods: As part of a larger study, 27 healthy adults (14f, ages 22-39y) spent 7 consecutive days in a sleep laboratory. On day 1, they received 10h TIB for sleep. They were then randomized to either a day shift (N = 14) or night shift (N = 13) condition. In the day shift condition, they received 10h TIB (22:00-08:00) each day. In the night shift condition, they had a 5h nap opportunity (15:00-20:00) on day 2, and on subsequent days received 10h TIB during the day (10:00-20:00). Starting with the third waking period, performance was measured 4 times a day at 3h intervals on a 10min PVT, a 30min driving task on a PatrolSim IV simulator (MPRI, Salt Lake City), and another 10min PVT. During each simulator session, subjects drove a simulated Ford Taurus in a standardized scenario. To examine the effect of the driving task on neurobehavioral performance, the difference in lapses (RTs > 500ms) between

the post- and pre-driving PVTs was analyzed as a function of time of post-driving PVT and condition.
Results: If simulator driving had no effect on PVT performance, the difference between post- and pre-driving PVT lapses would be ~0 in the day shift condition (as performance should be stable during the day), whereas it would be systematically > 0 in the night shift condition (as performance should decline steadily through the night). However, mixed-effects ANOVA revealed an interaction of time by condition ($F[3,506] = 3.82$, $P = 0.010$) in which the difference between post- and pre-driving PVT performance varied as a function of time of day. Post-driving lapses were consistently increased relative to pre-driving lapses, but especially during the biological night and midafternoon dip.
Conclusion: High-fidelity simulator driving led to increases in post-driving PVT lapses, with the circadian lows resulting in the greatest increases. This was attributable specifically to a simulator driving effect interacting with time of day, suggesting that circadian-modulated time-on-task effects carried over between simulator driving and the PVT, or that there is a circadian-modulated fatiguing effect of waking activity above and beyond that of wake duration.
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0198

ESTIMATED FATIGUE RISK FOR DUTY PERIODS WITH DIFFERENT START TIMES IN 24H OPERATIONS

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Introduction: Hours of service regulations mitigate fatigue by limiting the number of hours worked in a 24h day. Typically, maximum shift duration is specified, but the timing of the shift relative to the circadian cycle and hence the circadian timing of sleep is not. Yet, circadian factors affect both performance and the ability to initiate and maintain sleep. Using the two process model of sleep regulation, which encapsulates the effects of sleep/wake homeostasis and circadian rhythm on sleep propensity and waking fatigue level, we evaluated shift timing in terms of its effects on sleep and fatigue.
Methods: We analyzed the effect of shift start time on predicted total sleep time off shift per 24h (at 0.5h resolution) and mean fatigue on shift per duty period. We used a standard 9h shift duration worked daily in a 6-day work schedule, with shift start times held constant across the days. We created 24 separate 6-day work schedules, varying shift start times by 1h increments across the 24h clock. Sleep was disallowed during duty periods and during the 1h preceding and following each shift. Sleep duration and fatigue level from the last duty day in each work schedule were examined as a function of duty start time.
Results: Estimated sleep durations varied from 4.5h to 8.0h with maximum duration occurring for daytime duties starting between 09:00 and 14:00 and minimum duration for night duties starting between 20:00 and 24:00. Average fatigue expressed on the (arbitrary) default scale of the two-process model varied from 0.24 to 0.77, with maximum fatigue occurring for a duty start time of 23:00 and minimum fatigue for a duty start time of 09:00. There was a relatively sudden decrease in predicted fatigue for duty periods starting after midnight as compared to just before midnight. The reason was that the duty schedules with the later start times included sleep right before the duty period (so the duty period was begun well-rested); this did not happen in the schedules with the earlier start times because of the wake maintenance zone in the early evening caused by the circadian process.
Conclusion: Hours of service regulations based on shift duration, applied indiscriminately across the day, ignore circadian rhythmicity and are therefore not dependably fatigue-friendly. Provided mathematical model predictions are validated in real or simulated work environments, modeling may be used to recommend more fatigue-friendly duty schedules in a way that is sensitive to both shift duration and shift timing.
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0199

SLEEP, WAKE, AND PHASE DEPENDENT CHANGES IN NEUROBEHAVIOURAL PERFORMANCE

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Introduction: The interaction effect of prior wake and circadian phase on neurobehavioural performance is well known. It is unknown however, whether this interaction depends on sleep. Therefore, our aim was to investigate the interaction of sleep, prior wake, and circadian phase on waking neurobehavioural performance.
Methods: Twenty-seven healthy males were scheduled to 7x28h sleep/wake cycle in a temporal-isolation laboratory. Thirteen participants (22.5 ± 2.2yr) were given a 9.3h sleep opportunity each 28h 'day'; 14 participants (21.8 ± 3.8yr) were given a 4.7h sleep opportunity each 28h day. All participants completed a 10min Psychomotor Vigilance Task (PVT) every 2.5h during each wake period. For data analyses, a value for circadian phase, prior wake duration, and cumulative sleep loss was assigned to each PVT Reciprocal Response Time (RRT). Daily cumulative sleep loss for each participant was calculated as the sum of difference between self-report daily average sleep amount and total sleep time of each previous sleep period. Circadian phase was estimated from core body temperature.
Results: A mixed-model ANOVA with circadian phase, prior wake, and sleep loss as fixed terms, and participant as a random term, indicated significant sleep loss x prior wake interaction ($F(6,1213.1) = 2.48$, $P = .02$), sleep loss x circadian phase interaction ($F(5,1213.6) = 4.58$, $P < 0.001$), and sleep loss x prior wake x circadian phase interaction ($F(30,1213.9) = 1.61$, $P = .02$).
Conclusion: The interaction effect of prior wake and circadian phase on waking neurobehavioural performance did depend on sleep. When cumulative sleep loss was low, the effect of circadian phase on performance became more obvious as wakefulness increased. When cumulative sleep loss was high, the effect of circadian phase on performance was evident as early as 2h awake. This finding suggests that two prerequisites for optimal performance at adverse circadian phases are short prior wake and adequate amount of prior sleep.
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0200

FORCED DESYNCHRONY WITH SLEEP RESTRICTION AFFECTS SLEEP EFFICIENCY IN HEALTHY YOUNG MALES

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Introduction: Sleep restriction studies allow us to examine the effects of sleep dose on sleep efficiency for a fixed circadian phase. Forced desynchrony studies allow us to examine the effects of circadian phase on sleep efficiency for a fixed level of sleep dose. In the current study, we employed a novel protocol, forced desynchrony with sleep restriction, to examine the combined effects of sleep dose and circadian phase on sleep efficiency.
Methods: Twenty-seven healthy, young, male adults lived in a time-isolated, sound-attenuated, temperature-controlled sleep laboratory for 12 days. Participants completed either a control (n = 13) or sleep restriction (n = 14) condition. In both conditions, participants had 3 x 24-h

days of adaptation followed by 7 x 28-h days of forced desynchrony. On forced desynchrony days, participants in the control condition had 9.3h in bed and 18.7h of wake and participants in the sleep restriction condition had 4.7h in bed and 23.3h of wake. For both conditions, standard polysomnography was used to determine sleep efficiency for all sleeps.
Results: Sleep efficiency data were analysed using repeated-measures ANOVA, with one between-subjects factor, i.e. condition (proxy for sleep dose), and one within-subjects factor, i.e. day of study (proxy for circadian phase). There were significant main and interaction effects for condition and day of study (all $P < .001$). When sleep dose was low, sleep efficiency for sleeps that occurred during subjective daytime was lower than for sleeps that occurred during subjective night-time. In contrast, when sleep dose was high, sleep efficiency was maintained at a high level for sleeps across all circadian phases.
Conclusion: When sleep dose is low, the effect of circadian phase on sleep efficiency is pronounced. When sleep dose is high, this effect of circadian phase is eliminated. In future analyses, we will examine whether this finding holds for other aspects of sleep architecture.
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0201

GLUCOSE TOLERANCE IS IMPAIRED FOLLOWING EIGHT CONSECUTIVE DAYS OF SLEEP RESTRICTION AND SLEEP DISPLACEMENT

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Introduction: There is an emerging body of evidence to indicate that sleep loss and sleep displacement adversely affect human metabolic homeostasis. These two factors have previously been examined separately using sleep restriction and forced desynchrony protocols, respectively. The aim of this study was to examine the combined effects of sleep restriction and sleep displacement on metabolic homeostasis using a sleep restricted forced desynchrony protocol.
Methods: Thirteen male participants (20.9 ± 2.1 years) lived in a time-isolated, sound-attenuated, temperature-controlled sleep laboratory for 12 consecutive days. The protocol consisted of three days of adaptation, eight days of sleep restriction/displacement, and one day of recovery. Adaptation and recovery days were 24h in length with 16h of wake and 8h of time in bed. Sleep restriction/displacement days were 28h in length with 23.3h of wake and 4.3h of time in bed. Metabolic homeostasis was assessed on the second adaptation day and the recovery day using an oral glucose tolerance test under fasting conditions. The test consisted of a night of sleep from 00:00h to 08:00h; a 75g glucose challenge at 09:00h; then 2h of glucose monitoring until 11:00h, using a continuous glucose monitoring system (MiniMed).
Results: Data were analysed using a repeated-measures ANOVA, with two within-subjects factors: protocol day (i.e. before and after sleep restriction/displacement) and time after glucose administration (in 5-min intervals). There was a significant interaction effect of protocol day and time after glucose administration on glucose tolerance [$F(24,288) = 4.7$, $P = .02$]. Glucose levels were higher and remained elevated for longer after sleep restriction/displacement than before it.
Conclusion: Consecutive days of sleep restriction/displacement resulted in impaired glucose tolerance. This impairment was observed even after a full night of recovery sleep (i.e. 8h). Further studies are required to describe the rate of recovery of metabolic homeostasis (i.e. a return to baseline) following a period of sleep restriction/displacement.
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0202

CIRCADIAN AND SLEEP/WAKE MODULATION OF MOOD IN HEALTHY SUBJECTS

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Introduction: Previous forced desynchrony (FD) studies have shown the effect of circadian phase and prior wake on mood states such as one dimensional constructs. The current study explores the effect of circadian phase and prior wake on different mood dimensions as measured by the Profile of Mood States (POMS) in healthy participants living on a 28-h day.
Methods: Eleven male participants (22.4 ± 2.22yr) were scheduled 7x28h FD days in time isolation. Each FD day consisted of 18.67h of continuous wake and 9.33h of time in bed. The POMS was administered every 2.5h during all wake periods, and was used to assess Total Mood Disturbance (TMD) and 6 mood sub-scales of Vigour, Anxiety, Fatigue, Anger, Depression, Confusion and Tension. For data analysis, a value for circadian phase and prior wake duration was assigned to each mood rating. Core body temperature was continuously recorded with rectal thermistors and was used to determine circadian phase. Each mood rating was assigned a circadian phase based on core body temperature and prior wake.
Results: Mixed-models analyses with circadian phase and prior wake as fixed effects and participant as a random term, revealed that TMD, Vigour, Fatigue and Confusion were significantly affected by prior wake and circadian phase ($P < 0.05$); whilst sub-scales of Tension, Depression and Anger revealed no significant effects. There were no interaction effects between prior wake and circadian phase for TMD or any of the 6 sub-scales.
Conclusion: The findings of the current study suggest that circadian phase and prior wake have a selective influence on mood dimensions indicated by significant effects TMD, Vigour, Fatigue and Confusion only. This may suggests' that circadian phase and prior wake may only regulate some aspects of mood when sleep amount is sufficient. The current study examined mood under normal sleep opportunity, further studies are required to understand how this is affected by sleep restriction.
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0203

EVENING PREFERENCE RELATES TO THE INCIDENCE OF DEPRESSIVE STATE INDEPENDENTLY OF SLEEP-WAKE CONDITIONS

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Introduction: Although a series of studies have suggested the possible relationship between self-rated evening preference and susceptibility to depression in humans, it remains unclear whether evening preference can be an independent risk factor for depression or simply causes secondary influences on mood regulation via delayed sleep timing and/or socially restricted sleep length, etc. This study aimed to explore associations between chronotypes and the incidence of depressive states in general population with regard to their sleep-wake conditions.
Methods: Study subjects were 1,170 healthy Japanese adults (mean age 38.5 ± 12.3 (SD), range 20-59 yrs, 57.9 %female). Each subject completed the Morningness-Eveningness Questionnaire (MEQ), the Pittsburgh Sleep Quality Index (PSQI) and the Center for Epidemiologic Studies Depression Scale (CES-D).

Results: The MEQ score showed normal distribution in this study subjects with a significant positive correlation with age. Evening preference was associated with a significantly delayed sleep timing, larger discrepancy between desired and actual wake time (sleep debt), shorter total sleep time and stronger daytime sleepiness. The incidence of depressive states (CES-D > 15) was significantly higher in the evening chronotype compared to the intermediate and morning chronotypes. Logistic regression analysis showed that evening preference per se was associated with the incident of depressive states (OR 1.946), independently of other relevant factors such as later sleep onset time (OR 4.097) and daytime sleepiness (OR 2.475). There were no significant associations between evening chronotype and subjective sleep debt and actual wake time.
Conclusion: Evening preference can be an independent risk factor for depression from the sleep-wake conditions. These findings suggest the presence of direct functional linkage between circadian system and mood regulation in humans.

0204

SLEEP CHANGES THROUGH THE FALL DAYLIGHT SAVING TIME TRANSITION OBSERVED IN OBJECTIVELY MEASURED SLEEP IN THE HOME

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Introduction: The fall transition out of daylight saving time affords people the opportunity to gain extra sleep, and it is commonly believed that people tend to do so. It is also commonly believed that any disruptions are minor and usually resolve within 48 hours after the transition. We sought to objectively measure changes in sleep patterns occurring on the night of the transition and the week following.
Methods: The DOZER sleep registry is an IRB approved research database of sleep in the home. Its participants purchase and use the Zeo Personal Sleep Coach, a new instrument that uses a fabric headband to comfortably measure their sleep in their homes. Measures include Total Sleep Time (TST), time of first sleep (Bedtime), and time of final awakening (Risetime). Subjects that provided the weekend nights or at least three weekday nights of each week were included. 92 subjects were included in the weekend analysis, which compared the night of the transition with the previous Saturday (Student's t-test). 88 subjects were included in the weekday analysis, which compared the five nights following the transition with the prior week (ANOVA, Tukey's HSD test).
Results: Sleep measures did not differ significantly on the night of the fall daylight saving transition when compared to the weekend prior ($P > 0.05$). Risetimes for four nights following the transition were significantly earlier (20, 16, 19, and 20 minutes earlier than the week prior, respectively, all $P < 0.05$) according to clock time. On the fifth night Risetime was not significantly different from the week prior ($P > 0.05$).
Conclusion: Contrary to common belief, changes were not observed in sleep measures on the night of the transition to standard time (particularly, TST). However, Risetime was affected by the transition and did not stabilize for five days. The fall-back transition occurred on Halloween night, which may have confounded the findings.
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0205

RELATIONSHIP BETWEEN CIRCADIAN RHYTHMS OF BODY TEMPERATURE, MELATONIN SECRETION, AND SLEEP PROPENSITY DURING THE FOLLICULAR AND LUTEAL PHASES

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Introduction: Sex hormone variations across the menstrual cycle may influence sleep and circadian rhythms. Our aim was to determine if the timing of these rhythms differs between menstrual phases, and to explore the relationship between melatonin, body temperature, and sleep rhythms.
Methods: Eight women participated in a 72-hr ultra-rapid sleep-wake cycle (36 cycles of 60-min wake episodes/60-min naps) during the mid-follicular (MF) and mid-luteal (ML) phases of their menstrual cycle. Measures included polysomnographic sleep recordings, core body temperature (CBT), distal temperature (DT), a calculated distal-core temperature gradient (TG), and salivary melatonin (MEL; sampled before and after each nap). Values were averaged per subject per nap. Cross-correlations were used to quantify time-course relationships, and Mann-Whitney U-tests compared cross-correlation outcomes.
Results: Cross-correlations comparing MF and ML values revealed no menstrual phase differences in the time-course of CBT, DT, TG, MEL, sleep onset latency (SOL), sleep efficiency (SE), REM sleep (REMS) and REMS onset latency (ROL). After pooling data for both menstrual phases, DT was found to be significantly phase-advanced relative to SE (+2.00hrs), SOL (+2.50hrs), ROL (+3.25hrs) and REMS (+2.75hrs). CBT was significantly phase-advanced relative to SE (+0.75hrs), SOL (+1.00hr), ROL (+2.125hrs) and REMS (+2.125hrs), and significantly phase-delayed relative to DT (-1.00hr). TG was significantly phase-advanced relative to SE (+1.25hrs), SOL (+1.625hrs), ROL (+2.25hrs) and REMS (+2.25hrs). MEL was significantly phase-advanced relative to SE (+2.125hrs), SOL (+1.875hrs), ROL (+3.25hrs) and REMS (+2.875hrs), and non-significantly ($P = 0.07$) phase-advanced relative to CBT (+1.25hrs).
Conclusion: Rhythms of body temperature and melatonin were comparable between menstrual phases, supporting our previous findings of an unchanged circadian phase of these across the menstrual cycle. We also demonstrated that the time-course of REMS propensity was similar between menstrual phases. Present results, describing the relationship between body temperature changes and sleep, support the hypothesis that sleep initiation mechanisms are triggered by a thermoregulatory cascade possibly involving the onset of melatonin secretion.
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0206

PREDICTING SLEEP/WAKE SCHEDULE COMPLIANCE USING A PHYSIOLOGICALLY BASED MODEL OF SLEEP

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Introduction: Quantitative modeling of human performance and fatigue has important applications to shift work, transportation, healthcare and space flight work schedules. However, the practical issue of sleep/wake schedule "compliance" has received little attention, with most models assuming that imposed sleep and wake times are adhered to, with deviations only analyzed retrospectively.
Methods: We are developing a comprehensive model of human sleep by combining a validated model of the circadian pacemaker (St. Hilaire, 2007, J. Theor. Biol.) with a validated model of sleep physiology (Phillips, 2008, J. Theor. Biol.). The model includes mutually inhibitory sleep-active and wake-active regions in the hypothalamus and brainstem, as well as circadian, homeostatic, cholinergic and orexinergic drives. The circadian drive is modeled by a modified van der Pol oscillator, with light input gated by arousal state.
Results: Simulating a forced desynchrony protocol, the model dynamically predicts wakefulness during scheduled sleep periods, including the experimentally observed dependence of wakefulness on circadian phase. In addition to the previously demonstrated performance impairment during adverse circadian phases, the model demonstrates exacerbation of performance declines by the simultaneous insomnia. Furthermore, the model predicts times when a subject would require additional stimulation to avoid falling asleep when scheduled to be

awake, and estimates the degree of stimulation required, which has previously been shown to closely correlate with subjective measures of fatigue. The model also predicts sleep latency times that are consistent with experimental data, and provides a means of relating them to the underlying neuromodulator time constants. Wakefulness towards the end of scheduled sleep periods is overestimated by the model, suggesting that longer timescale homeostatic effects play an important role during forced desynchrony.

Conclusion: This work provides the basis for accurate assessments of schedule suitability in real world implementations, including predicting likelihood of wake during scheduled sleep and sleep during scheduled wake. Once validated, the model may assist in schedule design for 24/7 operations.

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0207

FREQUENCY AND CHARACTERISTICS OF ADVANCED AND DELAYED REST/ACTIVITY RHYTHMS IN OLDER MEN

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Introduction: The prevalence of circadian rhythm sleep disorders among older adults is estimated to be around 1% or less for advanced rhythms, and even less prevalent for delayed rhythms. This study estimated the frequency of advanced and delayed rhythms in older men and their association with sleep disturbances.

Methods: Self-reported sleep (PSQI and ESS), actigraphy collected for an average of 114+20 h and one night of in-home polysomnography, were measured in a cohort of 3,054 men aged 67 years and older, not selected on the basis of a sleep disorder. Advanced rhythms defined as sleep onset from 17:00-20:59 h and sleep offset on or before 5:00 h. Delayed rhythms defined as sleep onset from 2:00-13:00 h and sleep offset after 10:00 h.

Results: The frequency of advanced and delayed activity rhythms was 23 (0.75%) and 14 (0.46%), respectively. After adjusting for multiple potential confounders, men with delayed rhythms experienced more sleep disturbances than men with normal rhythms ($P < 0.047$ for all), such as poorer sleep efficiency (77.7% vs. 84.0%), greater awakening after sleep onset (94.9 vs. 68.3 min), more long-wake episodes (8.8 vs. 6.9), reduced REM sleep (15.4% vs. 19.3%), shortened REM latency (37.6 vs. 62.5 min) and more time in stage 1 sleep (9.2% vs. 5.9%). Conversely, men with advanced rhythms had fewer sleep disturbances than men with normal rhythms, such as less excessive daytime sleepiness (4.4 vs. 6.2), shorter sleep latency (15.1 vs. 23.1 min), more time in REM sleep (24.1% vs. 19.3%), shortened REM latency (45.4 vs, 62.5 min) and less time in stage 2 sleep (57.3% vs. 62.6%), but did not differ on other sleep characteristics.

Conclusion: Advanced and delayed rhythms occur infrequently in older men. Compared to men with normal rhythms, men with delayed rhythms have greater sleep fragmentation, whereas men with advanced rhythms have fewer sleep disturbances.

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0208

HUMAN DIURNAL PREFERENCE NOT ASSOCIATED WITH CLOCK 3111T/C GENE POLYMORPHISM

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Introduction: Diurnal preference, individual affinity for morning or for evening hours, exhibits normal distribution among human populations and may be assessed subjectively through the Horne-Östberg Morningness-Eveningness Questionnaire (MEQ). Individual differences in the circadian timing system have been proposed as influences on human diurnal preference, and previous studies have investigated the role of polymorphisms in "clock" genes. The 3111T/C polymorphism in *Clock* has been associated with diurnal preference, with reports of lower MEQ scores (stronger evening preference) in C/T heterozygotes and C/C homozygotes. Our study aimed to examine this relationship in a group of subjects enrolled in circadian rhythm or sleep studies in our laboratory.

Methods: One hundred fifty-four healthy individuals [35 females, 119 males; ages 19-71 (mean ± SD: 28 ± 12)] participated in the current study. Each subject completed the MEQ to assess diurnal preference, and in a subset of 30 subjects this was used as a selection criterion. Blood samples were sent to Partners HealthCare Center for Personalized Genetic Medicine for DNA extraction and genotyping of the *Clock* 3111T/C polymorphism. MEQ scores from genotypically different subjects were compared via ANOVA. Results are reported as mean ± SD. Allele frequencies in morning (M, MEQ ≥ 59, n = 59) and evening (E, MEQ ≤ 41, n = 27) groups were compared using Fisher's Exact test.

Results: Frequencies of the C/C, C/T, and T/T genotypes in the total population were 3.2%, 37.7%, and 59.1%, respectively. MEQ scores ranged from 19 to 75 and did not vary among genotypic groups (C/C: 52.60 ± 8.50, C/T: 51.69 ± 13.27, T/T: 52.92 ± 12.31; P = 0.844). Frequencies of the 3111C allele in the M and E groups were 27.91% and 16.28%, respectively, and were not significantly different (P = 0.36). In the subset of 132 subjects under age 36, MEQ scores ranged from 19 to 72 and also did not vary among genotypic groups (C/C: 51.00 ± 8.91, C/T: 50.58 ± 12.69, T/T: 50.91 ± 11.95; P = 0.989).

Conclusion: In this small and highly selected study population, MEQ score did not associate with *Clock* genotype, and the frequency of the 3111C allele was not significantly different in M and E types. Our findings suggest that the *Clock* 3111T/C polymorphism may not be a strong determinant of human diurnal preference.

Support (If Any): NIH grants HL080978, AG09975, AG06072, F32 HL078360, and the Brigham and Women's Hospital General Clinical Research Center, part of the Harvard Clinical and Translational Science Center, supported by M01 RR02635 and UL1 RR025758.

0209

BEHAVIORAL CHANGES FOLLOWING TOTAL SLEEP DEPRIVATION. THE ROLE OF PER3 POLYMORPHISM AND OF PERSONALITY FACTORS

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Introduction: Genetic factors have been recently shown to contribute to sleep-wake regulation. The clock gene PERIOD3 (PER3) appears to mediate circadian rhythmicity and sleep homeostasis. Approximately 10% of individuals are homozygous for the 5-repeat allele (PER 5/5), whereas 50% of individuals are homozygous for the 4-repeat allele (PER 4/4).PER3 polymorphism have been associated with cognitive performance in response to sleep restriction. Compared to PER 4/4 subjects, PER3(5/5) subjects show a greater cognitive decline after total sleep deprivation. Although sleep deprivation (SD) consistently affect cognitive performance of healthy subjects, some individuals can experience a beneficial effect following SD. SD improves depressive symptoms in 60% of depressed patients treated. Elevation in waking behavioral drive is also found in hyperthymic temperament individuals who report a reduced sleep need. It is hypothesizable that personality factors can contribute the way individuals react and cope to sleep restriction. We analyzed the behavioral effects of one night sleep deprivation in a sample of healthy subjects. The role of PER3 polymorphism and of personality factors were assessed.
Methods: Seventy-four healthy adults (aged 20-35 y) were studied. All subjects provided informed consent and provided a buccal swap sample from which DNA was genotyped with regard to the PER3 VNTR. Karolinska Sleepiness Scale (KSS) and Visual Analogue Scales (VAS) for Vigilance, Mood, and Activation were assessed each hour across prolonged wakefulness (from 8:00 p.m. to 8:00 a.m.). Personality dimensions were studied using Eysenck Personality Inventory (EPI)
Results: Three genotypes were identified: PER3(5/5) (n = 8), PER3(4/5) (n = 42) and PER3(4/4) (n = 24). The three genotypes showed equivalent increases in sleepiness across the night as measured by KSS. A significant mood increase ($F = 1.66$, $P = 0.034$) following SD was found in subjects with higher level of neuroticism compared to subjects with intermediate and low level of neuroticism. A high percentage (87%) of the group with high neuroticism was of PER 4/4 subjects.
Conclusion: No difference in subjective sleepiness following SD was found between PER 5/5 and PER 4/4 subjects. Our result of mood activation in the high neuroticism group suggests that PER3 polymorphism can also contribute to different response patterns to SD which involve mood and personality dimensions.

0210

SEASONAL SLEEP PATTERNS IN THE WHITE-CROWNED SPARROW (ZONOTRICHIA LEUCOPHRYS GAMBELII)

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Introduction: We have shown that during migratory restlessness, captive White-crowned Sparrows (WCS), reduce sleep duration by 60% relative to a non-migratory period under conditions of 12:12LD. However, not only do seasonal changes in day length profoundly affect the organization and timing of avian migration, but changes in day length may also influence total sleep amounts. To determine if sleep duration and organization are affected by seasonal changes in day length in the White-crowned Sparrow, we have characterized the electrophysiological correlates of sleep during four distinct seasons, including two migratory and two non-migratory periods.
Methods: 16 WCS were housed under an adjusting, species-specific photoperiod that simulated natural environmental conditions, and implanted for EEG recording. The amount and distribution of waking, drowsiness, slow-wave sleep (SWS) and rapid eye-movement sleep (REM) was analyzed by scoring every 4s epoch throughout one 24 hour period during each season—spring (14.75:9.25 LD), summer(21.5:2.5 LD), autumn (13.75:10.25) to (16.0:8.0 LD) and winter (9.5:14.5 LD).
Results: We observed marked changes in sleep duration as a function of both seasonal day length and migratory status. Sleep duration in summer occupied 14.6 ± 2.3 % of the day, a proportion comparable to that observed during both of the two migratory seasons. Sleep amount during the non-migratory winter season ($36.6 \pm 2.2\%$) was similar to that observed in our previous study during non-migratory summer in 12:12LD ($33.8 \pm 3.7\%$). Sleep during non-migratory seasons showed a strong diurnal pattern that was lost during the migratory seasons.
Conclusion: Sleep expression in the WCS appears to be highly dynamic and contingent upon prevailing environmental conditions and migratory status, suggesting that migratory sleep loss may not be physiologically remarkable. Migration, however, is associated with a loss of normal diurnal organization of sleep-waking behavior.

0211

CIRCADIAN ACTIVITY OF NORTHERN FUR SEALS UNDER THE CONTROLLED LIGHT-DARK CYCLE

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Introduction: The circadian rhythms of several species of terrestrial mammals have been extensively studied under the controlled light-dark cycle. In this study we examined for the first time the role of light in synchronizing the activity in a species of marine mammals - the northern fur seal (Callorhinus ursinus), that spends 6-10 months a year afloat in the ocean.
Methods: The activity-rest cycle of captive juveniles fur seals was videotaped under a 12L:12D photo cycle (light time 08-20 h, 110-130 lux at the water surface; dark time 20-08 h, < 0.02 lux; a total of 6 seals) and in continuous darkness (24D, < 0.02 lux; 5 seals). The seals were kept afloat individually in pools filled with seawater. The observations lasted between 11 and 30 continuous days.
Results: While in water fur seals sleep at the surface resting on their sides, holding two hind and one front flippers above water. Under a 12L:12D light photo cycle on average $65\pm8\%$(n = 6) of the rest time occurred during the dark time. Three out of 6 seals were more active during the light period ($P < 0.05$, paired t-test). In three other animals the activity and rest time were equally distributed between the light and dark periods. In continuous darkness periods of rest occurred randomly across the 24-h without features of a "free-running" activity. The difference between the amount of rest during the light and dark periods was not significant ($P > 0.05$) in all 5 seals in continuous darkness. The total rest time in fur seals did not differ under 12L:12D ($32\pm4\%$ of 24-h) and 24D conditions ($34\pm7\%$).
Conclusion: The daily activity of fur seals can be affected by light, as in terrestrial mammals. At the same time, fur seals become arrhythmic under the conditions of constant darkness suggesting a dampening of circadian control to adapt to marine conditions.
Support (If Any): The research was supported by Dolphin and I Ltd and NSF.

0792

PER 3 GENOTYPE DOES NOT EXPLAIN VIGILANCE RESPONSES TO TOTAL SLEEP DEPRIVATION

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Introduction: Variants of PER3 have been reported to be associated with effects of sleep deprivation (DEP) on homeostatic sleep pressure. Performance decrement on multiple trials of the Psychomotor Vigilance Task (PVT) during DEP is a behavioral assay of the consequences of homeostatic sleep pressure. This study examined the association of PER3 polymorphisms and the effects of DEP on PVT.

Methods: Genotyping was performed in N = 175 (age 28.2 ± 7.2; BMI 24.1 ± 4.1 kg/m^2) as part of a twin heritability design. These included 42 MZ and 34 DZ twin pairs plus 3 individuals (1 MZ, 2 DZ). Mixed model repeated measures (MMRM) analyses were used to compare among genotypes (PER3$^{5/5}$, PER3$^{4/5}$, and PER3$^{4/4}$) accounting for the difference in MZ and DZ within pair covariance. During 38 hrs of sleep deprivation 10-min PVT was done every 2 hrs. The primary PVT metric was transformed total lapses per trial. Slopes from a homeostatic (linear) plus circadian (sinusoidal) regression model were primary outcomes and the mean between 5:30am and 9:30am were secondary. Additive and dominance genetic models were assessed.

Results: 75 individuals were PER3$^{5/5}$, 78 with PER3$^{4/5}$, and 22 with PER3$^{4/4}$. Groups were similar with regard to zygosity, gender, mean age and BMI. Mean (SD) morningness-eveningness (M-E) scores (BALM) were 36.6 (6.5), 38.1 (5.5), and 39.5 (5.4), respectively. The significance of the additive genetic effect on M-E was P = 0.098 (t = 1.66, df = 130). The genetic model for PVT with the smallest P-value was an additive model using PVT slopes which was not statistically significant and not in the predicted direction (P = 0.18; t = -1.34, df = 151). Similar results were observed for the mean from 5:30am and 9:30am.

Conclusion: The PER3 gene does not explain variance in human vigilance responses to 38 hours of total sleep deprivation either across the entire deprivation period or of specified time intervals. Further replication studies are needed.

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0212

DISTURBED SLEEP AND RISK BEHAVIOR IN LOW-INCOME MINORITY TEENS

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Introduction: Sleep is particularly important for brain maturation and sleep deprivation in teens has a potent negative effect on behavior, emotion, and attention. Adolescents tend to experience more problems with sleep loss as a natural consequence of puberty, but teens from impoverished urban areas witness violence and experience stressors that are likely to affect sleep. The purpose of this study was to examine sleep disturbance in very low income youth (age range: 9.75-19.25 years) in the Mobile Youth Survey (MYS).
Methods: The MYS is a longitudinal household study of impoverished inner-city adolescents that has a very high repeat participation rate (~85%). Data from the years 1998-2005 were used to compare sequential surveys by subject (2-year increments, N = 20,716). The measure of sleep disturbance captured aspects of both insomnia and nightmares, and was elicited by a question about how sleep was affected "when bad things happen to a friend or a family member".
Results: Growth curve analysis showed that reports of sleep disturbance decreased incrementally from age 10 - 18 years, and that after age 10 boys had consistently lower levels of sleep disturbance than girls. Using a cross-lagged panel multivariate approach comparing reports by subject for sequential years and controlling for age/gender, sleep disturbance was associated with violent behavior (carrying, using gun/knife) quick temperedness, worry, and belief in the neighborhood Street Code in the subsequent year. Conversely, worry, traumatic stress, a quick temper, a positive attitude toward the neighborhood and identification with the Street Code were associated with sleep disruption in the subsequent year.
Conclusion: These results suggest a partial explanation for the negative effect of socioeconomic status on sleep among low-income adolescents. Research is needed to determine the prevalence of sleep disorders in this high-risk population and the longitudinal effects of disturbed sleep on teen violence, emotional and academic outcomes.

0213

PREDICTING MATERNAL ADAPTATION TO INFANT SLEEP: AN ECOLOGICAL PERSPECTIVE

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Introduction: Maternal adaptation to infant sleep may be a important determinant of infant sleep quality. The present longitudinal study takes an ecological approach to examine maternal, infant, and marital predictors of mothers' adaptation to infant sleep at 3 months of age.
Methods: This study (Project SIESTA), examines parenting, infant sleep, and infant-parent outcomes across the infants' first two years. To date, 44 families (of 150 total) have been recruited, and data are available at 1 and 3 months of infant age. Maternal adaptation to infant sleep was assessed with a composite variable that tapped mothers' satisfaction with infant sleep location, putting their infants to sleep at bedtime, and their infants' night waking. Infant and parent sleep quality was assessed from sleep diaries, actigraphy and video recordings at bedtime and during the night. Additional questionnaires assessed co-parenting quality and maternal depressive symptoms.
Results: Mothers' adaptation to infant sleep at 3 months was strongly associated with adaptation at 1 month, $r(31) = .73$, $P < .001$. In addition, 3 month co-parenting correlated with co-parenting conflict, $r(28) = -.39$, $P < .05$, maternal depressive symptoms, $r(31) = -.41$, $P < .05$, frequency of infant night wakings, $r(28) = -.55$, $P < .01$, and mothers' reports of their own sleep quality, $r(29) = .52$, $P < .01$. Multiple regression analysis revealed that, when all of these predictors were entered together as a block, only infant night waking and maternal sleep quality remained as significant predictors of maternal adaptation.
Conclusion: These findings support the premise that mothers' adaptation to infant sleep is responsive to mothers' well-being and social milieu, but at this early infant age it is most sensitive to the quality of infants' and mothers' own sleep. These and additional analyses will be based on a substantially larger complement of data by conference time.
Support (If Any): This study is supported by NIH Grant # 5R01HD052809, awarded to the author.

0214

OBJECTIVE IN-HOME WEEKDAY VS. WEEKEND SLEEP IN A SAMPLE OF THE US POPULATION

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Introduction: There is interest in understanding how populations sleep in their home environment. Studies aimed at this question have been mostly limited to self-report measures of selective parameters. Recent advances in technology now make it feasible to measure sleep parameters unobtrusively in the home.
Methods: The DOZER sleep registry is an IRB approved study of sleep in the US population in the home. Its participants purchase and use the Zeo Personal Sleep Coach, a new instrument that uses a fabric headband, to comfortably measure their sleep. Average Total Sleep Time (TST) was calculated for each of 477 subjects (47.9 ± 13.6years, 17.4% female) who contributed at least one weekday (Sun-Thu) and one weekend (Fri-Sat) night of nocturnal sleep data during the final two weeks of October, 2009. Mean and distributions of TST were compared between weekday and weekend nights.
Results: TST on weekday versus weekend nights was significantly different ($\chi^2 = 65.6$, $P < 0.001$): 20.3% of subjects averaged fewer than 6hrs TST on weekdays vs. 17.4% on weekends; 35.4% of subjects averaged between 6 and 7hrs TST on weekdays vs. 23.9% on weekends; 36.9% of subjects averaged between 7 and 8 hrs TST on weekdays vs. 32.1% on weekends; and 7.3% of subjects average at least 8 hrs TST on weekdays vs. 26.6% on weekends. Mean (± SEM) TST was also lower on weekday versus weekend nights: 6.79 (± 0.06) hrs vs. 7.20 (± 0.04) hrs, respectively (Student's T-test, $P < 0.0001$).
Conclusion: These data are consistent with previous findings. However, the proportion of people who obtain less than 7 to 8 hours of sleep is larger in this objectively measured study than in previous reports that are based on self-reported data, such as the 2005 National Sleep Foundation Sleep in America Poll and the 2004-2006 National Health Interview Survey. These findings may have important implications for our understanding of sleep in America.
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0215

MASTICATION AND SLEEP AND BEHAVIORAL CHANGES IN MICE

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Introduction: Decreased mastication from dental problems and soft diets causes various functional and morphological changes. Reduction in central histaminergic neurotransmission by reduced mastication, which may affect sleep and other behaviors, are also reported in experimental animals. In the current study, we have evaluated the effects in mice of chronic diet change (solid vs. powder diet) from weaning on sleep and other behavior (locomotor activity and anxiety).
Methods: Sixteen littermate WT mice aged 25 days were divided into two groups and fed either a solid (SD group) or a powder (PD group)

diet. Locomotor activity (LMA) was measured with home cage monitoring from 14 weeks of age to assess the change in activity pattern. In addition, mice underwent surgery for implantation of electrodes for recording EEG and EMG, and telemetries for LMA, and body temperature (Tb) at 28 weeks of age and 24 hour sleep (and LMA and Tb) recordings were carried out. We also assessed the body weight, anxiety levels using a marble bring test, as well as maxillo-mandibular bone morphology.
Results: We found the following results. 1) PD group showed a significant increase in body weight (plus 6% compared to SD group). 2) Maxillo-mandibular bone structure in powder-diet group was small ($P < 0.01$). 3) PD group represented a significant increase in the amounts of wake ($P = 0.016$) and a significant decrease in non-rapid eye movement (NREM) sleep ($P = 0.004$) in the light period. 4) Light/dark period ratios for wake and NREM amounts were significantly reduced in PD group. 5) There was no significant difference in the amount of activity at 14 weeks of age, whereas PD group had reduced LMA in the dark period at 28 weeks of age ($P < 0.05$). 6) No difference in anxiety levels was observed between groups.
Conclusion: Chronic PD feeding induced various developmental/behavioral changes. The behavioral changes in PD group are characterized with reduced diurnal rest activity pattern and its associated changes in sleep/wake amounts. It is important to study if these changes are due to changes in the quantity and quality of mastication or those in the patterns of feeding behavior.
Support (If Any): This study was supported by NIH Grant (R01MH072525)

0216

NOCICEPTIN/ORPHANIN FQ RECEPTOR-MEDIATED ANXIOLYTIC EFFECTS THROUGH INTERACTION WITH HYPOCRETIN/OREXIN NEURONS IN MICE

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Introduction: Nociceptin/orphanin FQ (N/OFQ) and Hypocretin/orexin (Hcrt) have been implicated in differential modulation of stress responses and anxiety, which are consistent with their opposite regulation of general behaviors e.g., wake/sleep, locomotion, feeding, and reward. To test the hypothesis that N/OFQ receptor (NOP) mediates anxiolytic effects through interaction with the Hcrt system, we studied the effect of the novel NOP agonist SR 16835 on anxiety-like behavior displayed by orexin/ataxin-3 (AT) mice, in which the Hcrt neurons almost completely degenerated after 4 postnatal weeks compared to wildtype (WT).
Methods: In the unconditioned fear paradigms, anxiety was assessed using elevated T-maze, Zero-maze, and light/dark box test in the SmartCage (AfaSci). Time spent in open quadrant or light compartment and transitions between open/close or light/dark were measured. In conditioned fear Vogel test, following water deprivation (two 24 hours and separated with 30 min free drinking), the number of free drinking or conflict drinking (with a shock after every 20 drinks) and number of shocks were recorded and compared among the two genotypes and SR 16835 (5mg/kg, ip) or vehicle treatment.
Results: There are no differences in unconditioned fear induced anxiety behavior assessed by the T-maze, Zero-maze or light/dark tests, among AT and WT mice, and drug treatment, except for sedative effect induced by SR16835. The sedation might confound the anxiolytic effect. In Vogel test, SR16835 treatment produced significant anxiolytic effects on WT mice only. The WT mice had conflict drinks 365 ± 98 in drug vs 60 ± 59 in vehicle, and shocks received 18 ± 5 in drug vs 3 ± 3 in vehicle ($n = 8$ per group). In contrast, drug-treated AT mice had similar number of drinks and shocks as the vehicle groups in both genotypes.
Conclusion: There was an apparent lack of endogenous Hcrt contribution to overt anxiogenesis. However, the NOP activation-mediated anxiolytic effect is critically dependent on the intact Hcrt neurons, suggesting more specifically anxiety-related learning is modulated by the interaction between Hcrt and N/OFQ systems following repeated conditioned fear.
Support (If Any): NIH R01 MH078194 and R43NS065555

0217

NEUROGLOBIN OVEREXPRESSION ATTENUATES COGNITIVE DEFICITS IN MICE EXPOSED TO CHRONIC INTERMITTENT HYPOXIA DURING SLEEP

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Introduction: Obstructive sleep apnea (OSA), which is characterized by intermittent hypoxia (IH) during sleep, is associated with neurocognitive and behavioral morbidity. IH induces neuronal cell losses via activation of oxidative pathways, such that oxidative stress is a critical contributor to cognitive deficits. Neuroglobin (Ngb) is a new member of globin family that is preferentially expressed in neuronal cells, and is up-regulated in response to hypoxia/ischemia. Ngb confers a protective role to cells against oxidative stress and beta-amyloid-induced neuronal cell injury. Furthermore, Ngb overexpression can protect the brain injury against global ischemia in Ngb transgenic mice. However, it remains unclear whether Ngb prevents IH-induced cognitive deficits.
Methods: Ngb Transgenic (Tg) Mice: We developed a transgenic mouse line in a C57Bl6 background that induces ubiquitous overexpression of Ngb transgene by using a human ubiquitin C promoter. Ngb mRNA and protein expression were assessed by real-time RT-PCR and Western-blotting respectively. Cellular distribution of Ngb was evaluated by immunohistochemistry. Morris water maze: Male Ngb Tg mice (8-week old) and age-matched controls (C57BL/6) were exposed to IH (cycling of 5.7% or 21% oxygen (RA) every 90 seconds) during the light period followed by RA during the dark period, or RA throughout in 2 identical commercially designed chambers for 15 days, after which, mice were subjected to spatial learning procedures in the Morris water maze.
Results: Increased Ngb mRNA and protein were apparent in brain, heart and kidney of Tg mice. Exposure to IH resulted in substantial impairments of spatial learning in control mice. However, Ngb over-expression attenuated spatial learning impairments. Experiments are underway to assess degree of oxidative stress and apoptotic cell loss in exposed mice.
Conclusion: Ngb overexpression attenuates IH-induced cognitive deficits in mice. These data provide further evidence that Ngb may play a protective role in the cognitive deficits associated with OSA.
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0218

CANNABIDIOL REDUCES ANXIETY AND ANXIETY-INDUCED SLEEP DISRUPTION

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Introduction: Patients with anxiety disorder are suffered from sleep disturbance. Sleep disruption, such as insomnia, is also a diagnostic criterion for anxiety disorder. Medications for relieving sleep disruption and anxiety frequently accompany with adverse effects. We have herein investigated the effects of cannabidiol (CBD), one of the major components of Marijuana, in sleep regulation and anxiolytic action. CBD improves peripheral immune system, reduces anxiety, and promotes sedation. However, the underlying mechanism of CBD in the brain is still uncertain. Various mechanisms of CBD have been proposed in different studies. We designed an anxiety animal model to evaluate a potential anxiolytic and its sleep regulation.
Methods: Two doses (1 and 0.5 μg) of CBD were administrated into the central nucleus of amygdala (CeA) where regulates sleep and emotion. Ratio of duration spending in the open and closed arms of the elevated

plus maze (EPM) is an indication for the anxious status. Rats were reinforced the anxious feeling by placing rats into an open field before the EPM. The sleep electroencephalograms (EEGs) were recorded after the manipulation of open field and EPM.
Results: The preliminary data revealed that reinforcement by open field significantly reduced first-hour NREM sleep duration and a sleep rebound was exhibited during the third hour. Total REM sleep duration was also decreased. CBD reversed the open field-induced REM sleep alteration. On the other hand, high dose CBD (1μg/2μl) administered into amygdala prolonged the duration of rat spending in open arms of the EPM, indicative of anxiolytic effect.
Conclusion: CBD reverses REM sleep disturbance and produces anxiolytic effect in the anxious rats.

0219

THE ROLE OF CRH IN TAIL SUSPENSION TEST (TST)-INDUCED SLEEP ALTERATIONS

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Introduction: Like other affective disorders, the underlying pathophysiology of depression is still uncertain. Depression is generally attributed to the imbalance of monoamines, especially for serotonin. Furthermore, hyperactivity of the hypothalamic-pituitary-adrenal (HPA) axis is common in depression patients. Therefore, corticotropin-releasing hormone (CRH) may be related to the depression-induced sleep disruption, since CRH is a well-known waking promoter. We used tail suspension test (TST) to evaluate depression based on the learning helplessness theory. This study determined how CRH affects sleep by intracerebroventricular (ICV) administration of CRH receptor antagonist, astressin, into acute and chronic TST-induced depression rats.
Methods: Male Wistar rats were implanted with electrodes and an ICV cannula, and randomly divided into two groups; one group received 1-day TST and the other group received 8-day TST. Baseline and vehicle control of EEG recordings were obtained before TST manipulation. TST were performed at the beginning of light period and lasted for 15 minutes. Astressin (2.5 and 12.5μg) was intracerebroventricularly administered 20 minutes prior to the light period. The intensity of struggling behavior indicative of learning helplessness was analyzed by EthoVision.
Results: In the first day after TST, slow-wave sleep (SWS) and rapid eye movement (REM) sleep were decreased by 17.51% and 24.66% in the light period, and were increased by 14.6% and 38.4%, respectively, during the dark period. As TST continuously performed, the sleep alteration gradually diminished, except that SWS was noticeably increased by 23.86% during dark period of the 8th day. In addition, we found that blockade of CRH reversed the sleep alterations caused by the first-day TST, whereas astressin showed no effect on sleep after the 8-day continuous TST. Behavioral observation showed that astressin has no effect on the progression of learning helplessness after rats receiving the 8-day TST.
Conclusion: CRH may participate in the initiation of depression, but is not dominant in the maintenance of stress-induced depression.

0220

ONLINE SELF-HELP INTERVENTIONS FOR COLLEGE STUDENTS' COGNITIVE OVER-AROUSAL AT BEDTIME

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Introduction: Many college students report that pre-sleep worry, planning, or racing thoughts interfere with sleep. The current study investigated whether interventions developed for in-person treatment of cognitive arousal in insomnia could be adapted for self-help delivery on-line, which would be convenient for students and cost effective.
Methods: Participants were 41 undergraduates (32 females) who fit inclusion criteria for poor sleep due to cognitive over-arousal. Mean age was 23.22 (SD = 6.11). Participants were randomly assigned to a condition (i.e., constructive worry, imagery distraction, or psychological placebo). Baseline measures included online questionnaires (i.e., Sleep Quality Scale, Pre-Sleep Arousal Scale, and Sleep Hygiene Index), and sleep diaries submitted daily for one week. After baseline, participants were e-mailed instructions for an intervention to do daily for a week, and to submit sleep diaries and measures of treatment adherence daily. Controls for demand and counter-demand were included. At the end of the intervention week, participants redid baseline questionnaires and answered questions about treatment effectiveness.
Results: 3 x 2 ANOVA indicated that sleep quality ($P < .01$), total sleep time ($P < .05$), cognitive pre-sleep arousal ($P < .001$) and somatic pre-sleep arousal ($P < .05$) improved from baseline to intervention, a trend toward improved sleep hygiene ($P < .06$), and no improvement in sleep latency. Type of intervention and interactions were not significant. Daily adherence was low for all interventions (40.5%). Participants in the constructive worry condition rated the intervention as more effective than did other participants ($P < .05$).
Conclusion: College students benefited from online self-help versions of constructive worry and imagery distraction as shown by reduced pre-sleep arousal and improved sleep quality. Similar improvements occurred in the placebo condition, suggesting that general participation in the study likely contributed to treatment effectiveness.

0221

PUTTING SLEEP TO THE TEST: A COLLEGIATE SLEEP STUDY

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Introduction: College students tend to sleep significantly less than the recommended amount (usually 9.24 hours a night for young adulthood), and there is little work to suggest how to relieve this problem. Previous studies this size have used self-report measures only to estimate sleep. The present study used Zeo, a novel tool to objectively measure sleep and provide personalized feedback.
Methods: Students were recruited from an introductory psychology class, taught by Dr. James Maas at Cornell University. 143 students (60% female), aged 18-24 years, completed the protocol. Subjects participated in a trial including six sleep-centered lectures in class, plus personal sleep feedback from the sleep-tracking tool. Objective sleep measures (such as Total Sleep Time (TST) and Time in REM) and subjective sleep measures (particularly, self-reported TST) were taken at Baseline (T1), one month later at Midpoint (T2) and at two and a half months at Endpoint (T3) during the fall semester.
Results: At T1, subjects' self-reported TST(± SEM) was 7hrs 25 (± 6.0) min and objectively measured TST was 6hrs 46 (± 6.2) min. Subjects' subjective and objective TST did not change significantly between T1 and T2. At T2, the bottom quartile of the class' objectively measured TST was only 4hrs 56 (± 9.0) min. However, after all students were given personalized feedback about their sleep, there was a significant increase in TST [6hr 37 (± 6.3) min to 6hr 49 (± 7.1) min, $P < 0.05$] from T2 to T3. Additionally, the bottom quartile of the class experienced an average increase of 50 (± 12.8) min in TST.
Conclusion: Students reported they were getting less sleep than recommended, and got significantly less still according to objective measure. Fortunately, there seems to be hope that education and personalized feedback could help students change their behavior - especially in the subset of the class that may need it most. More research is needed to isolate the causes of behavior change and sleep improvement in this population.
Support (If Any): Material support was provided for this study by Zeo, Inc.

0222

CAFFEINE CONSUMPTION, SLEEP QUALITY, AND PSYCHOLOGICAL SYMPTOMS IN UNIVERSITY STUDENTS

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Introduction: The purpose of this study was to examine whether caffeine consumption in university students is associated with sleep disturbances, psychological symptoms, and academic performance.
Methods: Participants included 150 undergraduate university students (79% female). The majority of students (76%) were enrolled in an Introductory Psychology course. Participants completed a variety of measures, including: a questionnaire regarding caffeine consumption, the Pittsburgh Sleep Quality Index (PSQI), the Centre for Epidemiological Studies Depression Scale (CES-D), the State component of the State-Trait Anxiety Inventory (STAI), the Interpersonal Support Evaluation List (ISEL), the Perceived Stress Scale (PSS), and the Satisfaction with Life Scale (SWLS). Participants also consented to the researchers obtaining their midterm grades for the semester of the study. Participants were categorized into four caffeine groups depending upon their self-reported monthly levels of caffeine consumption: Low (n = 38), Low-Medium (n = 38), Medium-High (n = 37), and High (n = 37). Overall group differences were assessed using a series of Kruskal-Wallis nonparametric tests; significant effects were followed-up with Mann-Whitney U tests.
Results: Compared to the Low caffeine group, the means of each of the other three caffeine groups were significantly poorer on the PSQI and the CES-D, $P < .05$. The means of the Low-Medium and the High caffeine groups were significantly worse than the Low caffeine group on the STAI and the SWLS, $P < .05$. The mean of the Low-Medium group was significantly poorer than the Low caffeine group on the SWLS, $P < .001$. Interestingly, the caffeine groups did not differ in terms of their midterm grades, ISEL, and PSS, $P > .05$ for all.
Conclusion: The results of this study suggest that while increased caffeine consumption in students is associated with poorer sleep quality and increased symptoms of depression, state anxiety, and life dissatisfaction, it is not associated with academic performance, ratings of support, or perceived stress.

0223

THE RELATIONSHIP OF SLEEP HYGIENE AND SLEEP QUALITY TO STRESS AND BURNOUT AMONG COLLEGE STUDENTS

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Introduction: High job stress combined with reduced personal accomplishment can lead to burnout, a state of global exhaustion marked by excessive fatigue, reduced job efficiency, and depressed mood. Disturbed sleep has been linked with burnout and may increase burnout vulnerability. Sleep hygiene, behaviors related to quality and quantity of sleep (i.e. consistent bedtimes, comfortable sleeping conditions, arousing activities before bed), can be voluntarily controlled and may provide an avenue to treat or protect from burnout. The relationship between sleep hygiene and burnout has not yet been examined. Our purpose was to assess this relationship in college students.
Methods: Participants (141 college students, 27 male, 114 female; age: 17-22 years) were given a series of questionnaires to assess sleep hygiene (Sleep Hygiene Index), sleep disturbance (Pittsburg Sleep Quality Index), burnout (Maslach Burnout Inventory, Oldenburg Burnout Inventory) and stress (Perceived Stress Scale).
Results: Sleep Quality: Greater sleep disturbance was related to higher perceived stress ($r(121) = .310$; $P < .05$) and higher burnout scores ($r(116) = .231$; $P < .05$). The latter was due mostly to a positive correlation between sleep disturbance and the exhaustion subscale of burnout, ($r(116) = .307$; $P < .05$). Sleep Hygiene: Poor sleep hygiene (e.g. engaging in voluntary behaviors that are likely to disturb sleep) was related to higher scores on perceived stress ($r(124) = .233$; $P < .05$), and both the exhaustion ($r(119) = .289$; $P < .05$), and cynicism ($r(119) = .169$; $P < .05$) facets of burnout. Higher exhaustion was significantly related to more substance use, negative emotions and working before bed; higher cynicism was significantly related to more negative emotions before bed and uncomfortable sleeping conditions.
Conclusion: A relationship exists between sleep hygiene, sleep quality, and burnout. Further research is needed to determine whether a sleep hygiene education program is of benefit to individuals experiencing or vulnerable to burnout.
Support (If Any): Arkansas Space Grant Consortium and The Hendrix College Brewer Fund

0224

IDENTIFICATION OF BRAIN RESPONSE TO BAROREFLEX STIMULATION BY FUNCTIONAL MAGNETIC RESONANCE IMAGING

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Introduction: Obstructive sleep apnea (OSA) in children leads to dysfunction of the baroreflex, an important component of autonomic control of blood pressure. Baroreflex dysfunction may even persist after treatment. This pilot study aims at identifying the cortical/subcortical brain responses to baroreflex stimulation.
Methods: Five healthy adult males (aged 21 to 35 years) underwent a lower body negative pressure (LBNP) protocol during functional magnetic resonance imaging (fMRI) at 3 Tesla. Whole brain T2*-weighted images with blood oxygenation level dependent (BOLD) contrast were acquired continuously every 3 seconds. A high resolution T1-weighted scan served as anatomic reference. Subjects experienced randomly-ordered 30s bouts of LBNP including 6 at -5 mmHg and -30 mmHg, each followed by 100s of recovery. Heart rate was recorded. Image data were processed voxel-wise using statistical parametric mapping software (SPM5). Voxel response was modeled by the LBNP timecourse for each subject. A group composite map of activation was then calculated for all subjects by non-parametric random-effects modeling.
Results: A trend toward positive activation was observed in pons and medulla and widespread areas of cerebellum with LBNP (nominal $P < 0.05$ -30 mmHg vs. -5 mmHg) The thalamus also had focal activations bilaterally. Cortically, positive activations included; inferior/middle temporal, inferior occipital, post central, opercular, cingulate, and superior parietal regions. Negative activation in the prefrontal cortex, insula, and putamen bilaterally was observed (nominal $P < 0.06$) Heart rate increased with LBNP (77 +/- 13 at -30 mmHg vs. 73 +/- 9 at -5 mmHg, $P < 10\text{-}4$).
Conclusion: The LBNP levels applied caused a measurable autonomic response, indicated by heart rate changes. The findings on fMRI suggest that the baroreflex is supported by specific cortical/subcortical regions. We report the feasibility of examining he central control of the baroreflex which could be applied to children with obstructive apnea.

0225

INCREASED ANXIETY RATINGS RELATE TO GREATER CEREBRAL RESPONSE IN INSOMNIA PATIENTS DURING A VERBAL ENCODING TASK

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Introduction: Anxiety is a common comorbid symptom of Primary Insomnia which may be associated with excessive stress, persistent worry, obsessive thoughts, and physiological arousal. In this study we hypothesized that relative to Good Sleepers (GS), patients with Primary Insomnia (PI) would demonstrate a positive relationship between subjective state anxiety scores and cerebral activation during a verbal encoding task.
Methods: 10 PIs (5F, 39.6 +/- 8.6yrs, 15.8 +/- 1.7yrs education) and 9 GSs (3F, 35.9 +/- 8yrs, 15.1 +/- 1.7yrs education) were evaluated with FMRI while performing a verbal encoding task. Each subject rated their state level of anxiety prior to testing using the Spielberger State-Trait Anxiety Inventory. State anxiety scores were correlated with BOLD activation, and FMRI analyses focused on task-specific regions of interest. Behavioral performance was measured by delayed recognition memory (d-prime).
Results: The two groups differed significantly on pre-scan state anxiety ratings ($P < .012$). However, there were no significant differences between the groups in memory (d-prime: $P = .241$). On FMRI, higher state-anxiety ratings in the PIs were significantly correlated with increased BOLD activation in the left inferior parietal lobe, inferior frontal gyrus, and angular gyrus, as well as right superior parietal lobe. For the GSs, anxiety ratings were significantly negatively correlated with activation in the left inferior frontal gyrus. In PIs, behavioral performance was negatively correlated with anxiety ratings and cerebral activation. However, these correlations did not reach statistical significance.
Conclusion: PIs with higher subjective anxiety ratings showed larger BOLD responses in task-related regions during a verbal encoding task. Thus state-related anxiety appears to moderate the relationship between insomnia and cerebral activation. These findings suggest PIs with more state anxiety may use greater cerebral resources to perform cognitive tasks. Alternatively, anxiety may relate to greater rumination which would also increase activation. Speculatively, treating comorbid anxiety may have important implications for treating insomnia and improving daytime functioning.
Support (If Any): NIMH NSRA-F31 MH077411-01A1 UCSD GCRC NIH M01 RR00827

0226

COUNTERMEASURES TO DRIVER SLEEPINESS, IS THE MESSAGE GETTING THROUGH?

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Introduction: The most effective countermeasures to driver sleepiness are caffeine and a nap. This information has been incorporated into the UK Government's 'Highway Code', as the appropriate recommendation, along with 'take a break' from driving every 2 hours. Our study investigated whether this advice was being followed, in two groups' of susceptible drivers 1. OSA patients 2. Truck drivers
Methods: 18 OSA, CPAP treated car drivers, 18 age-control car drivers and 148 truck drivers were surveyed as to whether they had previously fallen asleep while driving and what their preferred sleepiness countermeasures were.
Results: i) Patients vs controls: significantly more OSA drivers had fallen asleep while driving than controls (ChiSquare $P = 0.012$). OSA drivers were significantly more likely to have stopped driving due to sleepiness than controls (ChiSquare $P = 0.019$). There was nsd in preferred maximum driving time or choice of countermeasure. ii) Truck drivers: 8.9% had fallen asleep while driving; 61.5% had felt sleepy while driving. For all study groups, stretching legs and opening a window were in the top 2 choices of countermeasure. Caffeine was the least popular countermeasure among truck drivers.
Conclusion: Despite this advice on counteracting driver sleepiness being available in the 'Highway Code' since 1998, it is not being followed. Drivers are still utilising the Code's pre-1998 advice of 'opening a window' and 'stretching the legs'. Experienced drivers do not appear to be aware of the change. The two groups of drivers more susceptible to driver sleepiness (OSA and truckers) seem no better at choosing effective countermeasures than do controls. Hard hitting awareness campaigns are still needed, on how best to deal with sleepiness, especially with a greater dissemination from doctors treating OSA patients, and trucker employers.

0227

ASSOCIATIONS BETWEEN PERCEIVED INSUFFICIENT SLEEP, FREQUENT MENTAL DISTRESS, AND CHRONIC DISEASES AMONG US ADULTS, 2008

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Introduction: An estimated 50-70 million Americans suffer from chronic sleep and wakefulness disorders. However, little is known about associations between insufficient sleep and frequent mental distress (FMD, $\geq$ 14 days during the past 30 days) as well as with selected chronic diseases (diabetes, coronary heart disease, stroke, and obesity) in a national sample although evidence supports interrelationships.
Methods: The 2008 Behavioral Risk Factor Surveillance System (BRFSS), a random-digit-dialing telephone survey, was used to examine relationships between days of insufficient rest or sleep during the past 30 days, FMD and selected chronic diseases among 388,868 non-institutionalized US adults aged $\geq$ 18 years. Age-adjusted prevalence estimates and adjusted odds ratios (AOR) from multivariate logistic regression analyses were obtained using SUDAAN to account for the complex study design. AOR were adjusted for gender, age, race/ethnicity, education, marital status, employment status, number of children in household and insurance status.
Results: Days of self-reported insufficient sleep were categorized as zero (30.7%), 1-13 (41.4%), 14-29 (16.9%), and 30 days (11.0%). Prevalence of FMD increased with increasing days of insufficient sleep (4.8% for no days (referent), 6.3% for 1-13 days (AOR = 1.4), 18.5% for 14-29 days (AOR = 4.2), and 27.9% for 30 days (AOR = 6.0), $P < 0.0001$). Adults who reported $\geq$ 14 days insufficient sleep were more likely to have one or more chronic diseases than those reporting < 14 days (29.6% vs. 25.4% for at least one chronic disease (AOR = 1.3, $P < 0.0001$) and 10.7% vs. 6.4% for > 2 chronic diseases (AOR = 1.8, $P < 0.0001$).
Conclusion: Efforts on sleep-related health education and health promotion as well as increased awareness of the importance of optimal sleep among persons with mental distress and chronic diseases are needed.

0228

SLEEP QUALITY AND FATIGUE IN PATROL OFFICERS

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Introduction: Patrol Officers, faced with shift work, extended work hours, and physically and mentally demanding situations, risk getting

insufficient and poor quality sleep. This may lead to fatigue and impaired cognitive performance, therefore jeopardizing the safety of Patrol Officers and the public. However, it is believed by many that selection effects in this population result in a disproportionate level of resistance to fatigue. We used data on sleep quality and fatigue collected from four U.S. Police Departments between 1996 and 1998 to examine this issue.
Methods: Data were available for 282 Patrol Officers (31 identified as female) aged 23-59. At the beginning of their first shift after enrollment in the study, they filled out the Pittsburgh Sleep Quality Index (PSQI). PSQI global scores were used as an index of sleep quality. The Patrol Officers also indicated how often they felt tired at the beginning of a work shift in the month prior, on a scale ranging from 1 indicating "Always" to 5 indicating "Never." This was used as an operational measure of fatigue. Susceptibility to fatigue was examined by investigating the relationship between PSQI global scores and the frequency of feeling tired at the beginning of a work shift.
Results: PSQI global scores ranged from 0 to 15. Interpreting a score of ≥ 5 as clinically relevant poor sleep quality, it was found that 48.9% of Patrol Officers experienced poor quality sleep. There was a significant negative relationship between PSQI global scores and responses regarding feeling tired ($r = -0.47$, $P < 0.001$), such that reduced sleep quality was associated with Patrol Officers feeling tired more often at the beginning of a work shift.
Conclusion: Patrol Officers showed an inverse relationship between sleep quality and fatigue. This indicates a susceptibility to fatigue, and the potential to suffer the debilitating consequences of poor quality sleep.
Support (If Any): National Institute of Justice.

0229

THE ASSOCIATION BETWEEN CHRONOTYPE AND SLEEP PATTERNS IN CHILDREN

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Introduction: An individual's expressed preference for morning or evening activities i.e., "chronotype", is a powerful individual difference that reflects a circadian tendency. It has been suggested that variation in chronotypes encompasses sleep/wake cycles. Although these variations in the sleep/wake cycles have been shown in adults, only a few studies have examined differences in sleep patterns in children of different chronotypes. The goal of the present study was to use objective and subjective measures to determine whether children with different chronotypes exhibit different sleep patterns.
Methods: Chronotype and sleep were evaluated in 59 children (27 females and 32 males) aged 7 to 11 years. Chronotype was measured using the Morningness-Eveningness Scale for Children (Carskadon et al., 1993). Sleep was measured using the Child Sleep Habits Questionnaire (CSHQ; Owens et al 2007), actigraphy and Polysomnography (PSG).
Results: One-way ANOVAs revealed that on CSHQ, scores on the sleep onset latency and sleepiness were significantly higher in evening types compared to other chronotype groups ($F(2, 58) = 3.32$, $P < .05$, $F(2, 58) = 8.40$, $P < .001$, respectively). On actigraphic measures, sleep starting time was marginally later ($F(2, 58) = 2.00$, $P = .06$) in children with evening chronotype, and sleep end time was significantly later in this group, ($F(2, 58) = 5.49$, $P = .007$). Actual sleep time was longer in morning and evening types compared to neutral types ($F(2, 58) = 5.50$, $P = .007$). On PSG measures, children with evening chronotypes spent less time in Stage 1 compared to the other groups ($F(2, 58) = 3.78$, $P < .05$) and children with neutral chronotype spent more time in Stage 3 and REM sleep compared to other groups ($F(2, 58) = 3.20$, $P < .05$, $F(2, 58) = 3.80$, $P < .001$, respectively).
Conclusion: Individual differences in Chronotypes are associated with different sleep patterns in children, suggesting that chronotype may indeed be linked to circadian cycle.
Support (If Any): The study was funded by grants held by Dr. Reut Gruber from the Canadian Institutes of Health Research and Fonds De La Recherche en Santé.

0230

THE EFFECT OF FLUORESCENT LIGHTS OF DIFFERENT COLOR TEMPERATURE ON MORNING ALERTNESS AND EEG SPECTRUM

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Introduction: Bright light exposure has been shown to counteract the decline in cognitive performance and alertness level following morning awakening. Short-wavelength blue light was demonstrated to be especially effective in the enhancement of alertness. The lighting conditions used in these studies were different from the daily life lighting because they are higher in intensity (> 1000 lux) and/or monochromatic in light spectrum. The current study is to investigate the effects of exposure to lower intensity (~240 lux) fluorescent lights that are commonly used in daily life on morning alertness and EEG spectrum.
Methods: Six healthy college students participated in three conditions—a control condition with dim light (10 < lux), a 5000K condition (white light used daily life), and a 6500K condition (blue-light enriched light). The order of three conditions was counterbalanced across participants. After a 7 hours nocturnal sleep, they were awakened and exposed to the designated light. Subjective ratings of sleepiness/alertness measured with the Karolinska Sleepiness Scale (KSS) and Visual Analogue Scales (VAS) and an auditory vigilance task (AVT) were administered, and EEG recording was conducted six times every 10 minutes following awakening. The first measurement session served as a baseline for comparisons.
Results: Friedman test (3 Light conditions x 5 times) revealed no Light effect on subjective ratings. The mean reaction time on AVT at the sixth measurement session was faster in 6500K condition than in dim light condition ($X2 = 6.00$, $P = .014$). Alpha power on EEG showed less increase in 6500K condition than in dim light condition ($X2 = 6.00$, $P = .014$) at the sixth session of measurement.
Conclusion: Blue-enriched fluorescent light was shown to enhance cognitive performance that is accompanied by less increased alpha EEG power following morning awakening. However, no effect on subjective feelings of alertness/sleepiness was evidenced. The possibility of using blue-enriched fluorescent light to counteract morning sleepiness was suggested.

0231

SLEEP AND PACE OF LIFE. INQUIRY OF "INSTITUT NATIONAL DU SOMMEIL ET DE LA VIGILANCE"; DAY OF THE SLEEP 2009 JOURNÉE DU SOMMEIL

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Introduction: OBJECTIVE. Evaluation of pace of life influence on young adults sleeping
Methods: Internet Inquiry performed via BVA Institute with 1000 adults (18-55 years old) representatives of the French general population. The questionnaire was built by the scientific advisory board of INSV. It included: socio-demographic profile, labor and transport time, family structure (in particular homes with less than 3 years children), existence of insomnia (according to DSM-IV definition), sleep schedules and pre-

liminary known treatment for Sleep Apnea Syndrome (SAS), Periodic Limb Movements (PLM), insomnia or hypersomnia.
Results: The average time of sleep claimed by Frenchs is 7h07 during week and 7h50 on week-ends. 33% sleep six hours or less during week, 55% sleep less than they wish. 29% sleep lonely, 17% sleep occasionally with their children and 4% regularly. 20% sleep occasionally with a pet and 23% regularly. 57% have TV in their room, 46% mobile phone and 22% a computer. 32% claim to suffer from sleep disorders (of which 84% insomnia, 10% SAS, 10% Restless Legs Syndrome (RLS) and 2% hypersomnia-narcolepsy). 89% of less than 3 years old childrens' parents claimed to sleep well, but 63% awake earlier and 59% have night awakenings because of their children. Working life entry also disturbed young actives' sleep: 66% have to rise earlier than usually and 39% had night awakenings (during 14 weeks on average after starting working).
Conclusion: One third of French adult population has Sleep disorders, and one third sleep less than 6 hours per night during the week.

0232

SLEEPING IN "FEELS GOOD, AND THEN IT FEELS TOO LAZY…I WASN'T RAISED LIKE THAT": HOW AMERICAN CULTURE SHAPES ADOLESCENT SLEEP PERCEPTIONS AND BEHAVIOR

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Introduction: Many studies explore adolescent sleep behavior, but few examine teen perceptions of how much sleep is appropriate for them. These perceptions reflect American cultural norms, and affect the actual sleep behavior of adolescents.
Methods: As part of a larger study, 14 and 15-year old adolescents (N = 50, 48% male, 46% white) were asked about their perceptions of "sleeping too much" during an individual interview about sleep. Sleep diary data were subsequently collected from these same adolescents. Interview data were analyzed in Atlas.ti to identify pervasive ideas about sleep quantity, and means for total sleep time for weeknights and weekend nights were calculated in SPSS.
Results: Adolescents were evenly divided on whether it was possible to sleep too much. When teens talked about sleeping too much, they referred to being lazy and "wasting a day" sleeping. Sleeping too much generally had physical and emotional consequences similar to sleeping too little. Very few teens referenced an idea of needed catch-up sleep. Comparing total sleep time categories on weeknights and weekends, approximately half the adolescents followed their weeknight sleep pattern, or slept less, on at least one weekend night. This pattern was seen across gender and ethnicity, though among white teens, those who got less weekend sleep were more likely to report high physical activity.
Conclusion: American adolescents receive mixed messages from parents and other trusted sources about the value of sleep in America. Teens were told to go to bed early enough to be rested, but often simultaneously told that too much sleep equates with laziness. Teens often slept too little during the week, and may have been tired enough to sleep more on the weekends. Some rejected the "lazy teenager" stereotype, however, and relied on physical and social activities to maintain a culturally acceptable level of alertness on the weekend.

0233

THE EFFECT OF A GOOD NIGHT'S SLEEP ON DAILY MOOD

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Introduction: Research has shown that well-being is profoundly affected by everyday stresses, and uncovered a strong link between stress and mood. It is unknown, however, whether this link is influenced by sleep quality, particularly characteristics of the previous night's sleep. We investigated whether a night of troubled sleep affects the daily mood/stress relationship, specifically asking whether people who typically experience high quality sleep are more or less disrupted by a poor night's sleep, and whether poor sleep quality has a cumulative negative effect on mood. Because they are considered two independent systems, positive and negative affect were examined separately.
Methods: Participants (N = 619; ages 39 to 75) first completed the Pittsburg Sleep Quality Index measuring global sleep quality. Over the following 56 days they completed the Positive and Negative Affect Schedule measuring daily mood, the Perceived Stress Scale measuring daily stress, and an item addressing sleep disruption the previous night.
Results: Relationships among sleep, stress, and mood were assessed using multilevel modeling. Good global sleep predicted lower increases in daily negative mood, while poor global sleep predicted steeper increases in negative mood on high stress days ($P < .01$). Although there was no main effect of sleep quality on positive mood, a three-way interaction emerged among daily stress, daily troubled sleep, and global sleep predicting positive mood. Good global sleep quality predicted the highest positive mood when the least sleep trouble was reported, and the least decline in positive mood when daily stress was high ($P < .05$).
Conclusion: Both negative and positive affect were moderated by nightly sleep, although the influence of global sleep quality on daily mood was stronger for daily negative than positive mood. Identifying these relationships is essential for understanding mechanisms influencing sleep and well-being outcomes in adulthood.

0234

RELATIONSHIP OF SLEEP HYGIENE AND SLEEPINESS TO BURNOUT AMONG METHODIST MINISTERS

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Introduction: Burnout has been shown to be subjectively and objectively related to disturbed sleep. Sleep hygiene may be described as engaging in behaviors promoting good sleep quality and quantity and avoiding behaviors that may compromise sleep. Sleep hygiene may be a target for preventative intervention or treatment for individuals experiencing burnout. The present study is an examination of sleep hygiene, sleepiness, and burnout within Methodist ministers. This is the first study to examine sleep issues and burnout within a group of spiritual leaders, as well as the first study to examine the relationship between sleep hygiene, subjective sleepiness, and burnout within any group.
Methods: Data were gathered from 192 ministers (138 male, 54 female) from across the state of Arkansas via an online voluntary self-report questionnaire. Measures included the Sleep Hygiene Index, the Epworth Sleepiness Scale, The Pines Burnout Measure, and sociodemographic data.
Results: Sleepiness: Greater sleepiness was related to higher total burnout scores ($r(155) = .317$; $P < .05$). A positive correlation was seen between sleepiness and all three subscales of burnout: exhaustion ($r(163) = .372$; $P < .05$), demoralization ($r(165) = .270$; $P < .05$), and loss of motivation ($r(162) = .183$; $P < .05$). Sleep Hygiene: Maladaptive sleep hygiene was related to higher total burnout scores ($r(158) = .559$; $P < .05$). A positive correlation was seen between sleep hygiene and all three subscales of burnout: exhaustion ($r(165) = .473$; $P < .05$), demoralization ($r(168) = .505$; $P < .05$), and loss of motivation ($r(166) = .442$; $P < .05$). Higher burnout was significantly related to maladaptive behavior on every item of the SHI except extended napping (not related) and exercising close to bed (negatively related).
Conclusion: A relationship exists between sleep hygiene, sleepiness, and burnout. Establishing these relationships in Methodist ministers is important in understanding the current conditions within this subgroup and may have implications for other spiritual and helping groups. The results presented here may also suggest prevention and/or treatment strategies.

0235

MOTIVATION IN WAKING AND IN DREAMING: CONTINUITY OR COMPENSATION?

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Introduction: A majority of studies have supported the notion of continuity between waking and dreaming by showing that elements of waking life were reflected in dreams. On the other hand, some studies have revealed a compensatory relationship notably with achievement motivation. We examined here this potential relationship with a contemporary view of human motivation, Self-Determination Theory which is reflected in different aspects of waking life.
Methods: 81 undergraduate university students (54 females, 27 males aged 18 to 24) recorded two morning home dreams and completed a global measure of intrinsic and extrinsic motivation. Dreams were blind coded using the achievement imagery scale of De Koninck and Sirois-Berliss (1978). In addition the Hall & Van de Castle (1966) (HV) scales of type 3 aggression (being controlled), type 5 friendliness (affiliation type of activity), success, failures, good fortunes, misfortunes, positive and negative emotions were hypothesized to be related to motivation and were also coded.
Results: A significant negative correlation was found between the waking global motivation score and the achievement imagery score in the dreams ($r = -.293$, $P < .01$, two-tailed) suggesting that high levels of waking self-determined motivation was associated with low achievement themes in dreams. A stepwise multiple regressions of the HV scales showed that failures ($\beta = -.359$, $P < .001$) and positive emotions ($\beta = +.230$, $P < .027$) were the two significant predictors of waking self-determined motivation, suggesting that high waking motivation was associated with low instances of failures in dreams and high levels of positive emotions.
Conclusion: These results replicate the finding of a compensatory relationship between waking motivation and achievement motivation in dream. The continuity relationship observed with positive emotions and failures suggests a possible distinction between trait and state in the relationship between waking and dreaming.

0236

SEMANTIC ASSOCIATIONS ENHANCE AUTOMATIC ANALYSIS OF DREAM EMOTIONAL VALENCE

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Introduction: We previously demonstrated that Logistic Regression used in dream negative emotional tone classification achieved 59% agreement with a human judge using the following attributes: text mining, word-correlation, affect progression and dreamer's experience of Joy, Happiness, Apprehension, Anger, Sadness, Confusion, Fear and Anxiety. Here we attempt to improve the automatic analysis by incorporation semantic attributes. With word-association we attempt to include those words that might be semantically related to explicit words.
Methods: 458 English dream reports were used to construct a list of words and their definitions from Wordreference.com and Wikipedia.org. Frequencies of words in definitions were used to construct the word-association matrix. The normalized matrix produced a vector for each word relating it to all other words (Word Vector). The Word Vector for each word of a dream was summed and used as attributes for each dream. Attributes were selected using the Weka's Best-First algorithm. 66% of the dreams were used for classification of dream's emotional valence (positive and negative) as scored by a human. Weka's Simple-Logistic was used. The remaining 34% were used to test the model with a 10 fold cross-validation.
Results: On the negative affect scale, Simple Logistic Model achieved a machine-human judge agreement of 62%, kappa 0.466, MSE of 0.388 which represents a 3% improvement over the previous model. The model for the positive affect scale, tested for the first time, produced an agreement of 77%, kappa 0.520, MSE of 0.317.
Conclusion: Word-association attributes improved the machine-human agreement for the negative affect scale and was associated with a promising agreement on the positive affect scale. Word-associations seem to be significant contributors to automated classification. Other forms of implicit communication such as symbols and themes may also be strong contributors for affect classification.

0237

TYPICAL DREAM THEMES IN IDIOPATHIC RAPID EYE MOVEMENT SLEEP BEHAVIOR DISORDER

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Introduction: Idiopathic rapid eye movement sleep behavior disorder (iRBD) is characterized by potentially injurious sleep motor activity associated with vivid dream mentation. The objective of this study was to assess themes and frequencies of typical RBD dreams compared to those of healthy control subjects.
Methods: Seventy-three patients (55 men; mean age: 63.3 ± 10.5 years) with polysomnography-confirmed iRBD and 45 healthy control subjects (29 men; mean age, 60.6 ± 11.5 years) were studied. They completed the Typical Dreams Questionnaire (TDQ), which assesses the lifetime prevalence of a selection of 56 typical dream themes. Prevalences for each theme were compared between the two groups using chi-square tests.
Results: No between-group differences were observed for age and gender. More iRBD patients than controls reported dreaming at least once of "being attacked" (49% vs. 27%; P = 0.02). Moreover, fewer patients with iRBD than controls reported dreaming of "arriving too late" (32% vs. 50%; P = 0.05), "having superior knowledge or mental ability" (10% vs. 26%; P = 0.02), "being of the opposite sex" (1% vs. 11%; P = 0.03), "seeing yourself as dead" (13% vs. 27%; P = 0.05), "sexual experiences" (40% vs. 76%; P = 0.0002), "killing someone" (4% vs. 22%; P = 0.002) and "encountering a kind of demon or evil force" (11% vs. 24%; P = 0.03).
Conclusion: Results are consistent with a previous report that iRBD dreams lack sexual content (Fantini et al. Neurology 2005). They also suggest that iRBD dreams are much more likely to represent patients as victims of violence ("being attacked") than as violent aggressors ("killing someone"). Lower prevalences of some other typical themes (e.g., "being of the opposite sex," "seeing yourself as dead") suggest less flexibility of self-representation by iRBD patients. Further research with daily dream journals are needed to clarify these preliminary findings.
Support (If Any): Supported by the Fonds de la Recherche en Santé du Québec and Canadian Institutes of Health Research.

0238

DO THE EYES FOLLOW THE DREAM IMAGES DURING REM SLEEP? EVIDENCE FROM THE REM SLEEP BEHAVIOUR DISORDER MODEL

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Introduction: Rapid eye movements (REMs) and complex visual dreams are salient features of human REM sleep. It is not yet determined if the eyes scan the dream images, even when retrospectively comparing the REMs direction to the vague dream recall obtained after having awakened the sleeper. We used the model of the REM sleep behaviour disorder (RBD, when patients enact their dreams by loss of physiological muscle atonia) to directly determine if the eyes move in the same direction as the head and limbs.

Methods: In 56 patients with RBD and 17 healthy matched controls, the eye movements (REMs) were monitored by electro-oculography in the four (right, left, up and down) directions, calibrated before sleep with a target, and synchronized with a video and sleep monitoring. Movements of the limb, head and eyes were timely compared.
Results: When REMs accompanied a goal-oriented motor behaviour during RBD (e.g. grabbing a fictive object, greeting with the hand, climbing a ladder, in 19 occurrences), 82.1% of them were directed towards the action of the patient (same plane and direction). When restricted to determinant REMs, the concordance increased up to 90 %. REMs were absent (while expected when reproducing the scenario awake) in 38-42% behaviours. The RBD-associated behaviours occurred 2.3 times more frequently during REM sleep with than without REMs, and more often during or after REMs than before. The REMs density, index and complexity were similar in patients with RBD and controls.
Conclusion: This directional coherence between the limbs, head and eye movements during RBD suggests that, when present, the REMs imitate the scanning of the dream scene. Since the REMs are similar in subjects with and without RBD, this concordance could be extended to the REM sleep in normal subjects.
Support (If Any): Fondation pour la Recherche Medicale 2008. Federation pour la Recherche sur le Cerveau 2007

0239

IMPACT OF SLEEP DEPRIVATION ON SEROTONIN 2A RECEPTOR DENSITY IN THE HUMAN BRAIN: A [^{18}F] ALTANSERIN PET STUDY

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Introduction: Acute sleep deprivation (SD) shows a rapid antidepressant effect which is likely to be related to serotoninergic neurotransmission. Several serotonin 2A receptor (5-HT$_{2A}$R) antagonists are used and developed as hypnotics. Here we investigated the impact of one night of SD on 5-HT$_{2A}$R density in the human brain.
Methods: 10 healthy subjects (39-55 years) without sleep disorders participated in two subsequent dynamic [^{18}F]altanserin bolus/infusions positron emission tomography (PET) scans before and after 24 hours of sustained wakefulness. The binding potential relative to the plasma concentration corrected for metabolism (BP_p), proportional to the 5-HT$_{2A}$R density, was chosen as outcome parameter. Several studies evidenced that [^{18}F]altanserin BP_p is not susceptible to endogenous displacement by serotonin. Anatomical MRI scans were used for the delineation of regions of interest. Subjects sleepiness was screened with the Stanford sleepiness scale (SSS).
Results: Globally, BP_p increased in most cerebral regions with high 5-HT$_{2A}$R density. We found a 13.9 ± 23% (paired t-test: P = 0.06) increase in the ventrolateral prefrontal cortex and a 14.5 ± 18% (P = 0.04) increase in the anterior cingulate cortex. Regression of SSS scores at the end of scanning and the BP_p showed a significant linear relation for the prefrontal cortex (R^2 = 0.35, P = 0.006) and the cingulate cortex (R^2 = 0.25, P = 0.02). Additional subjects are currently under investigation to increase the statistic power.
Conclusion: This preliminary analysis points to an elevation of the 5-HT$_{2A}$R density after SD. Furthermore 5-HT$_{2A}$R density and subjective sleepiness ratings correlates to some degree. These results suggest that SD may trigger plastic changes in cortical 5-HT$_{2A}$R density. These and our previous findings of increased A_1-Adenosin receptor density after SD in humans and rodents support the general hypothesis of an increase in synaptic strength during wakefulness and downscaling during normal sleep as a maintenance mechanism of synaptic functionality.

0240

EXAMINING A REHEARSAL SPAN COMPONENT PROCESS IN WORKING MEMORY DURING SLEEP DEPRIVATION USING fMRI

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Introduction: Research on verbal working memory (WM) has shown mixed results regarding effects of total sleep deprivation (TSD) on neural activation. WM comprises multiple cognitive processes, and depending on demands of a given task, this may be one reason for inconsistent findings. Here, we manipulated rehearsal span to elucidate the neural processing for this WM component when participants were well-rested and following TSD.
Methods: Twelve (age = 24.5 ± 3.9yrs, 7F) participants performed a verbal WM task during an event-related fMRI design. Rehearsal span was manipulated by increasing the number of syllabi (2,3,4-syllibal) in pseudo-words participants had to maintain in WM. Participants attended to pseudo-words (learn-event), rehearsed pseudo-words for several seconds (rehearse-event), and performed a 2-option forced choice recognition test (recognize-event). Participants were tested 12 hours after normal night of sleep and again after 36 hours of TSD. Behavioral and neuroimaging data were analyzed with 2x3 (Night-by-Difficulty) ANOVAs.
Results: A main effect for difficulty was found where accuracy decreased as task demands increased regardless of night. Clusters of activation during the rehearse event demonstrating a night-by-difficulty interaction were found demonstrating three types of activation patterns. Increased activation following TSD as task demands increased was observed in right Broca's and left Wernicke's areas. Disinhibition of activation during TSD as task demands increased was found in the right superior/medial frontal gyrus, inferior temporal gyrus, and visual association cortex. Increased activation following well-rested as task demands increased was found in right insula.
Conclusion: Similar to previous research examining TSD and verbal tasks, we found disinhibition of activation following TSD related to impaired behavioral performance. We also observed compensatory activation in areas involved in maintenance of verbal information. These two types of activation patterns could counteract leading to maintained performance under TSD at the group level. Individual variability in performance would depend upon the relative emphasis on each of these patterns.
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0241

DQB1*0602 ALLELE PREDICTS INTERINDIVIDUAL DIFFERENCES IN PHYSIOLOGICAL SLEEP STRUCTURE, SLEEPINESS AND FATIGUE DURING BASELINE AND CHRONIC PARTIAL SLEEP DEPRIVATION

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Introduction: The human leukocyte antigen DQB1*0602 allele is closely associated with narcolepsy, a neurological disorder characterized by excessive daytime sleepiness, fragmented sleep, and shortened REM latency. We evaluated whether DQB1*0602 was a novel marker of inter-individual differences by determining its relationship to sleep homeostatic, sleepiness and cognitive responses to baseline and chronic partial sleep deprivation (PSD) conditions.
Methods: 37 DQB1*0602 positive and 92 DQB1*0602 negative healthy adults (29.9 ± 6.9y;63f) completed 2 baseline (10h TIB/night) nights, followed by 5 consecutive PSD (4h TIB/night) nights in a controlled laboratory experiment assessing physiological sleep responses and neurobehavioral measures (cognitive performance and executive function tests, subjective sleepiness and fatigue, MWT). Comparisons were made between DQB1*0602 groups. DQB1*0602 allelic frequencies did not differ significantly between Caucasians and African Americans.
Results: During baseline, although DQB1*0602 positive subjects were significantly sleepier and more fatigued by self report (KSS, VAS, POMS), they showed greater sleep fragmentation, and decreased sleep homeostatic pressure and differentially sharper declines during the night (measured physiologically by NREM EEG slow-wave energy [SWE]). During PSD, despite SWE elevation comparable to DQB1*0602 negative subjects, DQB1*0602 positive subjects were sleepier and showed more fragmented sleep. Moreover, they showed differentially greater reductions in REM latency and smaller reductions in stage 2 sleep, along with differentially greater increases in fatigue. Both groups demonstrated comparable cumulative decreases in cognitive performance (PVT, Digit Span) and increases in physiological sleepiness (MWT) to PSD, and did not differ on executive function tasks (Hayling, COWAT).
Conclusion: DQB1*0602 positivity in a healthy population may represent a continuum of some sleep-wake features of narcolepsy. DQB1*0602 was associated with inter-individual differences in sleep homeostasis, physiological sleep, sleepiness and fatigue—but not in cognitive measures—during baseline and chronic PSD. Thus, DQB1*0602 may represent a genetic biomarker for predicting such individual differences in both basal and sleep loss conditions.

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0242

THE EMOTIONAL IMPACT OF SLEEP RESTRICTION IN ADOLESCENTS

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Introduction: Adolescence is high-risk period for the development of psychiatric disorders. Sleep restriction is also very common in this age group. We therefore conducted a pilot study to examine the effect of experimental sleep restriction and extension on objective and subjective measures of emotion in healthy adolescents.
Methods: Using a randomized cross-over design, thirteen healthy adolescents 12-15 years old free from psychiatric and sleep disorders underwent two experimental conditions in a counterbalanced order separated by one week: sleep extension (10 hours TIB for two nights) and sleep restriction (6 hours and 2 hours TIB over two nights). Subjective mood and sleepiness were measured using 8 (i.e., sad, tense, happy) and 2 (sleepy, alert) visual analog scale items. Pupil dilation responses to negative, neutral, and positive auditory stimuli (14 each) were used as an objective physiological indicator of emotional reactivity. Trials consisted of a 6-second stimulus followed by an 8-second inter-stimulus interval.
Results: Participants reported more sleepiness ($t = 3.12$, $P = 0.009$) and lower mood ($t = 2.34$, $P = 0.038$) when sleep restricted versus sleep extended. Under both experimental conditions, pupillary responses were significantly larger to negative sounds compared to positive or neutral sounds; however, this effect emerged 2 seconds earlier and was much larger following sleep restriction, $F(2,11) = 8.38$, $P = 0.006$, than sleep extension $F(2,11) = 5.19$, $P = 0.026$. Pupillary responses to negative sounds were significantly larger during sleep restriction versus extension, $F(1,12) = 20.35$, $P = 0.001$. The comparison of negative minus neutral waveforms was also significantly larger during sleep restriction compared to extension, $F(1,12) = 7.66$, $P = 0.017$.
Conclusion: Two nights of sleep restriction altered subjective and objective measures of emotion. Adolescents reported more sleepiness and mood degradation when sleep restricted. Sleep restriction also significantly elevated physiological reactivity to negative emotional sounds. These findings suggest that sleep loss leads to emotional dysregulation, and may have implications for the link between sleep disturbances and mood disorders in adolescence.
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0243

CHRONIC SLEEP RESTRICTION IMPAIRS REACTION TIME PERFORMANCE MORE IN YOUNG THAN IN OLDER SUBJECTS

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Introduction: Acute sleep deprivation studies show that lack of sleep can have severe consequences on performance. Reports from prior acute sleep deprivation studies have indicated that the performance of healthy older adults may be better preserved than that of young adults. In the current study, we examined whether this holds true under conditions of chronic sleep restriction.
Methods: Twelve healthy young and seven healthy older volunteers participated in a 39-day inpatient study. Subjects had 10h time in bed (TIB) for 3 weeks before the study. For 6 baseline days, they received 10-12h nightly sleep opportunities, followed by 3 weeks of chronic sleep restriction (CSR) on a 28h forced desynchrony (FD) protocol (21.5h wake:6.5h TIB per cycle; equivalent to 5.6h TIB/24h). Subjects then underwent nine recovery days [14h wake:10h TIB]. Every 4h throughout the study, subjects completed a 10-min psychomotor vigilance task (PVT). Mean reaction time (RT), slowest and fastest 10% responses, and lapses (RTs > 500ms) at baseline, each week of CSR, and at the end of recovery were compared between older and young subjects.
Results: Overall, older subjects performed significantly better than young subjects for mean RT, slowest 10%RTs, and lapses (all $P < 0.01$), with no age difference for the fastest 10%RTs ($P > 0.05$). There was no age difference in performance at baseline. Across CSR, performance in both groups worsened, but this degradation was significantly greater in the young subjects. Both age groups showed a circadian rhythm in performance across FD, with a greater amplitude in the young subjects, largely due to their poorer performance at adverse circadian phases. The older subjects continued to show better performance at the end of recovery, although neither group returned to baseline levels of performance.
Conclusion: Although both older and young subjects performed similarly at baseline and both groups performed more poorly during CSR than at baseline, the degradation of performance was greater in the young subjects. While neither group returned to baseline levels of performance by the end of the recovery, the older subjects continued to show better performance at the end of the recovery period.
Support (If Any): The study was supported by NIH grant P01 AG009975 and was conducted in the Brigham and Women's Hospital Center for Clinical Investigation (part of the Harvard Clinical and Translational Science Center) supported by M01 RR02635 and RR025758. Additional support was provided by AG06072 and HL080978. SWC was supported in part by a fellowship from the Natural Sciences and Engineering Research Council of Canada; MYM was supported by fellowships from Novartis Foundation, the W. & T. La-Roche Foundation, and Jazz Pharmaceuticals. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NCRR or the NIH.

0244

THE EFFECTS OF MODEST SLEEP RESTRICTION FOR ONE WORK-WEEK FOLLOWED BY RECOVERY SLEEP ON LEPTIN, HUNGER AND APPETITE LEVELS, AND ENERGY INTAKE IN A NON-STRESSFUL ENVIRONMENT

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Introduction: Short-term sleep curtailment in some of the experimental studies is associated with decreased leptin levels and increased hunger and appetite. The aim of this study was to assess the effects of one work week of mild sleep restriction followed by two days of recovery sleep over the weekend on leptin, hunger and appetite levels, and energy intake.
Methods: Thirty-four young healthy individuals (16 men, 18 women) were studied in the sleep laboratory for 13 consecutive nights. The first 4 nights served as baseline nights (8h/night), followed by 6 nights of partial sleep restriction (6h/night), followed by 3 recovery nights (10h/night). Subjective ratings of hunger and appetite, energy intake (kcal) and serial 24h plasma leptin and cortisol levels were measured on days 4 (baseline), 10 (after one week of sleep restriction) and 13 (after 2 nights of recovery sleep).

Results: Preliminary analysis showed no significant change in hunger and appetite levels after restriction compared to baseline as well as after recovery sleep compared to restriction and baseline, respectively. Also, no significant change in total energy intake and energy intake from meals and snacks respectively was observed during the sleep restriction period and after two nights of extended recovery sleep. Furthermore, 24-h plasma leptin and cortisol levels did not change significantly during the sleep restriction period, compared to baseline, and remained similar to the baseline after recovery sleep in a non-stressful environment.
Conclusion: One work-week of mild sleep restriction as well as the extended recovery sleep over the weekend in a relatively non-stressful environment did not affect hunger and appetite levels, energy intake and leptin secretion in young men and women. It appears that previous findings that short-term curtailment of sleep results on decreased leptin and increased appetite levels are related to stress levels rather than sleep loss per se.

0245

METABOLIC CONSEQUENCES OF CHRONIC SLEEP RESTRICTION COMBINED WITH CIRCADIAN MISALIGNMENT

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Introduction: Laboratory studies have shown that short-term partial sleep loss or circadian misalignment (e.g. as occurs with nightwork) can impair glucose metabolism. Epidemiological studies have shown an association between short or disrupted sleep and the development of diabetes. In this study, we tested the mechanistic hypothesis that prolonged sleep restriction in combination with circadian misalignment impairs glucose metabolism.
Methods: Healthy adults (n = 12, 6F, age 22.9 ± 0.8, BMI 24.2 ± 0.9 kg/m^2) completed a 39-day protocol with a baseline 'sleep replete' condition with 1 week of 10 h/day of time in bed (TIB) at home, then 6 days with > 10 h TIB per day. Sleep opportunities were then spread across the circadian cycle on a 28-h "forced desynchrony" protocol, with 6.5 h TIB and 21.5 h of monitored wakefulness ('sleep restriction with circadian misalignment' condition) for 17 ± 3 days. A subsequent week of "sleep recovery" (10 h TIB/24 h) occurred under entrained conditions with the sleep period shifted to the same circadian phase as the baseline "sleep replete" condition. Metabolic assessments were made at similar circadian phases (± 2h). Standardized breakfasts (58-60% CHO) were consumed in less than 30 min. Glucose and insulin were measured for assessment of fasted levels and post-prandial responses (peak, Area Under Curve, trapezoidal method AUC, over 3 h).
Results: Relative to the baseline, sleep restriction significantly increased post-prandial peak glucose by 15.2 ± 3.9 mg/dL ($P < 0.01$); AUC increased in all subjects (mean 2606 ± 295 mg, $P < 0.0001$) and remained higher than at baseline for over 3 h. There was also a tendency for mean fasted glucose to increase with sleep restriction (2.8 ± 1.5 mg/dL; $P = 0.08$, NS). Insulin levels with sleep restriction were unchanged at baseline (NS) In response to the standardized meal, insulin levels exhibited a lower post-prandial peak by 29 ± 8 μU/ml ($P < .01$) and AUC was lower by 1993 ± 587 μU ($P < .001$). Glucose and insulin responses to the standard meal (peak and AUC) in the "recovery sleep" condition were not significantly different from "sleep replete" baseline.
Conclusion: Sleep restriction combined with circadian misalignment for 2.5 weeks caused an increase in the glucose response to a standardized meal and a reduction in insulin secretion, presumably due to an inadequate pancreatic beta cell response. Such effects may underlie the elevated risk of diabetes in conditions of chronic short sleep and circadian misalignment.
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0246

THE RELATIVE INFLUENCE OF CIRCADIAN AND HOMEOSTATIC PROCESSES ON SLEEP DURING FORCED DESYNCHRONY WITH A RESTRICTED SLEEP OPPORTUNITY

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Introduction: The effects of the circadian and homeostatic processes on sleep structure have been well documented. However, it is unknown how these two regulatory processes influence sleep structure when sleep opportunity is restricted. The aim of the current study was to investigate the relative influence of circadian and homeostatic processes on rapid eye movement (REM) sleep and slow wave sleep (SWS) using a forced desynchrony (FD) protocol with a restricted sleep opportunity.
Methods: Fourteen males (21.8 ± 3.8yr) lived in a sleep laboratory free from time cues for 12 days. Participants were scheduled to 3x24h baseline days (8h sleep opportunity, 16h wake) followed by 7x28h FD days (4.7h sleep opportunity, 23.3h wake). Sleep was measured using standard polysomnography. Core body temperature (CBT) was recorded continuously using a rectal thermistor. Each epoch of sleep was assigned a circadian phase based on the CBT data (6x60 degree bins) and an elapsed time into sleep episode (2x140min intervals).
Results: Linear mixed model analyses showed no main effects of circadian phase ($P = 0.1$) or elapsed time ($P = 0.5$) on %REM sleep. There was a significant interaction between circadian phase and elapsed time ($P < 0.01$) on %REM sleep, with the circadian influence becoming more pronounced in the second half of the sleep period. There was no effect of circadian phase on %SWS ($P = 0.5$). There was a significant effect of elapsed time on %SWS ($P = 0.5$), with the highest amount observed in the first half of the sleep period (40.8 ± 9.9%) compared to the second half (26.2 ± 20.6%). There was no interaction between circadian phase and elapsed time on %SWS ($P = 0.8$).
Conclusion: Previous FD studies have demonstrated a circadian influence on sleep, in particular REM sleep, when sleep opportunity is not restricted. The current study suggests that in the presence of high homeostatic sleep pressure the circadian influence on sleep is less prominent.
Support (If Any): This study was financially supported by the Australian Research Council.

0247

ROLE OF NITRIC OXIDE IN THE PERIFORNICAL-LATERAL HYPOTHALAMIC AREA IN THE REGULATION OF SLEEP AND WAKEFULNESS

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Introduction: The perifornical-lateral hypothalamic area (PF-LHA) is a major wake-promoting structure. It predominantly contains neurons that are active during behavioral and cortical arousal. PF-LHA stimulation produces arousal and PF-LHA lesions produce somnolence. Nitric oxide (NO) is gaseous signaling molecule that is involved in the regulation of various physiological and pathophysiological processes including sleep. In the basal forebrain it has been demonstrated that NO levels rise dur-

ing sleep deprivation (SD) and contribute to recovery sleep subsequent to SD. In this study we tested whether NO accumulates in the PF-LHA during SD and modulates the neuronal to facilitate sleep.
Methods: Experiments were conducted during lights-on phase between 8.00AM and 6.00PM. We measured levels of NO metabolites (NOx-) in the microdialysis samples collected from the PF-LHA in undisturbed rats (n = 8), during 6h SD (n = 14), and during SD with a broad spectrum NOS inhibitor, L-NAME (n = 6). We further recorded the discharge activity of PF-LHA neurons in urethane-anesthetized rats during local microdialysis infusion of a NO donor, NOC-18 (1.0mM).
Results: The level of NOx- (maen ± SEM) in the PF-LHA during 6h SD was (2.0 ± 0.1μM) significantly higher ($P < 0.05$) than during corresponding period of baseline day (0.4 ± 0.2μM), and during 6h SD when NO production was blocked by L-NAME (0.8 ± 0.2μM). Of 27 PF-LHA neurons examined, NOC-18 suppressed the discharge of 15 neurons, increased discharge of 2 neurons, and produced no effects on 10 neurons. Of 15 arousal-on neurons, NO suppressed the discharge of 9 neurons.
Conclusion: We conclude that SD increases the production of NO in the PF-LHA, and that NO predominantly exerts inhibitory effect on PF-LHA neurons. We hypothesize that the inhibitory effect of NO on PF-LHA neurons contributes to sleep homeostasis.
Support (If Any): MH63323

0248

SPONTANEOUS AND HOMEOSTATIC SLEEP REGULATION IN GHRELIN RECEPTOR KNOCKOUT MICE

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Introduction: Previously we showed that intracerebroventricular and intrahypothalamic injections of ghrelin induce wakefulness in rats. To further investigate the possible roles of ghrelin in the regulation of arousal, we studied the spontaneous sleep and sleep deprivation-induced rebound sleep responses in ghrelin receptor (GHS-R) knockout (KO) and wild-type (WT) mice.
Methods: Spontaneous sleep-wake activity was recorded in male GHS-R KO (n = 8) and WT (n = 8) mice for 2 days. On the third day, mice were sleep deprived by gentle handling for the last 6 hours of the light period and recovery sleep was recorded from the beginning of the dark period for 24 hours.
Results: WT and GHS-R KO mice had similar diurnal rhythms of sleep with more NREMS and REMS during the light period than at night. The amounts of baseline NREMS, REMS and wakefulness did not differ significantly between the two genotypes. Sleep deprivation induced rebound increase in NREMS, REMS and EEG SWA in both WT and KO mice. NREMS rebound in GHS-R KO mice was higher and longer lasting compared to control animals. NREMS during the 12-h period following the sleep deprivation increased by 39% in the KO and by 24% in the WT mice. There was no significant difference in REMS rebound between the two genotypes.
Conclusion: GHS-R KO mice exhibit normal amount of spontaneous sleep and they are capable of mounting normal homeostatic sleep responses to sleep deprivation. These findings are similar to those in ghrelin KO mice. The results are in line with the hypothesis that hypothalamic circuits formed by ghrelin, orexin and neuropeptide Y neurons play a role in regulating vigilance.
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0249

SLEEP DEPRIVATION (SD) DOES NOT ALTER WATER CONSUMPTION OR THIRST IN RATS

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Introduction: Sleep disruption results in an increased demand for energy, which typically produces increased motivation for food in an attempt to redress the imbalance in energy metabolism. Therefore, the effect of sleep disruption on food reinforced tasks may overestimate the effect of sleep disruption due to the additive effects of hunger and sleep disruption. In contrast, water is not a central component of energy metabolism, and thus thirst may not be affected by sleep disruption. However, there has been little work done examining the effect of sleep disruption on water consumption, or motivation for water reinforcement.
Methods: The effect of SD on water consumption and thirst was assessed in two strains of rats. Two cohorts of Sprague Dawley (six and 22 months old), and one cohort of Fischer-Norway rats (22 months old) were tested. Water consumption was measured during 24h of SD, or during 15 minutes of water availability that immediately followed 24h SD. 5 days of continuous SD was then assessed on water consumption and thirst as measured using a progressive ratio (PR) task (a measure of motivational strength).
Results: In all cohorts 24h SD did not alter the water consumption compared to controls either during the 24h SD period, or during 15 min of water availability after 24h SD. Furthermore, 5 days of SD had no effect on water consumption, or performance in the PR task.
Conclusion: The findings indicate that SD does not alter total water consumption or motivation for water in two strains of rats. These results suggest that water restriction and thirst are less coupled to sleep and energy homeostasis than are food restriction and hunger. The fact that SD does not alter water consumption or thirst indicates that water restriction is well suited for experiments examining the effect of SD on reward motivated tests in rats.
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0250

CHRONIC LIGHT PHASE TOTAL SLEEP DEPRIVATION WITH UNRESTRICTED DARK PHASE SLEEP DOES NOT ADVERSELY AFFECT HIPPOCAMPAL CELL PROLIFERATION IN ADULT RATS

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Introduction: Previously we reported that total sleep deprivation (TSD) induced by the intermittent treadmill method results in reduced hippocampal dentate gyrus cell proliferation (HCP) in adult rats. We hypothesized that sleep-associated processes are required for enabling progression of the cell cycle. However, the reduction in the number of proliferating cells may result from stress caused by TSD. If sufficient compensatory sleep counteracts the effect of TSD on HCP, this would support the hypothesis of the role of sleep in promoting HCP. In this study we examined changes in HCP in response to chronic TSD restricted to the light phase with ad libitum sleep during the dark phase.
Methods: Sprague-Dawley rats (n = 36) were divided into three groups: 1) TSD during the light phase, 2) treadmill control (TC) (equates the distance traveled on a treadmill with that in experimental group and provides periods of sustained sleep), and 3) cage control (CC) procedures. On day 14 of the procedures rats were injected with 5-bromo-2-deoxyuridine (BrdU, 300 mg/Kg) to label proliferating cells either at ZT 9 or 21 and sacrificed 2 h later. BrdU-labeled nuclei were detected immuno-

histochemically and then counted stereologically within the subgranular zone of the dentate gyrus.
Results: Rats subjected to chronic light phase TSD with unrestricted dark-phase sleep did not exhibit reductions in the number of proliferating cells that entered S phase in the dark or in the light phase compared to either CC and TC animals.
Conclusion: Chronic TSD during the light phase does not adversely affect HCP if sleep is permitted during the dark phase. These data support the role of sleep as modulator of HCP and stresses the importance of sufficient day time sleep in night shift workers.
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0251

DROSOPHILA AS A MODEL SYSTEM TO STUDY THE RELATIONSHIP BETWEEN SLEEP AND SEIZURE

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Introduction: Drosophila melanogaster has been used as a model system to study neurological conditions, such as seizure, that impact human health and quality of life. In mammals, sleep deprivation is known to increase seizure susceptibility. While the fly has been used to independently identify genes that are involved in either sleep regulation or susceptibility to seizure, the relationship between sleep loss and seizure has not yet been investigated. Thus, we evaluated the effects of sleep loss on two Drosophila mutants in which seizures can be induced by either a physical perturbation, stress sensitive b ($sesB^{9Ed-4}$), or by an elevated temperature, seizure (sei^{1}).
Methods: Sleep was monitored in 3-day old female $sesB^{9Ed-4}/+$ and sei^{1} mutants using Trikinetics activity monitors. Flies were sleep deprived for 12 hours using the Sleep Nullifying Apparatus (SNAP). Seizures were tested by vortexing the fly at the highest setting for 10 seconds and then monitoring the time until the flies moved ($sesB^{9Ed-4}/+$) or by placing flies into a glass vial submerged in a water bath at 37°C (sei^{1}). Valproate was mixed with enriched fly food at a concentration of 25 mM, consistent with previously published doses.
Results: We demonstrate that 12 hour sleep deprivation significantly increases seizure duration in both $sesB^{9Ed-4}/+$ ($P < 0.05$; $n = 74$) and sei^{1} mutants ($P < 0.01$; $n = 18$) compared to untreated controls. Moreover, $sesB^{9Ed-4}/+$ mutants fed Valproate prior to sleep deprivation did not exhibit an increase in seizure duration ($P > 0.05$; $n = 74$).
Conclusion: These data indicate that the fly can be used to model the relationship between sleep loss and seizure susceptibility. It is unlikely that the increased seizures were due to non-specific effects of the deprivation apparatus since they were observed when seizure was induced by two distinct methods and was absent in flies fed Valproate. Further studies are needed to elucidate the mechanisms whereby sleep loss increases seizure susceptibility.
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0252

MURINE MULTIPLE SLEEP LATENCY TEST INDICATES INCREASED SLOW WAVE SLEEP IN HUMAN Apoe4 TARGETED REPLACEMENT MICE FOLLOWING INTERMITTENT HYPOXIA AND SLEEP FRAGMENTATION

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Introduction: Alzheimer disease (AD) is accompanied by significant disruption in sleep/wake patterns. AD patients not only exhibit excessive sleep during the day but also an increased tendency to fall asleep during the day time. This disruption may lead to cognitive and functional impairment in AD patients. Sleepiness can be defined as the propensity to fall asleep and can be quantitatively measured by means of the multiple sleep latency test (MSLT). To determine whether human Apoe4 targeted replacement mice (hApoE4) show more sleepiness following sleep perturbations, we developed a murine MSLT (mMSLT) test.
Methods: hApoE4 mice and age matched C57BL/6NTac mice were chronically implanted with a telemetric transponder to measure EEG, EMG, body temperature (Tb) and gross activity (Ag) at 6 months. The mice were acclimatized in a custom developed SD/SF chamber. Following baseline recordings of 24 hours (7am -7am), mice were subjected to (a) intermittent hypoxia (IH; cycling 5.7% or 21% oxygen every 3 min), (b) sleep fragmentation (every 2 min), and (c) sleep deprivation, all from 1pm-7pm. Following each intervention, the animals were subjected the following day to mMSLT, during which animal were sleep deprived for 20 minutes followed by recovery time for next 20 min. This process was repeated 12 times. Continuous EEG, EMG, Tb and Ag were recorded during the entire mMSLT.
Results: Baseline mMSLT showed comparable SWS during each 20 min bin of recovery periods in both hApoE4 and C57BL/6Ntac mice. However, following every intervention (IH, SF and SD), hApoE4 mice spent markedly higher time in SWS during the recovery time (20 min following sleep deprivation) when compared to controls during the first 8 cycles. From cycle 9 to 12, control mice showed similar sleep time as the ApoE4 mice. The latency to first sleep bout after each forced arousal, number of sleep episodes and delta power during SWS are currently under analysis.
Conclusion: hApoE4 mice exhibit more sleepiness following IH, SF and SD during the day immediately after such intervention, suggesting limited recovery ability by hApoE4 mice.
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0253

CONCOMITANT EXPOSURES TO ACUTE INTERMITTENT HYPOXIA AND SLEEP FRAGMENTATION INCREASE SLEEP PROPENSITY AND HYPOTHERMIA IN HUMAN APOLIPOPROTEIN E4 TRANSGENIC MICE

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Introduction: Alzheimer disease (AD) is accompanied by significant disruption in sleep/wake patterns. The presence of sleep-disordered breathing, i.e., cyclic intermittent hypoxia (IH) and the resultant sleep fragmentation (SF) in AD patients may accelerate neurodegenerative processes. Linkages between apolipoprotein E4 (ApoE4), AD, and sleep apnea have emerged; however, no studies have specifically assessed sleep phenotype, core body temperature (Tb), and gross motor activity (Ag) regulation under simultaneous exposures to acute IH and SF conditions in human Apoe4 targeted replacement mice (hApoE4).
Methods: hApoE4 and age matched C57BL/6NTac mice were chronically implanted with telemetric transponders to measure EEG, EMG, Tb and Ag at 6 months. The mice were acclimatized in a custom developed sleep fragmentation chamber, which in turn was enclosed in commercially available hypoxia chambers operated under a 12-hour light-dark cycle. Following baseline recordings of 24 hours (7am -7am), the recordings were continued for another 24 h during which the animals were concomitantly exposed to IH (cycling 5.7% or 21% oxygen) and sleep fragmentation (every 2 min) for 6 hours, from 1pm-7pm.
Results: hApoE4 mice showed an increase in wake and decrease in SWS and REM sleep during IH/SF exposures. However, during dark hours when mice were in room air, there was a marked SWS and REM rebound in ApoE4 mice when compared to C57BL/NTac mice control mice. IH/SF also induced marked hypothermia and drastic decreases in gross motor activity. Body temperature returned to baseline immediately after cessation of IH and SF exposures during the recovery

period; however, gross motor activity remained reduced compared to control mice.
Conclusion: Using a combination of sleep-wake, Tb, and Ag recordings, the preliminary results support the hypothesis that IH/SF imposes global temporal effects on multiple physiological functions, and suggest unique vulnerability among transgenic mice aiming to replicate human neurodegenerative disorders.
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0254

ARE ENDOGENOUS SEX HORMONES RELATED TO DNA DAMAGE IN PARADOXICALLY SLEEP-DEPRIVED FEMALE RATS?

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Introduction: The aim of this investigation was to evaluate overall DNA damage induced by experimental paradoxical sleep deprivation (PSD) in estrous-cycling and ovariectomized female rats to examine possible hormonal involvement during DNA damage.
Methods: Intact rats in different phases of the estrous cycle (proestrus, estrus, and diestrus) or ovariectomized female Wistar rats were subjected to PSD by the single platform technique for 96h or were maintained for the equivalent period as controls in home-cages. After this period, peripheral blood and tissues (brain, liver, and heart) were collected to evaluate genetic damage using the single cell gel (comet) assay.
Results: The results showed that PSD caused extensive genotoxic effects in brain cells, as evident by increased DNA migration rates in rats exposed to PSD for 96h when compared to negative control. This was observed for all phases of the estrous cycle indistinctly. In ovariectomized rats, PSD also led to DNA damage in brain cells. No significant statistically differences were detected in peripheral blood, the liver or heart for all groups analyzed.
Conclusion: Our data are consistent with the notion that genetic damage in the form of DNA breakage in brain cells induced by sleep deprivation overrides the effects related to endogenous female sex hormones.
Support (If Any): Associação Fundo de Incentivo à Psicofarmacologia (AFIP) and FAPESP (CEPID no. 98/14303-3 to ST; 06/58274-5 to TAA). MLA, DAR and ST are recipients of the CNPq fellowships.

0255

ESTRADIOL AND PROGESTERONE REPLACEMENT ALTERS THE SLEEP ARCHITECTURE OF OVARIECTOMIZED RATS BOTH UNDER BASELINE CONDITIONS AND AFTER SLEEP DEPRIVATION

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Introduction: We recently showed that ovariectomized (OVX) rats treated with estradiol (E) and/or progesterone (P) spent less time in non-rapid eye movement sleep (NREMS) and/or REMS than OVX rats receiving no hormones. After 6 h of sleep deprivation (SD), the hormonally treated rats showed a smaller increase in NREMS delta power but a larger increase in REMS amount. To understand better the hormonal influence on sleep regulation, we further analysed the sleep architecture in these and hormonally untreated male rats.
Methods: Female Wistar rats were OVX and implanted subcutaneously with silastic capsules containing oil vehicle (Oil), 10.5 µg of 17β-E (LE), 60 µg of 17β-E (HE), 40 mg of P (LP), or 10.5 µg of 17β-E and 40 mg of P (LEP). Males were left gonad-intact and implanted with oil-filled capsules. All rats were also implanted with EEG and EMG electrodes. Two weeks after surgery, EEG and EMG were recorded during a 24 h baseline period, followed by 6 h of SD (gentle handling) in the second half of the light phase, and an 18 h recovery period.
Results: During the baseline dark phase, the HE and LEP groups had 31-38% shorter NREMS episodes, and the HE, LEP and LP groups had 37-46% fewer REMS episodes, compared to the Oil group. The LEP group had twice as many brief arousals per hour of sleep than the Oil group. During the recovery dark phase, the mean duration of NREMS episodes increased significantly (by 45-69%) in the LE, HE, and LEP groups relative to their baseline dark phase. All groups showed significantly more REMS episodes compared to their respective baselines, with the smallest relative increase in the Oil group. The HE and LEP groups also had significantly longer REMS episodes and fewer arousals compared to their baselines. Males had longer NREMS episodes than the LP group under both baseline and recovery periods.
Conclusion: At baseline, treatments with E alone or combined with P decreased both the duration of NREMS episodes and the number of REMS episodes, and increased the frequency of brief arousals from sleep; these results parallel the previously reported reduction in baseline NREMS and REMS amounts. After SD, the hormonal treatments caused a larger relative increase from baseline in the duration of NREMS episodes and in the number and duration of REMS episodes, consistent with the previously reported larger increase in recovery REMS amount. Together, these results indicate that the presence of E and/or P influences sleep architecture both at baseline and after SD in female rats.
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0256

CHRONIC SLEEP RESTRICTION INCREASES WEIGHT GAIN IN ADULT MALE RATS

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Introduction: Short sleep duration has been associated with increased risk of overweight and obesity. Although it has been suggested that insufficient sleep leads to obesity, this hypothesis has never been confirmed in any experimental studies. Previous animal studies indicate that sleep deprivation (SD) results in weight loss and increased food intake. However, the SD methods used in these studies were not designed for chronic sleep restriction (CSR) to mimic human conditions. In the present study, we used a disc treadmill method to chronically reduce daily sleep of the animals by 20-25% for several weeks, and determined weekly weight gain and food intake.
Methods: Adult male Sprague-Dawley rats (n = 20) were chronically implanted with EEG and EMG electrodes. Each animal was placed in a disc treadmill chamber, which consists of a suspended cylinder with a fence-like divider and a rotatable tray controlled by computer program through a relay box and a DC motor. Baseline sleep and food intake were recorded. CSR was performed for 5 days per week for 4 weeks. The CSR rat was waken up by disc rotation upon computer detection of sleep according to EEG and EMG thresholds. During CSR, the animals were allowed to sleep for 60% and 20% of time during the light and dark period, respectively. Matched control animals received the same amounts of rotation stimuli as the CSR rats.
Results: Weight gain in both CSR and control rats stopped within the first week of CSR, and resumed thereafter. The CSR rats gain significantly more weight (5.71% vs. 3.04%, $P < 0.02$) during weeks 3-4 compared to the controls. The CSR rats also consumed more food during CSR period.
Conclusion: Results provide the first experimental evidence that CSR increases weight gain, and that SD with different methods may have opposite effects on body weight.
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0257

EXPOSURE TO BRIGHT, MILLISECOND LIGHT FLASHES ENHANCE OBJECTIVE MEASURES OF NOCTURNAL ALERTNESS IN HUMANS

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Introduction: Exposure to bright light at night can enhance both subjective and objective measures of alertness. In humans, most of the photic stimuli that have been employed in these studies have been at least an hour in length. In rodents, brief millisecond light exposure can shift the timing of the circadian system. This effect may be mediated, in part, by melanopsin-expressing intrinsically photosensitive retinal ganglion cells (ipRGC) that project to the suprachiasmatic nuclei and other hypothalamic regions.
Methods: To examine the effects of millisecond light exposure in humans, we had six subjects participate in a randomized crossover study, such that subjects received on two separate visits (> 2 weeks apart) either one hour of darkness or one hour of a light stimulus in which a 3-ms pulse of bright light was given once per minute for 60 minutes on a background of darkness (total of 180 ms of light during the 60 minutes of darkness). Subjects were wakened two hours after typical bedtime for stimulus administration. Vigilance was measured immediately before and at the end of the 60-minute stimulus using the Stanford Sleepiness Scale (SSS) and 10-minute auditory Psychomotor Vigilance Test (aPVT).
Results: SSS scores improved 0.86 units after dark exposure and 1.57 units after flash exposure. aPVT data (n = 4) indicated that compared with exposure to darkness, after exposure to flash stimuli, subjects had greater improvement in mean (+188 ms vs. +66 ms) and median (+72 ms vs. +36 ms) reaction time, had fewer lapses (-31 vs. -8), and less time-on-task decrement (+9% vs. -13%).
Conclusion: Our preliminary analyses indicate that in humans, exposure to extraordinarily brief, millisecond flashes of light has the capacity to improve alertness at night.
Support (If Any): Air Force Office of Scientific Research (F2-4506); VA Sierra Pacific Mental Illness Research, Education and Clinical Center; Stanford University office of the Vice Provost for Undergraduate Education.

0258

BRAIN ACTIVATION ON A VERBAL LEARNING TASK DURING RECOVERY FROM 60 HOURS OF TOTAL SLEEP DEPRIVATION

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Introduction: Individuals often show behavioral impairment following total sleep deprivation (TSD). We previously documented how the brain must compensate to perform at baseline levels after 36hrs TSD but fails to maintain the same level of compensation after 60hrs TSD. Here, we examined both behavioral and cognitive recovery on a verbal learning task after 60 hours TSD to see when performance and activation return to baseline levels.
Methods: Subjects (28, 13F, age = 24.6 ± 5.3, education = 15.3 ± 1.6) spent five consecutive days in the lab, including a baseline night of normal sleep, 60 hours TSD, and two nights of recovery sleep (7-9hrs in bed). In the evening each day, they completed a verbal encoding task with 2 levels of difficulty (easy and hard words) while undergoing FMRI. Analyses examined brain activation at baseline (Norm) and during both recovery days (Rec1 and Rec2).
Results: Behaviorally, subjects returned to baseline levels by Rec1 for both easy and hard words and improved over Norm at Rec2 for hard words (P = .005). During Rec1, bilateral inferior parietal lobes (IPL) and right inferior frontal gyrus (IFG) showed increased activation compared to Norm for easy words. For hard words, Rec1 (relative to Norm) showed increased activation in bilateral IPL, left superior parietal lobe, right parahippocampal gyrus, and right IFG. After Rec2, easy words continued to elicit increased activation in left IFG and IPL, but hard words showed no differences from Norm.
Conclusion: After 60hrs TSD, verbal encoding performance returned to baseline after one night of recovery sleep, but brain activation did not return to baseline until after at least two nights of recovery sleep. These data show that while performance may recover quickly after TSD, the brain still needs compensatory recruitment to produce this "recovered" performance. Thus, cerebral compensation is not only important for maintaining performance during TSD but during recovery as well.
Support (If Any): UCSD GCRC M01 RR00827; DMAD17-02-1-0201

0259

INDIVIDUAL DIFFERENCES IN THE EFFECT OF 36-HR SLEEP LOSS ON COMMON VOCAL MEASURES

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Introduction: Fatigue/sleepiness assessment is important in our 24/7 active world and vocal analysis shows promise for monitoring and detecting sleepiness. Vocal measures were evaluated for differential sensitivity to sleepiness in groups either vulnerable or resistant to 36-hr sleep deprivation.
Methods: Vocal recordings were analyzed from 13 each Control (female = 10) and 36-h sleep-deprived (SD) participants (age: 20.46+1.96). SD participants were divided into "Resistant" (n = 6, female = 3) and "Vulnerable" (n = 7, female = 3) based on Psychomotor Vigilance Task performance. Recordings included baseline at 2030h (session 1), 0830h (session 2), and 2030h (session 3). Tasks included counting aloud rapidly from 90-99 (COUNT) and reading a standard prose "rainbow passage" (RBOW). Measures included median fundamental frequency (F0 in Hz), speaking response-time latency (msec), syllables/sec speaking rate, db intensity-loudness, cycle-to-cycle perturbations in F0 (jitter) and intensity (shimmer), word misarticulations, and errors in speaking.
Results: Repeated-measures ANOVA across test sessions and between groups indicated that speaking rate on RBOW increased over time for Controls [$F(4,46) = 2.735$, $P = .046$, session $1 < 2,3$] as did COUNT speaking response-time latency which was marginally faster [$F(4,46) = 2.31$, $P = .072$, session $3 < 1$], but for Vulnerables was slowest at session 3. For all groups F0 significantly changed over time for RBOW [$F(2,46) = 8.004$, $P = .001$, session $3 > 1,2$] and for COUNT [$F(2,46) = 4.420$, $P = .018$, session $3 > 1$]. F0 was highest at session 3 and lowest at session 2, suggesting a diurnal trend. RBOW shimmer was highest at session 2 for all groups [$F(2,46) = 3.577$, $P = .043$, session $2 > 3$], somewhat more for Vulnerables [$F(4,46) = 2.198$, $P = .095$, session $2 > 3$]. Resistants had higher intensities even at baseline for both RBOW [$F(2,23) = 7.632$, $P = .003$] and COUNT [$F(2,23) = 15.106$, $P < .001$].

Conclusion: Vulnerables showed slightly more vocal sleepiness than Resistants for the measures tested. Controls showed apparent increased vocal efficiency or possibly a learning effect, likely fatigue-attenuated for SD groups. Voice sensitivity measures to sleep deprivation appear related to both choice of task and measure.

0260

RESISTANCE TO SLEEP LOSS AND ITS RELATIONSHIP TO DECISION MAKING DURING SLEEP DEPRIVATION

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Introduction: Previous research suggests that some aspects of executive functioning, such as emotion guided decision-making on the Iowa Gambling Task, are sensitive to sleep deprivation. It is well established that some individuals show trait-like vulnerability or resistance to the effects of sleep loss on simple tasks involving alertness and vigilance. Here, we classified individuals as either "resistant" or "vulnerable" based on their sleep deprived performance on a psychomotor vigilance test (PVT) and examined whether this trait-like resistance also extends to emotion-guided decision-making capacities on the IGT.
Methods: From a larger sample of healthy subjects, 13 (8 men; mean age = 23.1 years, SD = 3.4) were classified as "resistant" and 13 (7 men; mean age = 23.8 years, SD = 3.5) were classified as "vulnerable" to sleep deprivation based on scoring in the upper or lower quartile of PVT performance during 41 hours of sleep deprivation. During sleep deprivation, subjects were administered the Iowa Gambling Task (IGT) at rested baseline (following an 8 hour overnight sleep period) and again following 23 hours of wakefulness. Using a mixed-model ANOVA, performances on the 5 blocks of the IGT were compared between vulnerable and resistant groups and between baseline and sleep deprived conditions.
Results: A significant block by group by session interaction was found ($P = .04$). Whereas both groups learned the task similarly at baseline, only the "resistant" group showed significant improvement in decision-making during sleep deprivation. The decision-making capabilities of the "vulnerable" group, in contrast, were relatively suppressed during sleep deprivation ($P < .05$).
Conclusion: Subjects classified as "resistant" to sleep deprivation based on PVT performance performed similar to vulnerable individuals on the IGT at baseline, but outperformed "vulnerable" individuals on the IGT during sleep deprivation. Trait-like differences in vulnerability to vigilance decrements during sleep loss also extend to emotion-guided decision-making capacities.

0261

BASELINE EXECUTIVE FUNCTION ABILITIES PREDICT RISKY BEHAVIOR FOLLOWING SLEEP DEPRIVATION

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Introduction: Evidence suggests that individuals with greater activation/functioning of the prefrontal cortex at rested baseline may be better able to resist the adverse effects of sleep deprivation on alertness and vigilance. Whether this holds true for risk-taking behavior is not known. We examined whether baseline executive function capabilities (a putative measure of prefrontal functioning) are predictive of stability or change in risk-taking behavior on the Balloon Analog Risk Task (BART) after 24 hours of sleep loss.
Methods: Fifty-four (29 men) healthy individuals completed a battery of neurocognitive tests at rested baseline. The BART was completed at rested baseline and again following 24 hours of wakefulness. On the BART, participants pressed a key to pump up a virtual balloon, earning money for each pump, unless the balloon popped. Risk-taking was defined as the number of pumps made for unexploded balloons that were successfully redeemed (i.e., Adjusted Number of Pumps; AnP). Change in risk-taking was defined as the difference between the sleep deprived AnP and baseline AnP (i.e., CHANGE = AnP2 - AnP1). Neurocognitive test scores were used to predict CHANGE using Pearson correlations.
Results: As predicted, CHANGE was significantly predicted by baseline performance on prefrontal executive tasks including Letter-Number Sequencing ($r = -.39$, $P = .003$), Color Trails Part 2 ($r = .37$, $P = .006$), and phonemic verbal fluency ($r = -.33$, $P = .02$), but not for demographic factors such as age ($r = .12$), handedness ($r = .00$), education ($r = .03$), or cognitive variables such as full-scale intelligence ($r = -.23$), judgment of line orientation correct ($r = -.25$), or performance on the Stroop word ($r = -.04$), color ($r = -.04$), or color-word conditions ($r = -.16$).
Conclusion: Increased risk-taking following a night of sleep deprivation was predicted by lower executive function capacities at rested baseline, particularly those involving working memory, mental set shifting, and cognitive manipulation. Findings support an emerging perspective that baseline executive function capacities may be protective against the adverse effects of sleep loss on cognition.

0262

VULNERABILITY TO SLEEP DEPRIVATION IS DIFFERENTIALLY MEDIATED BY SOCIAL EXPOSURE IN EXTRAVERTS VS. INTROVERTS

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Introduction: Waking experience has significant effects on subsequent sleep need and sleep architecture. How social exposure affects the ability to resist the adverse effects of sleep loss on alertness in humans is not known, nor is it known whether the effects of social exposure during sleep deprivation differ between introverts and extraverts. We compared the effects of high vs. low social experience during 36 hours of continuous wakefulness in introverts vs. extroverts.
Methods: Participants were assigned to socially "Enriched" ($n = 24$) or "Impoverished" ($n = 24$) conditions (activities matched) for 12 hrs (1000-2200) on Day 1 followed by 22 h sleep deprivation (2200-2000; 36 hrs awake total), monitored by actigraphy. A median split of volunteers' Eysenck Extraversion scores was used for Extravert/Introvert categorization. The Psychomotor Vigilance Task (PVT), modified Maintenance of Wakefulness Test (MWT), and Stanford Sleepiness Scale (SSS) were administered every 2 h throughout. PVT speed, transformed lapses, modified MWT sleep onset latency, and SSS were analyzed using mixed-model ANOVAs, with total actigraphic activity during Enrichment/Impoverishment and age used as covariates.
Results: Social experience interacted with personality type to affect alertness and vigilance. Following social enrichment, PVT speed was significantly slower among Extraverts than Introverts during sleep deprivation, but no personality group differences emerged following social impoverishment. Similarly, social enrichment was associated with more PVT lapses at 0400 than following social Impoverishment overall. MWT sleep latency and SSS subjective sleepiness did not show significant personality or social condition effects during sleep deprivation.
Conclusion: The effect of social exposure on vulnerability/resiliency to sleep deprivation was modulated by the trait of Introversion/Extraversion. Extraverts exposed to social environments were more vulnerable to subsequent sleep deprivation than Introverts, perhaps as a function of lower basal cortical arousal and a greater tendency to ac-

tively engage in social interactions, resulting in more rapid fatigue of prefrontal cortical regions.

0263

GENERALIZABILITY OF INTROVERSION/EXTRAVERSION AS PREDICTOR OF VULNERABILITY TO NOCTURNAL SLEEP DEPRIVATION

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Introduction: Previous studies of individual differences in vulnerability to total sleep deprivation (TSD) did not find introversion/extraversion (I/E) to predict neurobehavioral performance as averaged over night and day. However, a recent study reported that greater extraversion was associated with greater impairment on a psychomotor vigilance test (PVT) specifically during the first night of 77h TSD. We examined whether I/E predicted PVT deficits across the night during 36h TSD in two studies conducted in our laboratory.
Methods: As part of study 1, N = 20 healthy adults (21-38y; 9f) underwent two 36h TSD sessions each starting at 10:00, and completed a 20min PVT every 2h. As part of study 2, N = 21 healthy adults (22-40y; 11f) also underwent two 36h TSD sessions starting at 10:00, and completed a 10min PVT every 2h. Subjects' I/E scores were determined with the Eysenck Personality Questionnaire administered prior to sleep deprivation. Sleep-deprived performance was assessed by averaging PVT lapses (number of RTs > 500ms) and speed (mean 1/RT) across the nocturnal period from 00:00 to 08:00. Baseline performance was quantified by averaging performance from 14:00 to 18:00 on the first day of each respective TSD session, and controlled for by expressing lapses as difference from baseline and speed as percentage of baseline. Results were averaged across the two TSD sessions in each study, and analyzed with ANOVA for each study separately and both studies combined.
Results: Increased extraversion predicted fewer PVT lapses relative to baseline ($F = 8.63$, $P = 0.01$) in study 1 (20min PVTs), but I/E did not predict PVT lapses in study 2 nor both studies combined ($F \leq 0.02$, $P \geq 0.88$). Also, I/E did not significantly predict PVT speed in either study 1 or study 2, nor in both studies combined ($F \leq 3.92$, $P \geq 0.06$).
Conclusion: I/E did not consistently predict nocturnal PVT performance during TSD. In agreement with earlier findings based on performance averaged over night and day, the present findings do not support I/E as a generalizable predictor of vulnerability to sleep deprivation.
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0264

EXTRAVERTS MAY BE MORE VULNERABLE THAN INTROVERTS TO SLEEP DEPRIVATION ON SOME MEASURES OF RISK-TAKING AND EXECUTIVE FUNCTIONING

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Introduction: Some evidence suggests that introverts are more resistant than extraverts to declines in psychomotor vigilance during sleep deprivation. However, it is not known whether introversion plays a similarly protective role for executive functioning during sleep loss. Furthermore, some evidence suggests that social exposure may exacerbate the effects of sleep derivation. We, therefore, compared the effects of introversion vs. extraversion and high vs. low social experience during 36 hours of continuous wakefulness on measures of executive functioning.
Methods: Participants were assigned to socially "Enriched" (n = 24) or "Impoverished" (n = 24) conditions (activities matched) for 12 hrs (1000-2200) on Day 1 followed by 22 h sleep deprivation (2200-2000; 36 hrs awake total), monitored by actigraphy. A median split of volunteers' Eysenck Extraversion scores was used for Extravert/Introvert categorization. The Evaluation of Risks Questionnaire (EVAR), Iowa Gambling Task (IGT), and Balloon Analogue Risk Task (BART) were each administered once between 0800-0900 on Day 1, at 25-hrs awake, and after a recovery night. The Wisconsin Card Sorting Task (WCST), Tower of London (TOL), and Thurston Word Fluency Task (TWFT) were administered once each between 0600-0800 on Day 2 (23-25 hours awake). ANOVAs were used, with between group factors social enrichment vs. impoverishment and introverts vs. extraverts and within-factor Condition (Day 1, sleep deprivation, and recovery) for EVAR, BART, and IGT.
Results: During sleep deprivation, extraverts engaged in "riskier" performance on the IGT, and performed relatively more poorly ("earned less money") on the BART, than introverts. Extraverts also performed worse on the WCST during sleep deprivation with relatively increased perseverative errors and responses. No other significant effects were found.
Conclusion: For risk-taking and some executive functions involving conceptual level responses, extraverts are more vulnerable than introverts to sleep deprivation-induced performance degradation. However, there were no significant main or interaction effects of social exposure in the present study.

0265

GENDER DIFFERENCES IN THE IMPACT OF SLEEP DEPRIVATION ON RISKY DECISIONS

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Introduction: Sleep deprivation (SD) alters risk taking. Generally, individuals take more risk while sleep deprived, although this may depend on whether they try to maximize gains or minimize losses. Here, we examine whether gender interacts with two types of sleep deprivation to alter risk-based decisions.
Methods: Twenty-eight participants (age = 25.47 ± 6.1, 16F) performed a gamble task when well-rested (WR: 6 nights, 9hrs in bed/night) and following either 24hrs total sleep deprivation (TSD) or 5 nights partial sleep deprivation (PSD: 4hrs in bed/night). The task required several decisions between a safe vs. risky gamble for both losing (Losses) and gaining (Gains) money. ANOVAs examined the effect of Gender, Night (WR vs SD) and Type of SD on risk preference score.
Results: For Gains, there was a significant Gender-by-Night-by-Type of SD interaction. Follow-up analyses showed a significant Night-by-Gender interaction for PSD, but not for TSD. For the PSD group, men were risk avoiding after WR, and they became risk seeking after PSD. Women, on the other hand, were also risk avoiding WR and became (non-significantly) more risk avoiding after PSD. For the TSD group, both genders were risk avoiding both while WR and after TSD. Gender did not interact with night or type of SD for Losses.
Conclusion: These data show both gender and type of SD affect risk behavior after sleep deprivation. As shown previously, both genders were risk avoiding when making decisions in an attempt to maximize real money gains when WR. The amount of risk women were willing to take did not change with either TSD or PSD. Men, however, were willing to take significantly more risk after PSD, but their risk preference was not affected by TSD. If extended to other types of risky decisions, these results would have significant implications in operational settings where risk is a relevant factor.
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0266

SEX DIFFERENCES IN VISUOSPATIAL ABILITIES UNDER SLEEP DEPRIVATION CONDITIONS

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Introduction: Although it is well established that males and females have different abilities on spatial tasks, few studies have examined the effects of sleep deprivation. The purpose of the current study was to examine the effects of short-term sleep deprivation on spatial performance in males and females.
Methods: Participants included 36 male and 20 female college students. All participants completed a variety of tasks four times during 30 hours of acute sleep deprivation. The tasks included the Perceptual Ability Test (PAT) portion of the Dental Admissions Test. The PAT resulted in five scores: a total score, angle discrimination, cubes, aperture, and paper folding. Angle discrimination required participants to distinguish between 2-D angles. Cubes required participants to count the cubes in a stack based on specific characteristics of the cubes. Aperture required participants to mentally rotate and pass a 3-D object through a 2-D aperture. Paper folding required participants to mentally fold up a 2-D representation of a paper into a 3-D form.
Results: A 2x4 ANOVA was completed on each of the PAT performance measures to compare male and female performance across the four testing sessions. There was a significant decrease across testing sessions for the total score ($P < .001$), cubes ($P < .001$), aperture ($P = .002$), and paper folding ($P = .046$). Females performed significantly worse than the males for the aperture ($P = .01$) and paper folding ($P = .041$) and approached significance for total score ($P = .077$).
Conclusion: These findings indicate that all participants performed worse on a standardized visuospatial task under sleep deprivation conditions. Furthermore, the females performed worse that the males on the spatial tasks that required a 2D to 3D transformation or mental rotation.
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0267

THE COMT Val158Met POLYMORPHISM PREDICTS INTERINDIVIDUAL DIFFERENCES IN SLEEP HOMEOSTATIC RESPONSES TO CHRONIC PARTIAL SLEEP DEPRIVATION

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Introduction: The COMT Val158Met polymorphism modulates cortical dopaminergic catabolism and has been reported to predict prefrontal cortex functioning and cognitive performance in healthy subjects. This polymorphism has also been associated with interindividual differences in brain alpha oscillations during total sleep deprivation and with modulating the effects of modafinil on waking functions, but not on sleep-deprivation-induced changes in recovery sleep. We determined whether the COMT Val158Met polymorphism related to sleep homeostatic responses and cumulative neurobehavioral deficits during chronic partial sleep deprivation (PSD).
Methods: 20 MetMet, 64 ValMet, and 45 ValVal healthy adults (29.9 ± 6.9y; 63 females) completed 2 baseline (10h TIB/night) nights, followed by 5 consecutive PSD (4h TIB/night) nights in a controlled laboratory experiment assessing physiological sleep responses and neurobehavioral measures (cognitive performance and executive function tests, subjective sleepiness and fatigue, MWT). Comparisons were made across the 3 genotypes. In our sample, MetMet genotypic and M allelic frequencies were significantly higher in Caucasians than African Americans; reported results were significant after statistically controlling for ethnicity.
Results: MetMet subjects had significantly larger declines in SWE during chronic PSD. ValVal subjects had significantly shorter REM latency at baseline and more stage 1 sleep across baseline and chronic PSD. The genotypes did not differ significantly at baseline in demographic characteristics, habitual sleep, circadian phase, cognitive performance, or physiological or subjective sleepiness. All genotypes demonstrated comparable cumulative decreases in cognitive performance (PVT, Digit Span), and increases in subjective and physiological sleepiness (KSS, MWT) to PSD, with increasing daily inter-subject variability. The genotypes did not differ on executive function tasks (Hayling, COWAT).
Conclusion: The COMT Val158Met polymorphism related to individual differences in sleep homeostatic, but not neurobehavioral, responses to chronic PSD. Thus, the COMT Val158Met polymorphism may be a novel genetic marker for predicting such differential sleep responses resulting from sleep deprivation.
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0268

OBJECTIVE SLEEPINESS AND NEUROBEHAVIORAL PERFORMANCE FOLLOWING ACUTE SLEEP LOSS WITH RESTRICTED RECOVERY SLEEP

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Introduction: A relatively robust literature has detailed relationships between neurobehavioral performance and objective sleepiness during sleep deprivation. Less is known about whether similar relationships are observed during recovery from sleep deprivation, particularly when recovery sleep is restricted. Here we examine the relationship between objective sleepiness and cognitive performance, during restricted recovery sleep following acute sleep loss.
Methods: Twenty-four healthy individuals (mean age = 32 ± 8y) participated in a protocol consisting of an adaptation and 2 baseline (BL) nights, followed by 39-45 hours of sleep deprivation, then 6 nights of either 9h (23-08h), 6h (02h-08h) or 3h (05h-08h) sleep opportunities (R1-R6). Participants completed computerized performance assessment batteries (PAB) every 3 hrs, along with the Psychomotor Vigilance Task (PVT). Sleepiness was assessed objectively using morning (10h) and afternoon (16h) sleep latency tests (SLT) of 20 min each. An average daily SLT score was obtained. The PVT variables mean reciprocal reaction time (RRT) and lapses (RT > 500ms) were examined; % change from BL accounted for interindividual variability. Regression analyses were used to examine whether sleep onset latency (SOL) predicted PVT performance.
Results: SOL was significantly associated with performance on the PVT in all groups ($r = .77$, $P < .001$), indicating that higher objective sleepiness predicted slower PVT reaction times. Longer SOL was also significantly associated with fewer lapses on the PVT ($r = -.58$, $P < 02$). There were no differences between 3h, 6h, and 9h groups in these re-

lationships. In contrast to the PVT, no significant relationships were found between SOL and PAB performance on Stroop, Manikin, Serial Addition, Six Letter Search or Running Memory tasks.
Conclusion: These results indicate that objectively-measured sleepiness reliably predicts psychomotor vigilance following sleep deprivation, with shorter SOL associated with more lapses and slower reaction times across all 3 recovery sleep conditions. No relationship was found between objective sleepiness and performance on other neurobehavioral tasks, many of which require complex reasoning and executive functioning. These results are consistent with evidence that tasks requiring different levels of cognitive reasoning respond differentially to sleep loss, and may also respond differentially to recovery from sleep loss and/or chronic sleep restriction.
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0269

COGNITIVE COMPONENTS OF SIMULATED DRIVING PERFORMANCE: SLEEP LOSS EFFECTS AND PREDICTORS

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Introduction: Driving involves a number of cognitive processes, several of which are thought to be measurable using neurocognitive tests. This exploratory study examined simulated driving and neurocognitive test performance after one night of sleep deprivation, and assessed the association between neurocognitive and driving performance measures.
Methods: Nineteen professional drivers (age 45.3 ± 9.1) underwent two experimental sessions in randomized order: one after normal sleep and one after 27h total sleep deprivation. A simulated driving task (AusEd), the Psychomotor Vigilance Test (PVT), and neurocognitive tasks selected from the Cognitive Drug Research computerized neurocognitive assessment battery (simple and choice RT, Stroop Task, Digit Symbol Substitution Task, Digit Vigilance Task) were administered at 10:00h in both sessions. Mixed-effects ANOVAs were performed to examine the effect of sleep deprivation versus normal sleep on performance measures. To determine if any neurocognitive tests predicted driving performance (lane position variability, speed variability, braking RT), neurocognitive measures that were significantly affected by sleep deprivation were then added as a covariate to the ANOVAs for driving performance.
Results: Simulated driving performance and neurocognitive measures of vigilance and reaction time were significantly impaired after sleep deprivation ($F > 5.1$; $P < 0.05$), whereas information processing speed and executive functioning were not significantly affected ($F < 3.4$; $P > 0.08$). The PVT was the only task responding significantly to sleep deprivation that provided predictors of driving performance. PVT lapses (RTs > 500ms) predicted variability in lane position ($F = 5.1$; $P = 0.04$). PVT fastest 10% of RT predicted variability in driving speed ($F = 6.4$; $P = 0.02$).
Conclusion: Measures of simulated driving performance and of vigilance and reaction time performance were adversely affected by sleep deprivation. PVT performance significantly predicted specific aspects of simulated driving performance. Thus, psychomotor vigilance impairment may be a key cognitive component of driving impairment when sleep deprived. The generalizability of this finding to real-world driving remains to be investigated.
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0270

INTER-INDIVIDUAL VARIABILITY IN THE PARAMETERS OF A MATHEMATICAL MODEL OF NEUROBEHAVIORAL PERFORMANCE AND ALERTNESS: RELATIONSHIPS WITH SUBJECT CHARACTERISTICS

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Introduction: Inter-individual variability in measures of performance and alertness has been observed under conditions of sleep deprivation and sleep restriction. This variability may be attributed to differences in circadian and/or homeostatic response that may be correlated with subject characteristics. Using the Circadian Neurobehavioral Performance and Alertness (CNPA) model (Jewett and Kronauer 1999), we investigated whether inter-individual differences in parameter values of best-fit models for circadian and homeostatic response could be predicted from individual subject characteristics.
Methods: The CNPA model includes both circadian and sleep homeostatic influences to predict neurobehavioral performance and alertness on a 0.0 to 1.0 scale using parameters fit from grouped (all subjects) data. We used serial addition (ADD) task (percent correct) and alertness ratings from the Visual Analog Scale (VAS, 0 = Sleepy, 100 = Alert) to fit model parameters for each individual. Data from 154 subjects scheduled to a 26-52h constant routine (CR) were fit using a non-linear optimization procedure (MatLab 7.1). Four parameters were fit for each individual and each model: uC (upper asymptote of circadian amplitude), A (circadian scaling), Hac (circadian-homeostatic interaction), rHw (rate of homeostatic decline during wake). These parameter estimates or their transformed versions were then regressed on subject characteristics, including age, gender, morningness-eveningness score, habitual sleep time, height, weight and baseline performance on the ADD task through multiple linear regression models.
Results: Habitual sleep time had a linear relationship ($P < 0.1$) with sqrt(uC) for both the performance and alertness equations. For performance, lower circadian amplitude was associated with earlier sleep times, while for alertness lower circadian amplitude was associated with later sleep times.
Conclusion: Of all subject characteristics included in the regression analysis, only habitual sleep time consistently emerged as significantly correlated with model parameters. Opposite correlations between circadian amplitude and habitual sleep time for performance compared to alertness model parameters further implicate the differences between objective and subjective measures of performance. Extension of this work with more subjects and more potential covariates will be important for future work on predicting individual performance and alertness.
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0271

NOCTURNAL TRAFFIC NOISE AND MORNING COGNITIVE PERFORMANCE

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Introduction: Exposure to traffic noise during nighttime is a growing problem. Annoyance and complaints about disturbed sleep are steadily increasing and hence call for noise protection. This study focused on the impact of nocturnal noise exposure to air, road, and rail traffic on sleep and performance.
Methods: 72 subjects (40 ± 13 years, 32 male) were polysomnographically examined during 11 consecutive nights. A psychomotor vigilance

task (PVT), a memory search task and an unstable tracking task were conducted after waking up in the morning. Traffic noise was played back in the laboratory during the night with 8 h time in bed. Each traffic mode consisted of five noise categories (maximum sound pressure level 45, 50, 55, 60 and 65 dBA) with 8 different noise events, i.e. 40 noise events in total. Therefore, between 40 and 120 noise events were realistically played back during single (AI, RO, RA, RORO), double (AIRO, AIRA, RORA) and triple (AIRORA) exposure nights. The design was complemented with a noise-free control night and carefully balanced. Mixed model ANOVA was used for statistical analyses.

Results: Only mean reaction time in PVT increased significantly by 3.6 ms (± 1.3 ms SE, P = 0.0069) after exposure nights. Reaction time increased significantly both with an increasing number of noise events (between 4.5 and 4.9 ms) and with equivalent noise level LAS,eq (between 4.8 and 5.0 ms) compared to the control night. Different traffic modes, or single compared to combined exposure nights, did not lead to specific performance alterations. Furthermore, combined traffic noise exposure conditions did not lead to stronger performance impairments than the single exposure conditions; effects were less than additive.

Conclusion: Sleep disruptions caused by different traffic modes seem to be uniform in the resulting performance decrements on the following day.

0272

SLOW EYE CLOSURE AS A MEASURE OF DROWSINESS AND ITS RELATIONSHIP TO PERFORMANCE

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Introduction: Slow eyelid closure measured as PERCLOS (PERcent eye CLOSure) can be used to assess drowsiness in sleep deprived individuals, although automated measures are not well validated. This study aims to determine whether drowsiness can be detected using an automated measure of slow eye closure, and how this relates to performance after sleep deprivation.

Methods: Twelve professional drivers (mean age = 45.58 ± 10.93) underwent two experimental sessions in randomized order; one after normal sleep and one after 24 hours of sleep deprivation. The Copilot measured PERCLOS during simulated driving. Driving performance and vigilance were assessed using the AusEd driving simulator and the Psychomotor Vigilance Task (PVT). Repeated measures ANOVA was used to examine differences in eye closure, measured during the driving task, between the two sessions. Correlational analysis was performed between PERCLOS and performance measures using Spearman's Rho. Regression analyses were used to determine how much variability in performance was associated with eye closure.

Results: After sleep deprivation, drivers had significantly more eye closure ($F(1,11) = 5.60$, $P < 0.05$), greater driving variation in lane position ($F(1,11) = 19.63$, $P < 0.005$) and more PVT lapses ($F(1,10) = 6.06$, $P < 0.05$). PERCLOS was significantly related to variation in lane position ($\rho = 0.68$, $P < 0.05$) and PVT lapses ($\rho = 0.64$, $P < 0.05$). Regression analyses indicated that 86% of variability in lapses ($F(1,10) = 54.65$, $P < 0.001$), and 56% of the variability in lane position ($F(1,11) = 12.87$, $P < 0.01$) was related to PERCLOS.

Conclusion: After 24 hours of sleep deprivation, professional drivers had more eye closure, PVT lapses and variation in lane position compared with the non-sleep deprivation session. PERCLOS contributed to a significant proportion of the impairment in simulated driving and vigilance performance. Automated measures of slow eye closure appear to be an effective means of detecting impairment due to drowsiness in the laboratory setting.

0273

JUDGMENT OF OBJECTIVE VIGILANCE PERFORMANCE IS AFFECTED BY SLEEP DEPRIVATION AND STIMULANTS

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Introduction: Emerging evidence suggests that sleep deprivation may adversely impact some aspects of executive function, judgment, and decision-making, while leaving other aspects relatively unaffected. In the present study, we examined how well sleep deprived subjects could subjectively judge their objective performance on a psychomotor vigilance task relative to their previous performance two hours earlier, and whether this judgment would be affected by the administration of stimulant medications during the second night.

Methods: Healthy adults were deprived of sleep for 61 hours and administered either modafinil 400mg (n = 12), dextroamphetamine 20mg (n = 16), caffeine 600mg (n = 12), or placebo (n = 14) at 44 hours of wakefulness. Subjects were assessed every two hours with a five-minute psychomotor vigilance test (PVT) and a 5-point rating scale that asked them to judge their current PVT performance relative to their perceived performance "two hours ago." PVT and scale ratings were transformed to a similar metric and differences were calculated for each time point during sleep deprivation. Differences from zero were evaluated using one-sample t-tests, and differences across groups were evaluated using repeated measures ANOVA and Bonferroni post-hoc comparisons ($P < .05$).

Results: When rested, participants were relatively accurate in their judgments of PVT performance. However, by early morning between 23-25 hours of wakefulness, subjects became significantly under-confident in their judgments relative to actual performance, a pattern that was significantly reversed to overconfidence by early evening (35-37 hours awake). Following stimulant administration, both caffeine and dextroamphetamine groups become significantly overconfident in their judgments by early morning while the placebo group became significantly under-confident. Judgments of the modafinil group remained relatively stable and accurate throughout.

Conclusion: Among sleep deprived individuals, subjective judgment of performance shows a circadian pattern of fluctuation that underestimates performance in the morning and overestimates performance in the evening. Dextroamphetamine and caffeine may temporarily exaggerate overconfidence in judgment during the circadian trough.

0274

SUBJECTIVE ASSESSMENT OF "READINESS TO PERFORM" AFTER SLEEP DEPRIVATION AND RESTRICTED RECOVERY SLEEP

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Introduction: A person who is intoxicated, or is acutely sleep deprived, is quite poor at evaluating his or her own readiness to perform. Few studies, however, have examined whether an individual can accurately report when he or she has recovered from sleep deprivation, and has reached an acceptable level of post-sleep deprivation "readiness." Here we investigate relationships between subjective alertness, self-evaluation of readiness to perform, and actual performance, over a seven-day period of recovery following sleep deprivation.

Methods: Twenty-four subjects (32 ± 8y) participated in a protocol consisting of adaptation, 2 baseline (BL), 39-45 hrs of sleep deprivation, and 6 nights of either 9h (23-08h), 6h (02-08h) or 3h (05h-08h) sleep opportunities. Subjects completed a 10-min PVT every 3 hrs. Prior to each PVT, visual analog scales were used to assess subjective sleepiness (VAS1) and prediction of how well he or she would perform on the ensuing PVT (VAS2). Regression examined relationships among VAS1, VAS2, and PVT mean reciprocal reaction time (RRT).

Results: RRT varied significantly with VAS1 scores ($r = .73$, $P < .01$), indicating a "match" between subjective sleepiness and PVT performance. Subjects in 6h and 9h accurately rated their readiness to perform as indicated by ANOVAs showing no significant differences between VAS2 and RRT in either group. In contrast, subjects in 3h overestimated their readiness to perform. VAS2 scores were significantly different from RRT on each recovery day. Whereas in 6h and 9h VAS2 scores and RRT corresponded, in 3h, VAS2 ratings were similar to BL while RRT performance declined precipitously across recovery days.
Conclusion: While it is important to evaluate how long it takes for neurobehavioral performance to recover from sleep loss, it is perhaps as critical to assess whether a sleep-deprived person can accurately self-monitor readiness to perform. The current results suggest that if one obtains sufficient recovery sleep to actually improve performance to BL, self-evaluations of readiness to perform are generally accurate. In contrast, when one is extremely sleepy, even if self-ratings of sleepiness are accurate, evaluation's of one's performance deficits do not parallel either sleepiness ratings or actual performance. It could be argued that this last scenario, in which a sleepy person knows he or she is sleepy, but does not believe that this will negatively impact performance, may be the most critical to address.
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0275

PATTERN RECOGNITION ALGORITHMS TO CLASSIFY PERFORMANCE DECREMENT USING BOTH SUBJECTIVE AND OBJECTIVE MEASURES

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Introduction: It is difficult to determine a priori whether an individual will suffer performance decrements with increasing time awake due to significant individual variability in performance. Existing methods to predict performance decrements require data collected over several hours. Furthermore, objective measures are frequently inconsistent with subjective measures within an individual. Here we combine objective and subjective measures using a pattern recognition algorithm called a support vector machine (SVM) to robustly predict performance under conditions of extended wakefulness.
Methods: We trained an SVM using PVT and KSS data collected every 2h during two laboratory studies in which 33 subjects were scheduled to 28-52h sleep deprivation (SD). A subset of 163 PVT/KSS sessions (11 subjects) were randomly sampled from 504 total sessions to train the SVM, using a "leave one out" method; the remaining sessions from 22 subjects were used to test the ability of the SVM to classify each subject as low, medium or high performance decrement during each session. Each session was defined by 5 features - KSS score, length of time awake, and the 5th, 50th and 95th RT percentiles from the PVT - and separately labeled as low, medium or high performance decrement based on the relative number of PVT lapses, with cutoffs of < 8, < 15 and ≥ 16 lapses, respectively. These values correspond to 1, 2, or 3 days of total SD as reported by Van Dongen et al. 2003. Classification with the 5-feature space was compared with those from a 2-feature (KSS, time awake) and a 3-feature (5th, 50th and 95th RT percentiles) space.
Results: The 5-feature space correctly classified 95% of the sessions in the test set, compared to 90% and 73% correct with the 3-feature and 2-feature spaces, respectively. For the 5-feature space, 80% of the incorrectly classified sessions were predicted as high, but labeled medium performance decrement; therefore, the SVM over-predicted the level of performance decrement during these sessions.
Conclusion: These results suggest that both objective and subjective measures should be used to classify an individual's performance ability. Combining SVMs with measures of performance and alertness could provide a real-time estimate of performance decrement robust to individual variability that does not rely on multiple measurements over time. Future work will explore whether this SVM can classify performance decrement in operational settings.
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0276

SUBJECTIVE SLEEPINESS AND OBJECTIVE PERFORMANCE: DIFFERENTIAL EFFECTS OF STIMULANTS DURING SLEEP DEPRIVATION

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Introduction: Subjective measures of sleepiness, such as the Karolinska Sleepiness Scale (KSS) are only moderately correlated with objective measures of alertness, such as the psychomotor vigilance test (PVT), suggesting that there is considerable variability in how individuals interpret feelings of sleepiness. Some evidence suggests that stimulants such as caffeine may improve objective performance on vigilance and cognitive tasks to a greater extent than subjective alertness. We examined the effect of several stimulants or placebo on the relationship between KSS and PVT performance during hours 44-61 of continuous sleep deprivation.
Methods: After 44 hours of sleep deprivation, subjects received either caffeine 600mg ($n = 12$), dextroamphetamine 20mg ($n = 16$), modafinil 400mg ($n = 12$), or placebo ($n = 14$), and remained awake for the next 17 hours and were tested on the PVT and KSS bi-hourly. The relationship between KSS and PVT speed (1/RT*1000) over the 8 sessions was examined using Pearson correlations and linear regression for each drug group separately. Differences among group correlation coefficients and slopes were tested.
Results: KSS and PVT speed were significantly correlated within the placebo ($r = -.63$, $P < .001$), dextroamphetamine ($r = -.28$, $P = .001$), and modafinil ($r = -.60$, $P < .001$) groups, but not the caffeine ($r = -.08$, ns) group. All groups showed significantly greater linear slopes than caffeine ($P < .05$), and caffeine was the only group with a slope that did not differ from zero.
Conclusion: Subjective sleepiness scores were moderately correlated with objective psychomotor vigilance speed performance after 2 nights of sleep deprivation. The relationship was most effectively maintained in the placebo and modafinil groups, and was less well correlated in the dextroamphetamine and caffeine groups. Among subjects taking caffeine, there was virtually no relationship between subjective sleepiness and objective vigilance performance. Findings suggest that caffeine may differentially enhance neurocognitive systems involved in alertness while having little effect on those involved in self-monitoring and awareness of cognitive and physical status.

0277

EFFECTS OF CIRCADIAN PHASE, PRIOR WAKEFULNESS AND SLEEP RESTRICTION ON MOOD REGULATION IN HEALTHY PARTICIPANTS

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Introduction: Studies have shown that changes to duration and timing of sleep can result in negative consequences for mood, exemplified by increased feelings of depression, confusion and fatigue. Forced

Desynchrony (FD) studies have examined circadian phase and prior wakefulness for their impact on mood; but not in conjunction with sleep restriction. The aim of the current study was to investigate the relative contribution of circadian phase and prior wake using a FD protocol with restricted sleep opportunity.
Methods: Fourteen healthy males participated (21.8 ± 3.8yr) in a FD protocol consisting of 7x28h days (FD1 to FD7), with FD7 repeating the circadian x prior wake phase relationship sampled in FD1. Each FD day consisted of 23.3h of continuous wake and a 4.7h sleep opportunity. The Profile of Mood Scale (POMS) was administered every 2.5h during all wake periods, assessing Total Mood Disturbance (TMD), and 6 sub-scales of Anger, Vigour, Fatigue, Tension, Anxiety and Confusion. Each mood rating was assigned a circadian phase based on core body temperature and prior wake. Mood was compared between these days to investigate possible effects of cumulative sleep loss across the experimental period.
Results: Mixed models analyses with circadian phase and duration of prior wake as fixed effects and participant as a random term, revealed that with the exception of the Anger sub-scale, all mood scales showed significant ($P < 0.05$) deterioration with increased PW and when approaching the circadian nadir. Depression, Fatigue and Vigour showed significant ($P < 0.05$) interactions of PW and circadian phase. Repeated measures analyses revealed significant ($P < 0.05$) interactions between FD day (1v7) and prior wakefulness for TMD, Fatigue, Confusion and Vigour. While mood was worse on FD7 than FD1, mood ratings were only worse from 2.5h of wakefulness until 17.5h of wakefulness, after which (17.5h-23.3h of wakefulness) mood ratings for both FD days (1v7) converged to similar levels.
Conclusion: The effects observed for mood appear to mirror those of neurobehavioral performance, following circadian and homeostatic disruption. This raises the possibility that negative mood states (fatigue, depression) may affect intermediary factors such as motivation that are reported to mediate neurobehavioral performance.
Support (If Any): This study was financially supported by the Australian Research Council

0278

BOTH PREVIOUS SLEEP AND LIGHT AT NIGHT AFFECT THE AMPLITUDE OF CORTISOL AND ALPHA AMYLASE

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Introduction: Cortisol is a hormone synthesized by the adrenal gland and modulated by the hypothalamic-pituitary-adrenal axis and by the sympathetic nervous system. Cortisol concentrations follow a circadian pattern across the 24h day with a sharp peak associated with rising in the morning, approximately 30 to 60 minutes after awakening. Concentrations of alpha amylase, a salivary enzyme that has been used as a marker for the sympathetic system response, roughly mirror the daily variations in cortisol concentration, including a sharp drop associated with rising. The goal of this study was to investigate the impact of sleep quantity and light exposure at night on these biomarkers and on melatonin.
Methods: Ten subjects were recruited for a 3-week study. Subjects experienced three counterbalanced 27h experimental sessions: baseline (no sleep), 3h and 7h of sleep. Subjects remained in a dimly illuminated room and were exposed every 4 hours during the 27h session, when not asleep, to 45min retinal exposures of 40lx from narrow-band, short-wavelength (blue) lights.
Results: The nighttime data for the different outcome measures were submitted to repeated measures analyses of variance and to post hoc, one-tail paired t-tests. With regard to the blue light exposure at night, cortisol levels significantly increased ($P < 0.05$) compared to the previous dim light condition. Cortisol levels upon rising were significantly higher after 7h ($P < 0.05$) and after 3h ($P < 0.05$) of sleep relative to baseline levels without sleep at the same time. The magnitudes of the changes in alpha amylase levels were smaller than those associated with cortisol, but were also significantly different upon awakening after 7h ($P < 0.05$) and after 3h of sleep ($P < 0.05$) compared to baseline.
Conclusion: Results show that cortisol and alpha amylase levels are influenced by sleep quantity and by the time of light exposure at night.
Support (If Any): Office of Naval Research

0279

REACTIVITY PATTERNS IN PRIMARY INSOMNIACS AND SLEEPDEPRIVED HEALTHY CONTROLS. A COMBINED fMRI AND FIELD STUDY

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Introduction: Emotional and physiological reactivity have rarely been objectively quantified in sleep research. Under the hypothesis viewing hyperarousal as a prominent contributing factor in both sleeping disturbances and performance levels in primary insomnia (PI), the present investigation aimed at linking disturbances in daily functioning with impaired reactivity to challenge, after acute/chronic sleep deprivation. In experiment 1 ('validation'), we investigated physiological parameters most sensitive to various stressors, and activation differences in brain areas controlling autonomic functions and mediating emotions.
Methods: Experiment 1: 12 healthy sleepers underwent fMRI emotion induction (horror vs neutral filmclips), and in-scanner cold pressor (CP) challenge (2x2 factorial design), with simultaneous cardiorespiratory recordings. Data collection included fMRI BOLD response, heart rate (HR), respiration. Experiments 2 & 3 involve 15 PI, and 15 healthy controls sleeping for 1 week according to the PI sleeping pattern. Data collection (still ongoing) as in Experiment 1, with additionally 5 nights PSG (at home), cortisol, daily questionnaires (POMS, PSAS, ECS, BISQ).
Results: Experiment 1 evidenced emotion induced enhanced BOLD response in thalamus (6,72), cerebellum L *6,54; fusiformis L *6,12, inferior temporal gyrus L *6,40; R amygdala *5,32; while CP induced BOLD activations in ACC L *5,68; insula R *5,27; thalamus *6,36; inferior temporal L *6,34 and mid temporal R *6,15 - L *6,14 regions (all surviving FWE $P < .05$; * = z scores). Respiration appeared more sensitive than HR to emotional content [$F(1,11) = 16,753$; $P = .002$].
Conclusion: Experiment 1 confirmed earlier findings that brain areas controlling autonomic functions show enhanced BOLD activation under emotion induction and CP. Furthermore, respiration exceeds HR as a sensitive index for autonomic reactivity to physiological and psychological stressors. Building on hyperarousal research, we expect experiments 2 & 3 (in process) to disclose distinct reactivity patterns after acute/chronic sleep deprivation, in insula, ACC, prefrontal structures and brainstem.

0280

HIGHER FRONTAL EEG SYNCHRONISATION DURING SUSTAINED WAKEFULNESS IN DEPRESSED WOMEN: EVIDENCE FOR INCREASED HOMEOSTATIC SLEEP PRESSURE?

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Introduction: Major depressive disorder (MDD) is characterised by a dysregulation of sleep-wake homeostasis and circadian rhythm organisation. However, there is little good data - and this controversial - to define what these changes are. Here we focused on the time course of frontal low-frequency EEG activity (FLA), as a marker of the ho-

meostatic build up of sleep pressure during wakefulness in depressed women and healthy controls, and its relationship with subjective sleepiness and the circadian rhythm of salivary melatonin during 40-h of sustained wakefulness.
Methods: EEGs were continuously recorded in eight young healthy women (mean age 25 ± 3.3y) and eight young women with MDD (mean age 24 ± 4.8y) during a total 40-h sleep deprivation under constant routine (CR) conditions. Artefact-free epochs of 12 EEG derivations were subjected to spectral analysis and compared with subjective sleepiness as well as salivary melatonin levels in the course of the CR protocol.
Results: MDD women exhibited significantly higher levels of frontal-low EEG activity (FLA, 0.5- 5.0 Hz) than controls during the entire 40 hours of sustained wakefulness (group x derivation, P = 0.02). Overall, they tended to be sleepier than controls (P = 0.07), and this difference was significant during the biological night. Night time melatonin secretion was significantly reduced in MDD women (P = 0.04), whereas the timing of melatonin onset was not different compared to the control women.
Conclusion: Our data imply that depressed women live on a higher level of homeostatic sleep pressure, as indexed by enhanced high FLA during wakefulness. They did not have any nocturnal sleep disturbances. The underlying reasons may be a use-dependent phenomenon (enhanced rumination in depression) and/or an attenuated circadian arousal signal in the evening, thus allowing more frontal delta activity.
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0281

SLEEP DURATION, SLEEP FRAGMENTATION, AND DEPRESSION IN PARENTS OF TWINS

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Introduction: Parents caring for newborn twins are at particularly high risk for altered sleep and depressive symptoms. Sleep restriction may be associated with development of postpartum depression. This study examined relationships between total sleep time, sleep fragmentation (measured by percent sleep during the night sleep period and number of long wake episodes ≥ 5 minutes during night sleep), and depression in mothers and fathers of twins.
Methods: Data were collected three times over the first three months postpartum. Measures included actigraphy, sleep diaries, and standardized depression instruments. Data for 49 mothers and 42 fathers were analyzed.
Results: For mothers and fathers, mean 24-hour sleep time did not change significantly over the first three months, with sleep duration ranging 413.6 to 432.1 minutes. Percent sleep during the night sleep period increased significantly from 70.0% to 81.4% for mothers, and from 78.8% to 86.2% for fathers. Mean number of wake episodes at night decreased significantly for mothers over time. Across time points, depressive symptoms were reported by 29-42% of mothers and 30-40% of fathers. For mothers with total sleep time ≤ 360 minutes, depression was significantly correlated with number of wake episodes at T1 (r = .68) and T2 (r = .87) and with percent sleep during the night at T3 (r = -.39). For fathers with total sleep time ≤ 360 minutes, depression correlated with percent sleep during the night period at T3 (r = -.87).
Conclusion: A majority of parents of twins are not substantially sleep restricted. Compared to previous research in parents of singleton infants, more parents of twins reported depressive symptoms. Sleep fragmentation, rather than duration, was related to depression in the subset of parents with less than six hours total daily sleep. Further study of the effects of sleep fragmentation on parental adjustment is needed.
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0282

DIURNAL VARIATIONS OF MOOD IN DRUG FREE UNIPOLAR DEPRESSED WOMEN UNDER HIGH AND LOW SLEEP PRESSURE CONDITIONS: IS THERE A SLEEP DEPRIVATION EFFECT?

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Introduction: Diurnal mood variations occur in healthy subjects and are a key symptom in depression. Total sleep deprivation (SD) in depressed patients induces a rapid, but usually short-lasting clinical improvement. Here we investigated whether differential sleep pressure levels (high vs. low) have significant repercussions on self-rated mood levels in young women diagnosed with major depressive disorder (MDD) when compared to controls.
Methods: Eight healthy women (mean age 25 ± 3.3y) and eight women (mean age 24 ± 4.8y) with MDD underwent a 40-h SD (high sleep pressure) and a 40-h nap (low sleep pressure attained with multiple naps) protocol under constant routine conditions. Subjective mood was assessed at 30-min intervals during scheduled wakefulness using a 100-mm bipolar visual analogue scale. MDD women suffered from symptoms of "sadness," "loss of interest," "anergy," "reduced feeling of self-worth," "diminished concentration" and "social withdrawal" but not from insomnia (assessed by the Pittsburgh-Sleep-Quality-Index and a full night sleep polysomnography).
Results: Under high sleep pressure, variations in mood were significantly determined by the factors "group" (P = 0.0003), "time" (P = 0.0005) and their interaction (P = 0.04). Under low sleep pressure only a significant group effect (P = 0.005) was found. Overall, in both protocols mood ratings were considerably lower in depressive women than in the control group.
Conclusion: Our data imply that depressive women without sleep disturbances show a significantly different time course of mood during a 40-h SD but not during a 40-h Nap condition. Under SD they exhibited a more distinct circadian modulation of lower mood than controls. Despite this higher circadian variation of mood fluctuations they did not profit from an antidepressant effect. This lack of an antidepressant effect suggests that SD response could depend on the magnitude of insomnia, which is a frequent co-morbidity in depression.
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0283

THE RELATIONSHIP BETWEEN PERFORMANCE AND SLEEP QUALITY IN SLEEP DEPRIVED PERSONS

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Introduction: Research has indicated that sleep quality is an important component of our sleep patterns; however, few studies have examined how sleep quality may influence the effects of sleep deprivation. The purpose of the current study was to examine how performance and sleep quality are related under short-term sleep deprivation conditions.
Methods: Participants were 58 students (38 males, 20 females). All participants completed the Pittsburgh Sleep Quality Index (PSQI) prior to a night of sleep deprivation. They also completed a variety of

tasks once during each of 4 testing sessions during the night. The tasks included two types of vigilance tasks: the Psychomotor Vigilance Task (PVT) and the Clemson Audio Task (CAT). The PVT lasted 10 minutes and required the participants to press a button as soon as numbers counted up on the device. The CAT lasted 30 minutes and required participants to identify specified keywords while listening to a non-fiction book on tape.

Results: Pearson correlations were completed between the PSQI scales and the performance variables for each of the 4 testing sessions. Of the PSQI scales, sleep disturbances (awakenings during the night) and sleep medication (how often used sleep medications) resulted in the most significant correlations with vigilance performance. Sleep disturbances resulted in 1 significant correlation ($r = .27$, $P < .05$) for the PVT and in 6 significant correlations (ranges: $r = .29$ to $.45$, $P < .05$ to $< .01$) for the CAT. Sleep medications resulted in 3 significant correlations (r range: .30 to .34, $P < .05$) for the PVT and 4 significant correlations (ranges: $r = .30$ to $.46$, $P < .05$ to $< .01$) for the CAT.

Conclusion: The current results suggest that the sleep disturbances and sleep medication subscales were better related to vigilance performance than the PSQI over-all score or other subscales of the PSQI.

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0284

IMPACT OF INSUFFICIENT SLEEP ON FIRST-YEAR COLLEGE STUDENTS' STRESS AND COPING

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Introduction: Insufficient and inconsistent sleep has been associated with stress, negative mood, and coping difficulties. The college transition may be particularly stressful and sleep patterns are one of the first habits to change during this period. This study examined the effects of insufficient, delayed, and erratic sleep schedules on first-year students' stress, mood, and coping strategies.

Methods: Students were recruited from a liberal arts college to participate in a survey (N = 146 1st years, 76 females) consisting of: Sleep Habits Questionnaire, College Chronic Life Stress Survey, Center for Epidemiologic Studies Depression Scale, Perceived Stress Scale, and Brief COPE. To examine stress and coping of students obtaining poor sleep, a priori defined groups were defined: short (< 6 hr 45 min) vs. longer (> 7 hr) class-night sleep; large (> 2 hr) vs. small (< 1.5 hr) weekend bedtime delay; high (> 100 min) vs. low (< 90 min) weekend oversleep; late (after 4:30am) vs. early (before 4:30am) class-night midsleep times. Students with longer sleep, smaller delays, shorter weekend oversleeps, or earlier midsleep times were defined as adequate sleepers, whereas students with insufficient, delayed, and/or inconsistent sleep as less than adequate.

Results: Students with less than adequate sleep reported increased difficulties with mood and coping. Shorter sleepers vs. long reported more daytime sleepiness, perceived stress, and depressed mood ($P < .01$). Those in the high weekend oversleep group reported more stress, poorer coping strategies, and greater depressed mood ($P < .05$). First-years with longer bedtime delays experienced higher levels of depressed mood ($P < .05$).

Conclusion: Undoubtedly, first-year students were obtaining insufficient sleep (class-night M = 7.0 hr, SD = 1.1). Inadequate, inconsistent, and delayed sleep patterns were associated with negative mood, greater stress, and worse coping skills. Future research should investigate the development of sleep patterns and coping strategies over the emerging adult years.

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0285

RELATIONSHIPS BETWEEN SLEEP AND TECHNOLOGY USE, BODY MASS INDEX AND ACADEMIC PERFORMANCE IN A COHORT OF UK ADOLESCENTS

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Introduction: Technology is widely accessible and utilised by adolescents and may be exacerbating the current global obesity epidemic. Media devices have also been shown to reduce sleep duration and quality. Research also suggests short sleep duration is associated with an increased body mass index (BMI) and lowered school performance but no UK data exists. We sought to assess these variables in combination in a UK adolescent sample.

Methods: A cohort of 624 adolescents aged 11-19 years from the east and west Midlands provided baseline data in 2009 using previously validated and reliable age-appropriate questionnaires. Objective measures of height and weight were obtained for BMI calculation. Age and gender specific cut points were identified using the International Obesity Task Force criteria for BMI.

Results: We found a negative correlation between weekday sleep duration and technology $r = -0.18$, $P < 0.001$ and a significant effect of technology use on sleep duration ($F(4, 619) = 6.22$, $P < 0.001$). Multiple logistic regression analyses revealed short sleep duration (< 8 hours) was significantly associated with obesity (OR = 2.72, 95% CI: 1.44, 5.12) and poorer academic achievement (OR = 3.74, 95% CI: 2.03, 6.87) after full adjustment for a range of potential confounders.

Conclusion: Use of technology before bed time was associated with reduced sleep duration in our UK adolescent sample. Short sleep duration was also associated with obesity and lowered academic achievement. Inadequate sleep has important public health implications and future interventions should educate both children and parents concerning the negative consequences with which it is associated. Further studies are needed to establish causal relationships.

0286

THE IMPACT OF SLEEP RESTRICTION ON COGNITIVE PERFORMANCE DIFFERS AS A FUNCTION OF TASK COMPLEXITY

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Introduction: While the neurobehavioral consequences of total sleep deprivation (TSD) have been well characterized, considerably less is understood about the effects of sleep restriction on cognitive performance. Here we report results from a study of TSD followed by restricted recovery sleep, with a focus on examining whether recovery sleep differentially affects performance on a simple, versus a cognitively complex, task.

Methods: Twenty-four healthy individuals (32 ± 8y) participated in a protocol consisting of an adaptation and 2 baseline (BL) nights, followed by 39-45 hours of TSD, then 6 nights of either 9h (23-08h), 6h (02-08h) or 3h (05-08h) sleep opportunities (R1-R6). Participants completed performance assessment batteries (PAB) every 3 hrs. Data are reported for the Manikin (MAN) and the PVT, as these indices tap substantially different levels of complexity in cognitive processing.

Results: On MAN, all groups recovered to BL by R1. Despite performing similar to BL, 3h performed significantly worse than 6h and 9h, who maintained or exceeded BL levels throughout recovery. In contrast, on the PVT, accumulating sleep loss in both 3h and 6h resulted in progressively longer reaction times relative to BL, whereas 9h recovered to BL by R2. The 3h group performed significantly worse than 9h; 6h fell midway between 3h and 9h throughout recovery (all n.s.).
Conclusion: Evidence indicates that sleep restriction effects on cognitive function are influenced by the complexity of the task, and in a manner that does not parallel how TSD affects cognition. Less complex reaction time tasks that utilize attentional networks have shown a predictable, consistent relationship with objective sleepiness - the greater the sleepiness, the poorer the performance. Yet, tasks that demand a higher cognitive load and utilize executive functioning have shown less predictable and more variable responses to restricted sleep. The current results are consistent with such findings, and suggest that a person can maintain BL levels on a cognitively complex task even as simple vigilance is negatively impacted by severely restricted recovery sleep. Such results may have implications for conceptual models of how chronic sleep restriction influences neurobehavioral performance. Additional analyses, including neurobehavioral tasks that utilize intermediate cognitive loads and tap other cognitive processes, will help to shed light on the complex relationships between TSD, chronic sleep restriction, and neurobehavioral function.
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0287

THE EFFECTS OF COGNITIVE WORKLOAD DURING SLEEP RESTRICTION ON EXECUTIVE FUNCTION MEASURES

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Introduction: Although sleep loss degrades cognitive functions, little theoretical or experimental attention has been paid to determining whether waking cognitive activity potentiates the effects of sleep loss. We investigated the effects of high cognitive workload (HW) versus low cognitive workload (LW) on two classic executive function tasks following both sleep restriction (SR) and no sleep restriction (NSR).
Methods: N = 33 healthy adults (33.9 ± 9.1y; 15 females) completed 3 baseline nights (8h TIB), followed by 5 nights of SR (4h TIB) or 5 nights of NSR (8h TIB) in a controlled laboratory setting. Subjects were randomized to 1 of 4 experimental conditions: HW+SR [N = 11]; HW+NSR [N = 6]; LW+SR [N = 8]; LW+NSR [N = 8]. The HW vs. LW conditions differed in the intensity and duration of cognitive workload. The Controlled Oral Word Association Test (COWAT; work production speed) was administered on baseline night 2 (B2) and the 5th night of SR (SR5) or NSR (NSR5); the Hayling task (initiation speed and response suppression) was administered on SR5/NSR5. One-way and mixed-model (night×condition) ANOVAs compared differences across all 4 experimental conditions; post-hoc Bonferroni-adjusted probabilities were used for significant group differences.
Results: Hayling performance was significantly different across the 4 conditions (P = 0.025); the SR+HW group had significantly higher scores than the SR+LW group (P = 0.017), but the NSR+HW and NSR+LW groups did not differ. By contrast, the COWAT did not significantly differ across the 4 conditions at B2 (P = 0.777) and SR5/NSR5 (P = 0.591), though all groups showed a significant improvement from B2 to SR5/NSR5 due to learning (P < 0.001).
Conclusion: Workload did not affect executive functioning under fully rested conditions. Our preliminary results suggest that sleep restriction promoted better response suppression of word generation, but this result is not likely to sustain once the sample size is increased.
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0288

THE EFFECTS OF COGNITIVE WORKLOAD DURING SLEEP RESTRICTION ON THE 10-MINUTE PVT

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Introduction: Although sleep loss degrades cognitive functions, there are little theoretical or experimental data addressing whether waking cognitive activity potentiates the effects of sleep loss. We investigated the effects of high cognitive workload (HW) versus low cognitive workload (LW) on the well-validated 10 minute Psychomotor Vigilance Task (PVT) during both sleep restriction (SR) and no sleep restriction (NSR).
Methods: N = 29 healthy adults (33.7 ± 9.3y; 13 females) completed 3 baseline (8h TIB/night) nights, followed by 5 SR (4h TIB/night) or NSR (8h TIB/night) nights in a laboratory setting. Subjects were randomized to 1 of 4 experimental conditions: HW+SR (N = 11); HW+NSR (N = 7); LW+SR (N = 7); LW+NSR (N = 4). The HW vs. LW conditions differed in cognitive testing intensity and duration. The PVT was administered 6 times each protocol day during diurnal waking hours. Baseline values were derived from the third baseline day (B3). Daily values for PVT lapses (> 500ms RT) were calculated by averaging scores from all test bouts that day. A mixed-model ANOVA (day: within-subjects factor; sleep and workload: between-group factors) was conducted; paired t-tests examined differences from B3 to SR5/NSR5 for each group.
Results: PVT lapses for the 4 groups did not differ at B3 (P = 0.273). There was a significant main effect of day on PVT lapses (P = 0.019) and a significant interaction with sleep (SR vs. NSR) for lapses (P = 0.017), whereby the SR groups showed significantly more lapses than the NSR groups (P = 0.02). By contrast, the interaction with workload was not significant for lapses (P = 0.799). The HW+SR group showed the most dramatic increases in PVT lapses (P = 0.018) from B3 to SR5.
Conclusion: The preliminary results from this experiment suggest that sleep restriction had the expected effects on PVT lapse rates. However, higher cognitive workload under sleep-restricted conditions may further potentiate deficits in PVT performance.
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0289

THE EFFECTS OF COGNITIVE WORKLOAD DURING SLEEP RESTRICTION ON SUBJECTIVE SLEEPINESS AND FATIGUE

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Introduction: Although sleep loss increases ratings of sleepiness and fatigue, whether waking cognitive activity potentiates the effects of sleep loss on these measures remains unknown. We investigated the effects of high cognitive workload (HW) versus low cognitive workload (LW) on the Karolinska Sleepiness Scale (KSS) and a visual analog scale of fatigue (VAS) anchored by "fresh as a daisy" and "tired to death," during both sleep restriction (SR) and no sleep restriction (NSR).
Methods: N = 30 healthy adults (33.0 ± 9.3y;13 females) completed 3 baseline (8h TIB/night) nights, followed by 5 SR (4h TIB/night)

or NSR (8h TIB/night) nights in a laboratory setting. Subjects were randomized to 1 of 4 experimental conditions: HW+SR (N = 11); HW+NSR (N = 7); LW+SR (N = 8); LW+NSR (N = 4). The HW vs. LW conditions differed in cognitive testing intensity and duration. The KSS and VAS were administered 6 times each protocol day during diurnal waking hours. Baseline values were derived from the 3rd baseline day (B3). Daily values for KSS and VAS were calculated by averaging scores from all test bouts that day. A mixed-model ANOVA (day:within-subjects factor; sleep and workload:between-group factors) was conducted; paired t-tests examined differences from B3 to SR5/NSR5 for each group.

Results: KSS and VAS scores for the 4 groups did not differ at B3 (P = 0.750 and P = 0.899, respectively). There was a significant main effect of day on KSS and VAS scores (P's < 0.0001) and a significant interaction with sleep (SR vs. NSR) for both variables (P's < 0.0001). However, the interaction with workload was not significant (KSS:p = 0.234; VAS:p = 0.071). The HW+SR group showed the most dramatic increases in KSS and VAS scores (P's < 0.0001) from B3 to SR5.

Conclusion: The preliminary results from this experiment suggest that sleep restriction had the expected robust effects on subjective sleepiness and fatigue. Higher cognitive workload under sleep-restricted conditions may potentiate perceptions of sleepiness and fatigue.

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0290

THE EFFECTS OF COGNITIVE WORKLOAD AND SLEEP RESTRICTION ON THE MAINTENANCE OF WAKEFULNESS TEST

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Introduction: Chronic partial sleep deprivation decreases the ability to resist sleep as measured by the MWT. It has been assumed that the nature of cognitive activity during wakefulness does not affect sleep latency. We tested this assumption by investigating the effects of high cognitive workload (HW) versus low cognitive workload (LW) on MWT following both sleep restriction (SR) and no sleep restriction (NSR).

Methods: N = 33 healthy subjects (33.6 ± 9.1y;15f) completed 3 baseline (8h TIB/night) nights, followed by 5 SR (4h TIB/night) or NSR (8h TIB/night) nights in a laboratory setting. Subjects were randomized to 1 of 4 experimental conditions: HW+SR (N = 10); HW+NSR (N = 7); LW+SR (N = 8); LW+NSR (N = 8). The HW vs. LW conditions differed in cognitive testing intensity and duration. Modified 30-minute single-trial MWTs were conducted between 1445h-1600h after the 3rd night of baseline (B3) and after the 1st, 4th and 5th nights of SR (SR5) or NSR (NSR5). Sleep latency was defined as time to the first microsleep (10-sec EEG theta) or 30 minutes if no sleep occurred. A mixed-model ANOVA (day:within-subjects factor; sleep and workload:between-group factors) was conducted; paired t-tests examined differences from B3 to SR5/NSR5 for each group.

Results: MWT latencies for the 4 groups did not differ at B3 (P = 0.882). The main effect of day on MWT (P < 0.0001) and an interaction with sleep (P = 0.001) were significant but the interaction with workload was not (P = 0.821). Specific examination of the HW+SR group showed a significant decrease in MWT sleep latency (P < 0.001) from B3 to SR5.

Conclusion: The MWT, as expected, was sensitive to sleep loss, while the impact of high cognitive workload on the ability to resist sleep was less pronounced. These preliminary results suggest that MWT sleep latency may be influenced by cognitive workload, but a larger sample size is needed to elucidate the exact relationship between these factors.

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0291

THE EFFECTS OF COGNITIVE WORKLOAD DURING SLEEP RESTRICTION ON POLYSOMNOGRAPHIC MEASURES

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Introduction: Sleep physiology is believed to reflect homeostatic sleep drive and circadian dynamics, but little systematic research has been conducted on whether the intensity of waking activity influences sleep. We investigated the effects of high cognitive workload (HW) versus low cognitive workload (LW) on polysomnographic (PSG) measures following both sleep restriction (SR) and no sleep restriction (NSR).

Methods: N = 25 healthy adults (31.5 ± 8.9y;10f) completed 3 baseline (8h TIB/night) nights, followed by 5 SR (4h TIB/night) or NSR (8h TIB/night) nights in a laboratory setting. Subjects were randomized to 1 of 4 experimental conditions: HW+SR (N = 6); HW+NSR (N = 3); LW+SR (N = 8); LW+NSR (N = 8). The HW vs. LW conditions differed in cognitive testing intensity and duration. Standard PSG sleep measures were collected on the 3rd night of baseline (B3) and the 5th night of SR (SR5) or NSR (NSR5). Sleep records were visually scored using standard scoring criteria by an experimentally-blind trained scorer. One-way and mixed-model (night×condition) ANOVAs compared differences across all 4 conditions; paired t-tests examined changes from B3 to SR5/NSR5 for each group.

Results: There were no significant differences in B3 PSG measures across the 4 conditions. The HW+NSR and LW+NSR groups showed significant increases in Stage 3 %TST (P ≤ .04) from B3 to NSR5, with significantly larger increases in the HW group (P = 0.002). By contrast, the HW+SR and LW+SR groups showed significant—but not differential—increases in SE and SWS%TST, and decreases in TST, SOL, WASO, Stage 1 and 2%TST, and REM duration from B3 to SR5 (all P < 0.05).

Conclusion: The preliminary results from this experiment suggest that cognitive workload may influence non-REM sleep physiology, but more data will be required to confirm this finding. Sleep restriction had the expected robust effects on sleep physiology, and cognitive workload did not appear to affect the homeostatic sleep response to partial sleep restriction.

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0292

INTERACTIONS BETWEEN COGNITIVE WORK AND HOMEOSTATIC, CIRCADIAN, AND SLEEP INERTIA PROCESSES ON SUBJECTIVE SLEEPINESS, ALERTNESS, AND MOTIVATION

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Introduction: Time awake and circadian phase modulate cognition, sleepiness, alertness, and motivation. Cognitive work has also been shown to influence sleepiness. We examined the interaction between cognitive work and time awake, circadian phase and sleep inertia using a forced desynchrony protocol (FD).

Methods: Six healthy subjects [5 males (26.8 ± 5.2y;mean ± SD)] were studied in a 28h FD for 12 days. A ~30 min performance battery was completed at scheduled wake time and every 2h thereafter until 18h scheduled wakefulness. Sleepiness was assessed with Karolinska Sleepiness Scale (KSS) pre/post battery while alertness and motivation were

assessed with Visual Analog Scales (VAS) pre/mid/post battery. Data were averaged into 60° circadian bins and into 2h time awake bins for pre, mid (VAS only), and post battery. Deviations from the mean were analyzed with repeated measure ANOVA.
Results: Significant main effects of time awake and circadian phase were observed for alertness, sleepiness and motivation; significant interaction effects between time within the battery and circadian phase and time awake were observed for alertness and sleepiness (all $P < 0.05$). In general, alertness, sleepiness and motivation were best ~240° and worst ~60° circadian degrees. Sleep inertia impaired alertness, sleepiness and motivation and all measures improved over the next 4h of wakefulness, worsening thereafter until scheduled bedtime. Influence of sleep inertia on alertness and sleepiness was decreased at the end of the battery, whereas influence of time awake and circadian phase on alertness and sleepiness was increased at the end of the battery, especially near the circadian temperature nadir when time awake was extended.
Conclusion: Cognitive work, time awake, circadian phase and sleep inertia each modulate sleepiness and alertness with cognitive work showing a non-additive interaction with sleep homeostatic and circadian processes to influence sleepiness and alertness level. These findings have important implications for shift workers staffing round-the-clock operations.
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0293

THE EFFECTS OF SUSTAINED SLEEP RESTRICTION ON DRIVING SIMULATOR (AusEd) PERFORMANCE

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Introduction: Little work has been done on the effects of chronic sleep restriction on simulated driving performance. This study examined driving simulator performance after a period of 5 nights of sleep restriction to 4h time in bed (TIB).
Methods: N = 86 healthy adults (30.3 ± 6.8y; 46 females) participated in a controlled laboratory protocol. N = 77 underwent 2 baseline nights (10h TIB/night, 10pm-8am), followed by 5 sleep restriction nights (4h TIB/night, 4am-8am). N = 9 were randomized to a control group that received 10h TIB per night. The 20-minute driving simulator (AusEd) was administered every morning between 1030h-1215h and was set to simulate a monotonous rural road at night. Driving performance measures included steering deviation (StD) from median lane position (measured in centimeters) and speed deviation (SpD) from 70km/h. Driving performance measures were averaged among subjects. Paired and independent t-tests were used to examine the differences between days and groups.
Results: There was no significant change from baseline day 2 (B2) to sleep restriction day 5 (SR5) in the sleep-restricted subjects StD ($P = 0.19$) or SpD ($P = 0.96$), while the control group improved their StD ($P = 0.02$) performance but not SpD ($P = 0.09$). The sleep restricted group differed at SR5 from the controls in StD ($P = 0.005$) but not SpD ($P = 0.67$).
Conclusion: Sleep restriction interfered with subjects' ability to improve steering variability performance on a 20-minute version of the AusEd driving task, when compared to well rested subjects who improved performance with each day of the study. These results are consistent with the increased variability in sustained attention tasks (e.g., PVT) produced by sleep restriction, and they support concerns that sleep restriction may contribute to driving risks.
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0294

THE APPLICATION OF SLEEP SCIENCE TO OPERATIONAL PRACTICE IN COMMERCIAL AVIATION

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Introduction: Fatigue risk management and the development of new legislation for duty hours in commercial aviation have progressed to the use of fatigue models instantiating the science of sleep and circadian rhythms. Fatigue modeling allows for quantitative comparison of one proposed flight schedule versus another. Although relative, these comparisons can be used to establish clear standards against which to evaluate flight schedules. We outline two scientifically defensible approaches.
Methods: The first approach is to predict fatigue during take-off and landing and other critical phases of duty using a validated fatigue model, and then to compare the predicted fatigue levels against a threshold derived specifically for the specific type of operation. The second approach is to predict fatigue during critical phases of flight for a selection of schedules, and to compare that against another (historically safe) selection of schedules used as a benchmark. Here we illustrate this second approach, using the SAFTE/FAST model to compare predicted fatigue in the hour prior to arrival for a set of 250 stereotypical ultra-long-range (ULR) flights (≥ 16h more than 10% of the time) against a set of 122 stereotypical 4-pilot non-ULR long-range flights (≥ 14h, < 16h) serving as the benchmark.
Results: The mean of the ULR fatigue predictions (85.4% effectiveness) was significantly better than the mean of the benchmark non-ULR fatigue predictions (83.3% effectiveness); $t = 4.20$, $P < 0.001$. Further, the variance of the ULR fatigue values (14.7) was significantly smaller than that of the benchmark fatigue values (25.6); $F = 1.74$, $P < 0.001$. Finally, no single ULR fatigue prediction was worse than the worst prediction encountered among the non-ULR fatigue values. It follows that, as a set, the stereotypical ULR flights are safer with respect to fatigue risk than the comparable non-ULR long-range flights.
Conclusion: We introduced a science-based approach for the use of mathematical modeling of fatigue in commercial aviation to set safety standards against which to evaluate duty schedules. This approach promotes the development of circadian-sensitive, fatigue-friendly schedules that lead to increased safety and reduced numbers of errors, incidents and accidents, and, relative to prescriptive duty hour regulations, may also lead to increased productivity.
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0295

LAPSES OF ATTENTION AND REACTION TIME IN SLEEP-DEPRIVED NURSES WORKING SUCCESSIVE 12-HOUR SHIFTS

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Introduction: Sleep deprivation is common among nurses working 12-hour shifts, and has the potential to reduce effectiveness by decreasing vigilence. Little is known about actual neurobehavioral performance of nurses during work. Our aim was to (1) describe sample heterogeneity in lapsing over days, and (2) predict lapses and reaction time based on endogenous and exogenous factors.
Methods: Registered nurses working three successive 12-hour shifts (either day or night) were recruited (N = 80). Using the 5-minute Palm

PVT, lapses and median reaction time were measured. Exogenous predictors included caffeine use, smoking status, shift worked (either day or night), consecutive day of work (1 thru 3), activity and noise level at work. Endogenous variables included age, depression, fatigue levels (acute, chronic, intershift). Heterogeneity of lapsing over consecutive days was estimated using Poisson latent growth curve analyses. Bivariate correlations were used to assess relationship of predictors to median reaction time, and negative binomial regression was used for prediction of lapses.
Results: Total sleep time between 12-hour shifts was short (mean 5.5 hours). Lapses showed an overdispersed Poisson distribution, and ranged from 0 to 48 lapses per PVT test, with half of nurses committing 0-1 lapse, and 10 % of nurses lapsing 9 or more times during the testing period. There was a trait-like pattern of lapsing with three latent classes identified based on frequency: rare (54%), moderate (39%) and frequent lapsers (7%) with class bearing little relationship to pattern of lapsing over time. Factors associated with lapses included: sleep prior to shift, caffeine use, and fatigue levels. Median reaction time showed little relationship to predictors.
Conclusion: Achieved sleep between 12 hour shifts is too short, and is related to lapses of attention. A small number of nurses with high trait lapsing accounted for a significant number of vigilence failures.
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0296

TRUE AND FALSE MEMORIES IN TOTAL OR PARTIAL SLEEP DEPRIVATION

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Introduction: Sleep facilitates memory recall and helps protect against interference, while sleep deprivation negatively affects memory processes. The majority of the literature has focused on total sleep deprivation. Here, we examined the differential effects of partial and total sleep deprivation (PSD or TSD) on recall and recognition abilities, as well as the development of "false" or "gist" memories.
Methods: Forty-two healthy subjects (age = 25.4 ± 5.3yrs, 26F) were studied well-rested (WR: 6 nights of 9hrs TIB/night) and after either PSD (15 subjects: 5 nights of 4hrs TIB/night) or 30hrs TSD (24 subjects). We administered a word and shapes version of the Deese-Roediger-McDermott (DRM) paradigm designed to test both true memory (stimuli presented) and gist, or "false," memory (stimuli not actually presented but related to the prototype or semantic associate from the presented list). DRM was administered at the same time of day after WR, three and four nights of PSD (PSD3, PSD4) and TSD. Repeated-Measures AVOVAs focused on both recall and recognition of true and false memory (n = 31 for recognition tasks; age = 25.42 ± 5.76yrs, 18F).
Results: Word recall was the same on PSD3 compared to WR, but significantly worse following PSD4 (P = .023) and TSD (P = .001). Word recognition (D-prime) was equivalent across all conditions. Shapes recognition showed marginal significance only for TSD compared to WR (P = .055) but not for PSD. Lastly, the rate of gist memories did not change with either TSD or PSD.
Conclusion: Four nights PSD or 30hrs TSD impaired word recall, but three nights PSD did not. This suggests sufficient continuous sleep restriction can impair encoding to the same extent as acute TSD. Object memory, on the other hand, was only marginally affected by TSD. Interestingly, in contrast to recent findings, gist memory was unaffected by sleep deprivation.
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0297

EFFECTS OF SLEEP DEPRIVATION ON CRITICAL THINKING IN FIRST AND SECOND LANGUAGE SPEAKERS

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Introduction: Performance on a variety of tasks suffers as a result of sleep loss. Bilingual individuals may face added stressors when operating in their second language under sleep deprivation conditions. The purpose of the current study was to determine whether acute short-term sleep deprivation had a differential effect on critical thinking in first and second language speakers of English.
Methods: Participants included 25 native English speaking and 38 non-native English speaking college students. The participants completed the Watson Glaser Critical Thinking Task before and after a night of sleep deprivation. During the night of sleep deprivation, all participants completed a simulated night shift incorporating a wide range of tasks. The Watson Glaser resulted in 6 performance measures: global score, inference, recognition of assumption, deduction, interpretation, and evaluation of arguments.
Results: Six 2x2 ANOVAs were completed examining performance on the Watson Glaser measures using pre and post deprivation as the first factor and first and second language speaker as the second factor. The significant results were: a decrease in the global score ($P < .001$) from pre to post deprivation, a decrease in inference ($P < .001$) from pre to post deprivation, lower scores in first than second language speakers in recognition of assumptions ($P = .035$), and a decrease in interpretation from pre to post deprivation ($P = .019$). All other ANOVA results were non-significant. Furthermore, dependent measures t-tests showed that second language speakers' scores significantly decreased from pre to post deprivation more than first language speakers (p-values ranged from $P < .001$ to $P = .029$).
Conclusion: The current results indicate that sleep deprivation had a greater negative effect on critical thinking skills in second language speakers than first language speakers. This suggests that the second language speakers may have been more mentally fatigued due to the simulated night shift.
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0298

RECOVERY OF NEUROBEHAVIORAL FUNCTION IN A GROUP OF YOUNG ADULTS FOLLOWING CHRONIC SLEEP RESTRICTION

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Introduction: Neurobehavioral performance has previously been shown to be affected by both acute and chronic sleep restriction (CSR) but the recovery of neurobehavioral function following CSR is less understood. The present study was designed to enhance the understanding of recovery of neurobehavioral function following three weeks of CSR in a group of healthy young adults.
Methods: Twelve healthy subjects (mean ± sd 22.83 ± 2.25 yrs, 6f) participated in a 39-day study. After spending 10h/night time in bed (TIB) at home for 3 weeks, the inpatient study began with six 24h baseline days (10-16h TIB/day) and was followed by 3 weeks of CSR-forced desynchrony, during which subjects lived on 28h "days" (6.53h TIB/28h, equivalent to 5.6h TIB/24h). Post-CSR, subjects were scheduled to nine

24h recovery days (10h TIB/day). On all study days, 10-min psychomotor vigilance tests (PVT) were administered every 4h beginning 2h after scheduled waketime. Data from each subject were assigned to baseline, CSR, or recovery conditions. For the purposes of this analysis, data from the first five recovery days are excluded. The effect of CONDITION on three PVT measures: mean reaction time (RT); mean of fastest 10% of RTs from each trial; and number of RT lapses (RTs > 500 msec) was assessed via mixed model analysis on raw data, incorporating into the model a random intercept statement allowing for means to vary between subjects.

Results: There was a significant main effect of CONDITION on mean RT, optimal RT and number of RT lapses ($P < 0.001$), with performance on all three PVT measures best during baseline and poorest overall during CSR. Performance during the final segment of recovery was significantly worse than during baseline ($P < 0.001$), despite there being five prior days of recovery excluded from our analysis.

Conclusion: Our analysis revealed that RT performance during recovery from three weeks of chronic sleep restriction was significantly worse than baseline even after allowing for five full days of recovery/sleep extension. Additional analysis of other performance measures and of amounts and stages of sleep are needed to better understand the time course of recovery of neurobehavioral function following chronic sleep restriction.

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0299

THE EFFECT OF VARYING RECOVERY SLEEP DOSE AFTER SLEEP RESTRICTION ON DRIVING SIMULATOR (AusEd) PERFORMANCE

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Introduction: No studies to date have examined the sensitivity of the driving simulation task, AusEd to varying recovery sleep doses following sleep restriction. This study was designed to address this question.

Methods: N = 86 healthy adults (30.3 ± 6.8y; 46 females) participated in a controlled laboratory protocol. N = 77 underwent 2 baseline nights (10h TIB/night, 10pm-8am), followed by 5 sleep restriction nights (4h TIB/night) and then a recovery night (R1) where TIB was given in different doses (0, 2, 4, 6, 8 & 10h TIB) by randomized assignment. The 20-minute driving simulator (AusEd) was administered every morning between 1030h-1215h and was set to simulate a monotonous rural road at night. Driving performance measures included steering deviation (StD) from median lane position (measured in centimeters) and speed deviation (SpD) from 70km/h. Driving performance measures were averaged among subjects. Paired t-tests were used to examine the differences between days and groups.

Results: There were no differences at baseline amongst the sleep dose conditions ($P > 0.05$). SpD and StD both decreased with the 0h sleep dose after sleep restriction, when compared to baseline ($P = 0.0004$ and $P = 0.002$, respectively). However, none of the other sleep doses (2h-10h TIB) differed from baseline for either variable (all > 0.09).

Conclusion: The AusEd driving task was sensitive to total sleep deprivation after sleep restriction but performance did not change systematically across the other recovery sleep doses. This suggests a 20min AusED task is not particularly sensitive to varying recovery sleep durations (following sleep restriction) which we have found to be important for other neurobehavioral outcomes. Confounding of the AusEd's sensitivity to recovery sleep dose with a learning effect may have contributed to this insensitivity.

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0300

EFFECT OF SLEEP DOSE ON RECOVERY SLEEP STAGE AND SLOW WAVE ENERGY DYNAMICS FOLLOWING CHRONIC SLEEP RESTRICTION

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Introduction: Sleep homeostasis shows a saturating-exponential rebound of NREM slow wave energy (SWE) during recovery sleep from acute total sleep deprivation (TSD). However, there has been little systematic examination of recovery sleep after multiple days of sleep restriction (SR). A sleep dose-response study was conducted to determine the nature of sleep stage rebound following SR.

Methods: N = 149 healthy subjects (30.6 ± 7.0y; 48% female) participated in a laboratory-controlled SR protocol. Subjects underwent 2 nights of baseline sleep (B1, B2; each 10h TIB) followed by 5 nights of sleep restriction (4h TIB) and a recovery night (R1) where TIB was given in different doses (2, 4, 6, 8 & 10h TIB) by randomized assignment. Sleep was monitored with PSG using a standard montage and scored by a trained technician according to R&K criteria. For each R1 sleep dose, we assessed the durations of SWS, stage 2 (S2), REM and total sleep time (TST), and the percentage of NREM SWE relative to baseline.

Results: Systematic linear increases as a function of R1 TIB dose were found for TST, S2, REM, and SWE (all $P < 0.001$). Systematic exponential changes were seen for SWS (increasing as a function of R1 TIB; $P < 0.001$). Subjects randomized to 10h TIB on R1 had TST equivalent to B2 but SE higher than B2. They also had slightly increased S2, REM, and SWS relative to B2, and averaged 25% more SWE than during B2.

Conclusion: Recovery sleep rebound following chronic sleep restriction was linear (rather than exponential) for SWE, which accumulated to levels above baseline when recovery sleep was prolonged ~9h TST (10h TIB). It appears therefore that SWE may serve to protect the continuity and intensity of sleep during prolonged recovery sleep periods following chronic sleep restriction.

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0301

ACCUMULATION OF SLEEP HOMEOSTATIC PRESSURE ACROSS REPEATED EXPOSURES TO TOTAL SLEEP DEPRIVATION

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Introduction: Slow wave activity (SWA) in the NREM sleep EEG is an established marker of sleep homeostasis. We investigated whether or not there was accumulation of sleep homeostatic pressure, as quantified by SWA, in an experiment involving repeated exposure to 36h total sleep deprivation at 3-day intervals.

Methods: Nine healthy volunteers (mean age 28.2 ± 6.1; 7 females) spent 11 days in-residence in a sleep laboratory. Following an adaptation night and day, there were three consecutive blocks consisting of baseline sleep followed by 36h total sleep deprivation followed by recovery sleep. All scheduled sleep periods were 12h time in bed (TIB) beginning at 22:00, and were recorded polysomnographically and scored visually using the criteria of Rechtschaffen and Kales. Slow wave activity (SWA),

computed as average delta power (0.4-4.4Hz) in the NREM sleep EEG for each of four EEG derivations (Fz, C3, C4, Oz referenced against A1/A2), was assessed for each night as a marker of sleep homeostasis. SWA data were analyzed with mixed-effects ANOVA of night type (baseline or recovery) by block (1 through 3).

Results: As expected, there was a significant increase of SWA during recovery sleep after sleep deprivation, compared to baseline sleep, at all four EEG derivations ($F > 11.4$, $P < 0.005$). There was no main effect of block ($F < 2.1$, $P > 0.14$). For the C3, C4 and Oz derivations, there was no significant interaction either ($F < 0.69$, $P > 0.51$). For the frontal derivation (Fz), there was a trend for an interaction ($F = 2.8$, $P = 0.078$), with SWA for the recovery sleep periods marginally declining over blocks.

Conclusion: Relative to baseline, SWA was significantly increased during recovery sleep periods following 36h total sleep deprivation. This is consistent with SWA being a marker of sleep homeostasis. Across repeated blocks of baseline sleep, total sleep deprivation, and recovery sleep, there was no build-up of SWA in either the baseline sleep periods or the recovery sleep periods, suggesting that one night of recovery sleep at 12h TIB sufficed to dissipate the sleep homeostatic pressure accrued during each of the 36h total sleep deprivation periods. Whether or not one night of recovery sleep was also enough to restore waking neurobehavioral performance to baseline levels remains to be investigated.

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0302

14 MONTHS OF DAILY SLEEP AND DAYTIME QUESTIONNAIRES IN A SINGLE INDIVIDUAL: FEELING RESTED UPON AWAKENING IS ASSOCIATED TO LONGER TOTAL SLEEP TIME AND BETTER QUALITY OF LIFE

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Introduction: Better health, mood and cognitive functions have been associated with good sleep in a number of studies. This study aimed at looking at the associations of a rested feeling upon final awakening with sleep quantity and with quality of life in a single individual over 14 months.

Methods: One healthy male (29y) completed daily sleep and daytime questionnaires over 440 days. These included measures of rested feeling upon awakening on a 0 to 10 scale, subjective total sleep time and quality of life measures (feelings of passion, health, love, success and pleasure throughout the day) each on a 0 to 10 scale. All quality of life measures were grouped, with a maximum score of 50 for this variable. Questionnaires were fully completed for a total 375 days for the rested feeling upon awakening score and subjective total sleep time and for a total of 395 days for the rested feeling upon awakening score and all quality of life measures. Correlations were performed between rested feeling upon awakening and 1) total subjective sleep time 2) quality of life measures of the following day.

Results: Results show a significant positive correlation between feeling rested upon awakening and subjective total sleep time ($r = 0{,}51$, $P < 0{,}001$) and also between feeling rested upon awakening and subjective quality of life measures ($r = 0{,}29$, $P < 0{,}001$).

Conclusion: These results suggest that a feeling of rest upon final awakening is associated with longer subjective total sleep time and a subjective sense of better quality of life throughout the following day. Further analysis of the 440 days of daily sleep and daytime questionnaires and associated 404 nights of sleep recordings in this single subject is needed to better understand links between sleep quality/quantity and quality of life that could be applicable to other individuals.

0303

404 NIGHTS OF SLEEP RECORDINGS ON A SINGLE SUBJECT: THE MOST RESTFUL NIGHTS CONTAIN MORE TOTAL SLEEP TIME, N2 LIGHT SLEEP, REM SLEEP AND WAKEFULNESS AFTER SLEEP ONSET (WASO)

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Introduction: Many studies support that sleep quality is linked to some aspects of quality of life including alertness, mood and cognitive performances. This longitudinal study aimed at verifying these associations, looking first at sleep architecture associated to restfulness upon awakening in a single individual.

Methods: Sleep recordings and daily questionnaires were performed on a healthy male (29y) for 404 nights over a 14 months period. Visual scoring using the AASM 2007 criteria was accomplished for the first 120 nights at the extremes of a rested feeling upon final awakening scale (score 0 to 10). Sixty one nights had a score of 0 to 5 and 59 nights had a score of 8 to 10. Correlations were performed between restfulness upon final awakening scores and 1) total sleep time, 2) sleep stages (N1, N2, N3, REM), 3) wakefulness after sleep onset (WASO), and 4) sleep efficiency.

Results: Scores of feeling rested upon final awakening disclose a significant positive correlation with total sleep time ($r = 0{,}62$, $P < 0{,}001$), N2 time ($r = 0{,}51$, $P < 0{,}001$), REM time ($r = 0{,}53$, $P < 0{,}001$), REM percentage ($r = 0{,}23$, $P < 0{,}05$) and WASO time ($r = 0{,}22$, $P < 0{,}05$).

Conclusion: The present results suggest that longer sleep, increased N2, REM sleep and WASO are associated with a more rested feeling upon final awakening. The results do not support the notion that good sleep is a sleep with minimal WASO. Aiming at long sleep time with some spontaneous awakenings could probably improve rested feeling, daytime performance and quality of life.

0304

SLEEP EXTENSION AND ATHLETIC PERFORMANCE IN COLLEGIATE FOOTBALL

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Introduction: Traditional athletic training regimens typically focus on multiple aspects of physical training, but few prioritize adequate sleep as an important component. This ongoing study of varsity sports at Stanford University continues to investigate the effects of sleep extension over a prolonged period of time on specific measures of athletic performance.

Methods: Seven healthy students (age 18-22) in varying positions on the Stanford football team maintained their habitual sleep/wake schedule for a two week baseline followed by seven to eight weeks of sleep extension during their regular season. Subjects obtained as much sleep as possible during the sleep extension period aiming for a minimum of ten hours of sleep each night. Indicators of athletic performance were conducted after every regular practice including the 20-yard shuttle and 40-yard dash drills as used at the annual National Football League Combine. Profile of Mood States (POMS) was administered once a week to monitor changes in mood and the Epworth Sleepiness Scale examined levels of daytime sleepiness. Subjects completed daily sleep journals and actigraphy monitored daily sleep/wake activity.

Results: Subjects executed faster sprinting combine drills including a significant decrease in the 20-yard shuttle (4.71 seconds at baseline vs. 4.61 seconds at end sleep extension, $P < 0.05$) and significant decrease in the 40-yard dash (4.99 seconds vs. 4.89 seconds, $P < 0.05$). POMS vigor scores significantly improved (12.86 vs. 19.14, $P < 0.05$) and POMS

fatigue scores significantly decreased (11.52 vs. 1.57, P < 0.05). Subjects reported improved ratings during practice and Epworth Sleepiness scores significantly decreased (9.43 vs. 3.14, P < 0.05).
Conclusion: Improvements in football performance as assessed by the NFL combine drills suggest that sleep extension may be beneficial to athletic performance.

0305

LONG SLEEP DURATION IS ASSOCIATED WITH THE METABOLIC SYNDROME: THE GUANGZHOU BIOBANK COHORT STUDY

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Introduction: Sleep duration and sleep quality have previously been linked to some components of the metabolic syndrome including obesity, development of type 2 diabetes and hypertension. Prevalence of the metabolic syndrome is rapidly increasing. A limited number of studies have directly examined the relationship between the metabolic syndrome and sleep duration and produced conflicting results. We therefore examined the possible relationship between sleep duration and the metabolic syndrome in a large cohort of elderly Chinese.
Methods: Design: Cross-sectional analysis of baseline data from the Guangzhou Biobank Cohort Study. Setting: Community-based elderly association in Guangzhou, China. Participants: 29,310 Chinese men and women aged 50 years or older. Measurements: Self-reported total sleep duration (including daytime naps) was obtained by questionnaire and the metabolic syndrome was identified according to the American Heart Association and National Heart Lung and Blood Institute's criteria.
Results: Participants reporting long (≥ 8 hours) and short (< 6 hours) sleep duration were 15% and 14% more likely to have the metabolic syndrome, respectively. The relationship remained unchanged in long sleepers after full adjustment for demographics, lifestyle and sleep habits, use of hypnotics, diagnosed mental illness, and metabolic markers (odds ratio for metabolic syndrome 1.15 [95% CI 1.07-1.23]) but diminished in short sleepers (odds ratio for metabolic syndrome 0.98 [95% CI 0.90-1.08]). Removal of those with potential ill health slightly attenuated the observed association (odds ratio for metabolic syndrome 1.13 [95% CI 1.04-1.22] in long sleepers).
Conclusion: Long sleep duration is associated with elevated prevalence of the metabolic syndrome in this older Chinese sample. Due to the cross sectional nature of this study, causality cannot be determined. Confirmation by longitudinal studies is needed.

0306

THE EFFECTS OF CAFFEINE GIVEN 0, 3, OR 6 HOURS BEFORE BED ON OBJECTIVE SLEEP PARAMETERS MEASURED IN THE HOME

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Introduction: Previous studies of the effects of caffeine on sleep have utilized laboratory PSG or self-reports and few have compared the disruptive effects of caffeine administered at different times prior to sleep. In the present study, sleep parameters were assessed at home using a headband sleep monitoring instrument that wirelessly transmits sleep data to a bedside display for processing (ZEO Inc.) to determine if disruptions in sleep could be detected when caffeine was administered at 0, 3 and 6 hours prior to habitual bedtime.
Methods: Seven normal sleepers (moderate caffeine intake) were given caffeine (400 mg; 0, 3, or 6 hrs before bedtime) in a double-blind crossover placebo controlled study. Monitoring of sleep was performed each night. Sleep-wake parameters (total sleep time (TST), wake time during sleep (WTDS), sleep efficiency, sleep latency, stage 1 and 2 sleep, slow wave sleep, REM sleep, and ZQ composite measure of sleep) were collected and automatically scored online using previously validated algorithms. Total time in bed was maintained at each subject's habitual schedule. Data was analyzed using repeated-measures ANOVA.
Results: Sleep latency (6hr: +42.1; 3hr: +18.6; 0hr: +19.4minutes) and TST (6hr: -84.0; 3hr: -44.4; 0hr: -46.2minutes) showed large disruptions for each caffeine condition relative to placebo (n.s.). Changes in ZQ approached significance, P = .10 (6hr: -19.38; 3hr: -10.4; 0hr: -10.9units). Due to the limited sample size only pairwise differences in ZQ (placebo: 88.7 vs 6hr: 69.3, P = .08), SWS (placebo: 116.2 minutes vs 6hr: 45.2 minutes, P = .07), and stage 1 and 2 sleep (placebo: 286.4 minutes vs 6hr: 232.2 minutes, P = .044) achieved/approached statistical significance.
Conclusion: This ongoing study using objective monitoring of sleep parameters suggests that a moderate dose of caffeine even 6 hours prior to bedtime can have a large disruptive effect on sleep and that these effects can be assessed unobtrusively outside of the laboratory.
Support (If Any): This study was supported by ZEO, Inc (USA).

0307

COMPARISON OF AUTOMATED AND VISUAL EDITING PROCEDURES FOR EEG SPECTRAL ANALYSIS OF NREM SLEEP

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Introduction: EEG artifacts may significantly affect NREM EEG power quantified with spectral analysis. Automated algorithms and visual inspection by a technician are two common methods for editing the EEG signal. The impact of automated or visual editing procedures on final NREM power values is uncertain. We compared NREM EEG power spectrum values using four different editing methods.
Methods: We selected six PSG studies representing a range of participant ages and diagnoses. Each record was edited for muscle, movement, and electrical artifacts using four different methods: 1) No artifact rejection 2) Automated artifact rejection only; 3) Automated artifact rejection plus targeted visual editing based on the power-frequency plot; and 4) Automated artifact rejection plus visual editing of the entire record in 4-second epochs. Method 3 used a program called Spec Edit developed at the University of Pittsburgh and modeled after a similar program by Havstad and Ehlers. NREM power-frequency curves and compressed spectral arrays corresponding to visually-scored epochs are examined to identify artifacts, which are then removed manually in 4 second epochs. Spectral analysis of whole-night NREM EEG was conducted as previously described.
Results: The average number of 4-second NREM epochs removed using the four methods were 0, 52+54.7, 254.5+449.2, and 521+426.14. Average whole-night NREM delta power values (0.5 to 4 Hz) were 57.3+69.9, 54.7+69.5, 48.4+71.5, and 47.6+72.5 microvolts/Hz. Average whole-night values for beta power (20 to 32 Hz) were 0.1099+0.0432, 0.0612+0.0379, 0.0484+0.0228, and 0.0464+0.0226. Technician time to edit a record using Method 3 was ~15 minutes, and for Method 4 60-90 minutes.
Conclusion: The four artifact identification/rejection methods excluded very different numbers of epochs. Final EEG power values were very similar for Methods 3 and 4, despite the difference in technician time. Using an automated rejection algorithm plus targeted visual editing provides reliable quantitative EEG values while maximizing efficiency.
Support (If Any): RR024153

0308

NIGHTTIME DRIVING AND FUEL USE: A HIGH-FIDELITY SIMULATOR STUDY IN A SLEEP LABORATORY

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Introduction: Although fatigue from sleep loss and circadian misalignment may compromise real-world driving, it is common in transportation industries to drive at night. We examined the effects of nighttime driving on performance in a high-fidelity driving simulator widely used to train professional drivers (PatrolSim IV, MPRI, Salt Lake City). We focus here on a calculated measure of fuel use, which in simulator scenarios we have shown to capture varying real-world fuel efficiencies reliably.
Methods: As part of a larger study in our sleep laboratory, 25 healthy adults (12f, ages 22-39) were randomized to either a daytime driving condition (N = 12) or a nighttime driving condition (N = 13). On the first day, subjects practiced driving the simulator, and went to bed at 22:00 for baseline sleep (10h TIB). Subjects in the daytime condition then had a rest day and again went to bed at 22:00 (10h TIB). They subsequently underwent five days with performance testing including 30min simulator drives four times daily (between 09:00 and 19:00); bedtimes remained the same as baseline. Subjects in the nighttime condition also had a rest day after baseline sleep, but went to bed at 15:00 for a transition nap (5h TIB). They subsequently underwent five nights with performance testing that included 30min simulator drives four times nightly (between 21:00 and 07:00); they went to bed at 10:00 (10h TIB) every day. During each simulator session, subjects drove a simulated Ford Taurus in a standardized scenario of rural highways. Ten straight, uneventful road segments with a speed limit of 55mph were used to extract data on cumulative fuel use (72Hz sampling).
Results: Fuel use was analyzed as a function of time of day and compared between conditions (mixed-effects ANOVA). There was an interaction of condition by time of day ($F[3,467] = 3.63$, $P = 0.013$). Fuel use was stable throughout daytime driving, but in the nighttime condition it increased steadily over time of night to 0.89% greater fuel use by the end of the night compared to daytime driving.
Conclusion: In this controlled laboratory study, nighttime driving involved a progressive decline of fuel economy over the hours of the night as measured in a high-fidelity driving simulator. The fuel use results tracked fatigue profiles predicted by fatigue and performance models and observed in other performance measures. If our results can be generalized to fatigue in real-world driving, they may provide a bottom-line incentive for transportation industries to manage fatigue.
Support (If Any): FMCSA contract DTMC75-07-D-00006 and DURIP grant N00014-08-1-0802.

0309

REAL-TIME DROWSINESS AS DETERMINED BY INFRA-REFLECTANCE OCULOGRAPHY IS COMMENSURATE WITH GOLD STANDARD LABORATORY MEASURES: A VALIDATION STUDY

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Introduction: Most laboratory-based measures of drowsiness require offline processing, so are ineffective at providing immediate, cautionary feedback for a sleepy individual. A new system using infra-red reflectance oculography (Optalert™) continuously monitors eye movements to assess real-time drowsiness via a Johns Drowsiness Score (JDS). Here we examine the validity of JDS scores by assessing homeostatic and circadian change, in comparison to objective and subjective measures of sleepiness.
Methods: Fourteen healthy adults were phase-advanced (8h) using 90lux polychromatic light of different wavelengths before undergoing a 30h period of extended wakefulness under constant routine (CR) conditions. Participants wore the Optalert™ system throughout the CR, and completed bi-hourly neurobehavioral tests, including the Karolinska Sleepiness Scale (KSS) and Psychomotor Vigilance Task (PVT). JDS scores, Mean RT, lapses, and KSS scores were assessed for change over time. Average JDS scores in the 10-minute period preceding PVT/KSS tests were averaged to compare proprietary 'low' versus 'cautionary' scores in predicting subsequent performance and ratings of sleepiness.
Results: Average JDS scores revealed a significant main effect of time ($P < 0.0005$): the 27th-30th hours awake were significantly more drowsy compared to the 10th-18th hours awake (wake maintenance zone). A repeated measures ANOVA revealed a significant main effect of time, no main effect of test, and a significant test*time interaction ($P < 0.0005$). Tests following JDS scores > 4.5 (cautionary level) were associated with increased mean RT (550.4ms vs. 2053.2ms), slowest 10% RT (1954.7ms vs 5330.4), lapses (4.2 vs. 10.2) and KSS (4.3 vs 6.5).
Conclusion: JDS scores fluctuated according to circadian and homeostatic sleep pressure. Average JDS scores above the cautionary level were associated with subsequent delayed responses time, lapses and subjective sleepiness when compared to those below the cautionary level. In sum, this real-time indicator of drowsiness, shows promise that it may be an effective monitoring tool for drowsiness. Further testing will be required to determine how effective it is in the field, such as while driving a vehicle.
Support (If Any): Data collection was supported by grants from the National Space and Biomedical Research Institute (NSRBI HPF 01601; NSBRI HPF0003). The project described was supported by Grant Numbers M01 RR02635, Brigham and Women's Hospital General Clinical Research Center and 1 UL1 RR025758 Harvard Clinical and Translational Science Center, from the National Center for Research Resources.

0310

A CONTROLLED METHOD FOR INSTRUMENTAL SLEEP DEPRIVATION

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Introduction: Automated sleep detection, with stimuli interrupting sleep at onset, has been used to study long-term sleep loss in rodents. The original disk-over-water control procedure, an ingenious duplex apparatus delivering a single stimulus to experimental and control subjects does, however, yield a significantly sleep deprived yoked control. This study presents a complementary control procedure designed to minimize sleep loss.
Methods: Arousal stimuli recorded from a 10 d total sleep deprivation (conveyor-over-water apparatus) were played back to different rats -- but only while these controls were awake. Playback was 12h out of phase so that the most frequent stimuli, from an experimental animal's dark period, were played back during its control animal's active period. Rats are not awake long enough to play back all the recorded stimuli (with intervals), so we increased the speed of the conveyor belt by 50% correspondingly decreasing the length of the stimuli and intervals to fit more of the stimuli into each day.
Results: Control animals received over 90% (dark) and 40% (light) of the belt motion of corresponding experimental animals (the actual number of stimuli was reduced since stimuli were not delivered when the animals were asleep). Visually scored samples showed wakefulness only slightly increased in controls, but the contrast between active and inactive phases of the day was enhanced.
Conclusion: This method delivers the approximate number and pattern of stimuli of sleep deprived animals to control animals with only a small effect on the amount of sleep experienced by the control animals. Less complete deprivation would permit even closer matching of stimuli with minimal loss of sleep.
Support (If Any): Supported by NIH/NHBLI R01 HL086465

0311

AUTOMATED SLEEP DEPRIVATION: SIMULATED GENTLE HANDLING USING A YOKED CONTROL

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Introduction: Sleep deprivation by gentle handling is preferred due to a minimal amount of concomitant stress. However, many limitations make this method unsuitable for periods longer than 12 hours. By fixing a slowly rotating bar inside the home cage we have successfully sleep deprived mice continuously for 24 hours. Linking this stimulus to actively recorded EEG waves, gentle bar nudging is selectively applied only when the mouse enters a sleep state.
Methods: Two wild-type C57Bl6 male mice were implanted with EEG and EMG electrodes. Following recovery, mice were connected to a recording tether and acclimated to the recording cage (48 hours). Mice remained on LD 12:12 with food and water available ad lib. 24 h of baseline sleep followed by 24 hours of sleep deprivation and 18 hours of recovery was recorded. A slowly rotating bar (10 rotations/min) one inch off the floor of the recording cage disturbed sleep. During the deprivation period, the sleep deprived mouse (SD) was nudged awake upon entering a sleep-like state (high EEG delta & low EMG). The yoked control (YC) was subject to the same bar rotation but allowed to sleep freely during other times. All data was scored into 10 sec. epochs of Wake, NREM or REM sleep.
Results: Both SD and YC mice demonstrated similar sleep times during baseline(SD: 571 min; YC: 569 min). During deprivation, the SD mouse had a total of 48.5 minutes of sleep (91% reduction) while the YC had 134.5 min (74% reduction). Average NREM delta power during the first 8 hours of recovery sleep was higher in the SD mouse (130% baseline) than in the YC mouse (108% baseline).
Conclusion: This novel sleep deprivation method results in successful long-term sleep curtailment with the ability to incorporate a yoked-control animal in a natural cage environment.
Support (If Any): Work supported buy NIH SIBR grant #: 5R44MH076318-03

0312

HOURLY VERSUS HALF-HOURLY SAMPLING TO DETERMINE CIRCADIAN PHASE FROM SALIVARY MELATONIN

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Introduction: The use of salivary melatonin to assess circadian phase is a valuable tool for both researchers and clinicians alike. Here we exam-

ined if the difference in the dim light melatonin onset (DLMO) obtained with hourly versus half-hourly sampling was statistically or clinically significant.
Methods: Baseline melatonin profiles from 119 young healthy adults (56 males, 63 females) were analyzed. Samples were collected half-hourly in dim light (< 5 lux) beginning 6 hours before habitual bedtime and continuing for 16 hours. Subjects maintained a fixed home sleep schedule for at least 7 days prior to sampling. Subjects abstained from alcohol and NSAIDs for at least 24 hours prior to saliva collection. An hourly sampling rate was derived by removing every other sample. A threshold to determine the DLMO was calculated by taking the average of the first three low daytime points plus 2 standard deviations of these three points (Kennaway method). The DLMO was defined as the time that the melatonin levels exceeded and stayed above the threshold.
Results: The DLMO determined from hourly sampling was slightly earlier than the DLMO determined from half-hourly sampling (mean ± SD 21:17 ± 51 mins versus 21:25 ± 56 mins, respectively, paired t-test P = 0.02). There was a high correlation between the two methods (r = 0.89, P < 0.001). The average absolute difference in DLMO between the two sampling rates was 17 minutes (range 0 to 120 minutes). The DLMO differed by more than 30 minutes for 17.7% of subjects and by more than 1 hour for 5.9% of subjects.
Conclusion: For circumstances that require precise calculation of the DLMO, half-hourly sampling is best. In cases where half-hourly sampling is not practical, hourly sampling can yield a good approximation of the DLMO that would be derived from half-hourly sampling.
Support (If Any): R01 0H003954, R01 NR007677, R01 HL086934

0313

ESTIMATION OF SLEEP ONSET LATENCY IN NARCOLEPTICS VIA DETRENDED FLUCTUATION ANALYSIS

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Introduction: Estimation of sleep onset latency (SOL) is important, especially for narcoleptics who typically show sudden sleep attacks at inappropriate times, which often risks their safety. Electroencephalograms (EEGs) are commonly used to trace this rapid change, involving a progressive reduction in the arousal level across the sleep onset. The purpose of this study is to introduce a method to examine the level of the brain activity and demonstrate a potential application of the method in the estimation of sleep latency in narcoleptics.
Methods: Multiple sleep latency tests were performed to 10 drug-free narcoleptic patients (19.3 ± 4.4 yrs.; 8 males). Four-channel EEGs, EOGs, ECG and EMG were recorded at 200 Hz, but only C3/A2 was analyzed in this study. The first 30 s epoch of each trial was analyzed by the detrended fluctuation analysis (DFA), yielding DFA scaling exponents (SE) as a measure of the arousal level of the subject. The correlation of the DFA SE to the SOL, determined following standard criteria, was statistically analyzed.
Results: The DFA SE increased across the sleep onset, giving a negative correlation to the SOL, i.e., the correlation coefficient r = -0.43 (P < 0.01). The linear fit of the two variables showed that SOL = 5.8 - 4.0 DFA SE, measured in minutes.
Conclusion: Our results of (i) increasing DFA SE across the sleep onset and (ii) its significant correlation to the SOL suggest that DFA could be a potential measure to estimate the SOL in narcoleptics.
Support (If Any): Australian Research Council, National Health and Medical Research Council

0314

AGING EFFECTS IN CARDIO RESPIRATORY VARIABILITY IN DIFFERENT SLEEP STAGES

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Introduction: Studies have shown that respiratory and heart rate variability exhibit fractal scaling behavior on certain time scales. We study the short-term and long-term correlation properties of heartbeat and breathing-interval data from disease-free subjects with focus on age-dependent fractal organization across sleep stages and night-time wake. We also investigate quasiperiodic variations associated with cardiac risk.
Methods: Cardio-respiratory polysomnography was recorded during two nights, including electrocardiogram and oronasal airflow. The data were collected in eight laboratories in five European countries. In total recordings from 180 subjects without health complaints (85 males, 95 females) aged from 20 to 89 years (seven groups) were recorded.
Results: Using detrended fluctuation analysis short-term correlations in heartbeat intervals (measured by the DFA exponent 1) show a characteristic age dependence with a maximum around 50-60 years besides the dependence on sleep and wake states. Long-term correlations (measured by DFA exponent 2) differ in non-REM sleep compared with REM sleep and wake, besides weak age dependencies. Results for respiratory intervals are similar to those for exponent 2 of heartbeat intervals. ECG deceleration capacity (DC) decreases with age; it is lower during REM and deep sleep (compared with light sleep and wake).
Conclusion: The age dependence of DFA exponent 1 should be considered when using this value for diagnostic purposes in infarction patients. Pronounced long-term correlations for heartbeat and respiration during REM sleep and wake indicate an enhanced control of higher brain regions, which is absent during non-REM sleep. Reduced DC possibly indicates an increased risk for sudden cardiac death with aging and during REM and deep sleep.
Support (If Any): The data were recorded in the SIESTA project funded by the European Union. The analysis was funded by the DAPHNET project funded by the European Union and the German Research Foundation Ka 1676/3-2 and Pe 628/3. Further support was received by the Biomedical Research Institute at Brigham and Women's Hospital, Harvard Medical School.

0315

QUANTITIVE EVALUATION OF ONTOGENETIC CHANGE IN HEART RATE AND ITS AUTONOMIC REGULATION IN NEWBORN RATS WITH THE USE OF A NONINVASIVE PIEZOELECTRIC SENSOR

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Introduction: HR has been evaluated by using ECG with subcutaneous electrodes ,or hook-shaped or ring-shaped electrodes in many studies of autonomic regulation in newborn rats, and therefore the measured HR does not necessarily represent the basal HR under nonstressed conditions. In an earlier study, HR measured by ECG in-

creased in a S-shaped curve in P0-P14(Wekstein. 1965),but it has not been evaluated under nonstressed conditions. In this study, HR was measured by a novel noninvasive piezoelectric transducer (PZT) sensor to verify whether HR measured by PZT increase in same S-shaped curve or not.
Methods: In this study, HR of born rats was measured by PZT in P0-P14, and measured by ECG electrodes. Quantitative evaluation of ontogenetic change in heart rate and its autonomic regulation was accomplished by comparing HR measured by PZT (PZT-HR) to HR measured by ECG (ECG-HR).
Results: PZT-HR was stable during 5 min ($P > 0.05$). PZT-HR increased gradually by the postnatal day, but not in same S-shaped curve. ECG-HR was markedly decreased during 5 min at P0-P6 ($P < 0.05$).
Conclusion: There were episodic weakness and HR decreasing shortly after attaching ECG electrodes during measuring HR by ECG. This phenomenon was not found during measuring HR by PZT. ECG-HR was markedly decreased because of the restraint stress of attaching ECG electrodes, with accompanying freezing behavior. In an earlier study, ECG-HR increased in a S-shaped curve (Wekstein. 1965). PZT-HR increased but not in same curve. It suggests that HR decreasing by attaching ECG electrodes may affect making S-shaped curve. In new born mice, same hypothesis was suggested (Sato 2008).

0316

AUTOMATED DETERMINATION OF SLEEP AND WAKING STATES IN RATS BASED ON NON-INVASIVELY ACQUIRED RESPIRATORY ACTIVITY AND MOVEMENT

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Introduction: We previously constructed a non-contact monitoring system to measure movement and respiratory activity using pulse Doppler radar. In this study, we describe a classification method for automated scoring of wakefulness, non-rapid eye movement sleep (NREM) and REM in rats based on these signals.
Methods: Respiratory activity and movement detected via Doppler radar were recorded concurrently with standard measures of EEG and EMG. Eight pre-defined features reflecting the periodicity of respiration and low frequency movement were extracted from the radar signals. Wakefulness, NREM and REM were manually scored in 10 sec epochs based on EEG and EMG to enable classification training and evaluation of automated scoring. Generalized discriminant analysis (GDA) procedures were applied to the 8 features and corresponding manually scored sleep in 4 h records of 2 rats. This resulted in the reduction of 8 dimensions (features) to 2 new dimensions. A support vector machine (SVM) model was then fed with GDA generated data to train it as a classifier for automated scoring of wakefulness, NREM and REM. Autoscored records were compared to manually scored records over 8 h in 4 rats.
Results: Compared to manually scored records, autoscoring accuracy using the GDA-SVM classifier was high for wakefulness [sensitivity (89%), specification (96%), positive predicted value (PPV; 96%) and negative predicted value (NPV; 90%)] and NREM [sensitivity (95%), specification (92%), PPV (91%) and NPV (96%)]. Autoscoring accuracy for REM was lower [sensitivity (79%), specification (96%), PPV (68%) and NPV (98%)].
Conclusion: The GDA-SVM algorithm was able to reliably detect wakefulness and NREM based on differences in respiratory patterns and movement. Detection accuracy of REM was lower due to an overlap of quiet wakefulness with NREM and REM. Work is ongoing to improve state discrimination using other non-invasively obtained parameters including heart rate, body temperature and body posture.
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0317

AUTOMATED SLEEP STAGING IN REAL TIME USING TWO ALTERNATIVE EOG CHANNELS (Fpz-E1, Fpz-E2)

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Introduction: Cognitive impairments caused by chronic sleep deprivation can be ameliorated by brief naps, but the effect depends on accumulated sleep debt and timing, duration and sleep architecture of the naps. Naps would likely be more effective if their timing and duration could be tailored with respect to the accumulated sleep debt and previous naps. Real-time assessment of sleep architecture using a minimal number of EEG channels and dry electrodes is a pre-requisite for such an approach. With an intention of developing a device for optimizing naps in operational environments, we developed algorithms for real-time sleep staging using two alternative EOG channels (Fpz-E1 and Fpz-E2).
Methods: EEG (C3-A2), standard and alternative EOG and chin EMG were recorded from eighteen healthy sleep-deprived subjects during daytime naps (2-4 hours of duration). A simple threshold-based classifier used a beta-alpha-slow-wave index (a ratio of EEG power at high and low frequencies), slow-wave-sleep index (%time with the EEG central frequency < 4Hz), and a correlation coefficient between Fpz-E1 and Fpz-E2 to classify 30-second epochs into Wake, Light (LS, corresponding to NREM1), Solid (NREM2), Deep (DS, corresponding to NREM3) and REM sleep. Visual scoring was done offline according to the AASM criteria (gold standard-GS), and epoch-by-epoch comparisons were performed between GS and automated scoring.
Results: The overall agreement (72.5%, kappa = 0.63) and sensitivity and PPV for detection of Wake (Se = 74.5%, PPV = 80.1%), NREM Stage 2 (Se = 77.5%, PPV = 74.2%) and SWS (Se = 81.8%, PPV = 80.5%) equal or outperform similar efforts in the literature. The algorithm tended to score LS too early during transitions from wakefulness into drowsiness, and often overlooked brief (15-30s) awakenings. REM was often confused with LS.
Conclusion: Automated assessment of sleep architecture from the alternative EOG channels in real time is feasible but more work is needed in order to achieve accurate separation between NREM1 and REM sleep.
Support (If Any): DARPA SBIR grant W31P4Q-08-C-0123

0318

NEW DATA ANALYSIS METHODS FOR ACTIGRAPHY IN SLEEP MEDICINE

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Introduction: Actigraphy is an inexpensive but sensitive and accurate method recommended by the American Academy of Sleep Medicine (ASSM) to evaluate circadian patterns of activity, sleep, and fatigue. An actigraph is a watch-like device that is commonly attached to the wrist and uses an accelerometer to measure movements nearly continuously over several days. We describe the first time functional data analysis (FDA) methods have been used to analyze actigraphy data. Different from conventional summary statistics and existing actigraphy analysis tools, functional data analysis allows us to study in more depth patterns of activity, behavior, and quantification of fatigue.
Methods: To better understand the variations in activity patterns of individuals referred for polysomnography, we collected a weeks worth of actigraphy data from over 100 patients presenting with insomnia, sleep apnea, or restless leg syndrome. Functional data analysis (FDA) con-

verted discrete activity values measured at each minute to continuous functions to better model within-subject minute-to-minute and between-subject variability. These functions were subjected to standard statistical analysis using methods from functional data analysis.
Results: FDA shows significant variation in patterns that correlate with clinical measures. Graphical displays of functional principle components analysis show within-subject behavior patterns that provide additional insight into sleep medicine patients. Software for performing FDA on actigraphy is presented.
Conclusion: With improved high-end statistical methods and software for analyzing this data, actigraphy has the potential to become more important as an objective diagnostic tool for determining fatigue, sleep abnormalities and assessing response to treatment.
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0319

INTERPRETING PITTSBURGH SLEEP QUALITY INDEX SCORES OF INDIVIDUALS RECENTLY ADMITTED TO COLLEGE

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Introduction: The Pittsburgh Sleep Quality Index (PSQI) is often used to indicate sleep disturbance. Although developed with adults, the PSQI is used in younger individuals. This report examines PSQI responses in a sample of late adolescents/young adults.
Methods: 146 individuals recently admitted to college (mean age 18 years, range 17 - 21; 68 males) completed an online questionnaire to assess sleep, mood, and behavior. Responses to individual PSQI questions and sub-scale component scores were compared with a single-item, "Do you feel you have a sleep problem?" The seven PSQI component subscales and the un-scaled measures (e.g., sleep efficiency, PSQI5b) used to build the PSQI sub-scales were analyzed using principal component analysis.
Results: The sample mean PSQI score was 4.5 (SD = 2.3). PSQI scores > 5 occurred in 43 cases (30%), although only 11 (7.5%) reported a sleep problem on the single-item (7 of these 11 were > 5 on the PSQI). Average PSQI scores were higher for individuals who felt they had a sleep problem (6.2, SD = 1.7, range 4 - 10) than those who did not (4.3, SD = 2.3, range 0 - 11) ($t(144) = 2.619$, $P = 0.01$ two-tailed). The highest component scores were subjective sleep quality (C1), sleep disturbances (C5), and daytime dysfunction (C7); the sum of these components averaged 3.1 (SD = 1.4), reflecting a high contribution to overall PSQI scores. Principal component analyses with varimax rotation of the seven PSQI sub-scales yielded three extracted components, sleep quality, medication use, and sleep duration/efficiency. Principal component analysis of the 17 PSQI measures, extracted six components that do not match the sub-scales used to compute the PSQI or components extracted using the sub-scales. For example, the items used to construct C5 straddle 4 extracted components.
Conclusion: Although, PSQI scores were not consistently associated with self-perception of a sleep problem, the extracted component structure of the PSQI sub-scales in our younger sample was similar to that of older adults, indicating similar response patterns across age groups. Principal components extracted from the PSQI measures differed from the seven added together to produce the PSQI, suggesting that each of the traditional PSQI components may not represent unified latent variables.
Support (If Any): This work was supported by the National Institute for Mental Health (grant R01 MH079179). Dr. Raffray is supported by the European Sleep Center, Paris France and l'Institut Servier, Neuilly-sur-Seine, France.

0320

SLEEP IMPROVEMENT IS STRONGLY ASSOCIATED WITH TREATMENT SATISFACTION FOR PATIENTS WITH RESTLESS LEGS SYNDROME

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Introduction: Restless Legs Syndrome (RLS) is a neurologic disorder characterized by unpleasant leg sensations. Symptoms tend to follow a circadian rhythm, intensifying during the evening or night. A major complaint cited by RLS sufferers is an inability to initiate and achieve restful sleep. Treatments are often successful at controlling symptoms and providing sleep improvements. Here we assess the relative impact of specific sleep outcomes and symptom severity on RLS treatment satisfaction.
Methods: This IRB-approved, online survey is ongoing; preliminary data are reported Subjects were recruited by their PCP/neurologist. Inclusion criteria were: US residency; age > 17 years; RLS diagnosis for ≥ 1 year; currently taking levodopa or a dopamine agonist (DA) for ≥ 6 months; not diagnosed with peripheral neuropathy, kidney failure or pregnant; symptoms occurring ≥ 2-3 days/week before treatment. Subjects rated treatment satisfaction on a 7-point scale (not satisfied to totally satisfied). Sleep status was determined using the Sleep Index II score from the MOS sleep scale. RLS symptom severity was determined using the IRLS global summary score. Specific aspects of sleep were assessed by MOS sleep domain scores.
Results: To date, 200 subjects have completed this survey. Mean current treatment satisfaction is 4.7 (SD: 1.4), with ratings higher among subjects with better sleep scores. Multiple regression analysis controlling for subject demographics and sedative use revealed worsened sleep quality and increased symptom severity to be significant predictors of lower treatment satisfaction ($P < 0.01$, both) and in that order of significance. Also, an average-over-orderings analysis (using MOS sub-scales) showed sleep disturbance to be the strongest determinant of treatment satisfaction, followed by daytime somnolence.
Conclusion: These data show sleep to be closely associated with treatment satisfaction even after controlling for demographics, sedative use and symptom severity. Specifically, treatment satisfaction is associated with better quality of sleep and lack of daytime somnolence.
Support (If Any): GlaxoSmithKline, Research Triangle Park, NC

0321

EVALUATION OF THE BRADLEY SLEEPINESS SCALE SPECIFICALLY DESIGNED FOR LATE ADOLESCENCE AND EARLY ADULTHOOD: PRELIMINARY RESULTS

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Introduction: Many adolescents and college students are sleep-deprived and consequently sleepy. A common self-report measure of sleepiness, the Epworth Sleepiness Scale (ESS), was developed for adults and may use situations rarely encountered by younger individuals. The aim of this analysis was to evaluate and compare another self-report scale, the Bradley Sleepiness Scale (BSS), for measuring sleepiness in high school and college students.
Methods: Sleep, mood, and other behaviors of 146 high school seniors mean age 18 years (ages 17 - 21; 68 males) were assessed using an online survey, including the ESS, the BSS (17 items querying sleepiness),

and reported school night sleep and wake patterns over the past 2 weeks. Total sleep time (TST) was computed using reported bedtime to rise time, minus sleep latency and wake after sleep onset; sleep duration (SD) was the report of usual sleep quantity on school nights.

Results: BSS and ESS total scores were correlated (Pearson's $r = 0.42$, $P < 0.0001$). Cronbach's Alpha reliability coefficients were 0.81 for the BSS and 0.72 for the ESS. TST and SD on school nights were negatively correlated with the BSS ($r = -0.29$, $P < 0.0001$; $r = -0.44$, $P < 0.0001$) and the ESS ($r = -0.17$, $P < 0.05$; $r = -0.28$, $P < 0.001$). Steiger's z test showed no significant difference between the BSS and ESS for TST correlations ($z = 1.35$, $P = 0.18$) and a trend toward significance for the SD correlations ($z = 1.87$, $P = 0.06$). Four BSS sub-scales were identified using a principal component analysis: situations requiring a high level of engagement, requiring a low level of engagement, involving social interaction, playing videogames.

Conclusion: Cronbach's Alpha was in the acceptable range for ESS and good for BSS. Both scales were correlated with each other and with TST and SD. Further, the principal component analysis revealed that several components of sleepiness are drawn upon within the BSS. Future research and analyses will assess sensitivity to changes in sleep behavior.

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0322

EXTENDING TIME IN BED IN SHORT SLEEPERS: EFFECTS ON OBJECTIVE SLEEP PARAMETERS MEASURED IN THE HOME

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Introduction: Previous in-home studies have assessed the effects of extended time in bed using self report/diary, actigraphy and/or polysomnographic measures. Each of these has significant limitations in terms of accuracy, user acceptability, and ease of acquisition and interpretation. For the present study, sleep parameters were assessed using a simple headband sleep monitoring instrument that wirelessly transmits sleep data to a bedside display for processing (ZEO Inc.) in order to determine if improvements could be detected during a 14-night in-home study period.
Methods: Eight healthy short sleepers (≤ 6.5 hrs/nt) were exposed to 1 week of extended time in bed (+2 hrs) and 1 week of habitual time in bed in a counter-balanced cross-over design. Ambulatory monitoring of sleep was performed on a nightly basis with the headband unit. Data for sleep parameters (total sleep time (TST), wake time during sleep (WTDS), sleep efficiency, sleep latency, stage 1 and 2 sleep, slow wave sleep, REM, and ZQ composite measure of sleep) were collected and automatically scored online using previously validated algorithms. A validated measure of creativity was assessed during a laboratory visit on the last day of each condition.
Results: Several sleep parameters showed significant ($P < .01$) changes during the extended condition compared to habitual sleep (TST: +1.6hrs; stage 1 and 2 sleep +65.9min; REM: +30.5min; WTDS +10.5min; Latency +15.5min; ZQ +15.2 [from 64.9 to 80.1 units]). Less than 2.5% data loss occurred during the 14-night protocol. Creativity on the fluency component of the creativity task also showed significant improvement with sleep extension (+2.9, $P = .05$).
Conclusion: Findings demonstrate that changes in sleep parameters can be detected using a wireless instrument during a 14-night home-based sleep extension and that this sleep extension coincides with improvement in behavioral task performance. These findings have important implications for the assessment of sleep parameters outside of the laboratory.
Support (If Any): This study was supported by ZEO, Inc (USA).

0323

BENEFICIAL EFFECTS OF MILD FACIAL WARMING ON SLEEP PROPENSITY AND SLEEP LATENCIES

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Introduction: Several recent studies have reported the sleep-promoting effects of mild warming of hands and/or feet either prior to or during the process of falling asleep. Anecdotal reports have implied a similar effect of facial warming but the objective evidence was lacking. This study examined the effects of mild facial warming on sleep latencies.
Methods: 10 young subjects (8 men; age: 23.8 ± 2.8) of good physical and psychological health (per self-report) and no objective signs of a sleep disorder (verified with SDQ, PSQI, and an in-home overnight sleep study) were tested on two consecutive days in the sleep lab under the modified Constant Routine protocol. Each day entailed eight 20-minute sleep latency tests (SLT) separated with a 10-minute break (during which the subjects took iso-caloric snacks and used the toilet) and 30 minutes of psychological tests. Face was warmed with an off-the-shelf electrical heating pad during half of the SLTs in a counterbalanced way. Rectal, facial, proximal (trunk) and distal (hands and feet) skin temperature was recorded during the SLTs in addition to the standard sleep montage to make sure only the facial temperature changed. SLT records were scored according to the AASM rules. Sleep latencies were subsequently calculated as a time difference between the sleep onset (defined as 3 consecutive epochs of any stage of sleep) and lights off time.
Results: 4-way ANOVA with Subject, Day (first/second), Time of the day (1 to 8) and Heat (On/Off) revealed a significant main effect of the facial warming on sleep latencies (ON: 5.1 ± 5.3 minutes; OFF: 7.5 ± 6.1 minutes; $F = 8.67$, $P < 0.001$). Significant main effects also existed for Subjects, Day (likely due to adaptation) and time of the day (all $P < 0.001$).
Conclusion: The results of the study indicate that mild facial warming can promote sleep onset.
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0324

OBESITY RESISTANCE IS ASSOCIATED WITH CONSOLIDATED SLEEP-WAKE CYCLE IN RATS

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Introduction: Deteriorating sleep quality promotes obesity development. Corroboratively, earlier we showed an association between resistance to weight gain and enhanced sleep quality in obesity resistant (OR) rats at the age of 3 months. However, it is unknown if these sleep/wake changes persist during the entire developmental period in OR rats. We hypothesize that OR rats might exhibit consolidated sleep throughout their development. Accordingly, we examined sleep/wake differences between OR and Sprague-Dawley (SD) rats at 3, 4, 5 and 6-months of age.
Methods: Obesity-resistant and SD rats (3-months) were implanted with transmitters for recording sleep/wake behavior. Rats were habituated to the recording chamber, followed by 24-h recordings. Thereafter, sleep/wake cycle was recorded twice a month for 24-h until the rats were 6-months old. Recording was scored as wakefulness (W), slow-wave sleep (SWS) and rapid eye movement sleep (REMS), in 10-s epochs. Number of episodes in each stage, mean duration of these episodes and number of transitions between stages were also noted.
Results: Total number of sleep and wake episodes was significantly less in OR rats at all the ages tested ($P < 0.005$ for W; $P < 0.05$ for REM and SWS). However, the duration of these episodes was prolonged in OR rats relative to SD rats ($P < 0.005$ for W and REM; $P < 0.01$ for SWS). Similarly, the OR rats exhibited significantly ($P < 0.001$) fewer transitions between stages in all the sessions indicating behavioral stabilization and lower sleep-fragmentation. Total time in wakefulness was greater and time spent in SWS was lower in OR rats during all of the 24-h recording sessions ($P < 0.001$). However, time spent in REMS was not different between groups.
Conclusion: Obesity-resistant rat exhibits consolidated sleep/wake cycle and enhanced wakefulness throughout the developmental period, supporting the hypothesis that obesity resistance is associated with consolidated sleep.
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0325

THE DISCOVERY OF THE CENTERS OF SLEEP: CONSTANTINE VON ECONOMO AND A RARE NEXUS OF CIRCUMSTANCES

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Introduction: Early 20th century was a period of proliferation of scientific knowledge, especially in neurosciences. In the 1920's, a confluence of elements led to the first localization of the structures involved in the regulation of wakefulness and sleep. At the center of this nexus was this unique clinical entity and an astute physician, Constantine von Economo.
Methods: Literature review pertaining to the Encephalitis Lethargica pandemic.
Results: Review of Von Enconomo's work shows that he identified an area near the diencephalic/mesencepahlic junction with implications for sleep. Lesions of the anterior portion of this area caused insomnia, and lesions of the posterior portion, lethargy.
Conclusion: The outbreak of Encephalitis Lethargica and its careful clinico-pathological correlation by Dr Economo resulted in understanding of the substrates of sleep. Clinical features of the disease suggested localization of the brain regions involved. He used these clinical observations to target histological examination, and noted cell loss in the area of the diencephalic/mesencepahlic junction. Damage to the rostal portion - called the "sleeping part" (lateral and medial preoptic areas) resulted in insomnia associated with hyperkinetic activity. Lesion of the caudal portion, which he called the "waking part" (paramedian reticular formation of the lateral and posterior hypothalamus) resulted in lethargy with pronounced ophthalmoplegia. These observations set the stage for further development of substrates of sleep - from the lesional studies of Bremer to the recent discovery of orexins. In retrospect, this was an important work with implications for future development of this field.

0326

RESIDUAL SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA/HYPOPNEA SYNDROME: A CENTRAL POST-HYPOXIC HYPERSOMNIA?

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Introduction: Residual excessive sleepiness (RES, Epworth score greater than 10) affects 6% of patients with obstructive apnea/hypopnea syndrome (OSAHS) adequately treated with continuous positive airway pressure (CPAP), when other causes (insufficient sleep, comorbid diseases) are excluded. The mechanisms of RES are unknown. We compared the clinical, cognitive, neurophysiological and biological characteristics of patients with and without RES, and controls.
Methods: 40 OSAHS patients (aged 61 ± 10 y, 75% men, with 42 ± 17 apnea-hypopnea/h and adequate CPAP), with (n = 20) and without (n = 20) RES were compared to 20 healthy controls. The participants underwent clinical interviews, questionnaires (chronotype, fatigue, mood, apathy, attention deficit/hyperactivity), cognitive tests, polysomnography, multiple sleep latency test (MSLT), and 24-hour ad libitum sleep monitoring. The human leukocyte antigen genotype and serum ferritin levels were determined.
Results: The marked subjective sleepiness (Epworth score: 16.4 ± 3) in the RES group contrasted with moderately abnormal objective measures of sleepiness (10% patients with RES had MSLT latencies lower than 8 min) and poor benefit of stimulants. Compared to patients without RES, the patients with RES had more cognitive and psychological fatigue (but no physical fatigue), had lower stage N3 percentage, more periodic leg movements (without arousals), lower MSLT latencies and longer daytime sleep during 24-h monitoring. There was a gradual increase, from controls to apneic patients without and with RES, in the frequency of morning headache, memory complaint, depressive and anxious symptoms, inattention, lack of self-confidence, apathy, and spatial memory impairment.
Conclusion: The phenotype of RES in OSAHS patients is different from other central hypersomnias. It includes a neuropsychological syndrome of sleepiness, memory, attention, mood and fatigue complaints that may be too mild to be caught by objective tests. The association of RES, periodic leg movements and decreased mood without depression may be caused by post-hypoxic lesions in noradrenalin, dopamine and serotonin systems in selectively vulnerable patients.
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0327

SLEEP-DEPENDENT MEMORY CONSOLIDATION IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is a common sleep disorder leading to sleep fragmentation and intermittent hypoxia. Past research has shown various levels of cognitive deficits in patients with OSA, which extend beyond those primarily associated with sleepiness. The aim of this study was to test the hypothesis that on a motor sequence learning task (MST) patients with obstructive sleep apnea exhibit only practice-related learning, and lack the normal learning benefit that occurs during sleep.
Methods: We studied 33 subjects (18-60 years) in the evening prior to their clinical polysomnography evaluation and again the following morning. Results were compared between subjects with OSA (n = 18; AHI 26.3 ± 6.0 [s.e.m.]), and those who had a normal study (controls n = 19, AHI 6.1 ± 1.0; P = 0.001). All subjects underwent computer sessions of the Psychomotor Vigilance Task (PVT) and the MST.
Results: PVT performance (mean reaction time and lapses) showed no significant differences for within group (evening versus morning) and between group (OSA versus controls) comparisons, ruling out a difference in attention and vigilance as potential confounders between groups and time of testing. OSA patients showed significantly less overnight improvement on the MST for absolute values in speed (number of typed sequence per 30 seconds: controls 4.2 ± 0.8, OSA 1.6 ± 0.6; P = 0.01), as well as percent overnight improvement (controls 20.8% ± 4.8%,OSA 8.5% ± 3.7%; P = 0.03). There was a significant correlation between overnight improvement and arousal index (r = 0.4, P = 0.03) as well as AHI (r = 0.3, P = 0.05) and oxygen nadir (r = 0.3, P = 0.05).
Conclusion: Our results suggest that there is a significant difference in overnight memory consolidation of the MST between OSA subjects and controls, which appears to correlate strongest with the arousal-index during sleep between sessions. Since many major groups (Medicare, AASM recommended criteria) have recommended apneas and hypopneas to be judged based on hypoxemia rather than arousals, this outcome may provide critical new information that could lead to a reassessment of how sleep apnea should be defined.
Support (If Any): American Sleep Medicine Foundation Physician Scientist Training Award

0328

WHITE MATTER INTEGRITY IN OBSTRUCTIVE SLEEP APNEA (OSA): CHANGES IN DIFFUSION TENSOR IMAGING (DTI) AFTER CPAP TREATMENT

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Introduction: DTI is used to assess the integrity and organization of white matter; in particular, diffusion anisotropy maps give information about the impact of degenerative or vascular changes on white matter. Macey et al. (2008) assessed DTI in moderate to severe OSA and showed numerous areas of abnormal FA in patients respect to controls. Aim of this study was to examine white matter integrity in severe OSA and to assess any changes after effective treatment of the disorder.
Methods: 15 untreated male patients (mean age 43.7 ± 7.5) with severe OSA (AHI > = 30) and 15 normal controls matched for age, verbal IQ, education, gender, and hypertension were studied. Patients underwent MRI before treatment and after 12-months of CPAP therapy. DTI data have been collected using a 3 Tesla scanner (Philips Achieva). To compare subjects, DT images were spatially normalized to a standard brain template (MNI). Voxel-by-voxel statistical analysis was performed using SPM5 software with a threshold of significance of P < 0.001 and a minimum extension of 10 voxels for the significant clusters.
Results: Our baseline results are in agreement with the literature data confirming an extensive white matter alterations in OSA compared to controls. Patients after 12-months CPAP treatment showed

a decrease in FA localized in the superior longitudinal fasciculus, bilaterally, in the fornix, in the fibers of corpus callosum close to the anterior frontal and prefrontal cingulated cortex. The comparison between controls and patients' FA maps along time revealed that the extension of the blobs decreases with time suggesting a possible role of the treatment. The comparison between controls and patients' MD maps showed a difference in MD localized in the left uncinate which disappeared after 12-months CPAP treatment.
Conclusion: Effective treatment with CPAP determined a modification in FA meaning an improvement in white matter fibers. The structural changes probably represent accumulated injury over time that can be partially recover with effective therapeutic intervention.
Support (If Any): Respironics Foundation, Pittsburgh, USA

0329

BRAIN STRUCTURAL CHANGES IN OSA PATIENTS BEFORE AND AFTER TREATMENT

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Introduction: Obstructive Sleep Apnea (OSA) leads to sleep fragmentation and intermittent hypoxemia and is commonly associated with neurocognitive impairments that, however, have not been consistently related to specific brain structure abnormalities. Knowledge of the brain structures involved in OSA and the corresponding functional implications could provide clues to the pathogenesis of cognitive impairment and its reversibility in OSA. Aim of the study was to assess structural brain changes in severe OSA (AHI > = 30) patients before and after CPAP treatment.
Methods: We used Voxel-Based-Morphometry (VBM) to investigate significant brain morphology changes, in particular grey-matter volume increases, in 17 patients: a) before treatment (BL) (patients compared to 15 normal controls); b) at 3-months follow-up (compared to BL) and b) at one-year follow-up (compared to 3-months). VBM data were collected using a 3 Tesla scanner (Philips Achieva). Statistical analysis was performed using SPM5 software.
Results: At BL patients showed focal reductions of grey-matter volume in the left hippocampus (enthorinal cortex), posterior parietal cortex, and right superior frontal gyrus. After 3-months CPAP treatment, we observed significant grey-matter volume increase in hippocampal and frontal structures. After 1-year CPAP treatment we did not find any region showing a significant grey-matter volume increase when using a statistical threshold corrected for multiple comparisons (at the voxel-level, or at the cluster-level). When using an uncorrected $P < 0.001$ statistical threshold, we observed only small clusters of grey-matter volume increase in the left posterior dorsal insula and in the left cerebellum. Overall, our results show significant grey-matter volume expansions after 3-months CPAP treatment without further improvement after 1-year.
Conclusion: Our study provide evidence of a neuro-structural damage in OSA patients (decrease of grey-matter volume compared with controls) affecting specific cerebral regions and an increase of grey-matter volume in specific hippocampal and frontal brain regions with treatment. This study offers hope to patients and physicians that adherence to CPAP therapy can lead not only to clinical, but also to brain-structural recovery.
Support (If Any): Respironics Foundation, Pittsburg, USA

0330

ASSOCIATIONS BETWEEN ANTI-ANGIOGENIC PROTEINS WITH OVERNIGHT HYPOXEMIA AND SLEEP DISORDERED BREATHING IN PREGNANCY

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Introduction: Soluble placental-derived anti-angiogenic proteins, some of which may respond to hypoxemia, have been identified in preeclampsia. Given an association between preeclampsia and sleep disordered breathing (SDB), we evaluated whether these protein levels vary with levels of SDB in an obese pregnant population.
Methods: Participants in an observational cohort of obese pregnant women (BMI > 30 kg/m^2) underwent overnight sleep studies for SDB using a portable home monitor (ARES Unicoder; Carlsbad, CA), recording nasal pressure, oxygen saturation, snoring, and head movement, and measurement of body composition using air displacement plethysmography (Bod Pod). Medical charts were reviewed for objective data documenting the presence of comorbid conditions. Serum collected at the gestational ages 13-20 weeks' was analyzed for levels of soluble fms-like tyrosine kinase 1 (sFlt1), soluble endoglin (sEng) and placental growth factor (PlGF). Data were analyzed utilizing chi square, t-test and Spearman correlation.
Results: The sample of 45 women was age 30 ± 6.4years, had a BMI of 40 ± 7 kg/m^2 with 44 ± 6% body fat, and was studied at 16.6 ± 2.5 weeks of gestation. Co-morbid conditions included chronic hypertension (28%), diabetes mellitus (30%) and metabolic syndrome (22%). Three have an apnea hypopnea index (AHI) > 5. The mean AHI was 1.5 ± 3 (range 0-15.8) and the mean percentage of time < 90% O_2 saturation was 0.17 ± 0.5. Mean levels of the anti-angiogenic molecules were: sFlt1 (1672 ± 1179 pg/ml), sEng (4.05 ± 1.1 ng/ml) and PlGF (126.2 ± 113 pg/ml). Increasing AHI was correlated with an increase in sFlt1 ($r = 0.38$, $P = 0.01$), sEng ($r = 0.30$, $P = 0.03$) and sFlt-1: PlGF ratio ($r = 0.29$, $P = 0.05$). Increasing percentage of time < 90% O_2 saturation was also associated with an increase in sFlt1 ($r = .48$, $P = 0.001$), sEng ($r = .32$, $P = 0.03$) but not an increase in the sFlt1: PlGF ratio ($r = 0.11$, $P = 0.45$).
Conclusion: Among obese pregnant women, an increase in serum levels of antiangiogenic proteins was observed with modestly increased levels of AHI and overnight hypoxemia. These results suggest a mechanism that may explain the increased risk of preeclampsia in women with SDB.
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0331

AN fMRI STUDY OF CEREBRAL VASCULAR REACTIVITY IN UNTREATED OSA PATIENTS AND HEALTHY CONTROLS

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Introduction: Functional magnetic resonance imaging (fMRI) studies enable investigation of neural correlates underlying behavioral performance and can also be used to assess the reactivity of cerebral vasculature to hypercapnia. A breath-holding task (BH) was used to compare cerebral vascular reactivity (CVR) reserve of patients with untreated obstructive sleep apnea (OSA) to that of age and gender matched healthy controls (HC). CVR results could be compared to those of a working

memory task that all subjects performed prior to the BH task during the same fMRI session.
Methods: A breath-holding task was used to investigate the pattern of cortical activation related to CO_2-induced vascular dilatation in 25 patients with moderate or severe OSA and 9 age and gender-matched healthy controls. Based on their performance on a 3-back working memory task, patients were divided in low (n = 12) and high (n = 13) performers' groups (LP and HP respectively). An ANOVA was used to compare LP, HP and HC.
Results: As expected, neither group of OSA patients exhibited regions with higher CVR as compared to HC. On the contrary, HC exhibited significantly higher CVR in left (BA6,9,32) and right (BA9,46) frontal, bilateral parietal regions as well as right lenticular nucleus as compared to LP; and in left cerebellar grey matter , left frontal and bilateral parietal white matter as compared to HP (minimal cluster size: 10 voxels, P = 0.001, uncorrected).
Conclusion: Our results indicate that untreated OSA patients have a decreased CVR as compared to HC and that the pattern of CVR differences with HC is distinct for LP and HP groups (grey and white matter respectively).
Support (If Any): This study was supported by research grants from Swiss National Foundation for Scientific Research and FSBMB, as well as Respironics, Resmed, and Covidien.

0332

IMPROVEMENT IN LEFT VENTRICULAR REMODELING IN PATIENTS WITH SEVERE OSA FOLLOWING CPAP THERAPY

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Introduction: Accumulating scientific evidence has suggested a strong link between obstructive sleep apnea (OSA) and the development of cardiomyopathy and congestive heart failure. Left ventricular remodeling appears to be the predominant mechanism leading to cardiac morbidity and mortality in patients with OSA. The objective of our study was to determine the improvement in Left ventricular remodeling following 6 months of therapy with CPAP.
Methods: We recruited 30 newly diagnosed patients with severe OSA who were administered CPAP therapy for 6 months. The patients with known cardiac disease were excluded. All subjects underwent baseline (before CPAP) echocardiographic measurements that were repeated at 3 and 6 months. Additionally, cardiac magnetic resonance imaging (CMR) was performed at baseline and 6 months.
Results: The average age of patients was 51.17 ± 3.54 years, 66% were male, average BMI was 33.84 ± 4.53 kg/m^2. OSA was diagnosed by split night polysomnography. Average apnea-hypopnea index for the group was 55.51 ± 20.86. Most patients (> 85%) were compliant with CPAP therapy. Echocardiographic determinants of LVDD improved from baseline to 3 months (Left atrial ventricular index, LAVI: 45 ± 2.83 ml/m^2 to 34.57 ± 4.95 ml/m^2, P < 0.001 and left ventricular end-diastolic dimension, LVEDD: 58.70 ± 1.41 mm to 52.13 ± 0.12 mm, P < 0.001). Further improvement occurred at 6 months (LAVI: 45 ± 2.83 ml/m^2 to 31.75 ± 1.41 ml/m^2, P < 0.001 and LVEDD: 58.70 ± 1.41 mm to 51.21 ± 0.11 mm, P < 0.001). CMR measurements paralleled the echocardiographic findings. LAVI improved from 48.90 ± 4.95 ml/m^2 to 33.93 ± 1.1 ml/m^2, P < 0.01; left ventricular end-diastolic volume, LVEDV: 199.24 ± 5.66 ml to 149.59 ± 5.66 ml, P < 0.001; left ventricular mass decreased from 184.28 ± 1.41 gm/m^2 to 149.31 ± 1.40 gm/m^2, P < 0.001.
Conclusion: Our study demonstrated that 6 months of therapy with CPAP resulted in 30 ± 7 % reduction in LAVI, 25 ± 0.7 % reduction in LVEDV, and 19 ± 0.2 % reduction in LV mass in patients with severe OSA. Therefore therapy with CPAP is expected to prevent development of congestive heart failure in patients with severe OSA.
Support (If Any): Sleep Disorders Center, University of Manitoba

0333

CARDIOVASCULAR AND ASSOCIATED MORBIDITY COMPARISONS BETWEEN OBSTRUCTIVE SLEEP APNEA PATIENTS AND GENERAL POPULATION CONTROLS USING WESTERN AUSTRALIAN LINKED HEALTH DATA

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Introduction: Obstructive Sleep Apnea (OSA) is often accompanied by cardiovascular (CVD) and metabolic disorders, and has been implicated in increased CVD mortality. The Western Australian (WA) Sleep Health Study data has recently been linked to population-wide WA Department of Health Datasets (via computerized probabilistic matching), including hospital morbidity and mortality records. These datasets, collected over the last four decades, allow large-scale linkage of health records to various study data. The primary aim of our large study was to compare co-morbidities in OSA patients with the general population, adjusting for conventional confounders.
Methods: OSA cases included consecutive new patients who have attended our sleep clinic since 1988. Controls were identified via the electoral roll. Past occurrences of cardiovascular and associated co-morbidities in the OSA patients were compared to age- and sex-matched population controls. All relevant International Classification of Disease (ICD) codes collected over the twenty-year period of interest were standardized to ICD-10 coding for analysis of the cases and controls. Sex-specific logistic regression models were fitted to characterize the multivariate associations (adjusted for age, obesity, co-morbidities, alcohol and smoking) with OSA case-control status.
Results: 16,300 sleep clinic patients (69% males aged 59.7 ± 14.1 years, 31% females aged 58.2 ± 14.4 years) were linked as part of this study. Occurrence of type II diabetes (17% vs. 8%, hypertension (30% vs. 17%), ischemic heart disease [IHD] (16% vs. 10%), angina (5% vs. 3%), myocardial infarction (3% vs. 2%), chronic IHD (14% vs. 9%), other heart disease (18% vs. 10%), heart failure (7% vs. 3%), arrhythmias (12% vs. 7%) and cerebrovascular disease (3% vs. 2%) were all significantly increased in cases compared to controls (P < 0.001). Sex-specific multivariate case-control analyses adjusted for conventional confounders indicated that diabetes, hypertension, hyperlipidemia, myocardial infarction and other heart disease (P < 0.001) were independently associated with OSA case-control status in males. In females, IHD was additionally associated with OSA case-control status (P < 0.05).
Conclusion: These results suggest that OSA susceptibility is associated with ischemic heart disease independently of other co-morbidities, including diabetes, hyperlipidemia and hypertension. This supports the notion that the link between OSA and IHD cannot be explained by hypertension alone.

0334

THE ASSOCIATION OF SLEEP DISORDERED BREATHING AND MEASURES OF ARTERIAL STIFFNESS AND CENTRAL PULSE PRESSURE

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Introduction: Sleep disordered breathing (SDB) may increase cardiovascular disease via mechanisms of vascular dysfunction. Investigation of arterial stiffness and central pulse pressure in SDB may be useful

given the ability of these indices to detect subclinical vascular disease and predict cardiovascular events. We postulate that SDB is associated with measures of arterial stiffness and central pulse pressure.
Methods: Analyses included 58 participants who completed baseline examination in a randomized controlled trial. Indices of SDB included: Respiratory Disturbance Index (RDI), nocturnal hypoxia (defined as % sleep time < 90% SaO_2 dichotomized: < 2% and > 2%), and Arousal Index (AI). Vascular measures [carotid-femoral pulse wave velocity (cf-PWV, cm/s), augmentation index adjusted to heart rate of 75 (AI75, %) and central pulse pressure (mmHg)] were averaged for evening and morning readings before and after polysomnography. Linear regression models with robust standard error estimate were used to assess the relationship of SDB indices with vascular measures. Unadjusted and adjusted means (95% confidence intervals, P value) are presented.
Results: Subjects were: age 53.3 ± 12.7 (mean ± SD) years, 67% male, 52% Caucasian, with median Body Mass Index (BMI) 35.8 kg/m^2 and median AHI = 24.2. RDI and nocturnal hypoxia were not associated with the vascular measures. AI was not associated with AI75 or cf-PWV. However, AI was significantly associated with central pulse pressure in unadjusted analyses: per 5-unit increase in AI there was a -2.04 [(-3.53,-0.54), P = 0.009] reduction in central pulse pressure. After adjusting for age, sex, race, BMI, hypertension and diabetes mellitus, this relationship was attenuated but persisted: per 5-unit increase in AI there was a -1.38 [(-2.56,-0.20), P = 0.02] reduction in central pulse pressure.
Conclusion: We noted an inverse relationship between AI and central pulse pressure in individuals with moderate to severe SDB which is consistent with prior literature describing increasing AI in association with reduced white matter disease and stroke suggesting a potential AI-related protective vascular influence.
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0335

SLEEP FRAGMENTATION AND HYPOXIA IMPAIR ENDOTHELIAL FUNCTION IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: Impairment of endothelial dysfunction is common in patients with obstructive sleep apnea syndrome (OSAS). Vascular changes in individuals with OSAS have not been fully elucidated, however. We investigated the hypothesis that repeated arousals in OSAS are related to endothelial dysfunction.
Methods: Standard polysomnography was performed in 28 patients with OSAS (age 52.7 ± 10.4 years) to determine the number of apnea and hypopnea episodes per hour (apnea-hypopnea index, or AHI), the number of arousal per hour (arousal index), and the oxygen desaturation index (ODI). Patients with AHI of ≥ 20 episodes per hour were randomized to received continuous positive airway pressure (CPAP) treatment. 24-h urinary catecholamine excretion was measured. We also assessed the effects of CPAP treatment on pulse wave velocity (PWV) and plasma nitric oxide (NO) concentration. Plasma NOx was measured in the early morning on days before and after the first night of CPAP treatment, and breachial-ankle PWV was measured with a volume-plethysmographic apparatus before and after 3 months of CPAP treatment.
Results: Plasma NO concentration was significantly lower, ODI and arousal index were significantly greater in patients with an AHI of ≥ 20/h than in those with and AHI of < 20/h or controls. The plasma NO concentration was correlated with arousal index(r = -0.45, P < 0.05), but not with AHI. The 24-h urinary excretion of norepinephrine was significantly reduced and the plasma NO concentration was significantly increased in the CPAP group after one night of CPAP. Multiple regression analysis, including the AHI, ODI, the arousal index, age and systolic and diastolic blood pressure, revealed that arousal index was the most significant contributing factors to the decreased plasma NO concentration.
Conclusion: Successful CPAP treatment may reduce the risk of cardiovascular complications due to endothelial dysfunction or increased sympathetic activity in patients with moderate to severe OSAS.

0336

ENDOTHELIAL DEPENDANT CORONARY VASOREACTIVITY IN OBSTRUCTIVE SLEEP APNEA PATIENTS USING MYOCARDIAL BLOOD FLOW QUANTIFICATION BY 82Rb CARDIAC PET

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Introduction: Obstructive sleep apnea (OSA) is associated with an increased risk of cardiovascular diseases. Endothelial dysfunction is believed to be one of the pathophysiological mechanism underlying this association. Our aim was to compare endothelial dependent coronary vasoreactivity in obstructive sleep apnea (OSA) patients and controls by quantifying myocardial blood flow (MBF) response to cold pressure testing (CPT) with 82Rb cardiac PET/CT.
Methods: Twenty-four OSA patients (2W/22M, mean age 58 yo, mean BMI 28.6 kg/m^2) with an apnea-hypopnea index (AHI) ≥ 30/h and 9 healthy volunteers (AHI < 10/h) underwent a full night sleep recording (PSG) and a dynamic 82Rb cardiac PET/CT scan at rest, during CPT and adenosine stress. In OSA patients the same measurements (PSG and PET/CT) were repeated 6 weeks after initiating continuous positive airway pressure (autoCPAP) treatment. To reflect differences in baseline cardiac work, values were normalized according to ratepressure product (RPP). Statistical analyses were performed using t-tests and 1-way ANOVA.
Results: At baseline, untreated OSA patients had a mean AHI of 48.8/h and showed a lower MBF response to CPT than controls (1.1 ± 0.2mL/min/g vs. 1.3 ± 0.4mL/min/g, P = 0.048). Interestingly, CPT-MBF was not different between controls and well-treated OSA patients (1.2 ± 0.3mL/min/g vs 1.3 ± 0.4mL/min/g, P = 0.68), but it was significantly lower for insufficiently treated patients (n = 10) with an AHI > 10/h (0.9 ± 0.2mL/min/g vs 1.3 ± 0.4mL/min/g, P = 0.03). There was also a trend toward a difference in CPT-MBF between insufficiently and well-treated OSA patients (1.2 ± 0.3mL/min/g vs 0.9 ± 0.2mL/min/g, P = 0.15).
Conclusion: Untreated OSA patients have an impaired coronary endothelial function as measured by MBF response to CPT compared to control subjects. This difference disappears after 6 weeks of autoCPAP therapy but only in OSA patients showing a good response to CPAP (AHI < 10/h). Further studies are needed to determine by which mechanism OSA and CPAP treatment influence coronary vasoreactivity
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0337

ENDOTHELIAL FUNCTION IN PATIENTS WITH POST-CPAP RESIDUAL SLEEPINESS

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Introduction: The significance of residual excessive daytime sleepiness (REDS) on cardiovascular markers in adequately treated OSA patients

remains unclear. The objective of this study is to investigate flow-mediated dilatation (FMD) and inflammatory markers (CRP, TNF-α, and IL-6) in continuous positive airway pressure (CPAP)-compliant patients with REDS compared to CPAP-compliant patients without REDS.
Methods: Flow mediated dilatation (FMD) of the brachial artery was measured by ultrasound in 12 CPAP compliant OSA patients with REDS and 12 age-, gender-, and body mass index (BMI)-matched CPAP compliant OSA patients without REDS on week 8 after initiation of CPAP. Twelve otherwise healthy subjects without sleep disordered breathing were used as controls. Serum levels of CRP, TNF-α, and IL-6 were quantitated by ELISAs.
Results: Baseline FMD was comparable between CPAP-compliant patients with REDS (7.2 ± 2.3), CPAP-compliant patients without REDS (8.6 ± 2.1) and controls (7.7 ± 1.4) (P = 0.37). The levels of CRP, TNF-α, and IL-6 were also not significantly different between subjects with CPAP-compliant REDS and those without REDS (P = 0.44, P = 0.37, and P = 0.42; respectively).
Conclusion: Residual excessive daytime sleepiness in adequately treated OSA patients may not represent a risk factor for cardiovascular diseases.
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0338

HABITUAL SNORING AND GESTATIONAL DIABETES

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Introduction: Recent literature suggests that habitual snoring (HS) and any underlying obstructive sleep apnea during pregnancy are associated with adverse pregnancy outcomes. One other important morbidity is gestational diabetes mellitus (GDM). Sleep apnea is believed to promote DM outside pregnancy. The prevalence of GDM is increasing, and the condition is associated with poor maternal and fetal outcomes. However, the relationship between HS and GDM remains unexplored.
Methods: Women were recruited from obstetric clinics during the last trimester of pregnancy and invited to complete questionnaires that included items about habitual snoring (HS, defined as ≥ 3 nights/week) and whether it began before or during pregnancy. Medical records were reviewed for results of 1-hour blood glucose screens, performed routinely between 24-28 weeks' gestation. GDM was considered present if glucose was ≥ 140mg/dl.
Results: Of 872 women studied (mean age 29.7 ± 5.7 years), 24% had GDM. Overall, 7.5% of women reported chronic HS and 27% reported pregnancy-onset HS. The group with chronic HS had a higher pre-pregnancy BMI on average than either the non-HS or the pregnancy-onset HS group (31.5 ± 9.2 kg/m^2 vs. 24.9 ± 6.3 kg/m^2 and 28.4 ± 7.9 kg/m^2; each P < 0.001 respectively). GDM was more frequent in women with pregnancy-onset HS compared to non-HS (33% vs. 21%; P = 0.0006). There was no difference in GDM between non-HS and chronic HS (21% vs. 25%; P = 0.5) or between chronic HS and pregnancy-onset HS (25% vs. 33%; P = 0.2). In a logistic regression model, GDM was associated with pregnancy-onset HS even after accounting for age, race, gestational age, parity, and pre-pregnancy BMI (odds ratio 1.6, 95%CI [1.1, 2.5], P = 0.026). In contrast, chronic HS was not associated with GDM.
Conclusion: Our findings suggest that the development of new HS during pregnancy confers an additional risk for GDM over and above BMI. Clinicians should ask during prenatal visits about snoring and its onset.
Support (If Any): NHLBI HL089918 University of Michigan Institute of Clinical and Health Research University of Michigan Institute for Research on Women and Gender. The Gilmore Fund

0339

SDB AND DAYTIME NAPPING ARE ASSOCIATED WITH HIGHER GLUCOSE LEVELS IN PREGNANT WOMEN

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Introduction: During pregnancy, the majority of women experience day-napping and sleep disturbances including sleep-disordered breathing (SDB). SDB may be associated with gestational diabetes (GDM), and longer day-napping in older adults was found to be associated with a higher risk of diabetes. However the health consequences of SDB and napping during pregnancy are poorly understood.
Methods: A group of 104 pregnant women who underwent a full polysomnography in the first trimester and a glucose challenge test (GCT), and completed Pittsburgh Sleep Quality Index (PSQI) and house questionnaires were studied. Bivariate and multivariable linear regression analyses were performed to determine the clinical characteristics that were significantly associated with GCT results. Using GCT values as the dependent variable, sleep and demographic variables having a P < 0.2 in a bivariate analysis were reevaluated in full linear regression models as independent variables.
Results: In unadjusted linear regression analysis, variables with a P < 0.2 were first-trimester BMI (kg/m^2) (β = 0.51, P = 0.12), first-trimester neck circumference (β = 1.89, P = 0.02), parity (β = 8.14, P = 0.09), first-trimester RDI ≥ 15 (β = 49.91, P = 0.004), habitual snoring (β = 19.27, P = 0.01), steady night-shift work (β = 13.09, P = 0.12), second-trimester nap duration (β = 0.07, P = 0.02), nocturnal sleep (β = -0.04, P = 0.10), PSQI-sleep duration subscale (β = 4.25, P = 0.08), PSQI-sleep efficiency (β = 2.74, P = 0.14) and PSQI total score (β = 0.88, P = 0.18). In the final multivariable model, first-trimester RDI ≥ 15 (β = 38.88, P = 0.02) and second-trimester nap duration (β = 0.06, P = 0.03) were significantly associated with increasing GCT values after adjustment for BMI, parity and nocturnal sleep duration.
Conclusion: SDB and longer day-napping are associated with higher GCT values. Day-napping may occur due to sleep disturbances that increase sympathetic activation. This may in turn carry over in wakefulness to induce insulin resistance. Even minor degrees of increased glucose intolerance may be associated with increased incidence of adverse perinatal outcomes. Further research is needed to determine whether pregnant women with SDB and longer day-napping are at risk for GDM and other adverse perinatal outcomes.

0340

THE EFFECTS OF OBSTRUCTIVE SLEEP APNEA AND VISCERAL FAT ON INSULIN RESISTANCE: THE ICELANDIC SLEEP APNEA COHORT

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Introduction: The independent role of obstructive sleep apnea (OSA) in insulin resistance (IR) is much debated. In this ongoing prospective

study we assessed the relative effect of OSA and obesity on insulin resistance.

Methods: Untreated OSA underwent abdominal magnetic resonance imaging to measure visceral fat. Blood was taken fasting in the morning for the homeostatic model assessment (HOMA-IR), plasma glucose [mmol/L] x plasma insulin [mlU/L] / 22.5, and log transformed for analysis. Subjects on diabetic medication were excluded from analysis (n = 22). A response surface model, a third order linear model, was employed to simultaneously estimate the effect of obesity and OSA severity and their interaction on log HOMA-IR levels. Expected[log HOMA-IR] = $\beta_0+\beta_1$*OSA+β_2*(OSA)^2+β_3*obesity+β_4*(obesity)^2+β_5*(OSA*obesity)+β_6*OSA*(obesity)^2+β_7*obesity*(OSA)^2.

Results: Altogether 348 OSA patients (males 84%) have been included; mean ± SD BMI 31.6 ± 4.4 kg/m^2 and mean apnea-hypopnea index (AHI) 39.4 ± 15.9. Altogether 37.6% of the subjects had HOMA-IR > 3.99 indicating insulin resistance. Different OSA severity markers were assessed for their relationship with insulin resistance; oxygen desaturation index (ODI) and minimum O_2 were weakly correlated with log HOMA-IR levels after adjusting for BMI and a trend for the same was seen for hypoxia time (minutes O_2 < 90%) but not AHI. The response surface model showed that AHI, ODI and hypoxia time were independently related to log HOMA-IR levels after adjusting for both BMI and visceral fat volume ($P \leq 0.02$), together explaining about 38% of the variability in log HOMA-IR levels. Terms involving BMI explained 23.7% of the variability (partial r^2), OSA 4.9% and visceral fat 4.1%. An interaction was found between OSA severity and BMI on log HOMA-IR levels, showing the strongest effect in the most obese, but a variable effect in the less obese.

Conclusion: OSA severity has a small independent effect on insulin resistance after controlling for obesity and visceral fat. This effect varies by the degree of obesity.

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0341

HPA AXIS IN NON OBESE MALE APNEICS: EFFECT OF CPAP

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Introduction: The goal of this study was to examine the cardiometabolic profile of nonobese apneic men and the effect of CPAP treatment. Previous studies have shown that CPAP treatment lowers the levels of cortisol in obese men with severe apnea. In this study, we examined the HPA axis in non obese apneics before and after CPAP use.

Methods: Eighteen nonobese, middle-aged men with obstructive sleep apnea participated in a four month study. Subjects were assigned on a 2 x 2 crossover design, with half of the subjects randomized to the sham-CPAP/CPAP sequence and the other half to the CPAP/sham-CPAP sequence. The subjects were assessed in the sleep laboratory for four consecutive nights three times: at baseline; 2 months following the use of CPAP; and 2 months following the use of sham- CPAP. 24h blood sampling was performed during the fourth day for the assessment of cortisol.

Results: There were no significant differences in 24h cortisol levels between non obese apneics compared to nonobese controls. In the apneic group, cortisol levels decreased significantly after the use of CPAP for two months (P = 0.02). Cortisol levels were also significantly lower after using CPAP compared to sham-CPAP (P = 0.018). There were no significant differences in 24h cortisol levels between baseline and sham-CPAP. We further categorized the apneic group into moderate apnea AHI < 30 (n = 8) and severe apnea AHI ≥ 30 (n = 10). Mean 24h cortisol levels significantly decreased after the use of CPAP in the severe apneic group (P = 0.31) but not in the moderate apneic group.

Conclusion: The use of CPAP treatment significantly decreases cortisol levels in middle age nonobese men with severe apnea. CPAP use may be beneficial for the adverse cardiometabolic effects associated with chronic hypercortisolemia.

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0342

DOES A NEUROBEHAVIORAL AND MOOD DOSE RESPONSE TO CPAP EXIST IN OBSTRUCTIVE SLEEP APNEA PATIENTS TREATED WITH CPAP?

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Introduction: Obstructive sleep apnea (OSA) patients' functional and sleepiness outcomes are associated with duration of CPAP use or dose. Neurobehavioral and mood outcomes relative to CPAP dose are not well-defined. The study objective was to examine the relationship between achieving "normal" neurobehavioral and mood outcomes as a function of CPAP dose.

Methods: A multi-site, international prospective observational study included severe OSA patients (n = 149) with baseline testing before treatment and after three months of CPAP. Subjects with abnormal baseline values were included in the dose response analysis using probit analysis. Neurobehavioral measures included Psychomotor Vigilance Task (PVT; Sustained attention), Digit Symbol Substitution Test (DSST; Cognitive processing), Probed Memory Recall Test (memory); Mood measures included Profile of Mood States (POMS). Objective CPAP use was overtly monitored. A validated cut point value of 265msec for PVT was used to estimate response probabilities as a function of mean CPAP use; selected cut point values for the DSST, Probed Memory Recall test, and POMS were used such that 25% of the sample was defined as having "normal" response.

Results: Subjects were middle-aged (46.8 ± 8.8 yrs) severe OSA patients (AHI 64.3 ± 29.1 events/hr). Responders, defined by the normal response thresholds for study outcomes, had longer CPAP use than nonresponders on all measures except DSST and Probed Memory Recall (P < 0.05). Improvement in POMS occurred with two hours CPAP use without further improvement with additional CPAP use (42.9% responders; P = 0.017). Improvement in PVT occurred with six or more hours CPAP use (26.9% responders; P = 0.021). No dose response was observed for DSST or Probed Memory Recall test.

Conclusion: Sustained attention neurobehavior outcomes and mood are associated with CPAP dose in CPAP-treated severe OSA. Future studies examining these relationships across OSA disease severity categories are needed to more robustly describe CPAP dose response for neurobehavior and mood outcomes.

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0343

A RANDOMIZED CONTROLLED TRIAL OF NASAL EXPIRATORY RESISTANCE AS A TREATMENT FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Positive airway pressure (PAP) is an effective treatment for patients with obstructive sleep apnea (OSA) but adherence to treatment is only around 50%. Upper airway surgery and oral appliances may be effective in some patients. However, other treatment alternatives for OSA are urgently needed. Two pilot studies of 24 and 34 patients with OSA found that a nasal expiratory resistance appliance (NERA) significantly reduced the apnea-hypopnea index (AHI). The NERA (Provent®, Ventus Medical, Inc.) consists of two expiratory resistance valves each covering a nostril and held in place by an adhesive tape. The valves have negligible inspiratory resistance but have sufficient expiratory resistance to create a back pressure. A large multi-center double blind randomized sham controlled 3 month trial of the NERA was undertaken to better document efficacy.
Methods: Patients with a diagnosis of obstructive sleep apnea (AHI > 10/hour) without significant co-morbidities were randomized to treatment with the NERA or a sham device for 3 months. A device trainer instructed the patients on use of the NERA and sham devices and was the only non-blind participant in the study. On the first week of use the patients underwent polysomnography (PSG) on two non-consecutive nights. In random order the study device was worn (Device-ON) or not worn (Device-OFF). The PSGs were scored by a central scoring laboratory using AASM recommended criteria. The two PSGs were repeated after 3 months of device use. Results for the first week PSGs are reported here. The three month results are not yet available.
Results: Nineteen sites enrolled a total of 250 patients. Patients were randomized to sham device (125 patients) and to the NERA (125 patients). Data for 119 NERA patients and 110 sham patients were available. The median Device-OFF/Device-ON AHI values for the NERA were (13.8 and 4.9 events/hour) and for the sham device were (11.1 and 11.6 events/hour). The reduction in the AHI with the NERA device was highly significant ($P < 0.0001$). The median decrease in the AHI in the NERA group was 53%. Analysis of subgroups of mild, moderate, and severe OSA patients was performed and the median improvement was > 50% in all groups. For example, in the severe OSA group (N = 17) the median AHI fell from 48.2 to 18.9 events/hour.
Conclusion: The nasal expiratory resistance appliance resulted in a statistically and clinically significant reduction in the AHI in a group of patients with mild to severe OSA.
Support (If Any): Ventus Medical

0344

NON-SLEEP SPECIALISTS ORDERING CPAP, AFRICAN AMERICAN RACE, AND MEDICAID INSURANCE STATUS ARE INDEPENDENT PREDICTORS OF REDUCED CPAP ADHERENCE IN PATIENTS WITH OSA

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Introduction: Factors leading to poor adherence can be patient-related, disease-related, or device-related. The area that has received less attention is the specialty and expertise of the physician ordering the PSG and CPAP therapy. The aim of this study was to quantify the impact of physician specialty on CPAP adherence.
Methods: In this prospective observational cohort study we analyzed CPAP adherence data on 407 adult patients in their first 30 days. None of the patients saw their physicians in this time period. Non-sleep specialist either ordered PSG without sleep consultation or referred patients for sleep consultation. A multiple linear regression model was used to evaluate the association between demographic and polysomnographic variables in addition to physician specialty on CPAP adherence.
Results: For the entire cohort the mean ± SD was 52 ± 14 years for age and 36 ± 9 kg/m^2 for BMI. Our cohort was 53% female, 54% African American, and 38% had Medicaid. Median (IQR) AHI was 36 (18-67). Severe OSA was present in 58% and split night PSG was performed in 41% of the patients. PSGs and subsequent CPAP therapy were ordered by sleep specialists in 116 patients (29%). In a multiple linear regression model that included numerous variables such as age, gender, race, education, marital status, BMI, type of PSG (split vs. full night titration), Medicaid status, physician specialty (sleep specialists vs. all other specialists), hypertension, type 2 diabetes, nasal allergies, chronic hypnotic use, self-reported habitual total bed-time, AHI, CES-D depression scale, Epworth sleepiness scale, and type of mask only three covariates were significantly associated with decreased CPAP adherence: 1) non-sleep specialist ordering the PSG (beta = -77 minutes/night, $P < 0.001$); 2) African American race (beta = -43 minutes/night, $P < 0.03$); and 3) Medicaid insurance (beta = -41 minutes/night, $P < 0.04$).
Conclusion: In this large and diverse cohort, physician specialty, race, and Medicaid insurance were independently associated with reduced CPAP adherence.

0345

EFFECTS OF REAL TIME MONITORING ON ADHERENCE TO CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY FOR TREATMENT OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Adherence to continuous positive airway pressure (CPAP) therapy is defined as 4 or more hours per night for 70% of nights. Patient adherence is typically measured retrospectively and is commonly reported to be less than 50%. Hypothesis: To determine if real time monitoring of CPAP use via embedded modem improves patient adherence in the first thirty days.
Methods: A retrospective observational analysis was performed on 436 patients diagnosed with obstructive sleep apnea (OSA) by polysomnography at the Minnesota Sleep Institute. None of the patients had previously received CPAP therapy. Data from January 2008 through June 2008 was collected on 206 patients using CPAP machines with embedded memory cards, and this was compared to data from January 2009 through June 2009 on 230 patients using CPAP machines embedded with modems. The presence of the modem allowed for sleep technicians to contact the patient in real time if the patient was not using their CPAP machine and assess the patient's obstacle to therapy. The data collected included the total number of hours CPAP was used each night and the total number of nights CPAP was used in the first thirty days. This data was used to compute the patients' adherence. The primary outcome was the percentage of patients adherent to CPAP use based on the above definition. Differences between the two groups were analyzed with Chi-square test for categorical variables and with the non-parametric Wilcoxon test for the numerical adherence data.
Results: An 8% absolute improvement in adherence was noted in the modem group compared to the memory card group (77.2% compared to 69.6%). This was statistically significant, with a P value of 0.005.
Conclusion: The use of embedded modems to facilitate real time monitoring of CPAP usage significantly improves patient adherence to therapy for treatment of OSA.

0346

LONGITUDINAL EFFECTS OF WEIGHT LOSS ON SEVERITY OF OBSTRUCTIVE SLEEP APNEA IN OBESE PATIENTS WITH TYPE 2 DIABETES: 4-YEAR FOLLOW-UP RESULTS OF THE SLEEP AHEAD STUDY

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Introduction: The long term effect of weight loss on regression of obstructive sleep apnea (OSA) has limited empirical support. This study determined the effect of a weight loss intervention on OSA severity over a 4 year period.

Methods: Sleep AHEAD (Action for Health in Diabetes) is a 4-center ancillary study of Look AHEAD, a 16-center clinical trial assessing long-term effects of an intensive lifestyle intervention designed to produce weight loss on cardiovascular events in overweight and obese patients with type 2 diabetes by randomizing participants to either an intensive lifestyle intervention (ILI) or diabetes support/education (DSE). Sleep AHEAD participants had home unattended polysomnography and body weight measurements at baseline, 1, 2 and 4 years. Changes in weight and apnea-hypopnea index (AHI) were assessed with a longitudinal mixed effects model.

Results: Of the 305 enrolled participants (60% female, age 61.3 ± 6.5[SD] yr, BMI 36.5 ± 5.8 kg/m^2, AHI 20.5 ± 16.8 events/h), 264 (87%) had OSA (AHI > 5) at baseline. No baseline differences in weight or AHI were present between participants in the ILI (N = 141) and DSE (N = 164) groups. Compared to the DSE group, the ILI group had a significantly greater weight loss at 1, 2, and 4 years: -10.5 ± 0.9[SE] kg, -6.8 ± 0.9 kg, -4.4 ± 0.9 kg respectively (all P values < 0.001). Compared to the DSE group, the ILI group also had a significant reduction in AHI in 1, 2, and 4 years: -9.0 ± 1.8[SE]; -6.5 ± 1.8, and -6.5 ± 2.1 events/h respectively (all P values < 0.002). Greater decreases in AHI were associated with higher baseline AHI (P < 0.001) and greater decreases in weight (P < 0.001).

Conclusion: In these obese patients with type 2 diabetes, ILI produced a greater reduction in weight and AHI at 1, 2, and 4 years compared to DSE. A substantial proportion of the improvement in AHI associated with initial weight reduction was maintained with modest weight reduction over 4 years.

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0347

RACE AND EDUCATION AS PREDICTORS OF CPAP ADHERENCE

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Introduction: CPAP is an efficacious treatment for OSA; however, CPAP adherence limits its effectiveness. Education level and health literacy, among other factors, may influence CPAP adherence. Small studies have shown black race to be associated with lower adherence. The HomePAP study, a multi-center randomized clinical trial comparing home vs. laboratory evaluation and management of OSA, measured CPAP adherence. We investigated whether race and education predicted CPAP adherence in study participants.

Methods: Eligible subjects with moderate to severe OSA (AHI > 15) who completed follow-up at one and/or three months were included in the analyses. All subjects received standardized care with respect to quality and resource intensity. Univariate associations between CPAP adherence, education and race were tested with chi-squared analysis. Multivariate linear regression was performed to assess if race and college education were associated with CPAP adherence at one and three months. Age, gender, smoking and marital status, BMI, AHI, baseline ESS, CPAP pressure and study arm were covariates.

Results: Of 191 eligible subjects, 62% were white, 22% were black, 16% were Hispanic or other; 41% were college educated. CPAP adherence (percent days > 4 hours CPAP use) at 3 months was lower in blacks (41% vs. 60%, P = 0.01) and was higher in college educated subjects (63% vs. 52%, P = 0.05). In adjusted analyses, black race but not education level was significantly associated with CPAP adherence (average minutes per day of CPAP use) at one month (P < 0.01) and three months (P = 0.04).

Conclusion: Black race is associated with poorer adherence to CPAP in subjects with standardized access to care and treatment. A number of factors related to race likely contribute to non-adherence including socio-economic status. Data on socio-economic status is being collected for additional analyses. Future research is needed to identify barriers to adherence and to develop interventions tailored to different populations to improve CPAP adherence.

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0348

COMPARATIVE EFFECTS OF MANDIBULAR ADVANCEMENT SPLINT AND TONGUE STABILISING DEVICE ON UPPER AIRWAY STRUCTURE IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Oral appliances for the treatment of obstructive sleep apnea (OSA) can be grouped into two design types. Mandibular advancement splints (MAS) mechanically protrude the mandible whereas tongue stabilising devices (TSD) protrude and hold the tongue using suction. Although MAS are more commonly used, both appliances can be efficacious. However their effects on upper airway structure have not been compared.

Methods: Patients undergoing oral appliance treatment for OSA had magnetic resonance imaging (MRI) of the upper airway without and with both appliances. The upper airway lumen and surrounding soft tissue structures (tongue, soft palate, parapharyngeal fat pads and lateral pharyngeal walls) were segmented using image analysis software. Changes in airway measurements and soft tissue centroid movements were analysed.

Results: Thirty-nine patients were recruited. Both appliances similarly altered velopharyngeal shape to become more elliptical along the lateral axis. However TSD caused a greater increase in velopharyngeal lateral diameter (+0.35 ± 0.07 cm vs. +0.18 ± 0.05 cm; P < 0.001) and ad-

ditionally increased antero-posteror diameter, enlarging velopharyngeal volume. In the oropharynx MAS and TSD increased lateral diameter and minimum cross-sectional area to a similar degree. Neither appliances changed hypopharyngeal dimensions. With both appliances upper airway changes were associated with lateral displacement of the parapharyngeal fat pads away from the airway. TSD caused anterior displacement of the centroid of the tongue (0.68 ± 0.04 cm; P < 0.001) and soft palate (0.12 ± 0.03 cm; P < 0.001), while MAS caused anterior displacement of the tongue base muscles (0.35 ± 0.04 cm). Both appliances moved the lateral pharyngeal walls laterally but TSD also caused in anterior and superior displacement.

Conclusion: MAS and TSD both increase upper airway dimensions and move the surrounding soft tissues, although the magnitude and pattern of changes differ between appliances. The relevance of these differences to treatment efficacy warrants further study.

0349

THE EFFECTS OF WEIGHT LOSS ON UPPER AIRWAY SIZE IN OBESE MALES WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is commonly associated with obesity and weight loss can improve OSA. Although weight loss correlates with improvement in apnea-hypopnea index (AHI), this improvement may be more closely linked to other factors such as a change in upper airway size related to head/neck fat loss. The aim of this study was to assess changes in upper airway and regional facial fat volume with weight loss and their association with AHI improvement.

Methods: Obese male OSA patients participating in a 24-week sibutramine-assisted weight loss study underwent a CT scan of the head and neck as well as overnight polysomnography at baseline and at study completion. Imaging software was used to segment the upper airway lumen and facial fat for volumetric analyses.

Results: Data from 44 patients (age 47 ± 9.8 years, BMI 34 ± 2.6 kg/m^2, AHI 44.5 ± 24.1 events/hour) have been analysed. All patients lost weight (mean 7.4 ± 4.2 kg) and significantly reduced AHI (-20.1 ± 17.8 events/hour; P < 0.001). Compared to baseline there was a significant increase in retropalatal airway volume after treatment (5.1 ± 2.3 cm^3 vs. 6.0 ± 2.2 cm^3; P < 0.05). Retroglossal airway volume remained unchanged. Change in AHI correlated with change in total body weight (r = 0.35, P < 0.02) but not change in airway or regional facial fat volume. Changes in regional facial fat volume correlated with change in weight (r = 0.75; P < 0.001) as well as neck circumference (r = 0.41; P < 0.001).

Conclusion: These preliminary findings suggest that weight loss in obese apneic men may improve retropalatal airway volume, however change in airway volume is not related to change in AHI. Facial fat volume does not appear to be a better explanatory variable for AHI improvement than body weight but further work is required to examine whether distribution of facial fat loss is important.

0350

THE STOP-BANG MODEL FOR SCREENING OF OBSTRUCTIVE SLEEP APNEA (OSA): RELATIONSHIP TO POLYSOMNOGRAPHIC MEASUREMENTS OF THE APNEA/HYPOPNEA INDEX (AHI)

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Introduction: The STOP-Bang model has been validated as a tool to screen surgical patients in preoperative clinics for OSA. In order to focus particularly on the highest risk patients in need of perioperative therapy, the value of this model could be enhanced if the score correlates with severity of the respiratory disturbances reflected by the apnea/hypopnea index.

Methods: Data from polysomnographic studies of 1,014 patients was analyzed retrospectively. The comparability of using four questions from our standard clinical questionnaire to determine the answers for the STOP portion of the model (Snoring, Tiredness, Observed apneas and blood Pressure) was validated in 151 patients who completed both surveys. Objective data for the Bang portion (BMI, Age, Neck circumference and Gender) was routinely obtained in all cases. The composite score from the STOP-Bang model was compared to three categories of AHI severity: Mild (> 5/hr), Moderate (> 15/hr), and Severe (> 30/hr). STOP-Bang model scores of 0 - 2 were considered normal and used as a reference for computing odds ratios by logistic regression.

Results: The mean (± SD) values for age, BMI and neck circumference were 48.8 (± 14.9) , 33.9 (± 8.1) and 41.0 (± 5.2) respectively. 58.3% were male. There was a progressive increase in AHI across the STOP-Bang scale (r = .44, P < .0001). In addition, a composite STOP-Bang score of 3-5 gives an odds ratio of 8.8, 5.9 and 4.9 for at least mild, moderate and severe AHI compared to the reference of 0-2. A composite score of 6-8 gives an odds ratio of 72.3, 22.2 and 17.2 respectively.

Conclusion: Progressive increases in the STOP-Bang composite score were strongly associated with severity of sleep disordered breathing. The STOP-Bang model could be used to prioritize patients for intervention and therapy. The clinical value of this application needs to be validated prospectively.

0351

MALLAMPATI GRADE AND SNORING IN PREGNANCY

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Introduction: Emerging data suggest that pregnancy is associated with an increased frequency of habitual snoring (HS) and sleep-disordered breathing (SDB) which may promote maternal hypertension. In sleep clinics, Mallampati grade (MP) is used to screen for SDB risk, but this assessment has not been widely used in the context of pregnancy. The goal of this study was to examine the relationship between HS, MP, and gestational hypertension.

Methods: Within a larger study of sleep in pregnancy, we obtained prospective data on women surveyed in the third trimester using validated instruments. HS was defined as snoring ≥ 3 nights/week. MP was obtained from medical records and dichotomized into grade I/II (low) or III/IV (high). Development of gestational hypertension was ascertained from the medical records after delivery.

Results: Data were obtained from 952 subjects (mean age 29.7 ± 5.7 years, mean BMI 30.7 ± 7.6kg/m^2). HS was present in 36% of women and was more frequent in obese women (BMI ≥ 30kg/m^2) than non-obese women (55% vs. 29%; P < 0.001). Women with high MP were more likely to have HS as compared to those with lower MP (51% vs. 34%; P = 0.001). In a logistic regression with maternal age, gestational age, race, BMI, parity, smoking status, and the presence of diabetes taken into account, a high MP showed independent association with gestational hypertension (O.R. 2.0, 95%CI[1.1-4.2]; P < 0.04). Addition of HS to the model made the relationship non-significant (O.R. 1.3, 95%CI[0.7-2.6]; P = 0.38).

Conclusion: A substantial proportion of pregnant women have HS, and this key risk factor for SDB is associated with a simple measure of oropharyngeal crowding. The independent association of high MP with gestational hypertension is likely mediated by SDB, as addition of HS to the model removed the association. Use of this non-invasive, cost ef-

fective, oral assessment during routine physical examination may have clinical utility in pregnant women.
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0352

THE PREVALENCE OF UNDIAGNOSED OBSTRUCTIVE SLEEP APNEA IN SURGICAL PATIENTS

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Introduction: The undiagnosed obstructive sleep apnea (OSA) in surgical patients is associated with an increased incidence of postoperative complications. The objective of the study is to evaluate the prevalence of undiagnosed OSA in surgical patients.
Methods: Following REB approval, the patients visiting preoperative clinics were approached. The patients giving consent underwent laboratory polysomnography (PSG) (n = 240) or portable PSG at home with Embletta X-100 (n = 600) preoperatively. Their charts were reviewed to ascertain the OSA diagnosis by surgeons and anesthesiologists. Of 840, 723 patients with complete data were included in the analysis.
Results: There were 380(52%) females and 357(48%) males, age: 59 ± 13, BMI: 31 ± 7. The surgery type was mainly orthopedic (49%) and general (18%). There were 473 patients (65%) with AHI > 5. Of them, 398 patients (84%) had at least one symptom of snoring, daytime sleepiness and observed apnea during sleep. Six (1.3%) and 40 (8.4) patients were diagnosed by surgeons, and 95 (20.1%) and 96 (20.3%) by anesthesiologist as possible OSA and OSA respectively. The diagnosis of possible OSA and OSA was made by surgeons in 2 (0.9%) and 12 (5.5%) of 219 mild OSA patients (AHI: > 5 to ≤ 15), 1 (0.8%) and 13 (9.9%) of 132 moderate OSA patients (AHI: > 15 to ≤ 30), and 3 (2.5%) and 15 (12.3%) in 122 severe OSA patients (AHI: > 30). The diagnosis of possible OSA and OSA was made by anesthesiologists in 36(16.4%) and 34 (15.5%), 28(21.2%) and 24 (18.2%) , 31(25.4%) and 38 (31.2%) in patients with mild, moderate and severe OSA.
Conclusion: 90.7% and 49.6% of patients with AHI > 5 were not recognized by surgeons and anesthesiologists respectively. However, 84% patients had OSA related symptoms. Had screening of OSA been a routine practice in preoperative clinics, the proportion of undiagnosed OSA would be significantly decreased.

0353

CANDIDATE GENE ANALYSIS FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Although obstructive sleep apnea (OSA) is known to have a strong familial basis, no genetic polymorphisms influencing apnea risk have yet been convincingly identified. We utilized the National Heart, Lung, and Blood Institute (NHLBI) Candidate Gene Association Resource (CARe) to search for apnea susceptibility loci.
Methods: We tested a panel of 46,449 polymorphisms from roughly 2,000 candidate genes from an Illumina iSelect chip designed to enhance the discovery of heart, lung, blood and sleep phenotypes for association with moderate to severe OSA (apnea hypopnea index ≥ 15) in 4,631 individuals phenotyped as part of the Cleveland Family Study or Sleep Heart Health Study. Ethnicity-, sex- and cohort-specific analyses were done adjusting for age and body mass index as well as the first 10 principal components to account for population stratification. Meta-analysis was performed to summarize results across cohorts.
Results: Among 3,755 Caucasians, 3 SNPs were associated with OSA at a P-value < 10-5, including two in the inositol 1,4,5-triphosphate receptor, type 2 (ITPR2) gene. Among 876 African-Americans, 6 SNPs were associated with OSA at a P-value < 10-5. The three strongest associations (all with P < 10-6) were with SNPs in the selectin E (SELE), neuregulin 2 (NRG2), and sialin (SLC17A5) genes. No overlap in OSA-associated SNPs were found across the two races.
Conclusion: Novel genetic loci for OSA may be identified through the use of customized gene chips and meta-analyses of data from large cohort studies. This approach is also conducive for future replication studies.
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0354

COMPARISON OF UVULOPALATOPHARYNGOPLASTY AND MAXILLOMANDIBULAR ADVANCEMENT FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Uvulopalatopharyngoplasty (UPPP) and maxillomandibular advancement surgery (MMA) have been used as an alternative therapy for patients with obstructive sleep apnea (OSA) who are unable to adhere to CPAP therapy. This study was performed to directly compare the short term clinical effectiveness of UPPP and MMA performed in isolation and in combination, for the treatment of OSA.
Methods: We retrospectively evaluated 107 adult patients who underwent UPPP alone (n = 34), MMA alone (n = 37), or UPPP followed by MMA (n = 36) for treatment of OSA. The study group was composed primarily of middle age (mean age = 46 years) males (78.5%). Each patient had polysomnography (PSG) performed before and 3-6 months following surgery.
Results: Preoperatively, all patients had moderate to severe OSA. Surgical treatment resulted in a significant reduction in AHI in both the MMA alone (56.3 ± 22.6 to 11.6 ± 7.4, P < 0.0001) and UPPP/MMA (55.3 ± 27.7 to 12.7 ± 11.6, P < 0.0001) groups. UPPP alone also produced a significant reduction in AHI (41.8 ± 27.4 to 30.1 ± 27.4, P = 0.0057), but on average, patients remained with severe OSA. Furthermore, UPPP followed by MMA, did not provide any significant benefit beyond MMA alone (P = 0.165). Improvement in minimum oxygen saturation occurred in all three groups. The largest improvement was seen in MMA alone (73.9% to 83.7%, P < 0.0001) followed by UPPP/MMA (81.5 to 85.2%, P = 0.0009) and UPPP alone (73 to76%, P = 0.1322).
Conclusion: MMA is a clinically effective treatment for patients unable to adhere to CPAP therapy. MMA performed alone is more effective than UPPP alone and as effective as UPPP followed by MMA. Therefore, for patients with moderate to severe OSA who cannot tolerate CPAP, we recommend MMA alone be performed as the primary and first surgical treatment.
Support (If Any): Supported in part by the Vanderbilt CTSA grant UL1 RR024975 from NCRR/NIH

0355

THE SEVERITY OF PREOPERATIVE OSA IS THE MAJOR FACTOR PREDICTING THE POSTOPERATIVE INCREASE IN APNEA-HYPOPNEA INDEX

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Introduction: After surgery, there is a significant exacerbation of the sleep breathing disorders in OSA patients.[1,2,3] The objective of this study is to investigate the factors affecting postoperative change in apnea-hypopnea index (AHI).

Methods: Following REB approval, the preoperative patients giving consent were invited to undergo polysomnography (PSG) with a portable device (Embletta x100) preoperative at home, first, and third postoperative night in the hospital or at home. The PSG recordings were scored by a certified sleep technologist. Then the AHI on different perioperative nights were treated as repeated measurements and analyzed with mixed model.

Results: A total of 202 patients completed all 3 nights of sleep study, 93 males and 109 females. Age was 59 ± 11, and BMI 31 ± 7 . Of them, 161 patients had major surgery, 23 intermediate surgery and 18 minor surgery, with 94 under general and 108 under regional anesthesia. ASA physical status: I-3 (1.5%), II-98 (48.5%), III-100 (49.5%) and IV-1 (0.5%).The opioids used in first 3 days after surgery was equivalent to 140 ± 110 mg morphine. AHI on preoperative, postoperative night 1, and night 3 was 19 ± 20, 29 ± 30, and 37 ± 35 respectively. The AHI increase was significant on postoperative night 3 and night 5. The severity of preoperative OSA was the only significant factor predicting postoperative AHI increase ($P < 0.001$). Compared to no OSA, the effect size of mild OSA , moderate OSA and severe OSA on postoperative AHI increase was 7.7 (1.5), 20.5 (1.5) and 48.8 (1.8) [beta estimate (standard error)]. Age, gender, BMI > 35, ASA classification, opioids used, type of anesthesia or surgery were not significant.

Conclusion: Compared to preoperative value, AHI was significantly increased on night 1 and night 3 after surgery. The severity of preoperative OSA was the significant factor predicting the increase of postoperative AHI.

0356

THREE-DIMENSIONAL COMPUTED TOMOGRAPHIC EVALUATION OF AIRWAY AND CRANIOFACIAL CHANGES IN ADULT PATIENT WITH OBSTRUCTIVE SLEEP APNEA UNDERWENT SEGMENTAL MAXILLO-MANDIBULAR ROTATIONAL ADVANCEMENT

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Introduction: This study is to evaluate the soft tissue airway improvement and the musculoskeletal change in adult obstructive sleep apnea patients underwent segmental maxillo-mandibular rotational advancement by three-dimensional computed tomographic images of head and neck.

Methods: Fifteen patients, 12 males and 3 females, aged from 24 to 47 (32.5 ± 7.2) years old, with moderate to severe obstructive sleep apnea (apnea-hypopnea index more than 15/hr), normal body mass index (body mass index less than 32 kg/m^2), and Class II malocclusion were included in this study. Segmented maxillo-mandibular rotational advancement, including segmental LeFort I osteotomy of maxilla, bilateral sagittal splits osteotomy of mandible and counter-clockwise rotation of maxillo-mandibular complex were performed with single splint technique. Within one month before and at least 6 months after the procedure, overnight polysomnography and three-dimensional computed tomography of head and neck region were performed for evaluation. PSG results and craniofacial measurements related to airway were obtained for analysis. Paired t-test was used for comparing data before and after surgery, and P-value less than 0.01 was accepted as significant.

Results: Three-dimensional tomographic measurements showed significant improvement of both antero-posterior and lateral diameters of soft tissue airway measurements. Meanwhile, sella-nasion-A point (SNA) angle increased from 80.8 ± 3.1° to 83.1 ± 3.9° (increase of SNA = 2.6 ± 3.3°). Sella-nasion-B point (SNB) angle increased from 72.3 ± 3.9° to 78.7 ± 3.8° (increase of SNB = 6.3 ± 2.4°). ANB was improved from 8.4 ± 2.3° to 4.4 ± 2.6°. Angular measurement between cervical spine and Frankfort horizontal plane decreased from 93.6 ± 8.7° to 88.9 ± 9.3°. AHI was reduced from 37.0 ± 17.0/hr to 5.4 ± 4.6/hr. Lowest oxygen saturation was improved from 82.4 ± 7.6% to 89.8 ± 4.7%.

Conclusion: The treatment of obstructive sleep apnea by segmental maxillo-mandibular rotational advancement showed improvements in AHI, oxygen desaturations, airway and craniofacial profile at the same time.

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0357

PREDICTORS OF EXECUTIVE FUNCTIONS IN INDIVIDUALS WITH OBSTRUCTIVE SLEEP APNEA TREATED WITH CONTINUOUS POSITIVE AIRWAY PRESSURE

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Introduction: Research in the past two decades has suggested two potential pathways (i.e., sleep fragmentation and associated sleepiness vs. hypoxemia) in causing two groups of cognitive deficits (i.e., alertness and vigilance vs. executive deficits) in individuals with obstructive sleep apnea (OSA). Investigating executive dysfunction in individuals with stably treated OSA may provide some special insights in dissociating the short-term impact of sleep deprivation and its associated excessive daytime sleepiness from the more long-term impact of sleep disruption and blood gas abnormalities. The purpose of this study was to evaluate the individual contribution of the two possible mechanisms.

Methods: Thirty-seven individuals with moderate to severe OSA treated with continuous positive airway pressure (CPAP) were compared to 27 age- and education-matched healthy controls on working memory tasks. Performances on the 2-back tasks that demonstrated differences between the two groups were regressed on demographic variables (age, BMI), illness variables (diagnostic respiratory disturbance index (RDI), diagnostic minimum peripheral oxygen saturation (SpO_2), post-treatment sleep efficiency, sleepiness (measured by Epworth Sleepiness Scale (ESS), and subjective sleep quality (measured by Pittsburg Sleep Quality Index (PSQI) using stepwise regressions.

Results: Verbal 2-back RT was predicted by diagnostic minimum SpO_2, with lower oxygen saturation associated with slower RT. Verbal 2-back accuracy was predicted by age and diagnostic minimum SpO_2, with younger individuals with higher oxygen saturation having higher accuracy. Spatial 2-back RT was predicted by diagnostic RDI, with higher RDI associated with longer RT. For Spatial 2-back accuracy, better performance was associated with lower age, more education, and higher level of post-treatment sleepiness.

Conclusion: Independent of demographic factors, high diagnostic RDI and low minimum SpO_2 were reliable predictors of long-term cognitive out-

comes after treatment. The persistent impact of sleep-disordered breathing highlights the importance of early detection and treatment, and the significance of hypoxemia indices in diagnostic and treatment considerations.
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0358

A NOVEL APPROACH USING PHRENIC NERVE STIMULATION TO TREAT CENTRAL SLEEP APNEA: FIRST-IN-MAN EXPERIENCE

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Introduction: Central Sleep Apnea (CSA) is often present in patients with heart failure (HF) and is associated with increased morbidity and mortality. CSA increases sympathetic activity and contributes to HF progression. Current treatments are limited, unproven, and require significant patient adherence. Thus, there is a critical need for newer approaches to treating CSA. Stimulation of the phrenic nerve can be used to modulate diaphragmatic contraction thereby affecting the breathing pattern. This technique can increase lung inflation. We hypothesized that stimulation of the phrenic nerve in pts with CSA could be used to initiate inspiration or increase inspiration, halting the apnea or preventing it entirely.
Methods: Eleven male HF patients (age: 56 ± 11 years, NYHA I-II, LVEF: 28 ± 9%) with predominantly CSA sleep disordered breathing (> 50% of apneas in CSA pattern) by prior testing were studied. The patients underwent temporary implantation of a transvenous lead adjacent to the right or left phrenic nerve. In all 11 patients, the phrenic nerve was successfully stimulated during periods of CSA. Patients were studied with both a control and treatment period. Average treatment period was 173 minutes.
Results: Overall apnea/hypopnea index (AHI) decreased from 40.2 ± 11 to 27 ± 15 ($P < 0.02$). Central apnea index decreased from 23.3 ± 16 to 1.2 ± 1.9 ($P < 0.001$). Oxygen desaturation index (ODI 4%) decreased from 25.4 ± 9.0 to 12.1 ± 13.0 ($P < 0.005$). Arousal index improved from 17.2 ± 6.5 to 11.2 ± 5.5 ($P < 0.005$). There were no adverse events or reports of patient discomfort, and there was no significant change in obstructive apneas or hypopneas.
Conclusion: In this early feasibility study, acute phrenic nerve stimulation significantly improved AHI and oxygenation. This may lead to a novel treatment for CSA.
Support (If Any): Cardiac Concepts, Inc.

0359

PREDICTING CPAP COMPLIANCE USING THE BEHAVIORAL INHIBITION SYSTEM (BIS) AND BEHAVIORAL ACTIVATION SYSTEM (BAS) SCALES

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Introduction: Compliance with CPAP for obstructive sleep apnea (OSA) has been problematic. Understanding the factors associated with noncompliance may assist with psychosocial interventions. Previous studies have examined personality factors and noncompliance, though consistent results have not been reported. This study examined the relationship between compliance and the Behavioral Inhibition System (BIS) and Behavioral Activation System (BAS). Elevated BIS is associated with moving away from something aversive, negative affect, and fear, while elevated BAS is associated with moving toward something desired and positive affect. Greater left frontal cortical activity is associated with BAS. It was hypothesized that (1) patients with elevated BIS would be less compliant, and (2) patients with higher BAS scores would be more compliant.
Methods: Ratings on the BIS/BAS scales, the Ways of Coping Inventory, and a broad personality measure (mini-IPIP) were analyzed among 63 adult men (31) and women (32) diagnosed with OSA. Data from the CPAP device was obtained following the initial 30 days, with compliance defined as > 4 hours per night on 70% of nights.
Results: As predicted, elevated BIS was associated with noncompliance ($r = -.334$, $P < .01$), but no relationship was observed between BAS and compliance. Regarding broad personality factors, a nonsignificant trend was observed between neuroticism and noncompliance ($r = -.237$, $P < .06$). No other relationships were observed.
Conclusion: The hypotheses were partially supported. Patients who reported elevated BIS were less likely to demonstrate compliance with CPAP. The theoretical underpinnings of BIS suggest that noncompliant individuals experience CPAP as aversive and "move away" from treatment. No relationship between compliance and BAS was observed, and thus is not a determining factor. In future studies, elevated BIS may inform early interventions that are designed to improve compliance. Studies may examine the relationship between BIS/BAS scales, physiological correlates, and compliance.

0360

AMYLASE mRNA IS ELEVATED IN SALIVA OF SUBJECTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is a common disorder that can have deleterious health consequences. An estimated 80-90% of OSA that exists in the population remains undiagnosed. Approximately 7 years transpires between suspected onset and the diagnosis of OSA. A simple, objective, and non-invasive test carried out in the primary care physician's office might encourage sufferers of OSA to expeditiously consult a sleep laboratory for diagnosis and treatment. To this end, we have evaluated salivary Amylase mRNA in patients with OSA to determine if it is elevated as it is in healthy sleep deprived adults.
Methods: Saliva was collected from patients visiting the Washington University School of Medicine Sleep Laboratory with an apnea/hyponea index > 15 (n = 20, mean AHI = 48 ± 6) and circadian matched controls (n = 20) following IRB approval. mRNA was extracted from whole saliva and Amylase mRNA was then quantified using qPCR. Amylase mRNA for each individual OSA patient was normalized to β-actin and expressed as a percent change from mean control values.
Results: OSA subjects (15 male, 5 female) with a mean BMI of 35 ± 2 and significantly elevated ESS scores (mean 10.2 ± 1) were compared to control subjects (14 male, 6 female) and a BMI of 26 ± 1. Amylase mRNA levels were elevated 3.58 ± 0.73 fold in patients with OSA compared to circadian matched controls ($P = 0.015$).
Conclusion: Saliva is a readily accessible biofluid that offers a source of analytes that can be used to assess sleepiness. Given that Amylase mRNA is also elevated in Drosophila during conditions of increased sleep drive, its behavior appears to be evolutionarily conserved. Salivary Amylase is a practical and objective test that can be used, in con-

junction with other indicators, to encourage patients to visit the sleep lab for testing and treatment of OSA. Ongoing studies are examining additional candidates to further refine future point-of-practice tests for sleep disorders.

0361

GENDER DIFFERENCES IN DISEASE SEVERITY AND QUALITY OF LIFE AMONG PARTICIPANTS AT HIGH RISK FOR MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA ENROLLED IN THE HOMEPAP STUDY

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Introduction: Women with obstructive sleep apnea (OSA) report lower quality of life despite lower disease severity and sleepiness. The goal of this study was to assess gender differences in baseline pretreatment disease characteristics and quality of life among participants with high risk for moderate to severe OSA.
Methods: Data were drawn from the HomePAP Study, a multi-site randomized controlled study of laboratory versus home based diagnostic testing for OSA. Participants were high risk for OSA (Epworth Sleepiness Scale (ESS) > = 12 and adjusted neck circumference > = 43 cm at screening). Analyses were conducted with t-tests, chi-square, and multivariate regression. Sleepiness was measured by the Epworth Sleepiness Scale (ESS) and quality of life was measured by the Functional Outcomes of Sleep Questionnaire (FOSQ). Covariates included demographics, education, marital status, comorbidities (diabetes, hypertension, coronary heart disease), Apnea Hypopnea Index (AHI), Body Mass Index (BMI), study arm, and site.
Results: Participants included 148 women and 225 men. Average age was 46 (SD = 12) years. Sixty-four percent of the sample was White, 23% was Black, 8% was Hispanic. Average ESS was 14 (SD = 3.7). Women had higher BMI (41 vs. 35 kg/m^2 P < .001) and lower AHI (21 vs. 30, P = .03). There were no gender differences in age, ESS scores, diabetes, hypertension, or coronary artery disease. Based on an AHI > = 15, 51% of the sample screened continued in the study. Participants with AHI < 15 returned to usual clinical care. Compared to men, fewer women continued in the study due to low AHI (49 vs. 60%, P = .04). Women reported significantly lower quality of life in all domains: productivity, social outcome, activity level, vigilance, sexual activity, and global quality of life (Ps < .01). Activity level was the only quality of life subscore independently related to gender in multivariate models (P = .04).
Conclusion: Women at high risk for moderate to severe OSA report lower pretreatment quality of life despite lower AHI and similar levels of self-reported sleepiness as men. However, activity level was the only quality of life subscore independently related to gender.
Support (If Any): American Sleep Medicine Foundation 38-PM-07, 5K12 HD055884

0362

AGE DIFFERENCES IN CLINICAL AND POLYSOMNOGRAPHIC FEATURES OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Our objectives were to determine age-related clinical and polysomnographic differences in obstructive sleep apnea and determine whether there is an age-related spectrum of disease with less NREM AHI and more REM AHI in young adults compared to older adults.
Methods: Retrospective record review of 570 patients seen in the sleep clinic at Naval Medical Center San Diego. Patient's were placed into one of four age groups: young adults, ages 18-29 (n = 209); early middle age adults, ages 30-39 (n = 106); late middle age adults, ages 40-49 (n = 102); and older adults, ages > 50 (n = 153). Group comparisons of demographics, Epworth Sleepiness Scale, Patient Sleep Questionnaire (PSQ), and overnight polysomnography were analyzed using the Kruskal-Wallis test with pair-wise comparisons using the Mann-Whitney test with Bonferroni correction.
Results: Older adults reported more nocturia (P < 0.001), less snoring, and had higher REM-related apneas (P = 0.008), and more severe oximetry desaturations than young and/or middle age adults (lowest desaturation P = 0.004, time less than 85%, P = 0.001). Young adults reported more witnessed apneas, excessive daytime sleepiness, and had higher respiratory related arousal indexes (P = 0.018) compared to middle age or older adults. All age groups were similar in BMI, self-reported sleep-related driving impairment, AHI, NREM AHI, and total obstructive and central apneas.
Conclusion: Higher collapsibility of the upper airways in older patients may explain the increased REM-related apneas and more severe oximetry desaturations than younger patients. Increased nocturia in older patients may be due to apnea severity as well as medical comorbidities. The higher respiratory related arousals in younger patients may be an early manifestation of OSA seen in young adults.
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0363

PREVALENCE OF SLEEP DISORDERED BREATHING SYMPTOMATOLOGY IN THE US POPULATION

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Introduction: Epidemiology and clinical studies demonstrate that untreated sleep disordered breathing (SDB) is an independent risk factor for cardiometabolic disease. The prevalence of SDB has been reported in epidemiology cohort studies, however, SDB symptom frequency has not been reported in a representative sample of U.S. adults.
Methods: The National Health and Nutrition Examination Survey (NHANES) is a U.S. population-based health surveillance tool administered by the Center for Disease Control. The 2005-06 and 2007-08 surveys contained questions related to SDB symptomatology. These questions were analyzed to determine the prevalence of self-reported snoring (> 3 nights/week); snorting, gasping, or stopping breathing (> 3 nights/week); and excessive daytime sleepiness (> 5 days/month). Exclusion criteria included age < 20 years, pregnancy, a diagnosis of OSA, and missing data.
Results: Surveys from 7871 individuals (men = 4009, women = 3862) were analyzed. Snoring was reported by 49.6% (C.I. = 47.3 - 51.8) of the sample and was more prevalent in men (58.0%, C.I. = 55.8 - 60.22) than women (41.5%, C.I. = 38.6 - 44.4). Snorting, gasping or stopping

breathing was reported by 10.6% of the sample. The prevalence was higher in men (13.3%, C.I. = 11.5 - 15.4) vs. women (7.9%, C.I. = 6.9 - 9.0). Daytime sleepiness was reported by 17.2% of adults with a higher prevalence in women (20.3, C.I. = 18.6 - 22.2) vs. men (13.9%, C.I. = 12.6 - 15.4). The percentage of individuals reporting snoring and gasping with daytime sleepiness (2.4%, C.I. 1.9 - 3.1) was lower than those reporting snoring and gasping without daytime sleepiness (7.7%, C.I. 7.0 - 8.6).
Conclusion: These NHANES data constitute the first report of SDB symptom prevalence in a representative sample of U.S. adults. The findings indicate gender differences in SDB symptoms and show that daytime sleepiness frequently does not accompany reports of snoring and breathing cessation.

0364

SEVERE SLEEP DISORDERED BREATHING IN VERY EARLY IN LIFE

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Introduction: Sleep-disordered breathing in pediatric population is commonly due to tonsillar or adenoid hypertrophy. In most cases, surgical treatment is the first choice. Surgical treatment for infants younger than age 4 is still controversial because of the higher risk of complication. We report our experience in patients with sleep-disordered breathing under age of 4.
Methods: Retrospective chart review was performed for the patients under age of 4 who underwent clinical evaluation and polysomnography in Toyohashi Mates Clinic Sleep Disorders Center from June 2002 to November 2009. Total of 125 patients under age of 4 were identified (88 men and 37 women). Mean age was 2.7 ± 1.0, ranging from 0.4-3.9. Total pediatric population was 538 (366 men and 172 women)
Results: 8 patients were under age of 1, 21 were 1 year old, 32 were 2 years old and 64 were 3 years old. Among 125 patients, 70 patients had AHI > 10. 27 patients had severe sleep apnea. Among 5 patients (ranging from 6 to 10 months old), 2 patients were diagnosed as primary sleep apnea of infancy (1 patient was treated with CPAP, the other was oxygen), 2 were obstructive sleep apnea (1 patient was surgically treated and the other was treated with CPAP) and 1 were congenital central alveolar hypoventilation syndrome and treated with CPAP. 70(56%) out of 125 patients under age of 4 were treated with surgery. Mean pre- and post-surgical AHI was 35.3 ± 18.0 and 6.9 ± 11.7. 55 patients with mild to moderate severity were decided to be observed without surgery, considering risk of perioperative complications and findings of upper airway stenosis.
Conclusion: Severe sleep-disordered breathing can be found in patients under age of 4. Risk and benefit needs to be carefully evaluated in this population when selecting surgical treatment options.

0365

OVERLAP SYNDROME: THE PREVALENCE OF OSA IN PATIENTS WITH COPD IN AN AMBULATORY TEACHING HOSPITAL SETTING

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Introduction: The specific aim of this study is to determine the prevalence of the Overlap Syndrome in the outpatient setting of our hospital. In addition predictors of obstructive sleep apnoea (OSA) in this group of patients with chronic obstructive pulmonary disease (COPD) is also being looked for. To date this has not been done in Singapore.
Methods: Patients aged ≥ 40, attending a dedicated COPD clinic, who satisfied inclusion criteria for COPD based on clinical grounds as well as on lung function, were recruited. Baseline demographic and anthropometric data were recorded. Patients who had other concurrent respiratory diseases, those on long-term oxygen therapy, obese individuals or those with a history of obesity-hypoventilation syndrome were excluded. Recruited patients then underwent an overnight polysomnogram. The polysomnogram was then scored by registered sleep technologists and then reported by a credentialled Sleep Physician. The diagnosis of OSA was based on an Apnoea-Hypopnoea Index(AHI) ≥ 5 events/hour of sleep. The data collected was then entered into statistical software to compute prevalance as well as predictors of OSA based on multiple linear regression models.
Results: Fourteen patients have been studied to date. They are all male. Of these, there are 7 Chinese, 4 Malay, 2 Indian patients and 1 other. Their mean age is 70.9 ± 9.8. They are/were heavy smokers with a median of 45.0 pack years. The mean FEV_1 percentage predicted was 46.6 ± 8.5 making them GOLD stage 3. The mean 6MWD was 348.4 ± 44.6m. They are not obese with a median BMI of 22.7. The mean BODE index was 4.5. As a group they were not sleepy with a median ESS of 4.5. The severity of the OSA was mild with median AHI of 9.2. Eleven of the 14 patients had OSA making the prevalence of the overlap syndrome 78.6%. In these 11 patients with overlap syndrome the mean number of hospital visits for COPD exacerbations in the past 1 year was 0.55 ± 0.69.
Conclusion: In our group of patients studied to date, a significant majority appeared to have the overlap syndrome. The patients with overlap syndrome appeared not to be obese and not sleepy and had reasonable exercise tolerance despite being GOLD stage 3 and did not appear to much have much exacerbations. This highlights the fact that standard clinical predictors of OSA in COPD cannot be used and a high index of suspicion is required in these patients. Linear regression models could not be applied at this stage due to the small patient numbers. The study is ongoing.
Support (If Any): Changi General Hospital Research Grant.

0366

PREDICTIVE CAPABILITIES OF THE FOUR-VARIABLE SCREENING TOOL, THE STOP QUESTIONNAIRE, AND EPWORTH SLEEPINESS SCALE FOR SLEEP DISORDERED BREATHING IN THE SLEEP HEART HEALTH STUDY (SHHS)

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Introduction: Clinicians frequently decide whether patients are referred for polysomnography to diagnose sleep disordered breathing (SDB). The Epworth Sleepiness Scale (ESS) has been used to help identify patients with potential SDB. However, the ESS was developed to measure sleepiness, not for its ability in estimating SDB. Recently, Takagami et al. proposed the 4-Variable Scale to determine SDB severity utilizing data commonly acquired in primary care settings. In addition the STOP questionnaire has also been used to screen for SDB. This study evaluates the ability of the 4-Variable, STOP, and ESS questionnaires in estimating accurately the severity of SDB as measured by the apnea/hypopnea index (AHI) using data from the SHHS.
Methods: Subjects with AHIs of ≥ 15 and ≥ 30 were considered to have moderate-to-severe or severe SDB, respectively. The risk of SDB for the 4-Variable Tool was calculated according to Takegami. Two cut points were evaluated; those with score values ≥ 11 and ≥ 14. The STOP questionnaire was evaluated including variables for snoring, tiredness/sleepiness, observed apnea, and blood pressure. High risk of SDB was considered by answering "yes" to two or more questions. Sleepiness was evaluated using the ESS questionnaire and dichotomized into < 10 and ≥ 10. Each tool was compared on sensitivity, specificity, the likelihood ratio for positive and negative test results, logistic regressions, and as-

sessment of the area under the receiver operating characteristic (ROC) curves.
Results: The STOP questionnaire had higher sensitivity (62%) and the 4-Variable Tool had higher specificity (89.9%) to predict moderate-to-severe SDB. The ROC curves were higher for the two different cut points of the 4-Variable Tool than for the STOP and ESS questionnaires.
Conclusion: Based on our ability to reconstruct the questionnaire variables and the ROC curves, the 4-Variable Tool had greater ability to predict severe SDB than did the STOP and ESS questionnaires.
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0367

DIFFERENTIAL CONTRIBUTION OF THORACIC AND ABDOMINAL EFFORT DURING RERA'S, AN ANALYSIS IN DIFFERENT SLEEP STAGES AND BODY POSITIONS

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Introduction: The current AASM criteria for scoring RERA do not include any requirements for the effort channel. No data exists regarding the difference in the degree of thoracic V/S abdominal effort contributing to RERA's, between men and women in various sleep stages and body positions. We analyzed the differences in the amplitude of the thoracic V/s abdominal effort signal (T v/s A) in different sleep stages and body positions in 50 patients.
Methods: T&A effort signal amplitude during RERA's was visually assessed; with a > 50% difference compared to the baseline established at biocalibration considered as significant. Data from 50 unselected PSG'S done on adults in an AASM accredited center were evaluated. X2 analysis was performed
Results: Using the entire night's data for 50 patients, 1116 RERA's were identified for analysis, 51.6 % were in Males (M) and 48.4% in Females (F). T effort was > A in 63% W compared to 37% M with the greatest difference seen in stage N2 -76% F v/s24%M ($P < 0.000006$) ($N = 711$); during REM it was seen in 50%Fv/s 26%M ($P = .09$ $N = 154$). In N1 in the lateral position Twas = A in 47% of F compared to only 6% of M ($P < 0.0009$). Overall in the supine position, T was = A in 58% of men compared to 42% women ($P = 0.03$), with the greatest difference seen during N3- M76% v/s W 52%.
Conclusion: Significant differences were noted between men and women and in different body positions between the degrees of thoracic versus abdominal effort during RERA's. If confirmed in a larger sample, this may lead to alteration in the criteria for scoring RERA's and deciding about the number of effort channels during polysomnography.

0368

FRACTIONALLY EXHALED NITRIC OXIDE IN SLEEP APNEA

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Introduction: Excessive Daytime Sleepiness, one type of sleep disorder, is becoming a pandemic disease affecting almost every country and is one of the leading causes of car accidents in the United States of America costing the US billions of dollars. One specific breath biomarker is fractional exhaled Nitric Oxide (FENO). Currently, FENO is used to detect, diagnose and manage other pathologies, such as airway inflammatory diseases, including asthma. Our proposed research should confirm FENO could be used to screen Excessive Daytime Sleepiness (EDS) through the measurement of (FENO).
Methods: We measured FENO levels in patients who are undergoing overnight polysomnography with or without Excessive Daytime Sleepiness (EDS). We used Epworth Sleepiness Scale to measure EDS. The Nitric Oxide (NO) levels measured in the evening (PM) were summarized in mean ± SEM form for the groups with EDS and without EDS. The between groups comparisons were performed using t-tests for independent populations. Paired t-test were used to assess the differences between the evening (PM) and morning (AM) NO levels for each subgroup. To account for the small samples by using Mann-Whitney tests yielded similar results to those reported above.
Results: The following results are based on 24 subjects enrolled in the baseline study. The PM NO measurements obtained from the subjects with EDS ($N = 13$), OSA ($N = 10$) and without OSA ($N = 3$) cases were statistically different ($P = 0.045$). The averages PM NO levels for subjects with OSA and without OSA were 23.57 (10.33) and 10.81 (6.45), respectively. For the subjects with OSA ($N = 15$), the difference in PM NO levels with respect to whether or not the patients had EDS was significant ($P = 0.016$). The average PM NO levels for subjects that had OSA with EDS ($N = 10$) and OSA without EDS ($N = 5$) were 23.57 (10.33) and 11.81 (6.18), respectively. There were no statistical differences obtained in PM-AM measurements of Nitric Oxide from the current samples. More observations are needed to account for differences in BMI and EDS statuses and CPAP usage as therapy for OSA. To account for the small samples by using Mann-Whitney tests yielded similar results to those reported above.
Conclusion: The results above suggest that FENO could be used as a breath biomarker to screen patients with Excessive Daytime Sleepiness. This could help prevent millions of lives caused by accidents due to drowsy driving.

0369

PREVALENCE OF OBSTRUCTIVE SLEEP APNEA AND SLEEP BRUXISM SYMPTOMS IN A DENTAL OFFICE POPULATION

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Introduction: The literature shows that the prevalence of the obstructive sleep apnea (OSA) is 2-5% in women and 4-9% in men, but it estimates that still are very people undiagnosed. The symptoms and, mostly the consequences of obstructive sleep apnea (OSA), have been deeply studied in the last decades and the cardiovascular system seems to be the most affected by this disease, compromising the general health and the quality of life among the OSA patients. The same way, sleep bruxism also has a bad impact on sleep physiology resulting in tiredness at wake up and mood alteration and literature have demonstrated that SB is associated to microarousals and rate heart variability alteration. Considering that dentists can treat OSA and SB, it is important that these professionals include in the dental anamnesis questions that may indentify OSA and SB symptoms. The purpose of this study is to determinate the prevalence of OSA and SB symptoms among patients of a dental office through a OSA and SB screening added to the standard dental anamneses which allows these patients to be referred to the correct therapy and reduce the number of undiagnosed and untreated OSA and SB patients within general population.
Methods: Eight hundred dental patient files were accessed in order to evaluate the prevalence of OSA and SB symptoms. Mean age was 44.0 ± 15.0 including male and female gender. The OSA and SB screening added to the standard dental anamneses were as follow, presence of snor-

ing and apnea events, excessive sleepiness, mood alteration, memory lapse, tiredness at wake up, concentration impairment, tooth grinding or clenching, masticatory muscles pain, headache and mandibular stiffness.
Results: The results showed that 60% of patient related snoring, 47% had apnea events related by partners, 68% related tooth grinding or clenching, 51% related headache and 64% related eventual mandibular stiffness. Concerning to muscle pain, 38% related chronic muscle pain and 86% related eventual muscle pain. Almost 90% related mood alteration. Fifty one percent of OSA patient presented SB.
Conclusion: We conclude that there is a high prevalence of OSA and SB patients among dental office population. Dentists should add OSA and SB screening and treatment in the daily practice which would reduce the number of undiagnosed and, consequently, untreated OSA and SB patients.

0370

OBSTRUCTIVE SLEEP APNEA IN SLOW WAVE SLEEP

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Introduction: Obstructive sleep apnea is a condition which is characterized by episodes of cessation or reduction in breathing during sleep due to partial or total occlusion of the upper airway. Sleep disordered breathing does not occur uniformly during sleep and can be influenced by multiple factors including stage of sleep. The purpose of this study was to determine the manifestations of obstructive sleep apnea during slow wave sleep (N3).
Methods: All sleep studies conducted at the sleep center during a 2 month period were reviewed and were scored according to the AASM Manual for the Scoring of Sleep and Associated Events. Patients who were included in the study were those with an apnea hypopnea index of 10 or greater and who had achieved at least 10 minutes of slow wave sleep. There were 21 patients who met these criteria. For each patient, the apnea hypopnea index was determined for N3 sleep (N3AHI) and compared to the overall total apnea hypopnea index (TAHI). The average TAHI and average N3AHI for all patients were then calculated and compared.
Results: In 20 of the 21 patients, the N3AHI was less than the TAHI. The average TAHI for the 21 patients was 28.5 episodes per hour compared to the average N3AHI of only 3.2 episodes per hour.
Conclusion: In patients with obstructive sleep apnea, sleep disordered breathing occurred much less frequently during slow wave sleep.

0371

RETINAL NERVE FIBER LAYER THICKNESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA/HYPOPNEA SYNDROME

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Introduction: Obstructive sleep apnea/hypopnea syndrome (OSAHS) is characterized by recurrent intermittent hypoxemia. Any factors compromising optic nerve head perfusion and oxygenation can lead to glaucomatous optic neuropathy. Glaucomatous optic neuropathy is associated with progressive retinal nerve fiber layer (RNFL) damage. Early signs of glaucoma typically manifest as thinning of the RNFL. The purpose of this study is to determine the RNFL thickness in patients with OSAHS of different severities compared to normal controls.
Methods: Subjects were recruited from among consecutive patients presenting with snoring and daytime sleepiness who underwent overnight polysomnography to determine OSAHS severity and were subsequently referred for ocular evaluation including measurement of RNFL thickness. Patients determined not to have OSAHS were included as controls.
Results: A total of 127 were recruited, including 105 patients with OSAHS and 22 control subjects. Mean RNFL thickness was significantly lower for the severe OSAHS group compared to the control and mild OSAHS groups overall ($P < .0001$) and with respect to the superior quadrants ($P = .0007$). When subjects without OSAHS or with mild disease (AHI < 15) were grouped together and compared with patients with moderate to severe OSAHS (AHI ≥ 15), RNFL thickness measurements for the latter group were significantly lower overall ($P < .0001$), and in the superior ($P = .001$), inferior ($P = .029$), and temporal ($P = .007$) quadrants. A positive correlation was also identified between minimum oxygenation saturation on PSG and RNFL thickness overall, in the superior and nasal quadrants, and at the 1 to 5 o'clock positions (all $P < 0.05$).
Conclusion: Compared to patients without OSAHS or those with mild disease (AHI < 15), RNFL thickness was lower in patients with moderate/severe OSAHS. Lowest saturation of oxygen in the moderate/severe OSAHS group correlated with decreased RNFL thickness.

0372

A CARE PROCESS MODEL FOR PERIOPERATIVE MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA (OSA) IN ORTHOPEDIC PATIENTS: PRELIMINARY RESULTS

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Introduction: Compared to patients diagnosed and treated prior to surgery, those with unrecognized sleep apnea have increased peri-operative complications. The STOP-Bang questionnaire has been validated as an easy method for preoperatively screening patients with OSA. We describe a care process model incorporating this questionnaire, overnight oximetry and clinical consultation to screen patients about to undergo arthroplasty, to initiate therapy with positive airway pressure (PAP) and to provide postoperative management.
Methods: Orthopedic patients were asked to complete the STOP-Bang questionnaire prior to undergoing surgery. Those with a positive questionnaire (≥ 3 affirmative responses) had overnight oximetry followed by sleep medicine consultation. The indication for polysomnography was determined by oximetry criteria and clinical consultation. Those diagnosed with OSA were offered PAP prior to surgery. Patients with a negative questionnaire or without a positive diagnosis of OSA were treated post-operatively with nasal oxygen. All patients were monitored postoperatively with oxy-telemetry.
Results: 46 patients (45-89 years; 22 females) were screened. 34 STOP-Bang questionnaires were positive (mean score ± SD was 5.1 ± 1.6). 7 patients refused further evaluation. 27 patients were seen in consultation and 22 patients had oximetries. 4 patients had no further testing (2 excluded with negative oximetries; 2 refused further evaluation). 23 patients were studied with attended polysomnography. OSA was found in all 23. Mean ± SD values for AHI and SpO_2 nadir measured 30.9/hr ± 24.2 and 78.8% ± 5.7 respectively. 20 underwent therapy with PAP. 3 refused further intervention.
Conclusion: All patients with a positive STOP-Bang questionnaire who underwent polysomnography had OSA. Their identification allowed prescription of PAP therapy prior to undergoing joint arthroplasty. These preliminary findings support the use of the STOP-Bang questionnaire as a component of a care process model designed to both identify and initiate therapy in patients who otherwise would have gone to the operating room with unrecognized and untreated OSA.

0373

REM SLEEP RELATED BREATHING DISORDERS: CLINICAL FEATURES AND IMPACT ON TREATMENT DECISIONS

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Introduction: We report clinical features of REM sleep related breathing disorders in a sleep disorders clinic population and their impact on treatment decisions.
Methods: The study involved retrospective chart review. Both baseline and CPAP polysomnograms (PSGs) were reviewed. Patients with REM apnea hypopnea index (AHI) > 5/hr and REM AHI > 2 x total AHI and 3 x NREM AHI was included. REM hypoxemia was defined as non-apneic hypoxemia occurring only in REM sleep.
Results: 94 patients met criteria. 65/94 patients were female (69%) and 29/94 (31%) were males. Average age was 49 (range 25-76). Average BMI was 40 (range 23-80). Snoring (69/94), excessive day time sleepiness (42/94), fatigue (27/94) and apnea (24/ 94) were the most common presenting complaints. Mean AHI was 8.6 (range 1.8-27), REM AHI was 34.5 (range 6.6-87) and NREM AHI was 3.9 (range 0.0-20.6). 8/94 had REM hypoxemia, 10/94 combination of REM hypoxemia and REM OSA. 76/94 had REM OSA.
Conclusion: Our investigation revealed that middle aged subjects with high BMI showed high prevalence of REM related breathing disorders. Female subjects had higher prevalence. Presenting complaints included snoring, excessive day time sleepiness, fatigue and apnea. Based on our study, high REM AHI compared to NREM AHI reiterates the importance of studying REM sleep in polysomnograms. REM AHI can provide high contribution to total AHI. Therefore, it is necessary to perform an all night polysomnographic study as percentage of REM sleep increases in the morning. In addition, it is important to consider that night to night variability in REM sleep proportion may affect total AHI. REM AHI and REM hypoxemia should be considered when making treatment decisions. This will help in blunting the variability and lead to effective treatment of a broader net of symptomatic patients. In addition CPAP titration should also include REM sleep for optimal effect.

0374

A COMPARISON OF TWO CRITERIA FOR THE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Untreated OSA is a modifiable risk factor for diabetes, cardiovascular disease, hypertension, and stroke. However, definitions for the treatment of obstructive sleep apnea (OSA) vary across insurance payers. While most insurance carriers accept either the American Academy of Sleep Medicine's (AASM) standard or alternative definition of hypopneas, Medicaid/Medicare has limited treatment of OSA to patients meeting the standard criteria. Medicaid/Medicare did allow for use a respiratory disturbance index (RDI), which included respiratory effort-related arousals (RERAs), but use of RERAs was removed in September 2010. Using the AASM's standard definition of hypopneas, we compared the yield of the apnea-hypopnea index (AHI) with the RDI.
Methods: A retrospective chart analysis was performed on all Medicaid/Medicare patients undergoing polysomnography for obstructive sleep apnea (OSA) at the Vanderbilt Sleep Disorders Center between 1/1/2009 through 6/30/2009. The AHI and RDI were calculated on each study. The AHI was calculated using the AASM-recommended definitions for both apneas and hypopneas. The RDI was calculated using the AASM-recommended definitions for apneas and hypopneas, as well as RERAs. OSA was defined as an AHI or RDI > = 5 events per hour.
Results: Fifty-eight patients were identified, with a median (range) age of 68 years (28-87). OSA was diagnosed in more patients using the RDI vs. AHI (50 vs. 39, McNemar's test; P = 0.0009). In all patients diagnosed with OSA based on either criteria, median AHI was 13.5 (0.0-99.8) and median RDI was 18.5 (5.5-99.8).
Conclusion: In this sample, the use of the RDI allowed for treatment of additional patients with OSA (86% vs. 67%). The change in OSA definitions may result in a missed opportunity to treat patients and prevent medical comorbidities. We are currently following up these patients to determine long term outcomes.

0375

BERLIN QUESTIONNAIRE IDENTIFIED PREVALENCE OF OBSTRUCTIVE SLEEP APNEA IN PATIENTS RECEIVING GENERAL ANESTHESIA

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Introduction: Berlin Questionnaire appears to be the most often used tool to screen the patients with high risk for the obstructive sleep apnea (OSA). We used Berlin Questionnaire to investigate the prevalence of OSA in the patients receiving general anesthesia.
Methods: We interviewed 666 adults who would receive general anesthesia before surgery with Berlin Questionnaire in West China Hospital of Sichuan University.
Results: Among 666 interviewed subjects, based on the general standard (score of two sub-items were positive) as the high risk for OSA utilizing Berlin Questionnaire, we found that 78 subjects (11.7%) were considered as the high risk for OSA. In the group of high risk, 54 subjects (69.2%) had snoring and high blood pressure, 17 (21.8%) had snoring and daytime sleepiness, and 7 (9%) had three symptoms of snoring, high blood pressure and daytime sleepiness. For all interviewed subjects, 344 (51.6%) had snoring, 121 (18.2%) had high blood pressure and 51 (7.6%) had daytime sleepiness. Between the groups of high and low risk, BMI and age were 24.4 ± 3.5 vs. 22.0 ± 3.3 (P = 0.21) and 61.4 ± 12.0 vs. 52.9 ± 13.6 (P = 0.08), respectively.
Conclusion: The investigation showed that the prevalent rate of high risk group with OSA revealed by Berlin Questionnaire among Chinese patients receiving general anesthesia is about 12%. The rate appears to be considerably lower than that reported in similar investigations in the United States (23.7%-37.5%). No differences were obtained between groups of high and low risk in BMI and age.
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0376

ASSOCIATION OF PHYSICAL ACTIVITY & RISK OF OBSTRUCTIVE SLEEP APNEA (OSA) IN THE ELDERLY

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Introduction: Excessive daytime drowsiness contributes to deterioration in health-related quality of life (QoL) in OSA, but recent evidence suggests that this manifests only in pre-elderly (< 65 yr) adults (Martinez-Garcia *et al. Sleep Med* 2009) and is due mainly to QoL attributes related to physical function. Vasquez *et al. (J Clin Sleep Med* 2008) found that reduced physical activity in OSA is attributable to high RDI and body mass index (BMI) in the pre-elderly. Low recreational physical activity (RPA) leads to weight gain, increased OSA severity, and greater likelihood of cardio-metabolic diseases. Thus, we examined influences of OSA risk on RPA in the elderly.
Methods: Subjects were 113 free-living individuals from the Stanford AAA STOP study (Abdominal Aortic Aneurysm: Simple Treatment or Prevention). Each completed the Berlin Questionnaire to classify OSA

risk (Low-risk, n = 85; High-risk, n = 28) and a questionnaire to assess RPA in the past year (LYRPA) and adulthood (LFRPA).
Results: The Low- vs. High-OSA risk groups did not differ in age (Mean ± SD = 71.9 ± 8.9 vs. 70.7 ± 7.9 yr), gender (84.7% vs. 89.3% male), or BMI (29.1 ± 5.3 vs. 30.0 ± 4.3 kg/m^2); However, waist/hip ratio was higher in the High-OSA risk group (0.95 ± 0.08 vs. 0.99 ± 0.08; P < 0.03). Correlation analysis demonstrated no association between AAA and key measures of interest, i.e. BMI, LYRPA. Neither LYRPA (1237 ± 987 vs. 1079 ± 1084 kcal/wk) nor LFRPA (998 ± 949 vs. 846 ± 860 kcal/wk) differed between groups. RPA in elderly adults at high risk for OSA may be similar to levels among peers at low-OSA risk. Advancing age is often associated with onset of multiple chronic diseases that may reduce PA behavior; however, paradoxically, this sample of elderly adults reported higher levels of last-year PA (P < 0.01) than they did for adult years, overall (1205 ± 1010 vs. 965 ± 929 kcal/wk).
Conclusion: Elderly adults at increased risk for OSA may be as active as peers at low risk for this disorder.
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0377

OBSTRUCTIVE SLEEP APNEA IS UNDIAGNOSED IN PATIENTS REFERRED FOR BARIATRIC SURGERY

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Introduction: There is a high prevalence of obstructive sleep apnea (OSA) in the general population. In severe obesity (BMI > 40 kg/m^2) the prevalence of OSA is reported as between 40% to 90% with a greater severity of OSA compared to leaner populations. However, the condition still remains undiagnosed even in this high risk group. We wanted to determine: (a) the prevalence of OSA in patients referred for bariatric surgery, (b) number of patients diagnosed with OSA prior to bariatric surgery evaluation and (c) number of patients diagnosed following mandatory sleep study as part of surgical evaluation.
Methods: Retrospective chart review of patients evaluated in clinic for bariatric surgery from January 1, 2007 to December 31, 2008. All patients had to undergo an overnight polysomnogram as a part of the evaluation process, if one was not done previously.
Results: A total of 146 patients were evaluated in clinic for bariatric surgery. 36/146 patients (24%) had been evaluated for OSA prior to the clinic evaluation and 35/36 (97%) had OSA. Polysomnogram (PSG) was done in 80 of the 110 patients not previously evaluated for OSA. 50/80 (62.5%) had OSA. 12/50 (24%) had severe OSA (AHI > 30 events per hour), 16/50 (32%) had moderate OSA (AHI 15-30 events per hour) and 22/50 (44%) had mild OSA (AHI 5-14 events per hour). Excluding patients where PSG data was not available (n = 30), the prevalence of OSA in this group was 73% (85/116).
Conclusion: OSA remains undiagnosed in a majority of patients presenting for evaluation for bariatric surgery. Mandatory testing as a part of the bariatric surgery evaluation in our hospital helps diagnose OSA in these patients. Greater awareness among internists is needed to improve diagnosis of OSA in the general population and obese patients in particular.

0378

SLEEPINESS OR FATIGUE IN SLEEP APNEA: WHICH IS THE WORSE SYMPTOM?

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Introduction: We sought to investigate the importance of fatigue as a symptom of sleep apnea distinct from sleepiness. We further examined the impact of fatigue and sleepiness, either separate or in combination, on health and psychological functioning.
Methods: We surveyed older individuals with daytime sleepiness, fatigue, or sleep problems who were systematically recruited from the community. They answered questionnaires including measures of sleepiness, fatigue, sleep quality, health and psychological functioning. All completed polysomnography and 124 were had a diagnosis of sleep apnea. Nineteen healthy controls were similarly studied.
Results: The apnea sample was divided according to clinically relevant cut-offs on the sleepiness and fatigue measures. The final groups included: low sleepiness/low fatigue (LL, n = 23), high sleepiness/high fatigue (HH, n = 28), high sleepiness/low fatigue (HS, n = 10), and low sleepiness/high fatigue (HF, n = 13). The respiratory disturbance index did not differ significantly among the four apnea groups and only the HF group was significantly lower than the other groups on average oxygen saturation. Multivariate comparisons revealed that the HH group was significantly worse than the LL group on most sleep, health and psychological measures. On these same measures, the groups for whom fatigue was low (LL and HS) were similar to controls.
Conclusion: Patients with sleep apnea can be classified into different sleepiness/fatigue groups. High fatigue is associated with more severe dysfunction than high sleepiness. The current debate on whether to treat apnea patients with low sleepiness needs to recognize the impact of fatigue.
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0379

USE OF AN ABBREVIATED, EVENING POLYSOMNOGRAM TO RULE OUT SLEEP-RELATED BREATHING DISORDER IN CHILDREN 2 YEARS OF AGE AND UNDER

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Introduction: Overnight polysomnography (PSG), the "gold standard" for diagnosing sleep-related breathing disorder (SRBD) in children, is expensive and time-consuming test. Previous studies in adults, comparing a full-night PSG (fPSG) to an abbreviated-night PSG (aPSG), demonstrated that an aPSG is reliable detector of SRBD in presence of REM. We could not identify similar studies completed in the pediatric population. Therefore, we decided to examine the validity of aPSG compared to fPSG to identify SRBD in children ≤ 2 years of age.
Methods: In 51 patients referred to the pediatric sleep laboratory for suspected SRBD, we retrospectively split the data of PSG studies into aPSG (4h) and fPSG (≥ 6h). In addition to descriptive analyses and pairwise correlations, sensitivity, specificity, and positive and negative predictive values (PPV & NPV) were calculated for an apnea/hypopnea index (AHI) threshold of > 1.5 event/h.
Results: Mean age of the group was 10.5 months, and 58.8% of patients were males. Results of sleep parameters for aPSG vs. fPSG respectively were comparable: sleep efficiency (aPSG 84% vs. 82% in fPSG); mean percentage REM out of total sleep time of 28% vs. 30%; mean AHI of 18.1 events/h vs. 17.8 events/h; mean nadir SpO_2% of 81% vs. 80%; and mean peak $PETCO_2$ of 49.3 mmHg vs. 50.1 mmHg. Pairwise correlation was significant for parameters: AHI (r = 0.93, P < 0.001), percentage REM out of total sleep time (r = 0.91, P < 0.001); and nadir SpO_2% (r = 0.94, P < 0.001). At AHI > 1.5 events/h, sensitivity was 94%, specificity was 100%, PPV was 100%, and NPV was 25%.
Conclusion: In children ≤ 2 years of age, with suspected SRBD, aPSG of 4-hour duration is adequate to confirm SRBD for AHI > 1.5 events/h. We speculate that finding may be adequate in all pediatric age groups.

0380

SICK, SYMPTOMATIC & UNDIAGNOSED: THE FAILURE TO DIAGNOSE OBSTRUCTIVE SLEEP APNEA WHEN THE RESPIRATORY DISTURBANCE INDEX IS NOT USED

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Introduction: Obstructive sleep apnea (OSA) can be diagnosed, according to the American Academy of Sleep Medicine (AASM) Diagnostic Manual-II (2005), one of two ways with the use of polysomnography (PSG): If the apnea hypopnea index (AHI) or the respiratory disturbance index (RDI) is > 5 per hour, with clinical symptoms; or if the AHI or the RDI > 15, with or without clinical symptoms. We assessed what proportion of OSA patients would have been diagnosed, using an AHI > 5, when patients who had an Respiratory Effort Related Arousal (RERA) > 15; were selected, regardless of their AHI. Since clinical treatment depends on the correct diagnosis, we sought to determine what proportion of OSA patients would remain undiagnosed if using only AHI.
Methods: 100 adult OSA patients, diagnosed by PSG, and who had an RERA index > 15 were chosen from existing patient files alphabetically. AHI was not a selection factor. Each RDI was then re-calculated by subtracting out RERA to yield the AHI. Groups were created using AHI: Group 1 (G1) included patients who would have received a positive OSA diagnosis with AHI alone (RERA > 5; AHI > 5) and Group 2 (G2) would have missed a diagnosis with AHI alone (AHI < 5; RERA > 5). All patient studies had to include PTAF, an agreed upon measure to detect RERAs; RERAs are necessary to formulate the RDI. Statistics included descriptive statistics and the binomial test.
Results: Use of the RDI plus the AHI was necessary to make an OSA diagnosis in 20% of the patients. AHI alone was sufficient to make an OSA diagnosis in the other 80% (binomial test P value < .001. Group 1: RDI: 39.6+21.9 (RERA Index: 25.0+11.6; AHI: 19.1+16.7) Group 2: RDI: 20.3+4.6 (RERA Index: 19.4+4.7; AHI: 1.6+1.1).
Conclusion: 20% of patients who are sick and symptomatic of OSA remain undiagnosed, if the AHI and not the RDI is used as the metric by which an OSA diagnosis is made.

0381

PRACTICAL CRANIOFACIAL MEASUREMENTS IN PREDICTING OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is characterized by repetitive closure of the upper airway during sleep as result of craniofacial soft tissue and skeletal anatomic abnormalities that appear to act synergistically to promote obstruction. OSA is associated with increased cardiovascular morbidity, poor cognitive function, and overall mortality. As a result, it is imperative to recognize and treat OSA early. Unfortunately, the diagnosis of OSA can be cumbersome because of the need for specialist assessment and overnight monitoring in a sleep lab, which can be expensive, labor intensive, and resource limited. This results in under recognition of OSA in the community. Several algorithms have been developed to risk stratify and screen patients for OSA, however these algorithms are based largely on demographics, symptoms, and obesity. These measurements obviously do not account for craniofacial morphology, which has increasingly become more appreciated as an important factor in OSA pathogenesis. Several recent studies have been conducted with radiographic cephalometry or by photographic analysis to assess craniofacial characteristics. Although innovative, these approaches tend to be cost-prohibitive, time consuming, and impractical for a routine patient evaluation. Based on prior cephalometric studies, we sought to develop measurements that could be obtained in real-time and be used to predict OSA. Secondly, we aimed to determine whether these measurements were significantly different when compared to patients without OSA.
Methods: The following measurements were obtained: Mallampati score, tongue size, jaw laxity, neck circumference (inches), gnathion to gonion (cm), subnasion to tragion (cm), nasion to opisthocranion (cm), nasion to inion (cm), gonion to clavicle (cm), exocanthion to tragion (cm), waste size, BMI. All patients had PSG done to document presence or absence of OSA/UARS.
Results: Mallampati score, subnasion-tragion length, gnathion-gonion length, neck circumference, nasion-opisthocranion circumference, waste size, and BMI were associated with the presence of obstructive sleep apnea ($P < 0.05$).
Conclusion: Craniofacial characteristics can be measured and used practically to predicted the presence of obstructive sleep apnea.

0382

EXAMINING PREDICTORS OF HEALTH-RELATED QUALITY OF LIFE IN SLEEP APNEA PATIENTS

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Introduction: Predictors of health-related quality of life have been studied in patients with sleep apnea. However, symptom-focused rumination (e.g., thinking repetitively about how sleepy one feels) has not been investigated. Thus, the present study examined whether demographic, OSA-related variables, symptom-focused rumination, and worry predicted health-related quality of life in patients with sleep apnea.
Methods: The sample included 569 consecutive patients (mean age 51.6; 33.2% women) who completed an overnight polysomnography study for suspected OSA and questionnaires assessing sleepiness, symptom-focused rumination, worry, and health-related quality of life. Participants with an apnea-hypopnea Index (AHI) ≥ 15 were used for data analysis, and predictors included age, sex, body mass index (BMI), AHI, sleepiness, symptom-focused rumination, and worry.
Results: Using bivariate correlations, results revealed significant relationships between health-related quality of life and age ($r = 0.19$, $P = .0002$), BMI ($r = -0.34$, $P < .0001$), AHI ($r = -0.12$, $P = .02$), sleepiness ($r = -0.15$, $P = 0.003$), symptom-focused rumination ($r = -.53$, $P < .0001$), and worry ($r = -.33$, $P < .0001$). Using a t-test, results also revealed that women had significantly poorer health-related quality of life than men ($t = 2.48$, $P = .01$). Using a simultaneous multivariate regression analysis with all predictors, results revealed that only a higher body mass index ($t = -4.64$, $P < .0001$) and higher levels of symptom-focused rumination ($t = -7.61$, $P < .0001$) significantly predicted poorer health-related quality of life.
Conclusion: BMI and symptom-focused rumination were significantly related to poorer health-related quality of life when accounting for other possible predictors. Focus on these clinical factors may lead to improved treatment and better health outcomes for patients with OSA.

0383

COMPARATIVE ANALYSIS OF THE ADJUSTED NECK CIRCUMFERENCE AND THE BERLIN QUESTIONNAIRE IN ESTIMATING PREVALENCE OF RISK AND GUIDING REFERRAL FOR EVALUATION OF SLEEP DISORDERED BREATHING IN A SAMPLE OF CALGARY POLICE SERVICE OFFICERS

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Introduction: A recent survey of 5, 296 North American police officers, found 35.1% prevalence of risk for sleep disordered breathing (SDB) us-

ing the Berlin Questionnaire (BQ) (Rajaratnam 2007). Samuels (2007) found the prevalence of risk for moderate and high SDB in 30 officers to be 27% and 33% respectively, using the Adjusted Neck Circumference (ANC). The purpose of this study is to compare the ANC and the BQ in estimating prevalence of risk for moderate to high SDB that would prompt a referral for evaluation.
Methods: Active-duty CPS officers (N = 333) participated in the study (281 male, 52 female). Average age was 35.99 years old, with a range of 21-54. SDB risk was assessed using the ANC and BQ. The ANC risk assessment is based on the neck circumference, self-reported snoring, history of choking/gasping, and hypertension. The BQ risk assessment is based on 9 questions assessing self-reported levels of snoring/apnea, daytime sleepiness and hypertension/BMI.
Results: Descriptive statistical analysis yielded a mean ANC of 42.15 cm (SD 4.59, Range 30.0-58.1). The ANC assessed 51.7% (172/333) of the sample as Low Risk, 39.3% (131/333) as Moderate Risk and 9.0% (30/333) as High Risk for SDB. The BQ assessed 56.5% (188/333) as Low Risk and 43.5% (145/333) as High Risk for SDB.
Conclusion: The results are congruent with previously reported findings; Higher prevalence risk of SDB in police officers than the general population. Combined ANC Moderate and High Risk prevalence was 48.3%, while BQ High Risk prevalence was 43.5%. Meeting these respective risk criteria usually results in a referral to a sleep physician for further evaluation. The findings indicate that both tools have similar capacity to inform the referral process. Despite limitations of the psychometric screening tools, the findings suggest the need for further research examining the prevalence of risk and incidence of SDB in police officers.
Support (If Any): Calgary Police Service, City of Calgary, Calgary, AB, Canada

0384

SLEEP STUDIES IN CRANIOFACIAL SYNDROMES

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Introduction: Children with craniofacial anomalies have an increased incidence of obstructive sleep apnea (OSA), which can occur at multiple sites. The efficacy of various craniofacial surgeries in the treatment of OSA in this population has not been established. The objective of this study was to evaluate the role of polysomnography (PSG) in the management of OSA in children with craniofacial deformities.
Methods: A retrospective chart review of 1478 consecutive patients seen by the craniofacial service between 1999 and 2009 yielded 122 patients that underwent surgery. A subgroup of these children (17 patients, 10 boys, median age 10.7 years ± 7, range 0.3-19 years) that underwent craniofacial surgery also had a pre- and post-operative polysomnogram (PSG) to assess sleep-disordered breathing.
Results: The pre-operative apnea-hypopnea index (AHI) was 33.8 mean ± 39.6, while post-operative follow-up AHI was 10.5 mean ± 11.4; $P < 0.05$. The severity of pre-operative OSA was determined as follows; severe (n = 11, 65%), moderate (n = 5, 29%), and none (n = 1, 6%). The post-operative OSA severity was; severe (n = 3, 18%), moderate (n = 2, 12%), mild (n = 3, 18%), and none (n = 9, 53%). Following surgery, 13 patients (77%) improved, 3 patients (18%) had no change, and, 1 patient (6%) had increased OSA severity. Mild oxygen desaturations were detected preoperatively; and persisted post-operatively. Data on improvement in daytime alertness was not available post-operatively. The type of surgery was not predictive of outcomes.
Conclusion: PSG provided valuable information in children with craniofacial anomalies and suspected OSA. The various craniofacial surgical procedures most often improved the severity of sleep-disordered breathing, but significant residual OSA was observed in nearly half of the patients. Prospective studies need to address outcome of OSA with different surgeries procedures in this population.

0385

RETROSPECTIVE REVIEW OF PSGS WITH AHI > 5

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Introduction: Diagnostic value of AHI > 5 in PSG for patients with OSA is well recognized though it was established empirically (Guilleminault, Tilkian, Dement, 1976). However the correlates for and clinical significance of AHI < 5 in patients with daytime sleepiness are not well characterized. The aim of the present study was to examine a subset of patients with revealed AHI < 5 in patients with daytime sleepiness.
Methods: We performed retrospective analysis of 9994 standard PSGs (adult patients only with excessive daytime sleepiness) with AHI < 5 acquired from Jan 2005 through Nov 2009 in 21 community sleep centers (SleepTech network). In all studies hypopnea were scored based on > 4% desaturation and > 30% flow limitation (AASM recommended criteria or Medicare (CMS) criteria). RERAs were scored based on flow changing ending with EEG arousals.
Results: Mean age of 9994 patients with AHI < 5 was 44.8+14.6 and majority were women: 57.8% female and 42.2% male. Most patients can be considered overweight or 1st degree obesity with BMI 29.8+7.0 and NS 15.0+3.4. Mean ESS was 9.3+6.5 and mean RERA index was 9.5+9.1. MSLT was conducted in only 779 (7.8%), significantly younger patients with mean age 36.4+12.6, and predominantly women (68.7% female and 31.3% male). No significant differences in AHI, BMI, NS and ESS were found. MSLT revealed REM in 2 or more naps in 156 (1.6%) patients (86 female and 70 male with mean age 29.7+10.2). CPAP titration study was conducted in 854 (8.5%) patients with slightly higher BMI (31.6+7.3). No other differences were revealed.
Conclusion: Our analysis focused on a group of PSGs with low AHI's scored using the current CMS criteria. Further analysis of this group (i.e. scoring these PSGs using a RERA index or alternative Hypopnea scoring criteria (AASM, 2008)) would likely alter the diagnosis and clinical outcomes. Further research is recommended to reveal patient group characteristics and appropriate use of the MSLT.

0386

CLINICAL CHARACTERISTICS IN MALE AND FEMALE PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: There are remarkable differences in the prevalence for obstructive sleep apnea (OSA) between male and female. We investigated clinical characteristics in male and female patients with OSA.
Methods: We collected the data of 153 male and 17 female patients with OSA in West China Hospital of Sichuan University. Their AHI were greater than 5.
Results: Between male and female groups, the differences in the comparison of mean values were significant in age (46 ± 11.4 vs. 58 ± 6.0), neck circumference (37.6 ± 3.2 vs. 35.6 ± 3.2), AHI (36.4 ± 26 vs. 21.4 ± 17.4) and micro arousal index (32 ± 17 vs. 25.7 ± 13), not in body mass index, Epworth sleepiness scale and the lowest arterial oxygen saturation. The incidence rate were greater in female patients than in male for the symptoms of morning headache, dry mouth, personality change and high blood pressure. No differences were obtained for snoring, daytime sleepiness, memory problem, diabetes and stroke between two groups.
Conclusion: In accordance with existing knowledge, the average age of female patients with OSA were considerably greater than male. Compare to male patients, female appear to be less severe in terms of AHI and micro arousal index, but more severe in somatic distress.
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0387

THE ROLE OF SLEEP APNEA IN INSOMNIA: THE SAO PAULO EPIDEMIOLOGIC SLEEP STUDY

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Introduction: Since the seventies it has been demonstrated that Obstructive Sleep Apnea (OSA) and Insomnia are often concurrent, however, little is known about how this association behaves in the general population. This study aims in investigating associated factors to the presence of OSA in individuals with Insomnia, from the Sao Paulo Epidemiologic Sleep Study.
Methods: A 3-stage probabilistic clustered sample (N = 1,042), by gender, age (20-80), and socioeconomic status, was selected, interviewed, completed questionnaires (demographic/psychological/physical/sleep), and underwent full in-lab PSG, to represent the sleep pattern in Sao Paulo. Insomnia was determined by the DSM-IV general criteria, and OSA by an Apnea and Hypopnea Index (AHI) > 5. Associations were investigated with the group Insomnia versus INS+OSA, for the following variables: gender, age, obesity, fatigue, sleepiness, headache, non-restorative sleep, disturbed sleep, anxiety, depression, and quality of life.
Results: Weighed prevalence of insomnia was 15% (N = 154), and of OSA 38% (N = 396); 71% and 43% were women, respectively. The prevalence of OSA in Insomnia was 42%, most with AHI between 5 and 15 (66%). Compared to Insomnia (N = 95), INS+OSA (N = 59) had a relative risk of being men [1.5(1.1-2.3)], 41yrs or older [8.2(1.2-55.5)], obese [2.6(1.7-3.9)], and sleepy [1.7(1.1-2.7)], and having more maintenance [2.0(1.1-3.6)] and moderate/severe insomnia [1.8(1.0-3.3)]. For the remaining symptoms both groups had high but similar frequencies.
Conclusion: The prevalence of OSA was high among insomniacs, and as previously described more frequently as mild. Most insomniacs were women, but among those with OSA there were more men, older, more obese, and sleepy, that is, all known OSA risk factors were found among insomniacs. Insomnia per se presented an important symptomathologic profile, worsened when concurrent with OSA.
Support (If Any): AFIP/CNPq/Fapesp.

0388

UPPER AIRWAY DYNAMICS IN RESPONSE TO NEGATIVE EXPIRATORY PRESSURE (NEP) DURING WAKEFULNESS IN CHILDREN WITH SLEEP-DISORDERED BREATHING (SDB)

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Introduction: Upper airway collapsibility is a major factor in the pathophysiology of SDB. Studies in adults have shown that flow-limitation in response to negative expiratory pressure (NEP) during wakefulness may be a potential method to asses upper airway collapsibility in SDB. We hypothesized that NEP could distinguish between normal children and children with SDB even during wakefulness.
Methods: Three groups were recruited: Controls (AHI < 1.5/h; no snoring); snorers (AHI < 1.5/h; habitual snoring)and obstructive sleep apnea syndrome (OSAS, AHI ≥ 1.5/h). During wakefulness, NEP of -5cm H2O was applied during the first second of expiration. Upper airway muscle activity was measured using intra-oral electrodes. The ratio of the area under the expiratory flow-volume curve during NEP compared to tidal breathing (RatioNEP) was calculated for 0.25, 0.5, 0.75 and 1 second time points. Similarly, integrated EMG moving average area under the curve during NEP as a ratio of baseline, was measured (RatioEMG).Groups were compared using ANOVA.
Results: 12 controls (14 ± 2 [mean + SD] yr; AHI 0.1 ± 0.1/hr), 9 snorers (11 ± 3yr, AHI 0.7 ± 0.3/hr) and 11 OSAS (13 ± 3yr., AHI 14.6 ± 14.7) were studied. Snorers were younger than the other two groups (P = 0.022). There were significant differences in the RatioNEP between controls and snorers (P < 0.01), and controls and OSAS (P < 0.05), at all time points. However, there were no significant differences between snorers and OSAS. For RatioEMG,no significant differences were found between groups.
Conclusion: RatioNEP distinguishes between normal children and children with SDB, be it snoring or OSAS, indicating that these children have a more collapsible upper airway even during wakefulness. However, it does not differentiate between snorers and OSAS. Upper airway EMG activity was similar between groups.
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0389

INSULIN RESISTANCE AND INFLAMMATION IN MIDDLE AGE NON OBESE MEN: ROLE OF SEVERITY

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Introduction: The overall goal of this study was to examine the cardiometabolic profile in nonobese apneic men and the effect of CPAP treatment. While the importance of treating severe sleep apnea is generally accepted, it is debatable whether mild/moderate forms of apnea require treatment. The specific goal of this analysis was to examine the role of severity of sleep apnea in association with subclinical markers of insulin resistance and inflammation.
Methods: Twenty nonobese, middle-aged men with obstructive sleep apnea, and 18 non obese controls matched for BMI and age participated in a four month study. Apneic subjects were assigned on a 2 x 2 crossover design, with half of the subjects randomized to the sham-CPAP /CPAP sequence and the other half to the CPAP/sham-CPAP sequence. The subjects were assessed in the sleep laboratory for four consecutive nights three times: at baseline; 2 months following the use of CPAP; and 2 months following the use of sham CPAP. 24h blood sampling was done during the fourth day for the assessment of CRP, and fasting glucose and insulin.
Results: Insulin and CRP levels were significantly higher in non obese apneics versus controls and glucose/insulin ratio was significantly lower. We further categorized the apneic group into moderate apnea AHI < 30 and severe apnea AHI ≥ 30. There were no significant differences between controls and moderate apneics in insulin or CRP levels. However, severe apneics had significantly higher insulin levels and CRP levels compared to controls and lower glucose/insulin ratio.
Conclusion: Insulin resistance and inflammation are significant in non-obese men with severe apnea but not moderate apnea. These results suggest that an AHI ≥ 30 is a clinically useful cut point of severity of sleep apnea and that our therapeutic efforts should be focused on severe apneics who are prone to experience significant cardiometabolic morbidity and mortality.
Support (If Any): This research is funded in part by the National Institute of Health grants R01 HL 51931; and General Clinical Research Center M01 RR10732; C06 RR16499.

0390

THE PRESENTATION OF PATIENTS ACCORDING TO THE SEVERITY OF OBSTRUCTIVE SLEEP APNEA SYNDROME (OSAS): THE SAO PAULO EPIDEMIOLOGIC SLEEP STUDY

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Introduction: The presentation of OSAS in clinical studies varies according to sex, age, and height. Little is known about this aspect in epidemiological studies. The objective of this study was to evaluate the presentation of patients according to the severity of OSAS in the Sao Paulo Epidemiologic Sleep Study.
Methods: A 3-stage probabilistic clustered sample (N = 1,042), by gender, age (20-80), and socioeconomic status, was selected, interviewed, completed questionnaires (demographic/psychological/physical/sleep), and underwent full in-lab PSG, to represent the sleep pattern in adult population of Sao Paulo. OSAS was defined according to the criteria of ICSD-2 (AASM, 2005). Associations were investigated for the following variables: gender, age, obesity, fatigue, sleepiness, headache, non-restorative sleep, disturbed sleep, anxiety, depression, quality of life and blood sample analyses.
Results: OSAS weighed prevalence was 32.9%, being 16.2% mild (AHI above 5 and bellow 15), 9.7% moderate (AIH above 15 and bellow 30) and 7% severe (AHI above 30). The individuals without OSAS and patients with mild OSAS were predominantly female (58.7 and 54.4% respectively), while patients with moderate and severe OSA were predominantly man (73 and 64.7% respectively, $P = 0.001$). There was an increase in the frequency of patients with more severe OSA with increasing of age and weight ($P = 0.001$). Patients with mild OSA presented more maintenance insomnia (50%), non-restorative sleep (60%), fatigue (60%), depression (18%) and poor psychological domain of life quality (24%) than other OSAS categories ($P < 0.05$). Severe OSA patients compared with the others categories had more complaints of snoring (29%) and suffocation (81%) ($P < 0.05$). These patients showed higher arterial pressure level, higher value of insulin, TNFa, VHS, lipid profile, glycemia, homocystein and Framingham risk.
Conclusion: Although the patients with severe OSA had more sleep complaints, cardiovascular and metabolic abnormalities, patients with mild OSA were predominantly female, had lower BMI and they had more complaints of insomnia, fatigue and depression during the day.
Support (If Any): AFIP/CNPq/Fapesp.

0391

SUSPECTED OSA IN HOSPITALIZED PATIENTS: PREVALENCE AND POTENTIAL FOR ADVERSE EVENTS

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Introduction: Hospitalized patients often have several co-morbidities associated with OSA and likely represent a population enriched for OSA. As OSA is under recognized, we hypothesized that hospitalized patients would have a high rate of undiagnosed OSA. We also sought to determine the frequency with which patients at risk for OSA are ordered to receive narcotics and/or benzodiazepines while hospitalized.
Methods: A convenience sample over 4 months of new inpatient admissions to general medicine floors at an urban academic center were surveyed for OSA risk. Patients had to be positive by both the STOP and the Berlin questionnaires to be considered as high risk for OSA. Data were also abstracted from the electronic medical records regarding the use of narcotics and/or benzodiazepines while hospitalized. This is a descriptive study.
Results: Two hundred and nineteen of 311 patients (70%) approached agreed to participate. Demographics: average age 51.1+/- 14.4 yrs, 47.5% male, 56.2% Caucasian, 37.9% African-American, 5.0% Hispanic, and BMI 32.3 kg/m^2 (35.1 vs. 29.0 kg/m^2 high risk group vs. remainder). Positive screens by both the STOP and Berlin questionnaires were found in 60.2% of patients. Of the high risk patients, 81.8% had not been previously diagnosed with OSA. In the high risk group, 40.2% had orders for (39.4% received) IV narcotics, 22.8% had orders for (22.8% received) benzodiazepines and 12.1% had orders for (12.1% received) both. None of the patients at risk for OSA with orders for narcotics and/or sedatives had orders for additional respiratory monitoring.
Conclusion: OSA appears highly prevalent in hospitalized patients and is widely unrecognized. A significant percentage of patients that likely have undiagnosed OSA are ordered medications that may place them at risk for respiratory depression and adverse outcomes. Objective verification of OSA prevalence in hospitalized patients deserves study and correlation with outcomes is needed.

0392

SEASONAL VARIATION IN PREVALENCE OF MILD SDB IN A POPULATION SAMPLE OF CHILDREN

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Introduction: Nasal abnormalities have been hypothesized to contribute to sleep-disordered breathing (SDB), especially in children. We recently observed that nasal abnormalities (chronic sinusitis/rhinitis) were a significant risk factor for mild SDB ($1 < AHI < 5$) in the Penn State Child Cohort, a representative population sample of prepubescent children. Thus, we further assessed whether the prevalence of SDB was associated with seasonality.
Methods: A random sample of local elementary school children (K-5) was assessed using a two-phased strategy. Phase I was a brief questionnaire completed by a parent of all of the children in a specified elementary school (N = 5,740) with a response rate of 78.5%. Phase II randomly selected children and a parent to spend a night in our sleep laboratory (N = 700) with a response rate of 70.0%.
Results: The majority of the children in Phase II of this study were recorded between June and November (N = 687). We assessed for differences across these six months in terms of prevalence of mild SDB and observed a steady increase from June (21.6%) through September (37.2%). This was followed by a decrease in prevalence by November (6.3%). We assessed these differences with a logistic regression model using September as the reference and controlling for age, BMI percentile, gender, race and year of the recording The overall model for recording month was significant ($P = 0.016$) and the odds of mild SDB in every month was significantly lower than that in September (all $P < 0.05$).
Conclusion: These results suggest that there may be a seasonal influence on the prevalence of mild SDB in young children. Further study is warranted to assess the contribution of allergies to this seasonal variation. In addition, these data may have implications for development of pharmacologic treatment strategies.
Support (If Any): NIH R01 HL063772, M01 RR010732, C06 RR016499

0393

SLEEP APNEA RISK IN SHIFT WORKERS AND ITS CORRELATIONS WITH INSOMNIA, FATIGUE, SLEEPINESS AND ALERTNESS

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Introduction: The objectives of this survey study were to evaluate sleep apnea risk in a shift working population and its potential correlations.

Methods: Five hundred and eighteen workers from a major employer in Canada completed the Berlin Questionnaire (BQ), Athens Insomnia Scale (AIS), Fatigue Severity Scale (FSS), Epworth Sleepiness Scale (ESS), and Toronto Hospital Alertness Test (THAT). Participants included 309 shift-workers and 209 non-shift-workers. The rate of high sleep apnea risk (HSAR) in shift-workers was compared to that in non-shift-workers; sleep apnea risk in male shift-workers was compared with that in female shift-workers; and scores on the AIS, FSS, ESS and THAT, and body mass index (BMI) in HSAR shift-workers were compared with those in low sleep apnea risk (LSAR) shift-workers.
Results: Among shift-workers, the rate of HSAR in males is higher than that in females (44.4% vs. 13.6%; X2 = 7.91; P = 0.005). Scores on the AIS (10.61 ± 4.67 vs. 7.05 ± 3.96; P < 0.01), FSS (4.46 ± 1.16 vs. 3.76 ± 1.20; P < 0.001) and ESS (10.50 ± 4.38 vs. 8.36 ± 4.38; P < 0.001), and BMI (28.94 ± 4.78 vs. 25.87 ± 3.41; P < 0.001) are higher, while the score of the THAT (22.57 ± 7.43 vs. 25.32 ± 11.09; P = 0.015) is lower, in HSAR shift-workers than those in LSAR shift-workers,. There is no significant difference between the rate of HSAR in shift-workers than that in non-shift workers (42.2% vs. 39.3%; X2 = 0.424; P = 0.515).
Conclusion: Male shift workers have a higher sleep apnea risk compared to females. In a shift working population, HSAR correlates with increased BMI, poorer sleep quality, higher fatigue and sleepiness, and lower alertness.

0394

PREDICTORS OF EXCESSIVE DAYTIME SLEEPINESS AND QUALITY OF LIFE IN PATIENTS WITH REM AND NON-REM OSA

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Introduction: REM-related OSA is diagnosed in 10-23% of patients with OSA. These patients have similar degrees of hypersomnolence despite significantly lower overall AHI when compared to patients with non-REM OSA. Our study aim was to determine if REM AHI is independently associated with symptom development in patients with both REM and non-REM OSA and to determine other predictors of hypersomnolence in a clinical population.
Methods: A cross-sectional study of 1019 consecutive adults who had an overnight PSG for suspicion of OSA. We used the Epworth Sleepiness Scale (ESS), mental and physical component summaries (MCS and PCS) of the SF-12 quality of life (QOL) questionnaire, and the Center for Epidemiologic Studies-Depression scale (CES-D). Multiple linear regression models were used to evaluate the association between REM AHI, non-REM AHI, ESS and QOL measures. Linear regression models were also performed after stratifying for type of OSA (REM or non-REM OSA).
Results: REM AHI was not associated with ESS, MCS and PCS after adjusting for age, gender, race, marital status, BMI, non-REM AHI, self-reported total sleep time (TST), CES-D score, type 2 DM, slow wave sleep and REM sleep duration in minutes. Independent variables associated with ESS were CES-D, BMI, and non-REM AHI (P < 0.05). Independent variables associated with MCS and PCS were gender, age, race, ESS (P < 0.05) and age, gender, BMI, CES-D depression scale, self-reported TST (P < 0.05), respectively. When stratified by type of OSA, the only predictor of ESS was CES-D in the REM OSA group and CES-D and non-REM AHI in the non-REM OSA group (P < 0.05).
Conclusion: In this large clinic-based population, REM AHI was not independently associated with sleepiness or measures of QOL. Non-REM AHI was independently associated with ESS but not with measures of QOL. The main predictor of ESS was the depressive symptoms from the CES-D depression scale.

0395

A TECHNIQUE FOR MEASURING AND MODELING THE PHYSIOLOGIC TRAITS CAUSING SLEEP APNEA

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Introduction: Physiologic traits that may cause OSA include a collapsible airway, a high loop gain (unstable ventilatory control), a low arousal threshold, and an inability of the pharynx to dilate/stiffen during sleep. We propose a technique for measuring these traits, as well as a model of OSA that incorporates these measured traits.
Methods: Subjects are placed on therapeutic CPAP during sleep. Intermittently throughout the night, CPAP is dropped to a sub-therapeutic level for 3 minutes. During the drops, ventilation decreases and PCO_2 and ventilatory drive increase. The increase in ventilatory drive is determined by turning CPAP back to the therapeutic level and measuring the ventilatory overshoot. A large ventilatory overshoot indicates a high loop gain (thus, loop gain is measured from the ventilatory overshoot). To quantify pharyngeal collapsibility, ventilation at the start of each drop is plotted against nasal pressure; the data are fit with a line, and the ventilation at CPAP = 0 is used as the collapsibility metric. The ability of the pharynx to dilate/stiffen during sleep is evaluated by comparing the ventilation at the end of the drop to that at the beginning of the drop; if the pharynx dilates/stiffens, ventilation should be higher at the end of the drop. Lastly, arousal threshold is quantified as the ventilatory drive (in L/min) associated with arousal (ventilatory drive during the drop is a derived signal calculated from the loop gain). These four traits are then entered into a mathematical model that we have developed to see if they predict OSA (AHI > 10).
Results: The traits were measured in 23 OSA patients and 5 controls. There was significant inter-individual variability in the traits. The model accurately predicted OSA in 19/23 OSA patients and 5/5 controls.
Conclusion: The physiologic traits causing OSA can be measured using CPAP drops and then entered into a mathematical model that predicts OSA.
Support (If Any): NIH, American Heart Association

0396

UTILITY OF THE BERLIN QUESTIONNAIRE IN HOSPITALIZED PATIENTS

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Introduction: Screening tools for Obstructive Sleep Apnea (OSA) have been validated in community settings. At-risk hospitalized patients often remain unevaluated and untreated for OSA. The utility of the Berlin questionnaire for predicting OSA in this setting has not been systematically examined.
Methods: Four hundred eighty-eight hospitalized patients were prospectively administered the Berlin questionnaire (BQ). Two hundred eighty-eight of these had high probability Berlin questionnaire results and thirty-eight underwent in-laboratory polysomnography (PSG) subsequent to hospital discharge. The thirty-eight patients were identical in clinical parameters [body mass index (BMI), age and gender] to twenty randomly selected hospitalized patients, who had high probability BQ results but declined PSG. The study group was then compared to a randomly selected group of thirty-eight patients from the community, referred directly for PSG by their primary care physicians.
Results: Thirty-seven of thirty-eight SG subjects had sleep apnea, defined as Apnea-Hypopnea Index (AHI) > 5/hr. The Berlin questionnaire had a positive predictive value (PPV) of 97.4%. Only 3 of the SG had prior history of OSA. Epworth Sleepiness score (ESS) and AHI were similar between the hospitalized and community groups. 65.8% of the SG had severe OSA (AHI > 30/hr) compared to 42.1% of the CG (P = 0.04). Mean nadir oxyhemoglobin quartile was lower in the SG com-

pared to the CG (71% and78% respectively, P = 0.02). Compared to the CG, the SG had similar anthroprometric profile, ESS and overall AHI, but were slightly older (56.7 ± 12.6 vs 50.5 ± 14.8, P = 0.05).
Conclusion: The Berlin questionnaire is a useful screening tool for predicting hospitalized patients that have OSA. Hospitalized patients with high probability Berlin are more likely to have severe OSA with lower oxyhemoglobin desaturations. Most hospitalized patients at high risk for having OSA decline diagnostic testing and remain undiagnosed.

0397

OCCURANCE OF SLEEP DISORDERED BREATHING IN PATIENTS WITH ATRIAL FIBRILLATION - COMPARISON BETWEEN PORTABLE SLEEP APNEA TESTING AND POLYSOMNOGRAM

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Introduction: Atrial fibrillation (AF) is the most common arrhythmia. Patients with AF have significantly poorer quality of life (QoL) compared to healthy control subjects, the general population, and other coronary heart disease patients. Untreated Obstructive Sleep Apnea (OSA) syndrome is an important treatable AF risk factor. OSA leads to increased cardiovascular morbidity and mortality and significant psychological morbidity, i.e. depression. Depression is strongly associated with QoL in AF patients. In our study we used portable sleep apnea monitoring followed by in-laboratory attended polysomnography (PSG) to confirm sleep disordered breathing (SDB) diagnosis in AF-patients.
Methods: We included 30 patients (17male, 13 female, mean age: 62,8 +/-9,6years, BMI: 29,4+/-5kg/m^2, LVEF: 57,8+/-5,5%,) with a documented paroxysmal (n = 12, 40%) or persistent AF (n = 18, 60%). We examined all patients for SDB with polygraphy by recording nasal flow, breathing movements, oxygen desaturation and ECG. After identification of SDB (AHI > = 5/h) an in-laboratory attended PSG was performed.
Results: SDB could be detected in 17 of 30 subjects (56,7%, AHI = 9+/-7,7per hour) by polygraphy: 13 patients showed mild (AHI = 5-15/h) and 4 subjects had moderate levels of SDB (AHI = 15-30/h). Only 8 subjects had excessive daytime sleepiness (ESS > 9). Using the PSG, SDB was confirmed (AHI = 37,3 +/-9,7 per hour). In all patients, sleep apnea severity as presented by AHI was higher than with portable sleep apnea monitoring.
Conclusion: A PSG should become part of the diagnostic evaluation of AF because (1) SDB is common, but often undiagnosed and untreated. (2) A remarkable prevalence of SDB was observed in patients with atrial fibrillation. (3) Treating SDB in patients with AF can reduce recurrence of AF after electrical cardioversion and could also improve QoL. (4) PSG is the best diagnostic tool for SDB diagnosis. Sleep apnea severity assessed by PSG can determine not only OSA severity, but also reveal other medical risk.

0398

VALIDITY OF ESS IN TRUCK DRIVERS WITH SUSPECTED OSA

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Introduction: To evaluate symptom reporting and assess sleepiness using Epworth Sleepiness Scale (ESS) in a cohort of truck drivers with obstructive sleep apnea (OSA).
Methods: Demographics, symptoms, comorbidity, ESS scores for prescreened truck drivers were collected and RDI recorded with Type 1 study in AASM accredited laboratory; documented pts with OSA provided with autoCPAP with compliance meters.
Results: 72 consecutive truck drivers (M70, F2) were evaluated. 63/72 (87.5%) had OSA of which 22 had mild, 23 moderate, and 18 severe disease. Mean RDI was 22.3 for the group and 49.33 for severe OSA. Pts with OSA reported symptoms of snoring in 33/63 (52.38%), WA (witnessed apneas) in 14/63 (22.22%), and EDS in 17/63 (26.98%). WA, EDS or both were more prominent in severe disease. Only 1 pt had a normal BMI, 54.16% were obese and an additional 26.38% were morbidly obese. Mean ESS score was 4.8, and ESS greater than 10 was seen only in 6.9% (5/72) and in 27.8% (4/18) subjects with severe OSA.
Conclusion: ESS scores may not be a valuable tool to assess presence of sleepiness in truck drivers with OSA. This could be due to a true lack of symptoms or may be because of underreporting. ESS likely should not be used to determine treatment decisions in this high risk group.

0399

RIGHT VERSUS LEFT LATERAL HEAD POSITION DURING SUPINE SLEEP CAUSING VARIATION IN RESPIRATORY EVENTS IN PATIENTS WITH SLEEP DISORDERED BREATHING

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Introduction: To study the relationship between head position to right or left and severity of sleep apnea.
Methods: Four patients who had sleep apnea on overnight polysomnographic (PSG). 1- Case A, a 65 year old man with insomnia and hypersomnolence for 15 years. 2-Case B, a 6 year old boy with snoring/gasping in sleep/witnessed apneas/hypersomnolence for three years. 3-Case C, a 38 year old man with snoring, hypersomnolence and witnessed apneas for four years. 4- Case D, a 63 year old man with hypertension, coronary artery disease, insomnia and daytime fatigue for 30 years.
Results: 1- Case A PSG showed obstructive sleep apnea with an apnea/ hypopnea index (AHI) of 26.0, O_2 sat nadir of 89. The respiratory events were worse with head turned to the left lateral position (AHI 50), compared to right lateral position (AHI 19.6) during supine NREM sleep. 2- Case B had AHI of 37.8 and O_2 nadir of 89 The respiratory events were more severe in right than the left lateral head position, both positions being worse than in neutral head position during supine NREM sleep. 3- Case C had an AHI of 32.5 with an O_2 sat nadir of 76.5. The breathing events were mostly in the supine sleep with head turned to the left but absent with head turned to the right lateral position. 4- Case D had an AHI of 49.0 and O_2 nadir of 91, he had runs of Cheyne-Stokes breathing in sleep when he turned his head to the right but improved when the head was turned to the left.
Conclusion: Association of lateral head position and severity of sleep apnea may have resulted from compression of neck vessels causing transient brain stem ischemia.

0400

PERIOPERATIVE PRACTICAL EXPERIENCES IN USING A LEVEL II PORTABLE POLYSOMNOGRAPHY

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Introduction: Portable polysomnography (PSG) is increasingly being used in clinical practice. The objective of the study is to summarize our practical perioperative experience using a portable PSG device.
Methods: After REB approval, the patients giving consent underwent PSG with a 10-channel portable device (Embletta x100) preoperatively at home; postoperative night 1, 3, 5 and 7 in hospital or at home. The device was installed by well trained technicians. The recordings were scored by a certified sleep technologist.
Results: In 385 patients, 1002 perioperative PSGs were done : preoperative - 385, postoperative night 1- 298, night 3 - 208, night 5- 56, Night 7 - 55. There were 204 females and 181 males. The age was 59 ± 13 years and

BMI 39 ± 5 kg/m^2. The majority of PSG recordings (88.7%) were technically good, which is defined as more than 4 hours recording with good quality on all channels. Nine percent of PSG recordings were technically acceptable, which is defined as more than 4 hours recording with defect in one or two channels, but the AHI was still viewed as reliable. This included PSG recordings without thorax and/or abdominal effort monitoring, no EOG , heavy EKG artifact on EEG, no EMG or only one channel of EEG. Only 23 (2.3%) PSG recordings failed, including 6 (0.6%) without EEG recording, 4 (0.4%) with battery failure within 4 hours and 13 (1.3%) with electrodes removed by patients within 4 hours. The scoring of AHI was viewed as reliable in 98.2% of home PSG recordings.
Conclusion: When installed by a well trained sleep technician, portable PSG device produced a very high rate of technically acceptable and good PSG recordings, and can be a good alternative for perioperative patients.

0401

A NOVEL METHOD FOR DETECTING ORAL BREATHING DURING PSG

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Introduction: Currently, oral airflow detection is suboptimal because 1) the oral signal is not specific to oral breathing; and 2) a poor oral signal can lead to mislabeled respiratory events. Since residual nasal flow can occur with typical oral breathing, nasal-specific breathing can be difficult to discern from scaled residual nasal flow. We employed a nasal cannula with an oral scoop (Braebon Medical, Ontario) modified to allow accurate assessment of the breathing route.
Methods: A modified cannula with an oral scoop to separately detect nasal and oral airflow was employed in 8 patients undergoing PSG evaluation at the Stanford Sleep Disorders Clinic. Air is sampled in the oral scoop for etCO_2, and a thermistor is suspended in the oral scoop. EtCO_2 measurement serves to confirm thermistor airflow signal and to allow improved detection of transient alterations in oral versus nasal flow. Oral breathing was determined by an etCO_2 signal that was within 5 torr of mouth breathing at bio-cals, or an etCO_2 signal above 20 torr with a characteristic breathing signal in the oral thermistor signal. We evaluated 8 PSGs (3Male, 5Female, Mean BMI = 24.5, Age Range (12-73 yo) for oral breathing and nasal-oral transitions.
Results: The mean oral breathing time was 137.2 minutes. The mean percent of TST with oral breathing was 37.1% (Wake = 6.7%, NREM = 38.1%, REM = 33.9%). Time in oral breathing was highly variable, with as little as 0% to as much as 73%. Increased information about timing of hypopneas relative to nasal-oral transitions was observed. Several nasal-oral transitions were observed, that would have been inaccurately labeled obstructive apneas without a valid oral airflow signal.
Conclusion: This novel method accurately identifies the precise alterations of breathing route that occur during sleep and around respiratory events. Like the combined oronasal thermistor, this method distinguishes breathing route changes from obstructive apnea, satisfying the intent of AASM recommendations. It also reduces mislabeling of respiratory events. Frequency, length, and pattern of changes in breathing route may have significant implications for respiratory effort, and may be associated with micro-arousals, or other elements of sleep instability.

0402

EVALUATION OF TRACHEAL RESPIRATORY SOUNDS AT DIFFERENT BODY POSITIONS IN HEALTHY AND PATIENTS WITH OSA DURING WAKEFULNESS

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Introduction: Studies with small number of participants have shown significant changes in tracheal inspiratory sounds of OSA patients when the body position changed from upright sitting to supine, this change was not significant in healthy individuals. In this study, we investigated the changes in nose and mouth breathing sounds in supine and upright positions. We hypothesize the difference between nose and mouth breath sounds intensity of OSA patients in the two body positions change significantly more than that of healthy controls.
Methods: Tracheal breath sounds signal at tidal flow rate (once through nose and once through mouth) from 5 patients with OSA (43 ± 15 y) and 5 healthy non-snorer individuals (47 ± 7 y) were recorded by a microphone (Sony M-77B) placed over suprasternal notch in both upright and supine positions, while they were awake. The sound signals were amplified, band pass filtered (50-2500Hz), and digitized at 10240 Hz. The signals were then high pass filtered (f0 = 150 Hz) to reduce the effects of heart sound and background noise. The inspiration and expiration phases were analyzed separately. For each phase, the power spectrum (PSD) of the sound signals was calculated (Welch Method, 100 ms windows, 50% Overlap) and averaged between the breaths. The variance of the averaged PSD (Var-psd) was calculated for the inspiratory phase at each body positions and each breathing maneuvers.
Results: The differences between Var-psd values of nose and mouth breath sounds during inspiration, on average, were 55.1 and 8.7 times higher for patients than healthy individuals at upright and supine positions, respectively.
Conclusion: Recording tracheal sound during wake time is a simple and non invasive method. The difference in PSD variations between the nose and mouth breath sounds seems to be a promising feature to provide a screening tool for OSA diagnosis during wakefulness.
Support (If Any): Supported by Telecommunication Research Laboratories (TRLabs), Winnipeg, Canada

0403

COMPARISON BETWEEN OPTICAL FIBER TYPE SAS SENSOR AND PSG BY COMBINED MEASUREMENT

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Introduction: We have developed a completely unrestrained novel SAS sensor using an optical fiber sheet. We named it "F-SAS sensor".
Methods: F-SAS sensor is composed of a plastic optical fiber sheet, an optical power meter with Si-Photodiode, LED (650nm) built-in a controller, a microcomputer, a memory card, and a small liquid crystal display panel. The fiber-sheet was settled between a sheet and a bed in Tsukuba University Hospital and measured PSG concomitantly for 25 subjects whose ages are from 41 to 65 and BMIs are from 21.1 to 51.3. The F-SAS sensor data recorded were automatically analyzed by using a newly developed data analysis program to signals of normal respiration, apnea, hypopnea, and rolling over independently from PSG analysis.
Results: Correlation coefficient between AHI of PSG and RDI of F-SAS was 0.71 in the region of AHI from 0 to 85.9. In AHI from 0 to 20, the correlation coefficient was much better 0.89. On the other hand, it was 0.57 in AHI from 20 to 85.9. This means that F-SAS sensor is more accurate and sensitive for mild degree of SAS. F-SAS sensor's RDI is smaller than AHI of PSG in moderate and severe degree of SAS because of the bigger difference of the sleeping time and the time in bed. It means that F-SAS sensor is suitable for a screening device rather than for diagnosis. In fact, we have succeeded to screen out five potential SAS patients from 19 subjects of ordinary people by this F-SAS sensor measurement at home, and the definite diagnoses in JR Sendai Hospital for the four screened out subjects were three mild and one moderate.
Conclusion: The newly developed completely unrestrained SAS sensor using an optical fiber sheet is much more suitable for screening potential SAS patients during usual sleeping at home.
Support (If Any): This research was partially supported by the Japanese Ministry of Education, Science, Sports and Culture, Grant-in-Aid for Scientific Research, 19656101, 2007-2008.

0404

VALIDATION OF LEVEL II PORTABLE POLYSOMNOGRAPHY DEVICE IN SURGICAL PATIENTS

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Introduction: Embletta X-100 is a level II diagnostic device for obstructive sleep apnea and is increasingly used in clinical practice. The objective of the study is to evaluate Embletta x-100 against simultaneously recorded standard polysomnography (PSG).
Methods: Following REB approval, the surgical patients giving consent underwent standard PSG and Embletta X100 simultaneously in sleep laboratory before surgery. The devices were installed by certified PSG technologists. The recordings from Embletta x-100 and standard PSG were scored by two different certified PSG technologists at two different laboratories, with Somnologia Studio 5.0 for Embletta and and Sandman version 7.2 for standard PSG recording. They were blinded to the results from each other.
Results: Of 24, 21 patients with good quality of PSG recordings on both systems were included analysis. 10 females and 11 males, age: 54 ± 11. BMI: 36 ± 9 kg/m^2. There was a significantly correlation between the corresponding parameters regarding sleep architecture and sleep breathing disorders from the two methods with Pearson correlation coefficient between 0.444 to 0.972, except for the central apnea index, mixed apnea index, average duration for apnea hypopnea episodes, longest duration for apnea hypopnea episodes and average wake SaO_2. However, there was a significant difference of absolute value of parameters between the two methods. For example, AHI is overestimated by Embletta by 2.3 ± 4.7 (mean ± SD) or 1.2 (2.6) (median(IQR)), P = 0.038. The inter-rater agreement between Embletta and standard PSG was substantial to perfect at different AHI cutoffs. Kappa coefficient was 1 for AHI > 5and AHI > 15, 0.811 (95% CI :0.566-1.000) for AHI > 10, and 0.69 (95% CI: 0.29-1.00) for AHI > 30 .
Conclusion: There was a strong correlation between parameters from Embletta X100 ,installed by well trained sleep technicians , and standard PSG. Embletta x100 is a good alternative when standard PSG was not available or impractical.

0405

NEED OF CLOSE LONG TERM MONITORING OF COMMERCIAL DRIVERS WITH OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: OSA is a major cause of morbidity and mortality in commercial drivers. As a cause of fatal crashes, screening and testing of commercial drivers is recommended and will soon become a DOT requirement. Under these guidelines, drivers with OSA must meet industry standard adherence to maintain a Commercial Drivers License. Important to the commercial driving industry is a method of testing and treating drivers with OSA while achieving rapid therapeutic adherence.
Methods: Recruited drivers were administered screening questionnaires (Berlin, Epworth Sleepiness Scale, SF-36 and the FOSQ), followed by history and physical. Drivers with a high pre-test probability for OSA underwent in-cab type 3 portable monitoring followed by APAP titration during their 34-hr restart. In-lab polysomnography was performed for AHI < 15 and when portable test results were technically suboptimal. PAP adherence was monitored using a web-based interface and pressure adjustments were made using wireless modems while drivers continued to work.
Results: Preliminary results were obtained for each driver for 2 week adherence (70% of day with 4 hour usage) at 14, 28, 42, and 56 days. Twenty-Six drivers were included in the study. Three were excluded due to incomplete data for a total n of 23. Number of drivers adherent at 14, 28, 42, and 56 days were 57% (n = 23), 60% (n = 20), 50% (n = 14), and 58% (n = 12), respectively.
Conclusion: In-cab testing and APAP titration with remote adherence monitoring is an effective means of diagnosing and treating commercial drivers, with adherence rates comparable to traditional methods. Adherent drivers became non-adherent at irregular intervals suggesting some drivers may need close long term monitoring.
Support (If Any): Research support of $2500, auto-titrating CPAP units and wireless modems were provided by Philips Respironics

0406

EVALUATION OF HOME-BASED SCREEN INDICATORS IN SLEEP DISORDERED BREATHING OF PROFESSIONAL DRIVERS

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Introduction: Sleepiness-at-the-wheel was well identified as a major cause for highway accidents. And, sleep-disordered-breathing (SDB) has been reported as an associate factor to cause these accidents. Any reliable SDB home-based screen indicator should be valuable in public security. The aim of our study is investigating systemically reliabilities of individual indicator and various combinations on professional drivers.
Methods: All 151 participants were long haul bus drivers with duty period more than 12 hours a day and duty shifting by two-hour-later day after day. Each of them had received overnight polysomnographic study (PSG) and following alternative devices' measurements simultaneously, post anthropometrics taking and questionnaires' filling-out.
Results: Based on either recording-time or actigraphy-corrected sleep time, 1) the oxygen-desaturation indices by > = 3 and 4 %; and 2) pulse-rising indices by > = 7 and 8 % from baseline detected with pulse oximetry; and 3) apnea-hypopnea indices measured with ApneaLink, all correlated significantly (all P < .0001, r = 1) 0.87~0.92; 2) 0.61~0.89; and 3) 0.70~0.70, respectively) and had high agreement (1) 94.5~96.6%; 2) 93.8~97.2%; 3) 91.1~91.3%, respectively) with apnea-hypopnea indices by PSG study(AHIpsg). They were confirmed reliable in SDB screening, according to under-curve-areas (1)0.93~0.95 or 0.94~0.95; 2)0.76~0.76 or 0.74~0.75; and 3)0.79~0.79 or 0.81~0.82, respectively) of the receiver-operator-characteristic curve analysis for selected points on 5 or 15 events/hr of AHIpsg threshold. Conversely, no validities of SDB screening were found in multi-variables apnea prediction questionnaire, Epworth sleepiness scale, night-sleep heart rate variability, wake-up systolic blood pressure and anthropometric variables.
Conclusion: The parameters from pulse oximetry and ApneaLink alone or adding actigraphy sleep-time-correction are eligible home-based indicators in screening professional drivers' SDB.

0407

HOME SLEEP TESTING: A PILOT STUDY IN PRIVATE PRACTICE SETTING

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Introduction: Despite approval by Centers for Medicare and Medicaid, the use of home sleep testing (HST) is not being widely utilized. We set out to determine the operational efficiency of HST for diagnosis of

obstructive sleep apnea (OSA) in a community based sleep medicine private practice.
Methods: 23 patients referred for evaluation and treatment of OSA had face to face evaluation and were determined appropriate for home testing. We used ResMed's Apnea Link Plus (type III) device to perform HST. Patients were instructed on the device use by a board certified sleep specialist. Follow up appointments were scheduled within 3 days for downloading the data. Manual analysis of the data was performed by the same physician.
Results: N = 23 patients were tested. All 23 devices were returned within 3 days. 3 tests failed due to user error with the device (13%). 17 patients had OSA (85%) of which 2 patients also had Cheyne-Stokes breathing (CSB). The device correctly detected CSB in both the patients. 3 patients had no sleep apnea (15%). 8 patients had mild OSA (40%), 5 moderate OSA (25%) and 4 severe OSA (20%). 16 patients had in-lab PAP titration (80%). One patient was prescribed APAP device (5%). Reimbursement varied across Medicare and national commercial payors. Average reimbursement was $145.41 (global).
Conclusion: We conclude that HST is an efficient tool for diagnosis of sleep apnea and could be used in addition to polysomnography in the private practice setting.

0408

A PILOT STUDY TO ASSESS SLEEP DISORDERED BREATHING IN A BUSY PHYSICIAN POPULATION

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Introduction: A continuing challenge in sleep disorders medicine is to communicate effectively to others that sleep apnea is a common disorder worthy of treatment. We sought to approach physicians not primarily involved in sleep medicine to assess their personal prevalence of sleep related breathing disorders. We wondered whether we would find treatable disorders and whether we had fulfilled our responsibility to promulgate information regarding the prevalence of sleep disorders in the community.
Methods: Ten local physicians were selected and all volunteered to participate in a pilot study to determine whether or not they had sleep apnea. Screening included anthropometric data, signs and symptoms of sleep apnea, and previously diagnosed conditions (hypertension, heart disease, diabetes, stroke, and respiratory disorders). None of the physicians had a previous diagnosis of any sleep disorder. Physicians participated in a home sleep study with a Respironics Stardust™ II, Class III device. Oral and nasal pressure, chest effort, oxygen saturation and heartbeat were measured. Snoring was determined from the oral/nasal pressure signal and supine vs non-supine body position was determined from the recording device. All physicians were counseled regarding results and offered complete sleep medicine evaluations.
Results: Ten physicians (9 male, 1 female, age 55.4 ± 7.28 years, BMI 29.09 ± 3.5 kg/m^2, neck circumference 17.11 ± 0.5 inches) were screened and tested for sleep apnea. Mean apnea hypopnea index (AHI) = 25.57 (± 17.56); mean Epworth score = 7.5 (± 4.4); mean low SpO_2 = 80.0% (± 5.8). All physicians had an AHI > 10 and all but two had an AHI > 15.0. All physicians reported snoring, while three reported a history of hypertension and two reported heart disease.
Conclusion: This pilot study suggests that physicians may not recognize the own sleep disorders. They may perceive excessive daytime sleepiness, if present, as a manifestation of long work hours and sleep deprivation. They may also feel that they do not have time to attend to their own sleep health issues. They may be inadvertently placing themselves at risk for medical consequences of sleep apnea as well as for fatigue-related medical errors. Awareness of personal sleep disorders may help consideration of sleep disorders in their patients.

0409

SCREENING FOR OBSTRUCTIVE SLEEP APNEA IN THE INPATIENT PSYCHIATRIC POPULATION: PRELIMINARY RESULTS OF A CARE PROCESS MODEL

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Introduction: Improvement in sleep quality is important for optimal treatment of patients with mental illness. Obstructive sleep apnea (OSA) not only fragments sleep but has also been associated with various psychiatric disorders. Therefore, recognition of patients with OSA and early intervention may be an important component of therapy of psychiatric inpatients. We have implemented a care process model for these patients utilizing the Berlin Questionnaire for routine screening, overnight oximetry, sleep medicine consultation and when clinically appropriate inpatient polysomnography over a wireless wide area network.
Methods: Berlin questionnaires were administered to all psychiatric inpatients. Those with positive Berlin questionnaires underwent further evaluation including overnight pulse oximetries and sleep medicine consultation. Patients identified as being at high risk for sleep disordered breathing were studied with wireless polysomnography while remaining on the inpatient psychiatric service. Therapy could then be expedited based upon objective findings.
Results: During the initial 3 month period a total of 347 Berlin questionnaires were administered of which 113 (33%) were positive for high risk of OSA. 37 patients with positive questionnaires were discharged from the hospital before further testing was possible. 27 patients (ages 27-60, 13 females) were clinically stable and able to be tested with polysomnography. 21/27 (77%) patients had sleep apnea as defined by an apnea-hypopnea index (AHI) > 5/hr. Mean AHI was 30.4/hr. Of the 21 patients, 8 had severe (AHI > 30), 10 had moderate (AHI 15-30), and 3 had mild (AHI 5-15) OSA.
Conclusion: Preliminary findings indicate that the Berlin questionnaire may be a useful tool for routinely screening psychiatric inpatients for sleep disordered breathing. However, the utility of this questionnaire depends upon having in place a structured care process model for clinical efficacy. Further prospective studies are indicated.

0410

DETECTION OF SLEEP APNEA IN PATIENTS WITH ATRIAL FIBRILLATION USING BERLIN QUESTIONNAIRE AND PORTABLE MONITORING

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Introduction: Atrial fibrillation (AF) is one of the most common arrhythmia. Sleep Disordered Breathing (SDB) is supposed to correlate with AF according to recent studies. In field of cardiology, Berlin Questionnaire (BQ) is widely used to estimate risk for co-existing SDB. In our study we used unattended Portable Monitoring (PM) to detect SDB in AF patients to compare both diagnostic approaches.
Methods: We included 42 patients (26 males, 16 females, mean age: 63+/-8 years, BMI: 29+/-4 kg/m^2) with a documented AF in this monocentric prospective study. All patients had an indication for rhythm control therapy as recommended in actual guidelines (antiarrythmic medication: 15 patients, electrical cardioversion: 13, catheter ablation of pulmonary veins: 14). Before treatment BQ was completed by all patients to estimate risk for SDB. In addition all patients got PM, recording nasal flow, respiratory movements, oxygen saturation and ECG.

Results: PM detected SDB in 27 of 42 subjects (AHI = 15+/-12 per hour, cut off 5 per hour). 19 subjects showed mild, 5 moderate and 3 patients severe levels of SDB. BQ classified 23 of 42 subjects to be at high risk for SDB. PM confirmed SDB in only 11 of these 23 patients (BQ: sensitivity 63%, specificity 60%, positive predictive value 74%, negative predictive value 47%).
Conclusion: A remarkable prevalence of SDB was detected in patients with AF and an indication for rhythm control therapy by both BQ and PM. Screening for SDB should be part of routine examination of AF patients, as treatment of SDB is supposed to reduce relapse rate of AF after rhythm control therapy. Further investigation is needed for outlining the best screening method for SDB in AF patients. Therefore all limited methods should be compared with polysomnography which is the gold standard.

0411

AMBULATORY AUTONOMIC DEVICE MEASUREMENT OF AHI WITH CPAP APPLICATION

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Introduction: Obstructive sleep apnea (OSA) is a common disorder with important clinical consequences including pronounced and immediate vascular changes. Stressors, like autonomic activation by arousal and brief hypoxic episodes, appear to induce exaggerated blood pressure changes. The peripheral arterial tonometer (PAT) has demonstrated usefulness in the ambulatory diagnosis of OSA; however no data exists regarding its sensitivity regarding CPAP treatment outcomes. Given the PAT's sensitivity for diagnostic studies, comparable changes in PAT after CPAP treatment would be expected. The purpose of this study was to see if the PAT can be utilized for measuring changes in AHI during CPAP.
Methods: This pilot study utilized a prospective, within-group, correlational design. Participants completed two overnight in-lab studies: diagnostic nocturnal polysomnogram (NPSG) and, if diagnosed with OSA, a CPAP titration study. The PAT device was applied during both studies. Informed consent was obtained during the initial clinical evaluation. NPSG and CPAP titrations were manually scored by experienced technologists blinded to study procedures.
Results: Although nineteen subjects had NPSG wearing PAT, only 4 had a CPAP titration study with the PAT. Paired t-testing (n = 4) was utilized for comparisons between NPSG, CPAP titration and PAT variables. AHI on NPSG (mean = 22.4) and PAT (mean = 12.6) differed significantly ($P = .01$). In contrast, TST ($P < .01$) and low SaO_2 ($P < .05$) were statistically different on CPAP nights.
Conclusion: Although this study is limited by the number of subjects studied during CPAP, initial findings suggest that PAT outcome variables may differ from that of manually scored NPSG with CPAP. Further testing is warranted to evaluate agreement between PAT variables and CPAP titration variables.

0412

EVALUATION OF A NEW AUTO CPAP EVENT DETECTION PERFORMANCE COMPARED TO SCORED PSG

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Introduction: This study was undertaken on OSA patients to validate the new Philips Respirionics Auto CPAP (Study Device) SDB event detection algorithm. The Study Device includes the ability to distinguish obstructed vs. clear airway apneas (OA and CA).
Methods: 20 subjects previously diagnosed with OSA and objectively compliant with PAP therapy were enrolled into this single blind, randomized, controlled study. Subjects were required to complete 2 overnight PSG studies. Subjects completed one night on the M-Series Auto device and one night on the Study Device. Only data from the Study Device study night are included in this analysis. PSG data were scored per AASM guidelines. Device Settings: Auto - 4/20cmH20 AFlex comfort feature enabled All patients used humidification.
Results: The population consisted of 17 males and 3 females with a mean age of 50.5 ± 8.4 (S.D.) years, a BMI of 32.8 ± 5.9, and a diagnostic AHI of AHI 30.9 ± 20.1. Respiratory event data from the Study Device were compared against scored polysomnography using an Intra-class Correlation Coefficient (ICC). Correlations were statistically significant for all respiratory indices ($P < 0.001$), with the following coefficients: AHI (0.916), OAI (0.986), and CAI (0.799).
Conclusion: This paper presents a validation analysis of data from 20 SDB participants using the Study Device advanced algorithms to detect and report obstructed and clear airway apneas. These data indicate that the advanced algorithms detection and reporting of OAI and CAI from the Study Device highly correlate to standard scoring of data from full polysomnograms.
Support (If Any): This study was funded by Philips Respironics.

0413

COMPARISON BETWEEN LEVEL III PORTABLE MONITORING SYSTEM AND PSG ON 44 INLAB PATIENTS

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Introduction: AASM published guidelines in 2007 for the use of portable monitoring (PM) systems in the diagnosis of OSA. Concern remains about the validity of PM measurements. PM devices usually provide modules for automatic and manual scoring. Evaluation of current levels of performance require direct comparison between PM (automatic and manual scoring) and PSG data.
Methods: AASM published guidelines in 2007 for the use of portable monitoring (PM) systems in the diagnosis of OSA. Concern remains about the validity of PM measurements. PM devices usually provide modules for automatic and manual scoring. Evaluation of current levels of performance require direct comparison between PM (automatic and manual scoring) and PSG data.
Results: APM vs PSG - no OSA Ss 80% Sp 93%; mild Ss 38% Sp 87%; moderate Ss 40% Sp 87%; severe Ss 83% Sp 100%; MPM vs PSG - no OSA Ss 80% Sp 86%; mild Ss 46% Sp 94%; moderate Ss 100% Sp 81%; severe Ss 92% Sp 100%.
Conclusion: The automatic scoring system in this device is within the range of the sensitivities of PSG studies (75-88%). Having the data reviewed manually significantly improves the sensitivities of the OSA severity classes. Misclassifications still remain a problem (for PMs and PSGs) and further improvement of the analysis software is awaited.

0414

GENDER DIFFERENCE AND THE SEVERITY OF NOCTURNAL OXYGEN DESATURATION IN OBESE PATIENTS

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Introduction: Obesity Hypoventilation Syndrome (OHS) is more predominant in obese males with BMI > 30. It is characterized by nocturnal hypoxemia, chronic daytime alveolar hypoventilation defined as $PaCO_2$ > 45 mm Hg and PaO_2 < 70 mm Hg. In this study, we evaluated the gender difference in these patients and the degree of nocturnal oxygen desaturation.
Methods: A convenience sample of 199 from a total of 281 persons with nocturnal oxygen desaturation (NOD) in our ambulatory practice between July 1, 2007 and December 1, 2009 was examined. Out of these, 110 patients required nocturnal oxygen. Twenty five patients (21 F, 4 M) were found to have NOD without a known cause and were included in

the study group. Eighty five (60 F, 25 M) patients had underlying cause for their NOD and were excluded. We evaluated BMI, nadir of oxygen desaturation, duration of oxygen saturation < 90%, PaO_2 and $PaCO_2$. No study patient had COPD, interstitial lung diseases, obstructive sleep apnea, congestive heart failure or neuromuscular disorders.
Results: Among 25 patients with NOD, female to male ratio was 5:1. Nineteen of 21 women and all 4 men were obese (median BMI, F 42, M 46). The nadir of oxygen desaturation (median F 80 %, M 86%), duration of oxygen saturation < 90% (median F 93 minutes, M 26 minutes), PaO_2 (median F 67, M 82) and $PaCO_2$ (median F44, M 41) were not significantly different between women and men (t test, independent samples).
Conclusion: Although our study did not show a statistical difference in the degree or duration of oxygen desaturation among males and females but interestingly we found an idiopathic form of NOD that has not been described in the literature which is five times more prevalent in females. Almost all women had underlying obesity and half of them didn't have day time hypercapnea.

0415

TREATMENT OF OPIOID RELATED CENTRAL SLEEP APNEA WITH ADDITION OF OXYGEN TO CPAP

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Introduction: The treatment for opioid central sleep apnea (CSA) is not standardized. Proposed therapies have varied from bi-level positive airway pressure therapy (PAP) or adaptive servo ventilators, to simply discontinuing the opioids. We report our experience of treating opioid related CSA in a Sleep Disorder Center at a Veterans Hospital.
Methods: We retrospectively reviewed charts of patients with CSA, defined as central apnea index (CAI) of ≥ 5/hr. We included patients on chronic opioid therapy. Beginning in 2006, we instituted a PAP titration protocol ('CSA Protocol') for treating patients with CSA (without or without concomitant OSA, apnea hypopnea index, AHI ≥ 5/hr). CPAP was begun at 5 cmH_2O and if CSA persisted despite a maximum CPAP of 12 cmH_2O, then supplemental oxygen was initiated at 2 l/min and increased to keep oxygen saturation > 93%. If CSA persisted, only then CPAP was switched to bi-level PAP with continuation of oxygen supplementation. An AHI < 5/hr and CAI < 5/hr at the optimal PAP with or without oxygen supplementation was defined as an 'optimal response'.
Results: Twenty-eight patients (age 58.3 ± 1.8 yr, BMI 33.2 ± 1.1 kg/m^2, males, mean ± S.E.M.), who met the diagnosis of CSA (CAI = 26.5 ± 4.9/hr) were also on chronic opioid medications. All had concomitant OSA, AHI = 58.3 ± 6.7/hr, minimum oxygen saturation: 76.8 ± 4.6%. Two patients also had diagnosis of CHF and one had stroke in the past. In 12 out of 28 patients who were administered CPAP plus oxygen per the CSA Protocol, the CAI decreased from 25.4 ± 7.8 to 5.5 ± 2.9, P = 0.002. The AHI was also corrected. In 8 patients the protocol was not followed and CSA was unresolved with CPAP alone; CAI remaining unchanged from 20.0 ± 5.5/hr to 30.9 ± 5.8/hr, P = ns.
Conclusion: CPAP with supplemental oxygen was effective in reducing central apneas in patients with opioid related CSA. Oxygen may be used as an adjunct to CPAP for treatment of opioid related sleep disordered breathing.

0416

WHAT IS THE PREVALENCE OF EMERGENT CENTRAL SLEEP APNEA DURING CPAP TITRATION?

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Introduction: There are few patients with obstructive sleep apnea (OSA) who have a component of central sleep apnea (CSA) during initiation of CPAP therapy. The aims of the study were to assess the incidence of CSA amongst patients receiving CPAP titration for OSA and to identify possible predictors of this condition.
Methods: This was a retrospective study. Among the patients referred to the Jefferson Sleep Disorders Center between January and July 2008, 179 consecutive patients who were newly diagnosed with OSA were enrolled in the study. Every patient underwent baseline polysomnography followed by CPAP titration. We reviewed polysomnographic and clinical records. Patients were considered to have emergence or persistence of CSA on CPAP if the residual central apnea index (CAI) at or near the prescribed CPAP level was ≥ 5/hr. The patients were divided into 2 groups: CSA-CPAP group and noCSA-CPAP group.
Results: The incidence of CSA-CPAP was 7.2 % (N = 13). The CSA-CPAP group differed from the noCSA-CPAP group with respect to gender (85% vs 63% men) but the two groups did not exhibit differences in sleep architecture and cardiovascular history. Diagnostic apnea-hypopnea indexes for the CSA-CPAP and noCSA-CPAP groups were 32.53 ± 20.8 and 30.02 ± 27.21 respectively (P = 0.3). The CSA-CPAP group had a higher NREM CAI during baseline PSG than the noCSA-CPAP group (2.97 ± 4.32 and 0.42 ± 2.72 respectively, P = 0.000). A review of PSG raw data revealed that central apneas were related to sleep-wake transitions in 8 of the CSA-CPAP patients. The exclusion of central apneas related to sleep-wake transitions resulted in a prevalence of CSA-CPAP of 4%.
Conclusion: Only 7.2% of patients with a primary diagnosis of OSA had emergent CSA on CPAP, and most were related to sleep-wake transitions. As in prior studies, risk factors for the emergence of CSA included male sex, and a higher CSA index on baseline PSG. However, the overall rate of emergence of CSA is lower than that reported in prior studies (13% and 15%). These differences can be explained by the fact that prior studies utilized split-night protocols, which may have been associated with greater sleep fragmentation and a higher frequency of sleep-wake transitions, thus leading to a greater frequency of central apneas. On the other hand, most of our patients (92%) were studied with 2-night protocols.

0417

POLYSOMNOGRAPHIC ANALYSIS OF CAP SLEEP INDEX AND DURATION IN COMPLEX SLEEP APNEA SYNDROME

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Introduction: Chronic opiate use has been associated with complex sleep apnea syndrome (CompSAS) as well as ataxic breathing patterns during sleep. Ataxic or Biot's breathing patterns have not been identified in other CompSAS patients. Mechanisms underlying CompSAS remain unclear, but presumably involve yet unidentified central neural and ventilatory control mechanisms, potentially including sleep instability that may be indexed by cyclic alternating pattern (CAP) sleep frequency and duration. We aimed to determine whether sleep stability differed between two subgroups of CompSAS patients, opiate users and non-users, by analyzing CAP sleep index and duration.
Methods: Polysomnographic data of 6 consecutively referred and diagnosed patients from the Mayo Center for Sleep Medicine CompSAS Database were automatically analyzed using Hypnolab CAP scoring software (ATES Medica Labs, Verona, Italy). Three patients with and 3 patients without opiate use were compared. The index and duration of CAP sleep occurring during the diagnostic phase of overnight polysomnography in all patients were obtained. Group averages were compared utilizing Wilcoxon Rank Sum tests.
Results: AHI was similar in non-opiate and opiate user groups (mean 55 vs. 66, P = 0.38). Non-opiate users trended toward higher A2 index (mean 23.2 vs. 4.8, P = 0.18) and duration (mean 15.0 vs. 6.0, P = 0.08), but A1 and A3 indexes and durations were no different between groups.

Conclusion: In this pilot study, CompSAS patients who were not opiate users manifested a trend toward higher index and duration of CAP sleep, suggesting greater sleep instability and increased arousal tendency than opiate users with CompSAS. This suggests that opiates may promote sleep instability by a distinct as yet unknown mechanism differing from idiopathic central causes. Further analysis of these patient groups is necessary to determine whether CompSAS patients with or without opiate use differ in CAP sleep frequency and sleep stability.

0418

AN ELECTROCARDIOGRAM-BASED TECHNIQUE TO IDENTIFY COMPLEX SLEEP APNEA IN PATIENTS WITH DIABETES AND SLEEP DISORDERED BREATHING

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Introduction: The incidence of diabetes in the US has tripled from 1980 to 2005. A recent report estimates a prevalence of obstructive sleep apnea among patients with Type II diabetes at 36% and the current world population suffering from diabetes is estimated at 230 million. It is unknown if complex sleep apnea is present in this population. The objective of the study was to examine the utility of an electrocardiogram (ECG)-based cardiopulmonary coupling (CPC) technique to identify complex sleep apnea in a diabetic population suspected of having sleep disordered breathing (SDB).
Methods: 101 studies were subdivided into 2 categories based upon the presence of elevated low frequency coupling (e-LFC) narrow band (nb): Group I- no e-LFC nb (n = 70); Group II- with e-LFC nb (n = 31). Complex sleep apnea was defined by the presence of narrow spectral band e-LFC.
Results: MANOVA performed for CPC and PSG sleep variables showed significant (Wilk's Lambda, F (3.08), $P < 0.001$) differences between groups. An independent t-test showed the high frequency coupling (HFC) was significantly reduced in Group II (33.38 ± 49.78) versus Group I (49.19 ± 20.06%; $P = 0.009$). A significant increase of low frequency coupling (LFC) was also observed in Group II (49.78 ± 20.06%) compared to Group I (35.31 ± 19.44%; $P = 0.001$). Standard PSG sleep stage variables were not statistically different. The arousal index and respiratory variables for obstructive sleep apnea index, apnea hypopnea index, apnea hypopnea index in NREM, apnea hypopnea index in REM and some oxygen desaturation indices were all statistically significantly different between groups.
Conclusion: The findings indicate that 30% of this diabetic population evaluated for obstructive sleep apnea is identifiable by the presence of e-LFC narrow band as having complex sleep apnea.
Support (If Any): Both authors are employed by Embla Systems, Inc.

0419

MEASURES OF STABLE INSTABILITY IN RECURRENT OBSTRUCTIVE VS. CENTRAL APNEAS DURING SLEEP

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Introduction: The hypothesis was that there is a relationship between oxygen saturation cycle length and apnea cycle length, and that measuring oxygen saturation cycle lengths could be a useful measure of event cycle lengths.
Methods: Variables were extracted from polysomnography records of 24 patients during recurrent sleep apneas and/or hypopneas. Measures included event type (obstructive apnea, central apnea, mixed apnea, and hypopnea), event length, event cycle length, and cycle length using oxygen saturation. Event length was measured from the peak in amplitude directly preceding the drop in peak thermal sensor excursion by > 90% (30% for hypopneas) of baseline to the peak in amplitude directly following this > 90% drop. Event cycle length was measured from the beginning of one apnea/hypopnea to the beginning of the next apnea/hypopnea, as previously defined. Oxygen saturation cycle length was measured from the middle of the plateau of the maximum peak in oxygen saturation to the middle of the plateau of the next maximum peak in oxygen saturation Values for each patient were extracted for a minimum of 19 consecutive cycles but no record had more than 36 cycles evaluated.
Results: Despite variations in event length, there is a close relationship between event length and cycle length in each patient ($P < 0.05$ or greater). A direct relationship was found between oxygen saturation cycle length and apnea cycle length in each patient; however, these variables were not identical between different patients ($P < 0.05$ or greater). Values for those with recurrent central apneas were similar between patients with both central (n = 5) and obstructive events (n = 19).
Conclusion: In this dataset, correlations exist among event length, oxygen saturation cycle length and apnea cycle length in individual patients. In addition, there appear no distinguishing differences in cycle length between those with primarily central and those with primarily obstructive events.

0420

REDUCED CORTICAL THICKNESS IN CONGENITAL CENTRAL HYPOVENTILATION SYNDROME

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Introduction: Congenital central hypoventilation syndrome (CCHS) is a rare disorder characterized by inadequate drive to breathe during sleep, reduced or absent ventilatory responsiveness to CO_2 and O_2, impaired perception of air hunger, and multiple autonomic abnormalities. We have demonstrated numerous brain irregularities in CCHS patients, including sites with structural injury, impaired cerebral autoregulation, and functional differences in response to autonomic, CO_2 and O_2 challenges. However, we have not assessed cortical tissue integrity in the syndrome, which is of interest because CCHS subjects show selected cognitive and affective deficits that may result from regional cortical injury in the condition.
Methods: Thirteen CCHS (mean age ± SD, 18.2 ± 4.7 years; female, 5) and 26 control (age, 18.4 ± 4.1 years; female, 11) subjects were studied. High-resolution T1-weighted MRI scans were collected from all subjects, and FreeSurfer software was used to assess cortical thickness. Analysis of covariance, with age as a covariate, identified regions of reduced cortical thickness in CCHS over control subjects ($P < 0.01$).
Results: Numerous regions showed reduced cortical thickness, including the dorsomedial frontal cortex extending to the medial anterior cingulate, ventral medial prefrontal cortex, border of the parietal and posterior cingulate, portions of the insular cortex, rostral and lateral temporal lobes, and mid and accessory motor strips.
Conclusion: The ventral medial prefrontal, insular, and temporal cortical thinning is of special interest, because of frontal and insular roles in cardiovascular regulation, and temporal cortex interactions with the hippocampus, which is damaged in CCHS. The cingulate and insular cortex injuries likely contribute to reduced perception of breathlessness, a significant drive to breathe, and to additional affective characteristics of the syndrome, including an impaired sense of self-care. Memory issues in the condition possibly reflect temporal and frontal cortex thinning. Extensive axonal injury in CCHS is paralleled by loss of cortical tissue.
Support (If Any): Institute of Child Health and Human Development RO1-HD-22695

0421

COMPLEX APNEAS DURING CPAP TITRATION IN OSA PATIENTS

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Introduction: Complex apneas are newly occurring central apneas during CPAP titration and sometimes during CPAP therapy. The aim of this study is a systematic review and investigation of the occurrence and its predisposing factors of complex apneas.
Methods: We analyzed the polysomnographic data from 50 OSAS patients (AHI > 10/h). All patients underwent three PSG nights, one diagnostic and two treatment nights. Following data were collected: number and find of breathing disorders, length of complex apneas, time of occurrence, sleep stage, body position and CPAP pressure at the onset of complex apneas, sleep parameters, oxygen saturation.
Results: 50 OSA patients were enrolled into this retrospective study (mean age 52 +/- 7.1, 32 -82 years). In 48 patients (96%) we could detect complex apneas under CPAP titration, 10 of them (18 %) developed an CAI above 10 per hour. The mean CAI was 15.6 +/- 28.2 during the first night and 8.2 +/- 14.6/h in the second titration night. Mostly the first complex apneas occurred in sleep stage 1 (41.5 %) and more less in stage 2 (26.8%) or REM (14.6 %) and SWS (9.8 %). The mean duration of complex apneas was 15.1 +/- 5.7 and the CPAP pressure at onset of complex apneas was 7 +/- 2 mbar.
Conclusion: Development of complex apneas during the first titration night is a common issue. The onset may be linked to the sleep stage (mostly stage 2), to the applied CPAP pressure (appr. 7 mbar) and to other influencing factors like body position, morbidity, medication, sleep depth, CNS diseases etc. Management include pressure changes and changes of the treatment mode. Complex apneas should be carefully followed if the initial titration is performed.

0422

HOW EFFECTIVE IS ADAPTIVE SERVOVENTILATION (ASV) TITRATION IN CONTROLLING COMPLEX APNEA AND CENTRAL APNEA RELATED TO OPIOID THERAPY?

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Introduction: Chronic use of opioids for management of non-malignant pain syndromes is widely accepted. Opiate-induced central apneas during sleep usually are refractory to CPAP or BiPAP. This study explores how effective ASV may be in controlling such central apneas.
Methods: We constructed a retrospective case series of 10 consecutive (age 54.9 ± 11.2) male veterans with positive-pressure-refractory opiate-induced central sleep apnea. These veterans had been given a RESMED-algorithm ASV titration PSG night. Their optimal ASV settings as prescribed for home use were summarized.
Results: Subjects had a BMI 35 ± 10 kg/m^2, Epworth Sleepiness Scale scores of 19 ± 5, AHI's of 34.6 ± 18 events/hour (e/hr), and Central Apnea Indices (CAI) of 23.5 ± 20 e/hr. Use of methadone (n = 7), oxycodone (n = 1), hydrocodone (n = 1), and morphine pump (n = 1), comprised their overall morphine equivalent dose 141 ± 76 mg/day. Low event rates (AHI-ASV 1.6 ± 4 e/h., CAI-ASV 0.5 ± 1.3 e/h) were achieved with the optimized ASV settings (EEP = 7.2 ± 1.5 cm, PS min = 4.2 ± 1.2 cm, PS max = 10.5 ± 0.7 cm). ASV arousal index was 0.8 ± 1.3 e/hr. All patients had favorable treatment responses (mean reductions: AHI-ASV 42 ± 17 e/hr; CAI-ASV 25 ± 20 e/hr).
Conclusion: This series demonstrated ASV's effectiveness in treating opioid-induced central apneas during sleep when titrated in our sleep center, at 57 meters (187 feet) above sea level. Prior literature has presented inconsistent findings for this patient type. We conclude that ASV's effectiveness with our patients was due to: 1) Our End-Expiratory Pressure was higher than a prior publication and 2) Our titrations occurred near sea level. Thus, ASV appears to be a valid treatment modality for opiate-induced central apneas during sleep, provided technical factors, patient casemix, and ambient air pressures are taken into account.

0423

EFFECTIVENESS OF ADAPTIVE SERVOVENTILATION IN PATIENTS ON OPIOIDS RESISTANT TO STANDARD POSITIVE AIRWAY PRESSURE THERAPY

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Introduction: Whether or not adaptive servoventilation (ASV) is effective in opioid-related complex sleep apnea is not yet apparent. It is not known whether the type or dose of opioid has an impact on the success rate of ASV titration to reduce AHI to ≤ 15/hour.
Methods: Retrospective case series of consecutive ASV titrations performed over an 18-month period due to failed sleep laboratory titrations with Continuous and/or Bi-level Positive Airway Pressure (CPAP /Bi-PAP).
Results: Among the 65 cases, the indications for ASV titration were Complex Sleep Apnea (58%), Cheyne-Stokes Apnea (26%), and other (16%). The baseline AHI was not significantly different between opioid patients (n = 36, AHI 54.7; 95% CI(44.8- 64.6)) and those not on opioids (n = 29, AHI 51.3; 95% CI (41.9- 60.6), P = 0.62) or among subjects on different types of opioids (ANOVA : F (5,59) = 0.45, P = 0.8); no correlation was found between the dose of opioid in morphine equivalent and the diagnostic AHI (r = 0.19, P = 0.28). With ASV titration, there was a significant decrease in the mean AHI in both the opioid and the non-opioid groups; however, there was no significant difference in the mean AHI achieved in patients on opioids (n = 36; AHI 21.3 (12.2-30.4) compared with those not on opioids (n = 29; AHI 13.4 (7.4-19.4) P = 0.17.) The rate of successful ASV titration (AHI ≤ 15) appeared higher in the non-opioid group (72% vs. 56%) but did not reach significance (OR 2.1 (0.74—5.98). A correlation was noted between the morphine dose equivalent and the mean AHI achievable with ASV (r = 0.51, P = 0.002).
Conclusion: Clinically meaningful improvements in sleep disordered breathing are seen during ASV titrations in patients on opioid therapy. Successful ASV titration in the sleep laboratory can be challenging in the patient population referred for ASV whether or not they are using opioids.
Support (If Any): Oregon Clinical and Translational Research Institute (OCTRI), grant number UL1 RR024140 from the National Center for Research Resources (NCRR).

0424

CARDIOPULMONARY COUPLING PREDICTS CPAP FAILURE, BUT NOT ADAPTIVE SERVOVENTILATION SUCCESS

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Introduction: The likelihood of CPAP controlling sleep-disordered breathing has been shown to strongly correlate with the degree and type of low frequency coupling (LFC) between heart and respiratory rate. Success occurs infrequently with elevated narrow-band LFC (nb-LFC), and occurs often with low levels of nb-LFC. Adaptive servo-ventilation

(ASV) is successful in eliminating CPAP emergent central sleep apnea in only 75-85% of cases. Given that the ASV algorithms might more accurately compensate for cyclic patterns, we predicted that ASV success would correlate with elevated nb-LFC.
Methods: We retrospectively identified 107 consecutive CompSAS patients who underwent ASV titration and whose polysomnogram allowed cardiopulmonary coupling (CPC) analysis. Success was defined as a treatment AHI < 10 at best setting. CPC, clinical, and demographic data were compared between ASV success and failure groups.
Results: Our patients were mostly male (81.45%), had a diagnostic AHI of 41.5 ± 24.3, and on CPAP had a residual AHI of 42.8 ± 28.3, with central apneas occurring 31.5 ± 21.6 hr-1. ASV brought the AHI to 11.0 ± 13.0, with success in 80.4%. nb-LFC was elevated (> 0) in 45.8%, but nb-LFC did not correlate with ASV treatment success (P = 0.852, $\chi 2$). Of clinical factors, age ≥ 81 was most associated with treatment failure (P = 0.010). Chronic opiate use was associated with a higher residual AHI on CPAP (57.0 ± 31.2 vs. 40.0 ± 26.4, P = 0.009) and was associated with lower nb-LFC (5.5 ± 13.2 vs. 10.2 ± 15.0, P = 0.045). Opiate use did not predict ASV failure.
Conclusion: Although elevated nb-LFC is reported to be predictive of treatment failure for CPAP, it does not appear to predict treatment success with ASV, which is successful in about 80% of CompSAS patients.

0425

CLINICAL SIGNIFICANCE OF FREQUENT CENTRAL RESPIRATORY EVENTS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Ventilatory control instability in a subgroup of patients with obstructive sleep apnea (OSA) may promote cycling of respiratory effort, predispose the airway to collapse and lead to more frequent occurrences of central apnea. Central respiratory events comprising of pure central and mixed events are commonly found in patients with OSA. The clinical significance of such events in OSA patients is not well studied.
Methods: We performed a retrospective chart review of patients with OSA based on polysomnography at Southeast Louisiana Veterans Health Care System from February 2007 to July 2008. Patients with severe psychiatric and neurologic disorders, central sleep apnea (central events > 50% of total events), severe periodic leg movement (PLMI > 50) were excluded. Demographic data and polysomnographic parameters were reviewed and analyzed
Results: A total of 313 patients met the study criteria. The mean age was 56.62 ± 10.08. Mean apnea-hypopnea index (AHI) was 38.65 ± 15.06 events/hour. "Frequent central events" was defined as central and mixed apnea > 20% of total respiratory events. Fifty-eight patients (18.5%) had frequent central events. The remaining 255 patients were used as controls. Comparing two groups, there was no difference in age, gender, body mass index, Epworth sleepiness scale, AHI and prevalence of heart failure, stroke and opiate usage. Patients with frequent central events had lower sleep efficiency (70.25 ± 17.76 vs. 75.09 ± 15.9; P = 0.04), higher percentage of stage N1 (30 ± 21.42 vs. 23.18 ± 17.69; P = 0.01), lower mean oxygen saturation (90.79 ± 5.65 vs. 92.84 ± 2.40; P = 0.004) and lower nadir oxygen saturation (76.02 ± 11.86 vs. 78.81 ± 9.14; P = 0.05) compared to control.
Conclusion: OSA patients with frequent central respiratory events are associated with lower sleep efficiency, mean oxygen saturation and nadir oxygen saturation.

0426

ASV THERAPY IN ANXIOUS OR INSOMNIA PATIENTS WITH COMPLEX SLEEP APNEA

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Introduction: Adaptive servoventilation (ASV) is currently used to treat CSA in SDB patients with CHF or chronic opiate use. Our clinical experience shows insomnia and anxiety patients with SDB also fail CPAP/BPAP due to central apneas induced during titration studies (complex sleep apnea). We conducted a chart review of insomnia and anxiety patients that completed ASV titrations to compare with their initial PAP therapy outcomes.
Methods: We reviewed charts of all patients with ASV titrations from Maimonides Sleep Arts and Sciences from 01/08 to 09/09. Patients were included if they reported one of the following: chronic insomnia, anxiety disorder, depression, PTSD, OCD, panic attacks, or claustrophobia. All patients had previously undergone titrations with CPAP and BPAP before ASV titrations. Patients were excluded with CHF, chronic opiate use, or no follow up contact.
Results: Of 87 ASV patients, 60 qualified. Patients served as their own historical controls of CPAP/BPAP use: 2.9% of patients could not tolerate traditional CPAP/BPAP in the lab; 20% could not use CPAP/BPAP consistently at home, 57.1% used CPAP/BPAP consistently with poor responses, 20% used CPAP/BPAP consistently with marginal improvements. PSG findings in sequential order revealed the following central apnea indices [mean (SD)]: diagnostic 2.45 (4.04); most recent CPAP/BPAP titration 16.17 (17.42); ASV titration 0.28 (1.04); and, 50 patients eliminated central apneas. All 60 were prescribed ASV, and 88.6% currently use their device regularly.
Conclusion: These anxiety and insomnia patients demonstrated a dramatic increase in CAI with CPAP/BPAP, almost seven times greater than diagnostic testing and consistent with complex sleep apnea. One hundred percent failed CPAP/BPAP adherence and outcomes. ASV markedly reduced CAI, and nearly all patients are currently using ASV; outcomes data are being collected. Randomized controlled trials should test whether ASV therapy yields greater adherence and better outcomes compared to CPAP/BPAP therapy for insomnia and anxiety patients with SDB.

0427

AUTO SERVO VENTILATION SUCCESSFULLY TREATS COMPLEX CENTRAL SLEEP APNEA (CompCSA) AND HUNTER-CHEYNE-STOKES BREATHING (HCSB)

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Introduction: This study evaluated the therapeutic performance of a new BiPAP auto Servo Ventilation (ASV) device (BiPAP autoSV Advanced©, Philips Respironics, (ASVA)) for the treatment of CompCSA and HCSB. The major differences are automatic expiratory pressure titration (VS. manual) and improved back up rate algorithm with the new BiPAP ASVA device. Participants: 37 participants, 27 with CompCSA, and 10 with HCSB.
Methods: This study was a prospective multicenter randomized controlled trial at 5 sites in the US. Subjects had an apnea hypopnea index (AHI) ≥ 15/hr during diagnostic polysomnogram (PSG) [AHI (mean +/- SD) [53 ± 23])] and had a central apnea index (CAI) ≥ 5 [19 ± 18} while on CPAP. Qualifying subjects underwent two additional PSGs,

the order of which was randomized. One night was conducted with a previously marketed device (legacy BiPAP auto SV© - ASVL), and the other with the new BiPAP ASVA device, with a modified auto back up rate and automatic EPAP adjustment.
Results: 37 consecutive subjects (32 males, mean age 64 ± 12; 5 females, mean age 60 ± 8) meeting all enrollment criteria are included. 10 patients presented with HCSB on their initial polysomnogram. Both devices were effective in treatment of CompCSA and HCSB. Compared to the Diagnostic, CPAP, and BiPAP ASVL treatment nights, the new BiPAP ASVA resulted in a statistically significant reduction in AHI (Diagnostic (53 ± 23), CPAP (35 ± 20), BiPAP ASVL (10 ± 10) and BiPAP ASVA (6 ± 6); respectively), CAI and OAI ($P < 0.05$). Other key sleep and respiratory variables of interest did not differ significantly
Conclusion: These results indicate that recent improvements to current ASV technology successfully reduced or eliminated CompCSA and HCSB.
Support (If Any): This study was funded by Philips Respironics.

0428

FACTORS PREDICTING THE DEVELOPMENT OF CENTRAL APNEA ON CPAP: ROLE OF AIR LEAK

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Introduction: There is considerable interest in the emergence of central apnea (CA) on CPAP. While most data suggest resolution of CA with ongoing CPAP therapy, mechanisms underlying emergence remain unclear. While some suggest lowering upper airway resistance can raise controller gain, others suggest the development of air leak may promote important hypocapnia. We tested the hypothesis that air leak was an important predictor of CA in OSA patients on CPAP.
Methods: We examined 168 consecutive CPAP titrations for OSA (all subjects CPAP-naïve) using nasal masks. We recorded demographic and cardiovascular variables, and continuous estimated total leak measurement from the CPAP machine. We assessed the prevalence of CA, and average and peak total leak recorded during treatment at physician-prescribed pressure.
Results: We observed 11% of patients with CPAP CA index ≥ 5. Average total leak (l/min) for subjects with CPAP CAI < 5 was 42 (36.0-52.0 CI) vs. 51 (42.5-57.3) for CPAP CAI ≥ 5. ($P = 0.010$, Mann-Whitney). Peak total leak for CPAP CAI < 5 was 56 (47.0-69.0) vs. 73 (58.3-80.5) for CPAP CAI ≥ 5 ($P = 0.001$, Mann-Whitney). Demographic and cardiovascular variables, and CPAP pressure were not predictive.
Conclusion: Air leak may be an important factor associated with CA in OSA patients on CPAP at prescribed pressure. Theoretically, anatomical and mask dead space may be sources of rebreathing in CPAP patients. Thus, the application of CPAP with leak may reduce dead space, resulting in lower $PaCO_2$ for a given minute ventilation. If $PaCO_2$ falls below the apnea threshold, the development of CA would be predictable. Whether resolution of leak contributes to improvements in CA over time is unclear. Alternatively, leak may be a predictor of overtitration which could yield CA through pulmonary stretch reflexes or other mechanisms
Support (If Any): Philips Respironics

0429

EFFECTS OF ADDED DEAD SPACE ON SLEEP DISORDERED BREATHING AT HIGH ALTITUDE

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Introduction: Sleep disordered breathing with central apnea or hypopnea frequently occurs during sleep at high altitude. The aim of this study was to assess the effects of added dead space (DS) on sleep disordered breathing and transcutaneous CO_2 ($PtcCO_2$) level during sleep at high altitude.
Methods: Full night sleep recordings were obtained on 12 unacclimatized swiss mountaineers (11 males, 1 female, mean age 39 ± 12 y.o.) during one of the first 3 nights after arrival in Leh, Ladakh (3500 m). In random order, half of the night was spent with a 500 ml increase in dead space through a custom designed full face mask and the other half without it. $PtcCO_2$ was measured in 3 participants.
Results: Baseline recordings reveled two clearly distinct groups: one with severe sleep disordered breathing (n = 4) and the other with mild or no disordered breathing (n = 8). Added dead space markedly improved breathing in the first group (baseline vs DS): apnea hypopnea index (AHI) 70.3 ± 25.8 vs 29.4 ± 6.9 ($P = 0.013$), oxygen desaturation index (ODI): 72.9 ± 24.1/h vs 42.5 ± 14.4 ($P = 0.031$), whereas it had no significant effect in the second group. This favorable effect was not related to dead space induced arousal, since the microarousal rate remained unchanged (16.8 ± 8.7/h vs 19.4 ± 18.6/h ($P = 0.51$). Added dead space did not have a significant effect on mean oxygen saturation level. Respiratory events were almost exclusively central apnea or hypopnea except for one subject. Only a minor increase in mean $PtcCO_2$ (n = 3) was observed: 33.6 ± 1.8 mmHg at baseline and 35.0 ± 2.62 mmHg with DS.
Conclusion: In mountaineers with severe sleep disordered breathing at high altitude, a 500 ml increase in dead space through a fitted mask significantly improves nocturnal breathing
Support (If Any): Swiss Pulmonary Society Fund for Research. Lausanne University Young Investigator Grant. Lancardis Foundation. Radiometer.

0430

RESPONSE TO HYPERCAPNIA DURING SLEEP IN OBESE ADOLESCENTS WITH AND WITHOUT THE OBSTRUCTIVE SLEEP APNEA SYNDROME (OSAS)

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Introduction: The prevalence of obesity and resultant OSAS is increasing in adolescents. However, many obese adolescents do not develop OSAS, despite having a presumably narrower upper airway. The reasons for this are unclear but may be related to upper airway neuromotor control. We hypothesized that ventilatory and genioglossal EMG (EMGgg) responses during sleep are decreased in obese adolescents with OSAS compared to BMI-matched controls.
Methods: Subjects underwent polysomnography using surface electrodes to measure EMGgg. CO_2 was introduced, sufficient to raise the transcutaneous PCO_2 by 3 mmHg. Ventilatory parameters were calculated for each breath before and during the hypercapnic challenge. The area under the curve of the filtered rectified inspiratory EMGgg moving time average was analyzed and compared to the baseline before the challenge.

Results: 8 subjects with OSAS (age 15 ± 1 [mean ± SD] yr, BMI z-score 2.5 ± 0.5, AHI 21 ± 21/hr) and 5 controls (15 ± 2 yr, BMI z score 2.0 ± 0.4, AHI 0 ± 0/hr) were studied. During CO_2 challenges, controls increased minute ventilation ($P = 0.002$), primarily by increasing flow ($P = 0.014$) and tidal volume ($P = 0.007$). Controls had a significant increase in EMGgg ($P = 0.027$). In contrast, OSAS also had a change in minute ventilation ($P = 0.008$), but this was due more to changes in the duty cycle ($P < 0.001$) than flow ($P = 0.139$) or tidal volume ($P = 0.031$). OSAS had no significant change in EMGgg.
Conclusion: Obese adolescents without OSAS have ventilatory and upper airway neuromotor responses to hypercapnic challenges during sleep. In contrast, adolescents with OSAS do not mount an upper airway response to CO_2, but instead compensate for the hypercapnic load by changing respiratory timing. We speculate that obese adolescents without OSAS maintain protective upper airway reflexes during sleep, whereas those who go on to develop OSA do not.
Support (If Any): This study was supported by NIH grants U54-RR023567, R01-HL58585 and Philips Respironics

0431

METRICS RELATED TO CYCLE LENGTH DERIVED FROM RECORDS OF PATIENTS WITH RECURRENT CENTRAL APNEA

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Introduction: Respiratory loop gain and its components play a role in determining recurrence of both events (Wellman et al, 2008). We are interested in developing descriptive metrics related to the cycle length to capture elements of loop gain from ordinary PSG records.
Methods: Design: Convenience sample of records of 4 patients with AHI > 20 with predominantly (> 50%) central apneas were selected from a three-arm drug study cohort in which the blind has not been broken. Methods: Three overnight attended PSG recordings from each patient were examined for AHI, arousal number, event length (EL), as well as cycle length derived from the flow signal. Flow cycle length (FCL) was the time in seconds between the start of one event to the start of the next event. Interevent interval (IEI) was calculated as the FCL minus the EL. Comparisons were made between the values for FCL, EL, and IEI inclusive of REM and NREM sleep, in the 12 records.
Results: The patient age range was 53-79 years; EF was 15-35%; BMI was 23-35. For each patient an FCL could be computed in each patient and the range of mean values was 74 to 245 seconds. Within a individual patient the variation between drug study records was between 40 and 150 seconds. EL (range 15-41 seconds) and IEI (59-218 seconds) also varied widely, with IEI having the most variation between and within subjects. In all records, there was a strong correlation between cycle length and IEI ($P < 0.0001$ or greater) but no correlation between FCL and EL (significance was set at $P < 0.01$). This was apparent in all subjects, independent of FCL.
Conclusion: We found a 3-fold variation in cycle length. The time between events was correlated with cycle length more strongly than event length and might reflect a fundamental controller property.
Support (If Any): VA Research Service and the National Institutes of Health (NHLBI)

0432

DELAYED OR DISRUPTED AXONAL MATURATION IN DEVELOPING MICE EXPOSED TO INTERMITTENT HYPOXIA DURING SLEEP

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Introduction: Premature babies are at high risk for both cognitive deficits and sleep apnea. Since axon development mainly occurs in the 3rd trimester and 1st year after birth, infantile apnea could lead to axonal impairment. To test this hypothesis, we used a neonatal mouse model of intermittent hypoxia (IH) during sleep between postnatal day 2 to 6, and determined if apnea-associated IH affects axon development.
Methods: P2 C57BL/6 pups were exposed to either 4 days of IH (8% O_2/21% O_2/2 min cycle/6hrs) or normoxia (NR, 21% O_2) with pseudo dam during the light phase. After IH exposure, all pups were restituted to their lactating dam in room air. The brains were collected at different post-exposure days. To assess axonal development, cytoskeleton and growth cone-related molecules of axon were explored by means of qPCR, immunostaining, and Western blots. The ultra-structure of axons including axonal caliber, microtubule (MT) and neurofilament (NF) density were examined in corpus callosum.
Results: All transcripts of neurofilament subunits (NF-L, M, and H) were significantly decreased with high percentage of NF-L/M components, indicating immaturity of axons. Consistent with these findings, expression of beta-tubulin III and MAP2 were inhibited, and less phosphorylated NFs were detected in IH-exposed developing brain. Intriguingly, expression and phosphorylation of axonal growth cone protein GAP-43 were down-regulated, suggesting a potential stunt or defect in axons. The analyses of axonal architecture showed that short-term neonatal IH exposures during sleep resulted in a higher density in axoplasm with thinner myelin sheath.
Conclusion: These findings suggest that IH during sleep, as occurs in apnea of prematurity, may inhibit axonal growth and maturation within a critical window of CNS development. Thus, postnatal IH leads to white matter hypoplasia following IH-induced oligodendroglial injury.
Support (If Any): 2P20RR017702-061A1 (R.M.G., J.C. is COBRE supported junior faculty), University of Louisville School of Medicine Basic Grant (J.C.), and HL-086662 (D.G.).

0433

LOOP GAIN IN OBSTRUCTIVE SLEEP APNEA: THE EFFECT OF ACETAZOLAMIDE

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Introduction: Recent evidence suggests that instability of the ventilatory control system or a high loop gain (LG) may be a consequence rather than a cause of obstructive sleep apnea (OSA). However, a high LG that occurs as a consequence of OSA may also worsen the severity of a patients OSA, as measured by the apnea-hypopnea index (AHI). Our aim was to investigate the effect of acetazolamide, which reduces central apneas in humans and reduces LG in animals, on LG and OSA severity.
Methods: Three subjects (to date) underwent 4 nights of polysomnography over 9 days. LG and AHI were measured on and off acetazolamide (500mg sustained release for 1 week). To measure LG, the ventilatory control system was disturbed during sleep by lowering CPAP to subtherapeutic levels for 3-minute intervals. This "drop" in CPAP reduced ventilation and increased PCO_2. The ventilatory response to the increase in PCO_2. was assessed by turning CPAP back to the optimum pressure, which opened the airway and permitted ventilation to increase transiently above eupnea. LG was calculated by dividing the ventilatory response (the amount ventilation increased above eupnea when CPAP was

returned to the optimum pressure) by the ventilatory disturbance (the amount ventilation was reduced below eupnea during the drop). This yielded the steady state LG.
Results: Acetazolamide significantly reduced LG in 2 subjects (64.1% and 28.9%), which was reflected by a similar reduction in AHI (67.3% and 27.7%). For unclear reasons, no change in LG or AHI was observed in the third subject.
Conclusion: Our preliminary data suggest that acetazolamide lowers LG and that ventilatory instability is important in the pathogenesis of OSA (since lowering LG with acetazolamide in these patients significantly reduces AHI). However, more subjects are needed before firm conclusions can be drawn.
Support (If Any): NIH, American Heart Association

0434

ASSOCIATION OF SLEEP APNEA WITH ALLERGIC DISEASE AND RELATED SYMPTOMS

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Introduction: There is increasing evidence of a bidirectional association between sleep-disordered breathing (SDB) and allergic diseases. However, evidence documenting the association of various allergic diseases and related symptoms with SDB in adults is limited. Therefore, the aims of this study were to investigate; 1) whether SDB was related to a history of allergic diseases, 2) if SDB was associated with allergic symptoms.
Methods: We included 4,576 adults (aged ≥ 20 years) from the National Health and Nutrition Examination Survey database 2005-2006. The frequency of self-reported asthma, hay fever, eczema, and having allergies, and associated symptoms over the past 12 months were analyzed. SDB was defined as self-reported habitual snoring ≥ 5 nights per week and/or having been diagnosed with sleep apnea.
Results: Prevalences of habitual snoring and sleep apnea were 20.7% and 3.0% for men and 12.6% and 1.6% for women, respectively. After adjusting for demographic, behavioral and environmental factors, comorbidities, and taking antihistamines or any respiratory medicines, sleep apnea was associated with approximately 2.0-fold increase in the odds of hay fever and eczema in men and 2.2- to 2.8-fold higher risks for asthma and allergy in women. Habitual snoring had no independent relationship with any allergic diseases in either gender. Sleep apnea was associated with episodes of asthma and hay fever and general symptoms related to allergic responses during the past 12 months in men, whereas habitual snoring was relate to sneezing/runny nose only.
Conclusion: This study demonstrates an association between sleep apnea and allergic diseases, both having inflammatory mechanisms. However, habitual snoring, the milder end of SDB spectrum, has no association. There also appears to be a gender bias where symptom manifestation occurs in men with sleep apnea, but not in women. The gender difference as well as potential mechanistic links between sleep apnea and allergic diseases needs further exploration.

0435

INCREASED CENTRAL ADIPOSITY IN MORBIDLY OBESE PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: With the growing epidemic of obesity, few data are available regarding adipose distribution and the severity of sleep apnea. Our aim was to precisely measure adipose distribution with dual energy X-ray absorptiometry (DXA) in a morbidly obese population with and without obstructive sleep apnea (OSA).
Methods: Morbidly obese (BMI > 35 Kg/m2 subjects without a previous diagnosis of OSA underwent overnight polysomnography and DXA analysis. Subject demographics, DXA variables, serum laboratory markers and physical exam characteristics were compared between individuals with and without OSA.
Results: For the study population (N = 31), mean body mass index (BMI) was 46.3 ± 7.8 kg/m^2; mean age was 47.7 ± 10.2 years and 90% (N = 27) were female. The central adiposity ratio (CAR) was higher in individuals with OSA (apnea-hypopnea index [AHI > 5]) than those without OSA (1.11 ± 0.07 vs. 1.04 ± 0.06; P = 0.007). The correlation between CAR and OSA, as expressed by AHI, was linear (linear regression coefficient CAR = 0.0013*AHI + 1.0579 (SE of coefficient 0.00045, R2 = 0.2151). No difference was observed in Epworth Sleepiness Scale scores, BMI or neck circumference between groups.
Conclusion: OSA is associated with increased central adipose deposition in patients with a BMI > 35 kg/m^2. These data may be helpful in designing future studies regarding the pathophysiology of OSA, and potential treatment options.

0436

RESPONSE OF PRO-INFLAMMATORY CYTOKINES AND ADHESION MOLECULES TO CPAP

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Introduction: OSA has been associated with elevations in both pro-inflammatory cytokines and adhesion molecules. This has been hypothesized as one mechanism to explain elevated cardiovascular risk with OSA. Reaction of these markers with CPAP, however, has been mixed in the literature. Only recently have investigators begun to address the degree to which response of these markers is related to adherence to CPAP over time. Our aim was to examine change in TNF alpha, IL-6, and ICAM-1 in response to CPAP and to incorporate adherence to treatment in the model.
Methods: We examined TNF alpha, IL-6, and ICAM-1 in a group of 40 patients with newly diagnosed OSA before and after CPAP treatment (Age = 53 ± 12; AHI = 32 ± 25). Baseline data were taken prior to any use of CPAP and outcome data were collected after 3 month of CPAP use. Adherence was monitored remotely by objective adherence monitors housed within the CPAP devices. Adherence data were then transmitted to an on line recording system, allowing researchers to monitor adherence nightly. Bloods draws occurred at roughly the same time of day on the two occasions.
Results: No measure demonstrated a significant change over time for the group as a whole. Examinations of change by adherence, however, demonstrated a significant reduction in ICAM-1 among more adherent users of CPAP (P < .05). Change in ICAM-1 from baseline was also correlated with adherence to treatment (r = .34, P = .05). Changes in TNF alpha or IL-6 were not related to adherence to CPAP.
Conclusion: Our data support the notion that adhesion molecules decrease only with effective use of CPAP and the amount of this reduction is related directly to the amount of CPAP used over time.
Support (If Any): This work was supported by a grant from NHLBI 2R01 HL67209

0437

USING NEW MEDIAS OF COMMUNICATION TO PREVENT ROAD ACCIDENT IN THOUSAND OF SLEEP APNOEA PATIENTS BEFORE HOLIDAYS - SUMMER 2009: NOT A BIG DEAL IF YOU HAVE THE TECHNOLOGY…

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Introduction: It is well known that patients with OSA have a higher risk of somnolence and accidents due to somnolence while driving. Treating OSA reduce sleepiness. However some patients have difficulties to

be compliant to CPAP or simply to begin the treatment, and thus stand still at high risk for road accident. New Medias of communication could help prevent this risk and help undecided patients to begin a treatment by CPAP.
Methods: Orkyn', a French leading home care provider (50 agencies, 33.000 patients treated by CPAP, working with 800 physicians on sleep apnea), associated with Association Prevention Routiere, a NGO which aim to prevent road accident by education and communication, and Hotel Dieu Sleep and Vigilance Center in Paris built a communication campaign based on common and new medias of communication just before holidays - summer (July 2009). French are usually taking their car to two or three weeks holidays. Physicians used to stress patients to take their CPAP with them on holidays. Along with dedicated brochures, posts in the doctors waiting room, Orkyn' sent SMS directly to patients treated by CPAP (both compliant and non compliant): Two different messages were sent, one message sent per day, at the end of the afternoon on July, 8th and 9th, 2009. Messages were different: first one insisted on CPAP compliance and its link to safety on road (The message insisted also on patients to take the CPAP on holidays) and second one stressed the need to rest 20 minutes every two hours on the road. To achieve this, we used a specific communication software able to generate SMS to thousand receivers, it just takes one o two hours. The software is provided by CEDRALIS, French company dedicated to "massive communication" tools specifically for alerts and/or prevention thousand of people in case of natural disaster or industrial crisis.
Results: 10,000 brochures and 500 posts were delivered to patients through 500 physicians, specialized in sleep apnoea management (in France, mainly pulmonologists). 2 SMS were sent to 12,546 patients (finally delivered : 9270, failed : 3376) under CPAP, every other day. 55 patients called Orkyn' and asked not to receive other messages after the first one (4/1000). On the contrary, many patients called Orkyn' and congratulated the communication campaign.
Conclusion: New Medias of communication could be very effective in educating patients on how to prevent road accident in high risk sleep apnoea patients.

0438

SNORER AND BED PARTNER ASSESSMENT OF A NOVEL OVER-THE-COUNTER NASAL DEVICE TO TREAT SNORING IN THE HOME SETTING

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Introduction: Habitual snoring is a common problem that affects both the snorer and the bed partner. Recent studies indicate that snoring may not be a benign condition, suggesting associations between snoring and arterial hypertension, ischemic heart disease, cognitive dysfunction, stroke and sudden death. We report on snorer and bed partner assessments of a novel, non-invasive nasal expiratory resistance device (In-Vent, Ventus Medical) used in the home setting for one week.
Methods: 45 snorers (34M, 11F) and their bed partners were recruited from three locations. Inclusion criteria for the snorer included being married, snoring 5-7 nights per week, and interest in treating their snoring. The study device was a single use, over-the-counter nasal device indicated for the treatment of snoring. Attached by adhesive, the nasal device comprises a series of small valves that create resistance to expiratory airflow while not appreciably interfering with inspiratory airflow. Each study subject wore the study device for seven consecutive nights. The snorer and bed partner each completed a questionnaire each morning and a questionnaire at the end of study.
Results: 84% of bed partners and 71% of snorers reported the study device reduced snoring on the first night of use. 73% of snorers stated that the study device helped their bed partner get a better night of sleep.
Conclusion: Based on the subjective report of the snorer and bed partner during this 1 week at home study, the novel device reduces snoring and helps the bed partner sleep better.
Support (If Any): Ventus Medical

0439

COMPARISON OF OSLER AND DIVIDED ATTENTION STEERING SIMULATOR FOR ALERTNESS EVALUATION IN PATIENTS TREATED FOR SLEEP APNEA WITH RESIDUAL SYMPTOMS: A PILOT STUDY

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Introduction: Daytime sleepiness and attention deficits in sleep apnea may interfere with driving, making patients at higher risk of motor vehicle crashes. Despite adequate treatment, some patients show residual symptoms. OSLER and Divided Attention Steering Simulator (DASS) are useful to measure vigilance/attention but DASS remains less accessible to sleep clinic. We were interested in correlating outcome variables from OSLER with DASS and reported vehicle crashes in treated sleep apnea patients with residual symptoms.
Methods: 17 patients of 47 ± 4 years participated in the study. Four sessions tests were carried out during the day, from 9:00 to16:00. OSLER measures sleep latency (min) and errors of attention (number of misses). DASS is a standard test of divided attention assessing operational competency: driving errors (deviation in cm from the optimal driving) and reaction time of visual scanning (sec). Results of all sessions were averaged and Pearson test was used for correlations.
Results: Patients had an AHI of 31.8 ± 5.7, BMI of 33.4 ± 7.8, Epworth score of 12.1 ± 6.4 and one accident in average in the last five years. Sleep latency (OSLER: 27.17 ± 12.1 min) correlated with driving errors (DASS: 145.4 ± 77.9 cm at $r = -0.5$, $P = 0.05$) and showed a trend with reaction time of visual scanning (DASS at $r = -0.5$; $P = 0.06$). Errors of attention (OSLER: 91.2 ± 73.3) correlated with reaction time of visual scanning (DASS: 2.8 ± 0.7 sec at $r = 0.5$, $P = 0.02$). Additionally, 53% of patients have missed only one test (41% the OSLER on sleep latency and 12% the DASS) and 30% have missed both tests. As a group, there was a trend between errors of attention (OSLER) and number of reported vehicle crashes ($r = 0.5$; $P = 0.06$).
Conclusion: Within a small group of patients with residual symptoms, we obtained good correlations between attention variables of the OSLER and DASS. OSLER can identify attention deficits recognized by the DASS.

0440

DRIVING HABITS AND ACCIDENTS RISK IN CPAP TREATED OSAS PATIENTS

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Introduction: It is well known that patients with OSA have a higher risk of somnolence and accidents due to somnolence while driving. Treating OSA reduce sleepiness. However driving habits in CPAP treated patients is poorly known.
Methods: Monocentric survey with 551 questionnaires sent to the patients of one single pulmonary physician, treated by CPAP for at least one year. The questionnaire included items on driving habits, average mileage (in kilometers), epiosdes of somnolence at the wheel, accidents and near misses accidents.
Results: 282 questionnaires were received. Sex ratio : 75.9% Males. Age : 17% 48-53 years old, 23% 54-59 years old, 26,2% 60-65 years

old, 12,1% 66-71 years old. Average duration of CPAP treatment : 33,7% between 20 and 40 months, 25,1% 12-20 months. Driving behaviour : 88,3% were driving, average mileage for 20% above 30.000 km/year, 18,4% are regularly driving between midhight and 5 a.m. Driving risk : 5% reported sleeping while driving in the last 12 months, 6,7% reported near misses accidents on the road in the last 12 months (attributed for 85% to sleepiness) et 4,6% neat misses accidents at work. 28 patients (9,9%) said they had to stop driving to have a nap in the last 12 months. The characteristics of these 28 were : - all compliant with CPAP (average 5,7hours per night - max 9,58, min 3,24) - residual RDI : average 2,8, max : 6,3 - initial RDI average 41 (max 81, min 24) - 85,7 % Males - Average mileage : 75% above 8000 km/year - 46,5% are driving daily - 17% are driving regularly between midnight and 5 a ;m - 21,4 % reported sleeping while driving in the last 12 months (half of them more than 3 times) - 7,1% have had a car accident , 28,6 % a near miss car accident (all attributed to sleepiness)

Conclusion: Even well treated OSAS patients have a persistant risk of car accident.

0441

CPAP USAGE AND COMPLIANCE ON OMANI SLEEP APNOEA PATIENTS

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Introduction: Obstructive sleep apnea is a common disorder effecting 4% of men and 2% of women. Continuous positive airway pressure (CPAP) is a standard treatment for patients with sleep apnea. CPAP compliance is a major problem in OSA patient. This study aimed to evaluate CPAP usage and compliance in our local population.

Methods: Patient recommended for CPAP after sleep study in Sultan Qaboos University Hospital in 2008 were reviewed. The data were collected from patient's medical record and telephone calling of the patients.

Results: 241 patients were performed PSG, only 113 patients were recommended for CPAP. Only 58 (65%) were traceable. The study revealed that 21 patients were using CPAP with 17 (29%) patients bought their own CPAP. 3 (5%) patients got it from private insurance and one (1.7%) patient got it from donation. The study also showed that 37 (64%) patients were not using CPAP, with 8 (13%) patients preferred weight reduction, 4 (7%) patients had Mandibular repositioning splint, 3 (5%) patients had operation. 14 (24%) patients could not purchased CPAP. 7 (8.3%) patients refused using CPAP.1 (1.7%) patient was using home O_2.

Conclusion: This audit revealed that CPAP use was not satisfactory in Omani sleep apnea patients and more fund and patient education is required.

0442

TREATMENT OF EXTRAESOPHAGEAL REFLUX WITH NASAL CPAP IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Nocturnal gastroesophageal reflux disease (GERD) resulting in extraesophageal reflux (EER) may contribute to airway inflammation and worsen obstructive sleep apnea (OSA). Conversely, OSA may aggravate nocturnal EER. We hypothesize that patients with OSA and GERD are at an increased risk for nocturnal EER and that continuous positive airway pressure (CPAP) will lead to its reduction.

Methods: Consecutive patients with GERD were enrolled if they required a polysomnography (PSG) for suspected OSA. All patients were tested off acid-suppressive medications. Each patient completed a 2-day diagnostic and therapeutic PSG with continuous monitoring of aerosolized pH by a probe placed into the posterior oropharynx through the nares. Wilcoxon signed-rank test was used to analyze paired data on the rate of EER before and after CPAP. Kendall's Tau coefficient was calculated to determine whether any improvement in the EER as a result of CPAP correlated with the baseline severity of EER.

Results: 8 subjects were enrolled. All were confirmed to have OSA with a median apnea-hyponea index (AHI) of 54, improving to 6 on CPAP ($P = 0.008$). The severity of EER at baseline was variable with a median reflux rate of 6 (IQR 3.5-23). We observed a non-significant reduction in the EER rate following CPAP (median: 0.8 vs. 0.4 events/hour, $P = 0.31$) in the overall comparison. However, when accounting for the severity of the underlying EER, a statistically significant reduction in EER following CPAP was observed for those with more severe EER at baseline ($Tau = 0.71$, $P = 0.013$).

Conclusion: In this small sample, we found that CPAP may be effective in improving nocturnal EER in patients with OSA and GERD. Its efficacy however is dependent on the severity of the underlying EER. Further prospective study is required to determine whether treating nocturnal EER with CPAP translates to meaningful clinical outcomes.

0443

IMPACT OF CPAP THERAPY ON DEPRESSIVE SYMPTOMS IN OSA

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Introduction: The prevalence of significant depressive symptomatology in adult population with OSA has been reported to be between 20-40%. The impact of CPAP therapy on depressive symptoms remains controversial. We hypothesized that improvement in depressive symptoms is related to CPAP adherence.

Methods: In this observational study we measured mental component summary (MCS) of the Short Form-12 quality of life (QOL) questionnaire before and 30 days after CPAP therapy in 206 patients. The MCS ranges between 30 and 70 with the US average being 50. Higher MCS indicates less depressive symptoms. Adherence was defined as using CPAP $\geq$ 4 hours per night on at least 70% of the nights (n = 92).

Results: For the entire cohort the mean ± SD was 52 ± 13 years for age, 37 ± 9 kg/m^2 for BMI, 50 ± 35 for AHI, 9 ± 5.5 for Epworth sleepiness scale (ESS), and 46 ± 11 for baseline MCS. Our cohort was 53% female and 62% African American. Severe OSA (AHI $\geq$ 30) was present in 66% of the cohort. Baseline variables were not different between the adherent and nonadherent groups with the exception of race with more African Americans in the nonadherent group. Paired t-tests indicated a significant improvement in MCS in both groups. However, the degree of improvement was greater in the adherent group. The mean change in MCS was 2.5 in the nonadherent group compared to 5.8 in patients adherent to CPAP therapy ($P < 0.05$). In a linear regression analysis the difference between adherence groups remained significant after adjusting for age, BMI, gender, race, baseline AHI, baseline MCS, and baseline ESS, and change in ESS (beta = 3.0, $P = 0.025$).

Conclusion: Our results suggest that the improvement in depressive symptoms is independently associated with CPAP adherence and that the effects can be observed in as early as 30 days after initiating therapy.

0444

EVALUATION OF A NEW AUTO CPAP DEVICE COMPARED TO A LEGACY AUTO CPAP DEVICE FOR THE TREATMENT OF OSA

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Introduction: This study was undertaken on OSA patients to validate that the new Philips Respironics Auto CPAP (Study Device) provides a clinically stable level of therapy and performs essentially equivalent to the M-Series Auto device. In addition to the clinically-proven auto-titrating algorithm inherited from the M-Series device, the study device includes the ability to distinguish obstructed vs. clear airway apneas.
Methods: 20 subjects previously diagnosed with OSA and objectively compliant with PAP therapy were enrolled into this single blind, randomized, controlled study. Subjects were required to complete 2 overnight PSG studies. Night 1 and Night 2 - in lab PSG: Randomly assigned to either the Study Device or M-Series. All patients used humidification. Device Settings: Auto - 4/20cmH20; AFlex comfort feature enabled.
Results: Four subjects were excluded from the analysis due to inconsistencies in protocol execution. The remaining 16 consisted of 14 males and 2 females, with a mean age of 50.4 ± 8.6 (S.D.) years and BMI of 32.6 ± 6.2. No statistically significant differences were observed between the Study Device and M-Series Auto for any sleep variables. ($P > 0.05$). Among the device parameters, 90% auto CPAP pressure values for the Study Device tracked to within 0.5 cmH2O of those from the M-Series device ($P = 0.42$), while both devices yielded a clinically acceptable AHI (M-Series: 3.2 ± 3.4 vs. Study Device: 2.9 ± 3.4, $P = 0.079$). The average auto CPAP pressure values tracked to within 0.02 cmH2O ($P = 0.50$).
Conclusion: These data demonstrate that the Study Device provides a stable level of therapy and performs essentially equivalent to the M-Series Auto.
Support (If Any): This study was funded by Philips Respironics.

0445

CPAP ADHERENCE IN MILITARY VETERANS WITH AND WITHOUT PSYCHIATRIC DISORDERS

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Introduction: Despite an increased prevalence of psychiatric disorders such as depression and post traumatic stress disorder (PTSD) in individuals with sleep apnea, little is known about whether such conditions impact adherence to CPAP treatment. The present study investigated rates of CPAP adherence in a large sample of military veterans with and without co-morbid psychiatric diagnoses.
Methods: Data were obtained from the Respironics Encore Pro® database of veterans receiving CPAP treatment for sleep apnea between 2000-2008. The presence or absence of psychiatric diagnoses was determined via investigation of VA medical records. Veterans were classified into three groups: no mental health diagnosis, mood disorders, and PTSD (with or without other psychiatric diagnoses). Due to the low prevalence, veterans with other psychiatric diagnoses were excluded.
Results: Records were analyzed for 740 veterans (96% male; mean age = 56.0 years, SD = 10.9, mean RDI = 39.1, SD = 28.9). One or more psychiatric diagnoses were present in 59% (39% PTSD, 20% mood disorder) of the sample. At 1 month, veterans with a psychiatric diagnosis used CPAP an average of 4.3 hrs/night on 64% of nights, whereas those with no psychiatric disorders used CPAP 4.6 hrs/night on 70% of nights. The difference in amount of CPAP use between groups was not significant. The percentage of nights used was significantly lower in veterans with a psychiatric diagnosis; subgroup analyses revealed that veterans with a PTSD diagnosis used CPAP significantly less often than those with a mood disorder or those with no psychiatric diagnosis. There were no group differences in CPAP use at 3 months post-treatment. Veterans were classified into "good" and "poor" adherence based on whether they used CPAP > 4 hrs/night and > 70% of nights at 1 month. Although a higher percentage of "good" adherers did not have a psychiatric diagnosis (49% vs. 43%), chi-square analysis was not significant.
Conclusion: Veterans with a psychiatric diagnosis used CPAP less consistently but for a similar amount of time each night compared to those without psychiatric disorders. Veterans with PTSD may be particularly vulnerable to CPAP non-adherence in the first month of treatment. Three months after treatment, the presence of co-morbid psychiatric disorders does not seem to greatly impact adherence to CPAP.

0446

A STATIC MODELING OF ORAL-AIRWAY COMPLEX FOR SLEEP APNEA PATIENTS

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Introduction: It is important to investigate the oral, nasal, pharyngeal and laryngeal cavities when Obstructive Sleep Apnea (OSA) patients are being investigated. Magnetic Resonance Imaging (MRI) is a flexible and non invasive diagnostic tool for this investigation purpose. The objectives of this study were to portray the dimensions and spatial relationships of tongue, soft palate, airway and mandible by generating a computational three-dimensional (3D) model of an oral-airway complex from a set of MRI data.
Methods: Multiple MRI slices of the head and neck region of a young non-overweight Caucasian male volunteer were taken in the supine position with a passive oral appliance in place. The DICOM MRI slices were transcoded into Analyze7.5 format and registered into a high-resolution volumetric data set using Amira® software package. A manual segmentation was performed before it could be used to generate a surface mesh, which was further edited to construct a volume mesh which could be manipulated in Artisynth, a 3D biomechanical modeling toolkit, for physical simulation of the anatomical structures.
Results: The tongue model consisted of the tongue body (intrinsic and extrinsic muscles), geniohyoid muscle, mylohyoid muscle and sublingual/submandibular glands. The airway model included naso, oro and hypo-pharynx volume. The levator and tensor veli palatinis of soft palate were less identifiable due to the overlapping soft tissue structures in the nasopharyngeal airway. The mandible segmentation proved to be challenging from MRI images due to lack of homogeneousity in bone intensity.
Conclusion: The manual segmentation of tongue, soft palate, airway and mandible creates a patient specific model that provides a visual treatment planning tool for OSA. The collapsibility and capacity of the major anatomical structures surrounding the airway area can be replicated and studied in a computerized platform (ArtiSynth) for treatment planning purposes.
Support (If Any): Natural Sciences and Engineering Research Council of Canada (NSERC) Vancouver Coastal Health Research Institute (VCHRI)

0447

DRUG METABOLISM AND CYTOKINE LEVELS BEFORE AND AFTER CPAP THERAPY IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) has been associated with excessive daytime sleepiness, cardiometabolic risk factors and inflammation. However, the effect of OSA on drug metabolism is unknown. The cytochrome P450 3A4 (CYP3A4) pathway is responsible for the metabolism of nearly 50% of all drugs. A drug probe for this pathway, midazolam (MDZ), was used to measure the effect of CPAP therapy on changes in CYP3A4 activity. In addition, the effect of CPAP on various inflammatory cytokines was investigated.

Methods: 10 CPAP-naive patients with OSA were recruited from an outpatient sleep medicine clinic. A micro-dose of oral MDZ (100 micrograms) was given prior to and after 4 weeks of CPAP therapy. Liquid chromatography-tandem mass spectrometry was used to measure plasma MDZ levels post-dose over an 8 hour period. Plasma cytokines were analyzed, before and after the CPAP treatment period.

Results: The mean BMI and apnea-hypopnea index (AHI) at baseline were 36 ± 9 and 41 ± 20, respectively. The average CPAP compliance was 5.0 ± 1.6 hours/night (n = 8). MDZ area under the concentration-time curves (AUC) were 1.3 ± 0.5 and 1.2 ± 0.7 ng/mlxhr before and after CPAP therapy, respectively. However, MDZ half-life was significantly reduced after CPAP therapy (2.2 ± 1.4 vs. 1.4 ± 0.7 hr, P = 0.03). There was no trend in the delta AUC versus BMI or AHI. There was no significant difference in TNF-alpha, IL-6, IL-1, and VEGF before or after CPAP therapy. In addition, there was no significant correlation between AHI and the various measured cytokines.

Conclusion: After CPAP therapy, there was no significant change in oral midazolam AUC or in pro-inflammatory cytokines. However, it is possible that better adherence to CPAP therapy may be required for a discernible effect on drug metabolism and inflammation.

0448

EFFECTS OF ADHERENCE TO CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY IN PROGNOSIS AMONG OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Obstructive sleep apnea (OSA) increases the risk of fatal and non-fetal cardiovascular events. According to the past studies, therapy with continuous positive airway pressure (CPAP) provides several benefits in the OSA patients. However, therapy adherence rate to CPAP among some OSA patients is still low. To evaluate the effect of adherence to CPAP therapy among OSA patients in prognosis is innovative in OSA study because in our best knowledge there is little evidence comparing effects in prognosis in the different CPAP adherence groups.

Methods: We observed 461 Japanese patients (394 men and 67 women, Age 55.1 ± 12.9 years, body mass index 27.8 ± 4.8 kg/m^2, apnea-hypopnea index 49.0 ± 23.2 /h) who had been diagnosed moderate to severe OSA by polysomnography and who had been treated with CPAP between August, 1999 and March, 2009, according to their medical records retrospectively. We examined the difference in the survival rates between two groups based on the level of adherence to CPAP therapy (CPAP > 4 hours/day and 70% of days per month; otherwise) by the Kaplan-Meier survival analysis.

Results: The cumulative survival rate in the high adherence group (293 patients (63.6%), 2 deaths) was significantly higher (odds ratio 6.08, 95% confidence interval 1.17-31.5) than in the other group (168 patients (36.4%), 5 deaths) during a follow-up of 33.2 ± 29.4 months.

Conclusion: Since enhancing CPAP therapy associates with reducing the risk of death among OSA patients, adherence to CPAP therapy should be encouraged. Our result would motivate patients to use CPAP treatment more as well.

0449

APPLICATION OF PATIENT REPORTED SNORING SEVERITY (PRSS) TO PREDICT CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) IN PATIENTS WITH SUSPECTED OBSTRUCTIVE SLEEP APNEA (OSA) AWAITING OVERNIGHT POLYSOMNOGRAPHY (NPSG): A PROSPECTIVE STUDY

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Introduction: Previously we demonstrated that technologist observed snoring severity (TOSS) during NPSG could be used to accurately predict effective CPAP (Pe-CPAP = 0.086xBMI+0.029xSSS+5.989 with SSS: none = 5, mild = 15, moderate = 30, severe = 75). Now we report our prospective clinical pilot study to validate our equation. In this study we substituted PRSS for TOSS.

Methods: Randomly, we assigned patients with suspected OSA awaiting NPSG to Group1 (G1) and Group2 (G2) and saw them one month before NPSG (Visit 1:V1), at NPSG (Visit 2:V2) and one month following NPSG (Visit 3:V3). G1 began CPAP at V1 using the Pe-CPAP determined from our equation but substituting PRSS for TOSS. G2 began CPAP after NPSG-titrated-CPAP (Te-CPAP) was determined at V2. CPAP among Group 1 was adjusted when Te-CPAP was not equal to Pe-CPAP. For all patients, Pe-CPAP and Te-CPAP were compared and Apnea-Hypopnea Index (AHI) at Pe-CPAP were determined. Epworth Sleepiness Scores (ESS) were determined among all patients at all visits. Mean ± standard deviation data were analyzed using Student□s-t and Wilcoxon Matched-Pairs tests.

Results: Respectively, 19 and 17 patients were randomized to G1 and G2. Six patients failed to keep their V2 (NPSG). One patient (G1) died before receiving a CPAP device. Two patients (G1) and 1 patient (G2) had NPSG cancelled because of technical problems in our sleep lab. Among the remaining 27 patients, our formula predicted Pe-CPAP within 2 cm H2O Te-CPAP in 12 patients, more than 2 cm H2O above Te-CPAP in 10 patients, and more than 2 cm H2O below Te-CPAP in 4 patients. Among those latter 4 patients, during their CPAP titration, only 1 patient had an AHI > 6 events/hour at Pe-CPAP (11 events/hour). Among the 2 groups, ESS trended lower in G1 at V2 (9.7 vs 10.5; P = 0.49). ESS did not differ significantly at V1 (G1:13.5, G2:11.9 P = 0.50), but at V3, ESS had declined significantly more among G1 (-6.1 ± 4.7 vs -4.8 ± 5.1; P = 0.008). At V3, compliance with CPAP use did not differ significantly among the two groups. Among G1, no adverse events occurred during their month of Pe-CPAP use prior to NPSG.

Conclusion: Using patient reported snoring severity predicted an effective CPAP that lowered AHI to < 6 events/hour in the vast majority of our study cohort. Using predicted effective CPAP prior to NPSG significantly reduced Epworth Sleepiness Score without deterring compliance with CPAP use. Our study continues.

0450

REFINING THE DEFINITION OF ADHERENCE WITH CONTINUOUS POSITIVE AIRWAY PRESSURE

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Introduction: Obstructive Sleep Apnea (OSA) is a serious illness that causes significant morbidity. Studies have found that the percentage of the adult population that suffer from moderate to severe OSA could be as high as 14%. Continuous Positive Airway Pressure (CPAP) has been proven as an effective treatment for OSA, but lack of adherence has been a major concern. One definition of CPAP adherence cited in the literature is an average of ≥ 4 or more hours/night of CPAP usage. We decided to vary the definition of adherence both in terms of number of hours/night and percentage of nights to see if any had a more distinct association of adverse outcomes.
Methods: This study was based on 1474 Veterans receiving PAP therapy between April 2003 and September 2006 who returned at least one recording card for PAP usage. Using this data, we defined adherence varying number of hours from 4 to 6 (or any) and percent of days from 40% to 80%. We evaluated which of these definitions was the best predictor of three outcomes: death, all-cause-hospitalization, and hospitalization with a discharge diagnosis of MI, stroke or heart failure.
Results: Using logistic regression and concordance statistics, our study found that defining adherence as five hours per night for at least forty percent of nights [N = 754, 51% adherence rate], was most strongly associated with significant reduction in hospitalization (OR = 0.623, 95% CI = 0.488 - 0.797) and CVD related Illnesses (OR = 0.621, 95% CI = 0.487 - 0.792). None of the tested definitions of adherence were related to death.
Conclusion: We determined that the best definition of a compliant patient was a patient who used a CPAP for 5 hours a night at least 40% of nights. We recommend further study on the best definition of PAP adherence.

0451

THE CLINICAL PREDICTORS FOR OPTIMAL POSITIVE AIRWAY PRESSURE TITRATION IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: The 2008 guidelines for the manual titration of positive airway pressure (PAP) for patients with obstructive sleep apnea provided consensus definitions for grading titration studies into four grades: optimal, good, adequate and unacceptable. We investigated the clinical predictors for optimal PAP titration in a single academic sleep disorder center.
Methods: Retrospective chart review. Data was collected from both full night titration and split-night polysomnograms and included patient demographics, baseline apnea-hypopnea index (AHI). Data was compared between groups using one way ANOVA and Chi-Square Test. Multiple logistic regression was used to determine which factors predicted optimal titration.
Results: 57 studies (full night PAP titration: 26, split night: 31) were reviewed. There were 39 females, 18 males with a median age of 51 yrs (IQR 43,59) and median AHI of 51.8/hr (30.8,88.0). There were 17 (29.8%) optimal, 9 (15.8%), good, 22 (38.6%) adequate (22) and 9 (15.8%) unacceptable studies. The median AHI was lowest in the optimal group: optimal: 20.6/hr (13.0,43.6), good: 66.4/hr (46.3, 88.7), adequate: 74.0/hr (42.0,118.0) and unacceptable: 52.3/hr (40.7-61.7), [P = 0.002]. The median NC was smallest in the unacceptable group: optimal: 16.5 cm (15.2,17.2), good: 17.5 cm (16.0,19.9), adequate: 17.5 cm (16.0,19.9), unacceptable: 15.3 cm (14.6,16.5), [P = 0.017]. The median BMI was lowest in the unacceptable group: optimal: 37.0 kg/m^2 (31.7,42.7), good: 43.0 kg/m^2 (35.2,53.3), adequate: 45.8 kg/m^2 (40.1,53.9) and unacceptable: 34.0 kg/m^2 (29.8,46.6), [P = 0.028]. Age, gender or type of study (full v. split night) were not different between the groups. Multiple logistic regression analysis showed only AHI as an independent predictor of optimal PAP titration (correlation coefficient, -0.04, P = 0.014).
Conclusion: Patients with a lower AHI are more likely to achieve optimal PAP titration compared to those with higher AHI. Unacceptable titrations are likely related to factors other than demographics as the demographic factors in this group were similar to those with optimal titrations.

0452

NECK SIZE AS A PREDICTOR OF PRESCRIBED CONTINUOUS POSITIVE AIRWAY PRESSURE

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Introduction: Knowledge of predisposing risk factors for Obstructive Sleep Apnea (OSA) in adults is important for early identification and treatment of OSA. Neck size is a known risk factor for potential OSA, but does having a larger neck size result in requiring a greater CPAP pressure. The goal of this study is to determine if a normal neck size versus a pathological neck size has an effect on prescribed CPAP pressure.
Methods: Approximately 200 patients who attended the Kitchener Sleep Clinic January and February 2009 were considered. Of these, 65 patients diagnosed with OSA with an AHI > 5/hr. and prescribed CPAP with a pressure > 5cm H2O were selected, 21 were female. We used a regular neck size of < 16 inches for females and < 17 inches for males. A large/pathological neck size was ≥ 16 inches for females and ≥ 17 inches for males. Thirty five out of the 65 patients (males and females) fell under the regular neck size and 30 patients (both genders) fell under the large/pathological neck size.
Results: A student t-test was used to determine a significant difference among prescribed CPAP air pressure of individuals with large neck sizes versus regular neck sizes. The t-test revealed no statistically significant differences between the CPAP pressure of large neck versus regular neck sized individuals (P < 0.05).
Conclusion: This result suggests that neck size, while a risk factor for potential OSA, does not play an obvious role in predicting prescribed CPAP air pressure.

0453

GENDER DIFFERENCES IN PROBLEM SOLVING AND COPING STYLES THAT PREDICT PAP ADHERENCE

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Introduction: Previous studies have identified problem solving and coping styles as pretreatment predictors of positive airway pressure (PAP) adherence. However, we have no knowledge of the presence or nature of gender differences in these predictive measures. We hypothesize that analysis of problem solving and coping constructs in gender sub-samples will identify distinct predictive models of PAP adherence for men versus women. Knowledge of these differential models can then

be applied to the development of assessments and interventions to prevent sub-therapeutic PAP utilization.
Methods: Archival data from 90 adult patients (25 women, 65 men) from a behavioral sleep medicine clinic were analyzed. Measures for analysis included: objective PAP adherence (7-day average use, all days), subscale scores of the Problem Solving Inventory (PSI), Proactive Coping Inventory (PCI), Proactive Attitude Scale (PAS) and Self-efficacy Scale (SES). A multiple linear regression analysis was used to assess gender specific coping styles predictive of PAP adherence.
Results: Weighted beta coefficients are as follows: for women, measures predictive of adherence included Emotional Support (b = 0.877, P = .008), Proactive Attitudes (b = 1.161, P = .040), and in a negative direction, overall PCI score (b = -1.574, P = .016) and Problem Solving Confidence (b = -0.881, P = .000). For men, PAP use was predicted by Avoidance Coping (b = 0.629, P = .003) and Self-Efficacy (b = 0.629, P = .007). The Proactive Attitude Scale was predictive in the opposite direction for men as it was for women (b = - 0.888, P = .008).
Conclusion: PAP adherence and factors that predict adherence are gender specific. While women's attitudes related to proactive coping were positively related to PAP use, this same measure was negatively related to PAP use in men. Specific to women, emotional support was positively predictive whereas proactive coping and confidence in problem solving negatively predicted PAP use. Specific to men, avoidance coping, and self-efficacy were positively related to PAP use.

0454

EFFECT OF CPAP PRESSURE TITRATION ON MSLT IN THE PATIENTS WITH SLEEP APNEA WITH DIFFERENT LEVEL OF DAYTIME SLEEPINESS

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Introduction: The level of daytime sleepiness between subjective and objective evaluation (e.g., Epworth Sleepiness Scale (ESS) vs. Multiple Sleep Latency Test (MSLT)) are not often consistent among the individuals with sleep apnea. The patients with different level of subjective sleepiness may have different responses in the evaluation of objective sleepiness to the first night of CPAP therapy.
Methods: After ESS collection and overnight polysomnographic recording, we recorded four-nap MSLT data on patients before and after CPAP pressure titration. Patients had an AHI greater than ten. Naps for the MSLT occurred at 10:00, 12:00, 14:00 and 16:00 in pre- (Day 1) and post-day (Day 2) of CPAP pressure titration. We analyzed data from 36 patients who used overnight CPAP and reported sleeping well.
Results: ESS scores negatively correlated with means of MSLT scores (correlation coefficient: -0.334, $P < 0.046$). Among the 36 patients, 22 had ESS scores of less than 12 (Low ESS, LE) and 14 had ESS equal or greater than 12 (High ESS, HE) in Day 1. Between LE and HE groups in Day 1, the differences were significant for means of MSLT scores (10.8 ± 4.3 vs. 7.8 ± 4.0 min, $P < 0.044$) and for fourth individual nap (12.4 ± 6.7 vs. 7.7 ± 6.4, $P < 0.44$). Comparisons between Day 1 and 2 (pared t-test) revealed that the differences were only observed for mean MSLT scores (10.8 ± 4.3 vs. 13.3 ± 4.2, $P < 0.001$) and for fourth nap (12.4 ± 6.7 vs. 17 ± 4.3, $P < 0.0008$) in LE group, not in HE groups.
Conclusion: In terms of objective daytime sleepiness, the patients with low ESS scores appear to benefit immediately from CPAP treatment, but those with high ESS do not. Lack of immediately positive response on MSLT may reflect the patients with high ESS scores have more severe pathological changes in the brain, and thus may require long term of CPAP treatment to display improving effect.
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0455

TNF-α, IL-6 AND NT pro-BNP LEVELS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME AND THE EFFECT OF CPAP TREATMENT OVER LEVELS OF THESE PARAMETERS

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Introduction: We examined the levels of TNF-α, IL-6 and NT pro-BNP, profile of lipids in obese men with obstructive sleep apnea syndrome (OSAS) and without OSAS. We also measured TNF-α, IL-6 and NT pro-BNP levels in OSAS subjects after treatment with continuous positive airway pressure (CPAP) to understand the relationship between these parameters and sleep apneic activty.
Methods: 33 patient with moderate-severe OSAS (apne-hypopne index:AHI ≥ 15) and 24 control (AHI < 5) were studied. To confirm the diagnosis, all patients underwent standart polysomnography (PSG). Serum samples were taken at 08:00 h in the morning. Those subjects who received regular treatment with CPAP were recruited to the reassessment study at 3 months (25 patient).
Results: BMI of the patient group was higher than the control group (33 ± 4.0, 30.7 ± 1 kg/m^2 respectively), (P = 0,004). A significant difference was not determined between the patient and the control group in the values of Cholesterol (P = 0.672), Triglyceride (P = 0.958), LDL (P = 0.649), HDL (P = 0.817), NT pro-BNP (P = 0.892), IL-6 (P = 0.782), TNF-α (P = 0.722). The levels of NT pro-BNP (P = 0.350), IL-6 (P = 0.137), TNF-α (P = 0.279) were lower in the group after the treatment but statistically a significant increase could not be determined. Statistically a significant relation in positive way was found between IL-6 and neck circumference before the treatment of the OSAS patients, ($r = 0.469$ $P = 0.06$). Statistically a significant relation ($t = -2{,}138$ $P = 0.047$) between improvement in average oxygen saturation by the treatment in 25 patients that used CPAP and the decrease at the level of TNF-α oppositely with the regression analysis was determined.
Conclusion: The levels of IL-6, TNF-α and NT pro-BNP being not higher significantly in OSAS patients than the control group and not detecting a significant decrease in the levels by three monthly CPAP treatment. Other factors might play role in the develop of cardiovascular cases in OSAS and inflammation was not systematic but rather localized in OSAS

0456

NONLINEAR ASSESSMENT OF OBSTRUCTIVE SLEEP APNEA SEVERITY FROM HEART RATE FLUCTUATIONS: EVALUATION OF THE TREATMENT OF CONTINUOUS POSITIVE AIRWAY PRESSURE

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Introduction: Heart rate oscillations (HRO) in patients with obstructive sleep apnea (OSA) can be entrained by periodic breathing induced by repetitive hypopnic/apneic (H/A) conditions. However, non-sinusoidal (triangular) shapes and varying periods of the entrained HRO during OSA present a methodological challenge for accurate assessment of OSA severity because the conventional techniques are not suitable for the analysis of such nonlinear and nonstationary signals. To address the problem, the empirical mode decomposition (EMD), an innovative approach based

on nonlinear theories, was proposed in this study to extract nonstationary HRO and was used to quantify the OSA severity in patients with OSA before and after continuous positive airway pressure (CPAP).
Methods: Eight-six patients with OSA were recruited and underwent a two-day overnight polysomnogram (PSG) examination. Following the first baseline day, the CPAP titration was administrated on the second day. Data during sleep episodes were analyzed. The HRO corresponding to the quasi periodic breathing were extracted using the EMD method. The power of the extracted HRO (P_{OSA}) was used as an index of severity of sleep apnea, i.e., a larger power indicates severer apnea. The Apnea-Hypopnea index (AHI) was also calculated for comparison.
Results: All patients showed significant reductions in P_{OSA} ($P < 10^{-12}$) and in AHI ($P < 10^{-15}$) after CPAP treatment, as compared to baseline. The change of P_{OSA} and AHI between baseline and CPAP treatment were highly correlated ($r = 0.507$, $P < 10^{-6}$).
Conclusion: The proposed nonlinear decomposition method may provide an accurate assessment of the effect of CPAP on OSA severity as the golden standard AHI while the new method has the advantage of using only heart rate signals. The marker P_{OSA} derived from the new method may serve as one of the cost-effective and non-invasive measures of OSA severity and be used to evaluate treatments of sleep apnea.

0457

EFFECT OF CPAP PRESSURE TITRATION ON THE CHANGE OF MSLT IN THE PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: The change of multiple sleep latency test (MSLT) between pre- and post- day of CPAP pressure titration may serve as the chance to judge the immediate effect of CPAP treatment for the patients with obstructive sleep apnea (OSA).
Methods: We collected four-nap MSLT data on patients before and after CPAP pressure titration. Patients had an AHI greater than ten. Naps for the MSLT occurred at 10:00, 12:00, 14:00 and 16:00 in pre- (Day 1) and post-day (Day 2) of CPAP pressure titration. We analyzed data from 36 patients who used overnight CPAP and reported sleeping well.
Results: Among the 36 patients, 20 had mean MSLT scores of less than 10 min (Short Latency, SL) and 16 had mean of MSLT greater than 10 min (Long Latency, LL) in Day 1. We compared Day 1 and 2, mean MSLT scores: SL group: 6.6 ± 2.9 vs. 9.8 ± 4.4 min ($P < 0.0006$, pared t-test); no differences were found in LL group (13.3 ± 2.8 vs. 14.5 ± 4.2, $P = 0.29$). Comparing individual naps in SL group, the differences were significant for the first (6.8 ± 5.3 vs. 10 ± 5.5, $P < 0.05$) and forth (6.3 ± 5 vs. 12.2 ± 6.5, $P < 0.0008$) naps. No difference was found comparing individual naps of LL group.
Conclusion: Only those with short MSLT sleep latencies appear to benefit immediately from CPAP in terms of objective daytime sleepiness. The early morning and late afternoon naps were more sensitive in detecting the effects of CPAP for this group.
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0458

CPAP PRESSURE RETITRATION IS NECESSARY FOR FINDING THE ACCURATE THERAPEUTIC PRESSURE OF OBSTRUCTIVE SLEEP APNEA PATIENTS AND IMPROVING COMPLIANCE UNDER LONG-TERM CPAP TREATMENT

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Introduction: Obstructive sleep apnea syndrome is a common sleep disorder affecting at least over 2% middle age population1, and it will cause excessive daytime sleepiness, impaired cognitive function, incidental hypertension. Continuous positive airway pressure (CPAP) therapy is a gold standard medical therapy for this sleep breathing disorder. However, CPAP acceptance is less than 50 % due to its inconvenience and hard to tolerate at the first beginning. However, about 15-20% CPAP using patient stop CPAP treatment after a year for less effective feeling. We retitrate CPAP pressure of our obstructive sleep apnea patients, and found most of their CPAP therapeutic pressure decrease after continuous using for years. This could explain why some patient felt CPAP therapy less effective after using for several months or years.
Methods: We had collected 187 Obstructive sleep apnea patients under regular pressure CPAP machine treatment within 5 years within one sleep center in Taiwan. CPAP pressure retitration was done routinely or if patient felt less effective or some side effect of CPAP like aerophagia or flatulence in the morning after using over a year.
Results: Within 187 OSA patients, there are 173 male and 14 female. Their mean age was 48.51 years old, mean neck circumference was 41.81cm, mean weight 84.18kg, mean height 168.99cm, mean BMI 29.41, we used paired-T test to compare CPAP retitration pressure to CPAP original titration pressure. CPAP orginal pressure - CPAP retitration pressure was 1.796 ± 2.78 ($P < 0.0001$).
Conclusion: According to the previous result, we can see the therapeutic CPAP pressure decrease after regular using CPAP for years, and that could explain why some patients stop using CPAP after almost a year. The reason of why therapeutic CPAP pressure decreased might be related to upper airway inflammation or swelling improved after CPAP treatment. Further research about mechanism of therapeutic pressure change need to be done in the future.

0459

THE NEW TAP-PAP CUSTOM FACE MASK FOR CPAP SATISFACTION

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Introduction: Compliance for CPAP therapy nationwide has been shown to be 51%. The development of the Thornton Adjustable Positioner (TAP) to the TAP-PAP Custom Mask (CM) combines the intra-oral mandibular advancement appliance attached to a custom molded shield, thereby eliminating the need for straps and stabilizing the mask from leakage by both taking an impression of the face for a perfect fit and by its connection to the skull base through the attachment to the TAP appliance (no straps).
Methods: CMs were fabricated (TMD Technologies) for 25 patients referred to our sleep center. All had severe OSA with averages being AHI 42, PSO_2 77% and CPAP 15 cm H2O. All had a lack of symptomatic success with the CPAP and stock mask (SM) and were about to abandon therapy. These patients were fitted for the CM and complied with CPAP therapy. This telephone survey compares the CM and the SM satisfaction of the patient and bed partner (from 0-5 (5 being very dissatisfied)).
Results: Of 25 CM patients, 2 left therapy for other options, and three no contacts leaving 20 for this survey. *Top unresolved sleep complaints: fatigue (14) and interrupted sleep (10). *Top SM complaints: leakage (16) and strap discomfort (8). *Top CM features: comfort (8), no straps (4) and quiet (2). *Bed partner unanimous satisfaction rated 1-2 *SM satisfaction was 4-5 (14) *CM satisfaction was 1-2 (16).
Conclusion: Satisfaction of patient and bed partner of the CM are far superior to the SM. Because the CM was successful in resolving sleep symptoms that the SM failed to resolve, the CM should be considered when severe OSA patients are going to abandon therapy. The results indicate the need for a more a comprehensive study that is underway by this author at this time. Reduced pressures also need validating. The TAP-PAP Custom Mask has an important role in treating Sleep Disordered Breathing (SDB) and is a critical option to address the CPAP compliance issue in the treatment of SDB and OSA.

0460

SUBJECTIVE AND OBJECTIVE CPAP COMPLIANCE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: The aim of this study was to investigate the objective and subjective CPAP compliance in patients with obstructive sleep apnea syndrome (OSAS). Also, we evaluated the factors and benefits that were associated with good compliance to CPAP use.
Methods: Patients with OSAS who underwent polysomnography for CPAP titration between November 2006 and September 2009 were included in this study. Body mass index (BMI), Epworth sleepiness scale (ESS), Pittsburgh sleep quality index (PSQI) and Beck depression inventory (BDI) were obtained before and during CPAP use. Subjective and objective compliance were defined as CPAP use of 5d/wk with 4hr/d, and 70% of recording time with 4hr/d.
Results: A total of 148 patients with a mean age (± SD) of 53.8 (± 12.2) years were examined. The subjective and objective compliance was 32.4% and 20.9%. Among subjectively compliant patients, 73.7% of them were objectively compliant. In 75 patients who discontinued CPAP treatment, 71% of them had stopped CPAP use within a month. Subjectively compliant patients had higher CPAP pressure, lower PSQI score, lower minimum O_2 saturation and higher % time of O_2 saturation lower than 90% than non-compliant patients. Objectively compliant patients had higher CPAP pressure, lower PSQI and BDI score, higher BMI and lower minimum O_2 saturation than non-compliant patients. ESS and PSQI were significantly improved both in objectively compliant and partial-compliant patients. The improvement was more prominent in compliant than partial-compliant group, although statistically insignificant.
Conclusion: Lower insomnia score and more severe degree of OSA were related with better CPAP compliance. As effects of CPAP use were evident with higher objective compliance and some patients overestimated their CPAP use, determination of objective compliance is essential in evaluating CPAP compliance and it effects.

0461

EARLY EXPERIENCE WITH EFFICACY OF ADAPTIVE SERVOVENTILATION IN SUBTYPES OF SLEEP DISORDERED BREATHING

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Introduction: The use of adaptive servoventilation (ASV) in treatment of central, mixed and complex sleep apnea syndromes (CompSAS) has been previously studied. Our aim is to perform a review of our experience with the use of ASV and describe its efficacy in patients with sleep disordered breathing (SDB) including Cheyne Stokes respiration, CPAP induced CompSAS and opiate induced sleep apnea, and its effects on cardiac function.
Methods: We performed a retrospective analysis of patients being treated with ASV for SDB at a large sleep center in St Paul, MN. Our hypothesis is that the efficacy of ASV in percentage reduction of apnea hypopnea index (AHI) varies by different subgroups of patients on treatment. Measured parameters included pre and post treatment polysomnographic data and subjective and clinical patient outcomes including cardiac ejection fraction.
Results: 19 patients (11 with CPAP induced CompSAS, 6 with CSR, 2 with central sleep apnea and 4 with opiate related sleep apnea) with initial diagnostic AHI ± standard deviation 53.5 ± 23.2/hr and REM RDI 36.3 ± 29 were studied. Percentage reduction in AHI with ASV treatment was statistically different between CPAP induced CompSAS vs opiate related sleep apnea (79.7 ± 10% and 42.2 ± 26%, P = 0.007) and CSR vs opiate related sleep apnea (82.7 ± 18% and 42.2 ± 26%, P = 0.02) despite no differences in effective treatment pressures (EPAP,IPAP/PS and backup rate). A small overall trend was also noted in improvement of cardiac ejection fraction between the CSR and opiate related sleep apnea which was not statistically significant. REM sleep was also noted to be statistically increased on ASV in all subgroups (P = 0.05).
Conclusion: These results indicate a need to further stratify patients with indications for treatment with ASV and the difficulty in improving sleep quality in patients with opiate related sleep apnea.

0462

THE COMFORT OF FULL-FACE VERSUS NASAL PAP MASKS

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Introduction: Positive airway pressure (PAP) continues to be the most effective treatment for obstructive sleep apnea(OSA). Untreated OSA has been associated with congestive heart failure, stroke, and hypertension. In spite of this, patient compliance is surprisingly low. Potentially, the discomfort associated with treatment may play a role in these poor compliance rates. The purpose of this study was to characterize the perceived comfort of treatment depending on the specific mask type.
Methods: There were 41 study participants, 17 females, 24 males, ranging in age from 33 - 82. All participants had been previously diagnosed with OSA and had returned for PAP titrations at the Center for Sleep Medicine, Weill Medical College of Cornell University. Participants were randomly assigned to use a full-face mask, standard nasal mask, or nasal pillows. Comfort was assessed by a questionnaire filled out at the end of the titration study.
Results: In comparison the the full face and standard nasal masks, participants found the nasal pillows more comfortable ($F(2,32)$ 5.47, P = 0.010), and were less likely to awake with symptoms such as congestion, dry mouth, or a choking feeling ($F(2,32)$ 4.87, P = 0.014). Lastly, participants were more likely to use the nasal pillows treatment at home than full-face or standard nasal mask ($F(2,32)$ 5.12, P = 0.012).
Conclusion: The discomfort associated with the use of PAP masks may be responsible for poor patient compliance. Nasal pillows treatment was shown to give patients the most comfort overnight, which may improve compliance when used at home.

0463

RDI REDUCTION WITH MANDIBULAR ADVANCEMENT APPLIANCES IS MAINTAINED OVER TIME DESPITE INCREASED BMI

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Introduction: Mandibular advancement appliances (MAA) are used to treat mild-to-moderate obstructive sleep apnea syndrome (OSAS). This study assesses the efficacy of two MAA over time from a previous comparative study (PCS).
Methods: Sixteen subjects had participated in a PCS testing two Canadian MAA using a randomized cross-over design. Fifteen wore their appliances at the follow-up interview and 14 (4 women and 10 men, 51.9 ± 1.7 y.o.) participated in an overnight sleep study to assess the efficacy of the MAA that they selected after the PCS. Mean follow-up time is 40.9 ± 2.1 months (mean ± SEM, range 31-53 months). Three polysomnographic evaluations (PSGE) were used: baseline (PCS), night with the selected appliance, and a follow-up night. Subjects completed the Epworth Sleepiness Scale (ESS), the fatigue severity scale (FSS),

and a quality of life questionnaire (FOSQ) after each PSGE. Statistical ANOVAs were performed.
Results: Respiratory disturbance index (RDI) were significantly reduced from baseline (10.4 ± 1.3) to the night after the PCS (5.7 ± 1.1, P = 0.004) and remained low at follow-up (4.5 ± 0.7, P < 0.001 compared to baseline). Questionnaires also revealed that the ESS, FSS, and FOSQ significantly improved from baseline to the night after the PCS (P < 0.02) and remained improved at follow-up (P < 0.02 compared to baseline). Surprisingly, even though body mass index (BMI) increased significantly from baseline to follow-up (P < 0.05), MAA efficacy was maintained.
Conclusion: The EES, FSS, FOSQ, and MAA efficacy remained improved at follow-up after a 31-53-month waiting period. RDI was significantly reduced at follow-up, despite increased BMI.
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0464

RELATIONSHIP BETWEEN SLEEP DURATION AND CHANGES IN THE BODY WEIGHT IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME ON CONTINUOUS POSITIVE AIRWAY PRESSURE

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Introduction: In this study, we evaluated the relationship between sleep duration and the changes in the body weight in patients with OSAS on nCPAP. To evaluate whether the changes in the body weight observed in patients with OSAS may have a potential association with the duration of sleep while the patient is under nCPAP. To examine a relationship between the duration of nCPAP ventilation and the changes in the body weight every 6 months after the initiation of nCPAP. To evaluate the daily duration of sleep while under nCPAP ventilation and the changes in the body weight. Subjects: Between January 2001 and June 2009, 206 patients with OSAS, as diagnosed by PSG. Of these patients, 192 (157 with obesity, 35 without obesity at first examination) with a percent days of device CPAP usage of 70% or more were enrolled in this study.
Methods: BMI was calculated from the height and body weight at the first examination, and the subjects were divided into obese and non-obese groups, using BMI 22 as the point of reference. Calculation of the nCPAP usage time during sleep: The time taken to fall asleep after fitting of the nCPAP device and the time spent on the nCPAP device after awakening were determined using a questionnaire. The CPAP usage time during sleep was calculated by subtraction of the CPAP usage time while awake from the average duration of use of CPAP obtained from a memory card.
Results: The non-obese patients tended to lose weight for the first 2 years after the initiation of CPAP ventilation and to gain weight thereafter. The obese patients tended to lose weight for 1.5 years after the initiation of CPAP and to gain weight thereafter. There was no definite relationship between the duration of use of the CPAP device and the changes in the body weight. In the non-obese group, patients with a 6-hour sleep duration during CPAP ventilation showed the greatest and most sustained decrease of the body weight. The changes in the non-obese group were smaller than those in the obese group. In the obese group, patients with a sleep duration of 5 hours showed the most significant decrease of the body weight. The obese patients were likely to gain weight with a sleep duration of less than 5 hours or of 6 hours or more.
Conclusion: It is suggested that the optimal sleep duration for obtaining the greatest decrease of the body weight may be 5 hours in obese patients and 6 hours in non-obese patients with OSAS under nCPAP ventilation.

0465

DIFFERENCES IN EFFECTIVENESS OF NASAL AND FACIAL CPAP MASKS IN OBSTRUCTIVE SLEEP APNEA, AND EFFECT OF MANDIBULAR STABILIZATION

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Introduction: Nasal and facial masks are often used interchangeably for the application of CPAP in the treatment of obstructive sleep apnea (OSA). However, clinical practice shows that for some patients CPAP titration with a facial mask is excessively difficult. This study compared the effective CPAP applied with nasal and facial masks in a group of difficult to treat OSA patients, and assessed the effect of mandibular stabilization.
Methods: Eight OSA subjects were recruited from a tertiary care hospital. They had a history of difficult titration using a facial mask or poor CPAP tolerance. Each underwent 2 therapeutic polysomnographies with esophageal pressure monitoring. During each study, CPAP titration was repeated using both nasal and facial masks successively. A mandibular advancement device (MAD) in the neutral position was added for the second night.
Results: By nasal mask, an effective pressure was achieved in all patients (average 10.4 cmH2O, range 5 - 15 cmH2O). Only 2 subjects had equivalent effective CPAP with both masks. With the facial mask, obstructive events persisted at the maximal pressure (20cmH2O) in 4 subjects and an effective pressure was reached in 2 subjects but was higher by 5 and 8 cmH2O respectively compared with the nasal mask. Total air leak was not higher with the facial mask. With the MAD, effective CPAP was lower for the facial mask only in one subject and for both masks, in another subject.
Conclusion: Facial CPAP may be ineffective or higher pressures may be needed compared with nasal CPAP. The findings are not explained by air leak, or by change in mandibular position as the MAD didn't change effective CPAP in most cases. Possible explanations include induced ventilatory instability, or increased upper airway resistance or collapsibility. Use of the MAD with CPAP may help reduce the effective level of pressure in some cases.

0466

OUTCOME ASSESSMENT OF AGGRESSIVE VERSUS CONSERVATIVE MANAGEMENT OF REM PREDOMINANT SLEEP APNEA

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Introduction: Continuous positive airway pressure (CPAP) remains the mainstay of therapy in patients with moderate to severe obstructive sleep apnea (OSA). In patients with REM predominant, mild OSA different treatment approaches exist, consisting of CPAP, or less aggressive treatment with weight loss counseling and positional therapy. As, there is no clear consensus regarding the management of REM predominant, mild sleep apnea, we studied the effects of these two management strategies on clinical outcomes.
Methods: We conducted a retrospective review of 5038 polysomnogram and CPAP titration studies recorded at our sleep disorders center from February 2005 to August 2009. We included patients with REM predominant, mild OSA defined as having an overall RDI < 15 and a REM RDI > 15. We excluded patients that had less than three follow ups. Demographic information, comorbidities, and polysomnographic data were collected. All patients were grouped according to treatment regimen - aggressive management (CPAP/BiPAP therapy) or conserva-

tive management (weight loss counseling and positional therapy). We analyzed outcome measures (blood pressure, heart rate, oxygen saturations, BMI) pre and post therapy according to treatment group.
Results: 218 patients were eligible for our study based on selection criteria, of which 55 had appropriate follow up. There were no significant differences with respect to demographic information and subjective sleepiness by Epworth Sleepiness Scale. Thirty patients received CPAP/BiPAP therapy and 25 patients received conservative therapy. Both groups were similar with respect to blood pressure, heart rate, and BMI before therapy. A significant difference between the two groups was found when comparing change in systolic blood pressure (-6.3 ± 13.5mmHg, aggressive therapy vs. 1.7 ± 15.2mmHg conservative therapy, P = 0.05). There was no significant difference between groups when comparing other outcomes.
Conclusion: From our retrospective study, a statistically significant difference was found in change in blood pressure between the aggressive and the conservative therapy groups for REM predominant, mild OSA. These findings suggest that a larger, prospective trial comparing different management strategies of REM predominant, mild OSA may be necessary to determine optimal treatment.

0467

CHARACTERISTICS OF OSA PATIENTS WHO REJECTED CPAP THERAPY DURING TITRATION NIGHT

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Introduction: The purpose of the study was to determine the characteristics of obstructive sleep apnea patients who reject nasal CPAP therapy during titration study at the laboratory.
Methods: Thirty-three patients who rejected CPAP therapy at the laboratory and 69 control patients who uses CPAP on a regular basis at least 3 months were compared in terms of age, sex, neck circumference, Epworth Sleepiness Scale, BMI, comorbidity, apnea-hypopnea index, previous palatal surgery, nocturia, diuretic use and socioeconomic status.
Results: Compared with controls, rejecters of therapy have a significantly lower apnea-hypopnea index (52.1/h vs. 40.7/h, P = 0.014) and higher level of education (17.4% vs. 48.5%, P = 0.001). Age, sex, neck circumference, Epworth Sleepiness Scale, BMI, comorbidity, palatal surgery, nocturia, diuretic use and total income were not different in both groups.
Conclusion: We conclude that apnea severity and level of education may predict CPAP acceptance during titration night at the laboratory.

0468

DISSATISFACTION WITH OSA MANAGEMENT AMONG CPAP REJECTERS AND THE ROLE OF THE PRIMARY CARE PHYSICIAN

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Introduction: Limited data exist regarding how satisfied patients who reject CPAP are with the management of their OSA. Furthermore, data on the role of the primary care physician (PCP) in the care of those that reject CPAP is also limited.
Methods: 100 CPAP rejecters (52M, 48F) drawn from an online panel of roughly 3 million individuals were surveyed using an online questionnaire. Inclusion criteria included: age between 35 and 64, obstructive sleep apnea (OSA) diagnosis by a physician requiring a sleep test, and history of physician recommendation of CPAP and then outright CPAP refusal (n = 4) or CPAP use and subsequent discontinuation (n = 96).
Results: 69% of subjects reported that their initial physician conversation about their sleep issues was with their PCP, compared to 13% with the sleep specialist (SS). 82% of the rejecters reported not consulting a physician prior to rejecting CPAP. 67% percent of subjects were not currently treating their OSA. Of the 33% that were currently treating their OSA, lifestyle changes (55%) and positional therapy (51%) were the most cited therapies used. 52% of all subjects reported being either very dissatisfied or somewhat dissatisfied with their current OSA management. Of those who were dissatisfied, 58% cited being symptomatic/tired/poor sleep as the reason for their dissatisfaction. When asked which physician they would approach for future OSA questions, 65% and 36% of all subjects named their PCP and SS respectively (multiple selections allowed). Finally, when asked how frequently their PCP asked them about their OSA, 56% responded rarely or never.
Conclusion: More than half of the CPAP rejecters in the survey are dissatisfied with their current management of OSA. The survey results also highlight the importance of the PCP in the initial triage and diagnosis of OSA and after CPAP has been discontinued.
Support (If Any): Ventus Medical

0469

CAN HEATED HUMIDITY WITH A HEATED BREATHING TUBE COMPARABLY IMPROVE CPAP USAGE AND NASAL SYMPTOM COMPLAINTS AS AN INTRANASAL STEROID?

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Introduction: A common complaint and compliance issue with nasal CPAP treatment are adverse nasal symptoms, such as congestion and rhinorrhea. Despite some benefit provided by standard heated humidity, many patients still require usage of a nasal steroid. The current study attempts to determine if heated humidity with a heated breathing tube, Thermosmart™, is comparable to an intranasal steroid in improving CPAP usage and nasal symptom complaints.
Methods: Patients on CPAP > 3 weeks with usage < 5 hrs/night and a complaint of adverse nasal symptoms related to CPAP completed this single blind placebo run-in, double blind crossover trial to determine improvement in compliance and nasal symptoms. After screening, patients completed 7-10 days run-in with heated humidifier and purified water nasal spray. Next, patients completed each of two 21-day treatment arms in which they received either heated humidity with heated breathing tube and steroid placebo (TH) or heated humidity with nasal steroid (NS). Nasal symptoms were assessed at each time point using the nocturnal Rhinoconjunctivitis Quality of Life Questionnaire (nRQLQ).
Results: A total of 35 patients have completed (Mean age 50.2, Males = 18, Mean CPAP duration 5.5 months). TH treatment compliance (P < .05) and nRQLQ (P < .001) scores significantly improved as compared to screening. Both treatment groups demonstrated significant compliance improvements from baseline (136.4 min screening vs. 232.9 min NS vs. 210.7 min TH, P < .05), however compliance was comparable between treatments (P = .30). Nasal symptoms also significantly improved from screening through treatment, with the most change in the TH arm (14.5 screening vs. 8.11 NS vs. 7.34 TH, P < .001). Of note, 74% of completed patients requesting treatment change switched to a device with a heated breathing tube.
Conclusion: A significant improvement was observed with both treatments for compliance and adverse nasal symptoms. More importantly, the TH arm results were as comparably effective as the nasal steroid, which is critical when considering continuity of treatment management and ideal compliance.
Support (If Any): Study funded by Fisher & Paykel Healthcare, Inc.

0470

ESZOPICLONE ADJUNCT IN THE MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: The use of hypnotics is a common but unvalidated practice to facilitate initial adaptation to CPAP. This study is a randomized placebo controlled study to determine the potential role of eszopiclone in facilitating CPAP initiation in patients with OSA in during an attended study and during the first month of home use.
Methods: Non-insomniac patients (18-64 yrs) scheduled for CPAP titration were invited to participate if their initial sleep efficiency on their diagnostic sleep study was under 85%. Patients were randomized to receive either eszopiclone 3 mg or placebo on the first night of an attended CPAP titration study. Patients returned to the sleep clinic with their new CPAP units prior to sleeping with them at home. The mask fit and CPAP settings were verified and instructions for using CPAP were reviewed. The patients were then given a 30 day supply of either medication or placebo to use while on CPAP at home. After 30 days the compliance/usage data from the CPAP unit was downloaded and analyzed. SF-36 data was also obtained at baseline and at the end of the study period.
Results: A total of 67 subjects were enrolled. Sleep efficiency with hypnotic was higher on the first CPAP night (78 vs 67%). Average use of CPAP for the hypnotic group was 158.4 hours per month. Average use for the placebo group was 137.0 hours per month. The hypnotic group used CPAP on average 42 minutes more per night. SF-36 data will also be presented
Conclusion: Eszopiclone improved sleep efficiency during the CPAP titration night. Eszolpiclone improved CPAP usage during the first month of CPAP in the home. Hypnotics may be useful to facilitate CPAP use in the home in patients with low sleep efficiency on their diagnostic sleep study.
Support (If Any): Unrestricted education grant awarded to Stanford University by Sepracor Pharmaceuticals.

0471

CHANGES IN OSA SEVERITY, BIOMARKERS, AND QUALITY OF LIFE AFTER MULTILEVEL SURGERY

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Introduction: The objectives were to evaluate the impact of a multilevel obstructive sleep apnea surgical treatment on sleep disordered breathing severity, health-related measures, and sleep-related quality of life and to examine the association between changes in sleep-disordered breathing severity and these other outcomes.
Methods: This prospective cohort study included subjects with obstructive sleep apnea intolerant of positive airway pressure and with evidence of multilevel (palate and hypopharynx) obstruction. All subjects underwent uvulopalatopharyngoplasty/tonsillectomy and genioglossus advancement, with or without hyoid suspension. Preoperative and postoperative assessments included polysomnography; assays for C-reactive protein, interleukin-6, homocysteine, HOMA-IR, and leptin; and Functional Outcomes of Sleep Questionnaire score.
Results: For all thirty subjects, mean AHI decreased from 44.9 ± 28.1 to 27.8 ± 26.4 events/hour (P = 0.008). Thirteen (43%) subjects achieved a response (defined as AHI reduction of ≥ 50% to absolute levels < 15 events/hour), and body mass index ≤ 32 kg/m^2 was associated with a higher likelihood (55%, 12/22, P = 0.04). There was no change in C-reactive protein levels overall, but responders demonstrated a decrease in C-reactive protein levels (-1.02 ± 0.98 mg/L, P = 0.003) that was independent of changes in body weight. There were no significant changes in other health-related measures besides a small increase in homocysteine levels, although there was a trend towards a decrease in interleukin-6 levels. Responders and nonresponders both demonstrated improvements in sleep-related quality of life.
Conclusion: Multilevel surgical treatment was associated with a low likelihood of response in subjects with body mass index > 32 kg/m^2. Responders had decreased C-reactive protein levels that were independent of changes in body weight.
Support (If Any): This research was supported by Dr. Kezirian's career development award from the National Center for Research Resources (NCRR) of the National Institutes of Health (NIH), the Triological Society Research Career Development Award of the American Laryngological, Rhinological, and Otological Society, and a UCSF Research Evaluation and Allocation Committee research grant. The project was also supported by NIH/NCRR/OD UCSF-CTSI Grant Number KL2 RR024130. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH. The UCSF AIDS Specimen Bank was responsible for all processing, storing, and management of specimens for this study.

0472

THE SEDATIVE MEDICATION ESZOPICLONE INCREASES SLEEP DURATION AND REDUCES SLEEP APNEA SEVERITY IN PATIENTS WITH A LOW RESPIRATORY AROUSAL THRESHOLD

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Introduction: How easily a patient arouses from respiratory stimuli (respiratory arousal threshold; AT) is important in OSA pathogenesis. Cessation of respiratory events can occur in 2 ways: 1) arousal from sleep or 2) adequate recruitment of pharyngeal dilator muscles to restore airway patency and preserve stable sleep. Preventing premature arousal by pharmacologically increasing the AT to enable greater opportunity for pharyngeal dilator muscle recruitment may be of therapeutic benefit for certain patients (ie. those with a low AT). This study aimed to assess the effect of eszopiclone on sleep apnea severity. We hypothesized that eszopiclone would reduce the AHI in patients with a low AT.
Methods: This was a double-blind, randomized, cross-over study. 3 separate 8 hr overnight supine PSGs were performed in 17 untreated OSA patients of varying severity (AHI range: 8-82 events/hr) ~1 week apart. During each visit, patients were instrumented with an epiglottic pressure catheter to quantify the AT (mean of nadir epiglottic pressure immediately prior to arousal during ~15 replicate non-REM respiratory events selected at random). Patients with severe O_2 desaturation (nadir SaO_2 < 70%) during the baseline PSG were excluded from further participation. All remaining patients received placebo or 3mg eszopiclone in random order immediately prior to sleep during the 2 subsequent PSG visits.
Results: During the 8 hr PSG, compared to placebo, a single 3mg dose of eszopiclone significantly (P < 0.05) increased: total sleep time (5.3 ± 0.4 vs. 6.8 ± 0.2 hr), N2 sleep (ΔN2 7 ± 2 %TST) and reduced: N1 sleep (ΔN1 -9 ± 2 %TST), the arousal index (28 ± 4 vs. 21 ± 3 arousals/hr), and the AHI (31 ± 5 vs. 24 ± 5 events/hr). Markers of hypoxia (eg. min SaO_2 80 ± 1 vs. 80 ± 2 s) and event duration (32 ± 1 vs. 32 ± 2 s) were not different (P > 0.05) between conditions. All 7 patients with a low baseline AT (defined a priori as < -15 cmH_2O) had at least a 20% improvement in AHI with eszopiclone (mean improvement 42 ± 14 %).
Conclusion: In untreated OSA patients in whom nadir SaO_2 > 70% during a baseline PSG, 3mg of eszopiclone significantly increases total sleep time, improves sleep quality, and lowers the apnea/hypopnea index, particularly in patients with a low arousal threshold, without causing longer or more severe respiratory events. While larger long term safety and outcome trials are required, the results of this acute physiological study indicate that eszopiclone may be a novel therapeutic tool, particularly in patients with a low arousal threshold.

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0473

OUTCOME OF TRACHEOSTOMY FOR OBESITY HYPOVENTILATION SYNDROME - 10-YEAR EXPERIENCE

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Introduction: To determine the outcome of patients with obesity hypoventilation syndrome (OHS) who required tracheostomies.
Methods: A 10-year retrospective study of patients with clinical OHS (BMI > 30, arterial pCO_2 > 45 mm of Hg) who have undergone tracheostomy for hypercapnic respiratory failure (HRF) in an urban teaching hospital. Patients with primary suspected OHS were reviewed. Primary outcome measures were mortality and morbidity. Data collection was from patient records and social security death index.
Results: There were 5941 hospitalizations with a diagnosis code of sleep apnea from 1999 to 2009. A total of 121 patients had documented obesity (BMI range 31-105) with HRF and had tracheostomies. 49/121(40%) patients were identified to have primary OHS. Mean age was 60 years with BMI range 31-105. There were 17 men and 32 women. At the time of discharge, 26 patients had weaned to trach collar and 23 patients needed ventilator support at night or continuously. 26 patients were discharged to home, 4 to nursing home and 10 to long-term ventilator facility. Mean arterial pCO_2 was 79 pre and 60 mm Hg post-tracheostomy. 31 had evidence of RV dysfunction / pulmonary hypertension. Only 3 had decannulation, 4 had admissions for respiratory infections and 6 had recurrent HRF. 33 deaths were identified; 9 deaths during the initial hospitalization; 63% deaths had occurred in 1 year and 36% in 5 years; 16 are alive at 10 years. Causes of death were: cardiac arrest 16, tracheostomy complications 2 and miscellaneous 15.
Conclusion: OHS is a serious condition when it cannot be managed by non-invasive ventilation and may require a long-term tracheostomy. In our series, the overall mortality was 67 %. Hypercapnia may persist even after tracheostomy.

0474

UTILITY OF UPPP IN OSA: THE CLEVELAND CLINIC EXPERIENCE

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Introduction: Uvulopalatopharyngoplasty (UPPP) was first described by Fujita as a treatment for obstructive sleep apnea (OSA). Despite ongoing research, there is little consensus as to which factors predict favorable outcomes following surgery.
Methods: We conducted a retrospective study using a database of 800 patients 18 years and older who had undergone UPPP +/- tonsillectomy and/or septoplasty between 2002-2009.
Results: Of the 250 charts reviewed to date, thirty patients met inclusion criteria. Subjects (28 men [93%]; mean age, 43.3 ± 10.4 years; mean BMI, 31.0 ± 4.1 kg/m^2) had a PSG with an average of 9.2 ± 21.3 months before UPPP and 7.9 ± 7.9 months after UPPP. Overall, there was a decrease in the overall AHI in all the patients undergoing surgery (mean AHI ± SD, 45.6 ± 29.2 pre-UPPP vs. 30.4 ± 26.1 post-UPPP, P = 0.019*.) Thirteen patients (43%) achieved a 50% or greater reduction in the AHI and/or an AHI of 20 or less. These patients were younger (mean age ± SD, 39.1 ± 11.9 vs. 46.5 ± 8.1; P = 0.025*) and had lower Friedman tongue position scores (mean score ± SD, 2.4 ± 0.5 vs. 2.9 ± 0.3; P = 0.001**.) There were no significant changes in BMI before and after UPPP. Two patients (6.6%) attained surgical cure with an AHI of 5 or less. Of the patients requiring CPAP therapy post-UPPP, there was no significant decrease in pressure requirements (mean CPAP pressure ± SD, 9.4 ± 0.5 pre-operatively vs. 9.1 ± 0.7 post-operatively, P = 0.35.) Patients improved symptomatically with a decrease in the Epworth Sleepiness Scale (ESS) score (mean ESS ± SD, 11.6 ± 6.4 pre-UPPP vs. 8.8 ± 5.3, P = 0.038*.) The complication rate was low (two cases of self-resolved post-operative oropharyngeal bleeding.)
Conclusion: UPPP achieved surgical success in 43% of our patients. Younger patients (< 40 years) with lower Friedman scores (≤ 2) seemed to have greater surgical success rates. BMI, neck circumference, tonsillar size, severity of OSA and presence of retrognathia did not seem to be predictors of outcome.

0475

A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED, PARALLEL-GROUP STUDY OF VI-0521 FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA/ HYPOPNEA SYNDROME IN OBESE ADULTS

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Introduction: Obstructive Sleep Apnea (OSA) is one of the co-morbidities closely associated with obesity. Since weight loss is known to improve objective parameters of OSA, the aim of this study was to evaluate the safety and efficacy of VI-0521 (a proprietary combination of topiramate and phentermine) compared to placebo in the treatment of adults with OSA. The primary objective was to assess the change in the apnea/ hypopnea index (AHI) between baseline and Week 28.
Methods: This study was a single-center, randomized, double-blind, placebo-controlled, parallel group trial and included 45 obese men and women (BMI 30 to 40 kg/m^2 inclusive), 30 to 65 years of age with OSA (AHI ≥ 15) at baseline, who had not been treated with, or who were not compliant with CPAP within three months of screening. Subjects were randomized to placebo or VI-0521 (15 mg phentermine/92 mg controlled-release topiramate). Subjects underwent a four-week dose titration followed by 24 weeks of additional treatment. Subjects were also provided with a lifestyle modification program (LEARN®). Overnight polysomnography was performed at baseline, Week 8, and Week 28. The primary endpoint was the change in AHI between baseline and Week 28.
Results: Subjects treated with VI-0521 achieved a significant improvement in AHI, from a mean AHI of 45.5 at baseline to a mean of 19.1 at Week 8 and 13.4 at Week 28 - a reduction of 26.4 and 32.3 events per hour, respectively (ITT/LOCF). Subjects in the VI-0521 group lost a mean of 5.6% and 11.0% of baseline body weight by Week 8 and Week 28, respectively. Significant improvements were also observed in secondary endpoints.
Conclusion: VI-0521 may represent a safe and effective treatment alternative to CPAP for some patients with OSA. Additional studies are needed to evaluate this approach.
Support (If Any): This research funded by grants from ViVUS, Inc.

0476

A CONVENIENT EXPIRATORY POSITIVE AIRWAY PRESSURE DEVICE IS EFFECTIVE FOR THE TREATMENT OF SLEEP APNEA IN MANY PATIENTS NON-ADHERENT WITH POSITIVE AIRWAY PRESSURE

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Introduction: Effectiveness of current OSA treatments is suboptimal because of inadequate efficacy or poor adherence. The efficacy and short-term effectiveness of an expiratory positive airway pressure (EPAP;

Provent) device was evaluated in patients previously non-adherent with positive airway pressure (PAP).
Methods: Participants were OSA patients > 18 y/o who refused PAP therapy or used PAP an average of < 3 hours per night. After demonstrating tolerability of one of two devices with different resistive loads (50 and 80 cm H2O/liter/sec at a flow rate of 100 ml/sec; D50, D80), pts underwent a baseline PSG and a PSG with their preferred device after 1 week of treatment. Patients meeting prespecified efficacy criteria (AHI < 10 or reduced > 50% or reduced > 30% with ESS reduced > 2) underwent another PSG after 5 weeks.
Results: Forty-seven of 59 eligible patients (80%) tolerated a device (24 preferred D50, 15 D80, 8 no preference; D50 assigned to 1, D80 to 7). Forty-three patients (27m, 16f; 53.7+10.9yrs) qualified for week 1 PSG. For baseline and week 1, respectively, mean AHI was 43.3+29.0 vs 27.0+26.7 ($P < 0.001$), mean minutes < 90% SaO_2 was 51.6+74.8 vs 35.7+76.5 ($P < 0.001$), and mean Epworth Sleepiness Score (ESS) was 12.5+5.1 vs 11.4+5.2 ($P = 0.096$). Twenty-four patients (56%) met prespecified efficacy criteria at week 1 PSG. At baseline, week 1 and week 5, respectively, the mean AHI was 31.9+19.8, 11.0+7.9, 16.4+12.2 ($P < 0.001$, baseline vs both week 1 and 5); mean minutes < 90% SaO_2 was 20.0+16.1, 4.9+5.6, 8.5+8.3 ($P < 0.001$, baseline vs both week 1 and 5; $P = 0.04$, week 1 vs 5); and mean ESS was 12.3+4.8, 11.1+5.1, 8.7+4.4 ($P < 0.001$ baseline vs week 5; $P = 0.03$, week 1 vs 5) . During an average of 32.4+2.0 nights per pt, the device was reported to be used during 93.7+6.9% of all sleep hours.
Conclusion: EPAP applied with a convenient device appears to be efficacious and effective for at least 4 weeks in many patients who were non-adherent with PAP therapy.

0477

PALATE-SUPPORTED SURGERY FOR OBSTRUCTIVE SLEEP APNEA/HYPOPNEA SYNDROME

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Introduction: Surgical treatments remain a highly desirable option for the patients with OSAHS. However, the current surgical treatments have equivocal results and are invasive to patients. Here we introduce a new surgical technique, palate-supported surgery for patients with OSAHS who are intolerant to CPAP.
Methods: Palate-supported surgery is the implantation of a palate-supporter made of Titanium with a certain rigidity and flexibility. One end of palate-supporter was fixed at about 10 mm to the edge of the hard palate. The other end was implanted into soft palate. The palate-supporters were different in the size as the length of patient's soft palate and the extent of pharyngeal stenosis and obstruction. With the approval of Institutional Review Board, 20 cases with moderate or severe OSAHS and tolerant to CPAP were enrolled into the study. All patients had both preoperative subjective assessment of daytime sleepiness and snoring level and objective assessment of polysomnogram (PSG). All patients received palate-supported surgery. Tonsillectomy, radiofrequency tongue-base reduction or nasal surgery was performed when needed. Follow-up continued for 6~18 months temporarily.
Results: Seventeen patients achieved significant subjective improvement. One patient also felt improvement in snoring in spite of the loosening of one palate-supporter. Two patients complained pain at the soft palate for 4 weeks after the operation. No the other discomforts were found during swallowing, velopharyngeal incompetence or speech disturbance at 12 weeks. No major perioperative complications occurred.
Conclusion: Palate-supported surgery may be a safe and effective surgical method to the CPAP-intolerant patients.

0478

IMPROVED OUTCOME OF FULL FACE MASK CPAP TREATMENT WITH MANDIBULAR STABILIZATION USING A DENTAL APPLIANCE

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Introduction: OSA patients encountering difficulties with nasal CPAP masks are frequently transitioned into Full Face masks (FFM). Unfortunate failure with FFM can frequently occur. Clinical experience has demonstrated that one of the pitfalls of FFM therapy results from displacement of the mandible by tightening the lower mask straps. Typically the straps are tightened to overcome leakage from the chin region of the FFM when the mandible relaxes. Tightening the straps enhances the patients obstruction in the back of the throat. To overcome FFM failures mandibular advancing dental appliances, such as the TAP, have been utilized to stabilize the mandible and provide a better anchor against the FFM cushion. This approach has worked well over the past several years. This study is an attempt to provide a statistical analysis of this approach to show clinical benefit in FFM failure patients.
Methods: Ten consecutive patients meeting the profile of 1) failing treatment with a Full Face mask 2) having intact teeth allowing utilization of a dental appliance and 3) who on examination with the FFM and machine on, a recognized improvement of mask fit was obtained by the examiner while the patient was supine, protruding the mandible slightly forward or keeping the mandible in a stable end on end relationship of the bite. A boil and bite dental appliance (SnoreFree) was made and fitted in conjunction with their FFM for optimal fit to resolve leakage. A six question questionnaire was taken before and after a treatment period with the combined FFM / Dental Appliance therapy.
Results: Of the ten patients, nine completed the study. One patient dropped out of the study because of pain from the appliance. Subsequent assessment revealed chronic nasal obstruction in that patient requiring mouth breathing into the mask. All remaining 9 patients demonstrated statistical improvement on the 6 question survey. Analysis of variance was significant with a $P < 0.001$
Conclusion: It is clear from clinical experience that FFM failures frequently occur from mandibular movement. This study supports clinical experience that mandibular stabilization can improve the performance of FFM CPAP treatment. However, this combined method is not applicable to all patients and particularly those with nasal obstruction, requiring oral breathing, a dental appliance seems contraindicated.
Support (If Any): SnoreFree appliances were provided by the SMILE Foundation and the APPLIANCE THERAPY GROUP, Chatsworth California

0479

EFFECT OF ARMODAFINIL ON CORTICAL ACTIVITY AND WORKING MEMORY IN PATIENTS WITH RESIDUAL EXCESSIVE SLEEPINESS ASSOCIATED WITH CPAP-TREATED OSA: AN fMRI STUDY

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Introduction: A prior neuroimaging study identified persistently decreased prefrontal cortical activity and impaired working memory performance in patients with CPAP-treated OSA. The current study evaluated armodafinil's effect on these alterations in patients with residual excessive sleepiness associated with CPAP-treated OSA.

Methods: In this 2-week, multicenter, randomized, double-blind, placebo-controlled study, 40 patients were randomized to armodafinil 200 mg/day or placebo. The primary efficacy measure was change from baseline to final visit in activation volume of the dorsolateral prefrontal cortex (DLPFC) measured using fMRI. The key secondary measure was change in response latency on the 2-back working memory task performed during scanning. Other measures included activation volume in other predefined regions of interest (ROI), and % change in blood oxygenation level-dependent (BOLD) signal intensity and resting state activation in ROI. Safety and tolerability was also assessed.
Results: Patients given armodafinil (n = 20) or placebo (n = 16) had similar demographic and baseline clinical characteristics. During the task, changes in activation volume in the DLPFC and other ROI and in 2-back response latency were not significantly different between groups, and changes in BOLD signal intensity in ROI were inconsistent. In the resting state, although not statistically significant, patients in the armodafinil group showed increases in functional correlation in ROI compared with placebo, especially in the DLPFC and thalamus. Resting state imaging in the areas of the default mode network also suggested increased correlation compared with the placebo group. Armodafinil was generally well tolerated.
Conclusion: During performance of a working memory task, armodafinil did not increase activation in ROI as measured by fMRI or decrease response latency compared with placebo in patients with residual excessive sleepiness associated with treated OSA. Although not statistically significantly different from placebo, resting state data suggested that armodafinil 200 mg/day may enhance functional connectivity in the attention/executive function network and increase activation of the default mode network.
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0480

EFFECT OF A SELF-MANAGEMENT INTERVENTION ON OSA OUTCOMES

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Introduction: Adherence to CPAP is suboptimal. This study compared Usual Care (UC) to a Self-Management (SM) Program. This abstract focuses on whether key OSA outcomes differed by group.
Methods: This was a randomized, controlled trial of UC compared to a SM intervention, which consisted of group-based self-management education and is based on social-cognitive theory. The SM education consisted of three weekly sessions over the first 2 weeks of CPAP use, and included group review of CPAP, along with a focus on troubleshooting any problems. Only CPAP-naive patients were included in this study. Changes scores were calculated as post-score minus baseline score. T-tests were run on change scores.
Results: 240 patients diagnosed with OSA and prescribed CPAP were studied. At baseline, mean age = 58.1 ± 12.3, mean AHI = 37.5 ± 20, and mean BMI = 33.4 ± 6.3 (mean ± SD). At baseline, the groups did not differ on sleep apnea severity or body mass index. At one-month follow-up, the groups did not differ on self-reported sleep apnea symptoms, Epworth Sleepiness Scale, SAQLI, PSQI or QWB. The groups did differ on measures of social-cognitive theory, including outcome expectations (-.21 vs. .05, P = .03) and self-efficacy (-.39 vs. .07; P = .001) (UC vs. SM, respectively). The magnitude of change on CPAP across groups was clinically significant, for example, ESS was reduced from 12.4 to 8.6 (P < .001).
Conclusion: Self-Management training did not result in significant symptom improvement relative to Usual Care at one-month. However, SM did result in greater levels of self-efficacy (SE) and outcome expectations (OE) than UC. It may be that SE and OE are important for longer-term use of CPAP. Future analyses will focus on whether these SCT variables are predictive of higher levels of adherence or symptom improvement at longer follow-up periods.
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0481

WEIGHT LOSS IMPROVES RDI AND VASCULAR FUNCTION

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Introduction: We hypothesized that weight loss may improve vascular function to a greater degree in those with improvement in sleep apnea after weight loss surgery.
Methods: Obese subjects, free of pre-existing cardiovascular (CV) disease and known CV co-morbidities (other than obesity, OSA, hypercholesteremia & htn) undergoing bariatric surgery were enrolled. OSA was defined as RDI > 10/hour. All patients underwent overnight polysomnography (PSG) and vascular studies the following morning. Vascular function was measured by high resolution ultrasound of the brachial artery before and after flow mediated vasodilation and 400 ug sublingual nitroglycerin. Vascular function is reported as the percent increase in the diameter of the brachial artery after flow mediated dilation (FMD) and nitroglycerin (NID).
Results: Nine subjects (8 females and 1 male) were studied at baseline and approximately 6 months after weight loss surgery. 7 out of 9 subjects met criteria for a diagnosis of OSA, and 1 of 9 subjects had both htn and hypercholesteremia. Subjects were middle aged (mean age 41 years), obese (mean baseline BMI 46 kg/m^2), with an average RDI of RDI 20 events/hour. On follow up, subjects showed significant improvements in weight (mean 133 vs. 98 kg, P < 0.009), BMI (mean 46 to 35 kg/m^2, P < 0.009), RDI (mean 20 vs. 9 events/hour, P = 0.04), total sleep time (mean 350 vs. 403 minutes, P = 0.01), sleep efficiency (mean 85 vs. 93%, P = 0.02), and FMD (7.5 vs. 12.4%, P = 0.04). NID was also improved, but these changes did not reach statistical significance (14 vs. 18%, P = 0.3). In addition, 4 of 7 subjects had resolution of their OSA. Improvements in FMD and NID were not significantly correlated with changes in either RDI or BMI. However, those that had an improved FMD after weight loss (defined by an absolute improvement of 5%) were more likely to have a change in RDI on the second visit (mean RDI dropped by 21 rather than 3 events/hour) and a greater decrease in BMI on the second visit (mean BMI dropped by 14 rather than 9 kg/m^2). These changes did not reach statistical significance. There were no such differences in those subjects with an improved NID after weight loss.
Conclusion: Our data suggest that even relatively young, obese sleep apnea subjects without pre-existing cardiovascular disease, have improved vascular function with weight loss. This improvement may be associated with a decrease in both weight and RDI. Limitations include the small number of subjects and further research is ongoing.
Support (If Any): This work was supported by the American Sleep Medicine Foundation Physician Scientist Training Award

0482

EFFICACY OF A BODY POSITION DEVICE FOR THE TREATMENT OF POSITIONAL OBSTRUCTIVE SLEEP APNEA SYNDROME (OSASp)

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Introduction: Pure OSASp (i.e only apnea and hypopnea events on back position) is a frequent diagnosis which represents about 10% of apneic patients in our sleep centre. CPAP is the best treatment when IAH is high (IAH > 30/h). Light, moderate or more severe OSASp could benefit of a positional treatment. The usefulness of a tennis ball treatment has

been demonstrated, however patient are usually not convinced and rapidly abandoned. The aim of this study has been to precise the efficiency of a positional treatment specifically developed for OSASp and fitted on each patient. The device is a big volume on back obliging patient to stay on left or right side.
Methods: Twenty-eight patients with OSASp has been included (after a sleep center PSG recording) for a first part of the protocol (wearing the device 7 nights, D7) and 20 patients signed for the second part of the protocol (wearing the device for 3 months,M3).
Results: Statistically significant results : 1) Sleep : i) Time spent on back has been reduced from 187 min to 13 min at D7 and 32 min at M3; ii) reduction of the Total sleep time, (384 min to 335 min at D7 and 331 min at M3), iii) mainly on stage N2 (205 min to 159 min at D7 and 146 min at M3); 2) AHI : Total AHI reduced from 26,3/h (sd = 13,3) to 10,1/h (sd = 8,2) at D7 and 7,8/h at M3; BackAHI has been reduced from 49,6/h (± 20,1) to 9,2/h (± 18,7 ; P < 0,0001) at D7 and 10,8/h (± 20,2 ; P = 0,0003) at M3; NonbackAHI stay stable from 8,5/h (± 6,1) to, 11,3/h (± 8,3 ; P = 0,14) at D7 and 7,9 (± 7 ; P = 0,45) at M3; 3) SpO_2 : the minimum nocturnal SpO_2 increase from 84,8% to 87,6% (± 5,6 ; P = 0,03) at D7 and 88,3 (± 4,2 ; P = 0,04) at M3. 4) Micro arousal index decreased from 22,1/h (± 12,3) to 9,2/h (± 10,6 ; P = 0,0009) at D7 and 8,2/h (± 6,8 ; P = 0,0005) at M3.
Conclusion: This is an efficient device which can be used as a first line treatment for OSASp. Apnea and hypopnea events has been normalized under treatment as well as sleep parameters (decreased of light sleep and no micro arousal). Fatigue has been also significantly decreased on fatigue scale after 3 months treatment.

0483

A SECONDARY ANALYSIS COMPARING A HEATED CPAP BREATHING TUBE TO A NASAL STEROID IN POORLY COMPLIANT PATIENTS: QUALITY OF LIFE AND FUNCTIONING

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Introduction: Some of the consequences of sleep apnea are diminished quality of life (QOL) and impaired daytime functioning due to poor sleep quality. Improving these variables can lead to better long-term treatment compliance. The current study is a secondary analysis of a larger study to determine if heated humidity with a heated breathing tube, Thermosmart™ (TH), is comparable to an intranasal steroid (NS) in improving QOL and daytime functioning in poorly compliant CPAP patients.
Methods: As part of a larger study assessing compliance between TH and NS treatments, patients completed the Functional Outcomes of Sleep Quality (FOSQ), the Fatigue Severity Scale (FSS), the Pittsburgh Sleep Quality Index (PSQI), and the nocturnal Rhinoconjunctivitis Quality of Life Questionnaire (nRQLQ) at each study visit. Visits occurred at screening, baseline, and after each treatment arm (TH or NS). Patients had to be on CPAP > 3 weeks with usage < 5 hrs/night and a complaint of adverse nasal symptoms related to CPAP.
Results: A total of 32 patients were included in this secondary analysis. Compliance data is discussed in detail elsewhere, but significantly increased from screening in both treatment arms. Consequently, global FOSQ scores significantly improved in both treatment arms (61.5 screening vs. 48.9 NS vs. 44.7 TH, P < .001), as well as FSS scores (4.76 screening vs. 5.10 NS vs. 4.20 TH; P < .05) and global PSQI (10.2 screening vs. 7.3 NS vs. 7.1 TH, P < .001). Improvements in nasal symptoms using the nRQLQ were identified as a strong correlate with improved daytime functioning and sleep quality (P < .05) and was a predictor of perceived sleep quality (F = 7.09, P < .05), suggestive as a potential secondary factor in improved CPAP usage.
Conclusion: The TH group performed as well, and even marginally better at improving vital outcome variables linked with the consequences of OSA as the NS group. Improvements in these variables can be critical to improve and sustain proper treatment compliance.
Support (If Any): Study funded by Fisher & Paykel Healthcare, Inc.

0484

GREATER LOS ANGELES VETERANS ASSOCIATION EXPERIENCE WITH MANDIBULAR ADVANCEMENT DEVICES FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Compliance with CPAP for obstructive sleep apnea (OSA) remains suboptimal and mandibular advancement devices (MADs) are an alternative treatment option. Although MADs are recommended for mild to moderate OSA, at times they are used for severe disease due to patient preference or non-compliance with CPAP. We describe our institution's experience with MADs for mild, moderate and severe sleep apnea.
Methods: Nineteen patients (mean age 64 ± 9; 18 male) with OSA underwent an overnight polysomnogram at baseline and after treatment with an MAD. All patients were offered CPAP as initial therapy but were noncompliant and then transitioned to an MAD.
Results: At baseline the average AHI was 33 ± 25 (11 severe OSA; 3 moderate OSA; 5 mild OSA). Baseline BMI was 32 ± 5 kg/m^2. After treatment with the MAD the AHI decreased to 15 ± 13 but the BMI remained stable at 32 ± 6 kg/m^2. Fourteen patients had improvement in their AHI while five patients showed no change or a deterioration in their AHI. There was a significant improvement in AHI after treatment with the MAD (18 ± 23% improvement in AHI; P = .003) without significant reduction in BMI (P = .37). There was no correlation between change in AHI and change in BMI.
Conclusion: MAD is a viable option for patients with OSA who do not tolerate CPAP. A sleep study to verify effective treatment with an MAD is recommended.

0485

TITRATABLE MANDIBULAR REPOSITIONING APPLIANCES IMPROVE PSG PARAMETERS

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Introduction: Mandibular Repositioning Appliances (tMRAs) designed with a titrating mechanism are effective to treat Obstructive Sleep Apnea Syndrome (OSAS) but are not widely used besides many studies have proven their value. The aim of the present study was to evaluate the efficacy of the ARMIO oral appliance on the polysomnographic parameters as Apnea Index (AI), Hypopnea Index (HI),Total Time of Sleep (TTS), Sleep Efficiency (SE) Oxygen Saturation (O_2Sat), Arousals per hour (AH), Total Time REM (TTR), Longest Apnea Time (LoAp) and Mean Apnea Time (MeAp).
Methods: We treated 136 (97M/39F) OSAS patients with ARMIO™ oral appliance, 43 with mild, 58 with moderate and 35 with severe OSAS. They went through a new polysomnography after ARMIO titration protocol to access sleep parameters. Wilcoxon test and Student t Test were performed to analyze data.
Results: The means of TTS, pre and post titration protocol, were 360,8 ± 66,5min. and 362.6 ± 67.5min. (P = 0.727), ES: 83.3 ± 11,1min. and 85.2 ± 11min. (P = 0.085), O_2Sat: 82.9 ± 6.9% and 87.3 ± 6.7% (P < 0.001), AH: 26.9 ± 17.9/h and 11.9 ± 11.7/h (P < 0.001), AI: 12.4 ± 17.9h and 2.6 ± 4.3/h (P < 0.001), HI: 11.6 ± 10.1/h and 3.1 ± 3.6/h (P < 0.001), RTT: 66,6 ± 30.8min. and 72.2 ± 29.3min. (P < 0.072), LoAp: 39.7 ± 22.9secs. and 22.7 ± 16.6secs. (P < 0.001), MeAp: 18.8 ± 8.2secs. and 13.6 ± 8.4secs. (P < 0.001) respectively. Eighty-one (59%) of the 136 patients were treated successfully (AHI < 5). Thirty-two (76%) of the

mild patients, 36 (62%) of the moderate patients and 13 (37%) of severe patients with OSAS were treated successfully according to the American Academy of Sleep Medicine. (AHI < 5).
Conclusion: The majority of PSG parameters have improved with ARMIO™ treatment suggesting that tMRAs are an additional valuable option even for some cases of severe apnea in which the patient does not tolerate CPAP or cannot afford this treatment.

0486

COGNITIVE BEHAVIOR THERAPY FOR APNEA

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Introduction: Obstructive sleep apnea syndrome (OSAS) is associated with sleepiness, fatigue, depression, and obesity. It is important understanding the need for treatment and compliance to it. There is no cognitive behavioral therapy for apnea although changes in behavior and cognition are essential to improve the outcomes in treatment. Objective. To propose a cognitive behavior therapy for OSAS (CBT-OSAS) and access its feasibility and efficacy.
Methods: Consecutive OSA patients of Neuro-Sono Unifesp were assigned to an 1.5 hour 3 weekly group meeting CBT-A including 3 components: educational - what OSAS is, its consequences, risks, severity, types of and compliance to treatments; behavioral - diet and exercise program, reduction/elimination of alcohol consumption; cognitive - change in dysfunctional beliefs and attitudes about OSAS and its treatments. After treatment, 23 (11M/12F) participants, age 56 ± 9.5, education years 8.5 ± 5.0, attended to follow up and answered a subjective questionnaire with scores from 1 (very bad) to 5 (excellent) were used to evaluate CBT-OSAS effect.
Results: Ten patients (44%) were not doing physical exercising before CBT-OSAS and 5 of them started a non-supervised exercise free schedule after it. Sixteen patients (70%) were on a diet program before CBT-OSAS and 17 (75%) were on a non-supervised diet free schedule after it. Six patients (25%) were not on a diet program and 1 of them (4%) does not exercise while the other five patients (22%) were on an exercise program. Scores obtained for CBT-OSAS after treatment were: 4.6 ± 0.6; learning about apnea: 4.2 ± 1.0; apnea risks: 4.7 ± 0.6; need for CPAP use: 4.6 ± 0.6; need of accepting CPAP: 4.1 ± 1.2; and importance of compliance to the treatment: 4.7 ± 0.5. All results post CBT-OSAS were in the range of good to excellent.
Conclusion: CBT-OSAS improved patient's knowledge about OSAS and how to cope with it. The extent in which this knowledge will positively impact on the outcomes must be further investigated.

0487

PREDICTORS OF COMPLIANCE WITH CONTINUOUS POSITIVE AIRWAY PRESSURE TREATMENT IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA TO INITIATION OF USE HEATED HUMIDIFIER FROM INITIATION OR TO USE OF AFTER 1 YEAR LATER

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Introduction: The efficacy of CPAP for OSAS is directly proportional to the duration of use. One of the most important factor reducing compliance is often the nasal resistance in sleep. This study compared patient compliance with heated humidifier from initiation or to use it of duration 1 years later.
Methods: Compliance with two period of duration (from initiation vs. after 1 year later of usage) Remstar M CPAP (n = 150) or with humidifier (n = 150), as well as with differences of pressures (< 8 cmH2O vs. > 8 cmH2O) therapy was compared in parallel groups of patients with severe OSAS (RDI: 52 ± 12/hour, mean oxygen saturation: 82 ± 8%;). Patient compliance was assessed by determining mean duration of respiratory support use in hours. Therapeutic efficacy was appraised by monitoring RDI, arousal index at control visits. All patients had normal, or mild respiratory dysfunction. Patients with heart failure or advanced respiratory disease were excluded
Results: After two years, mean daily duration of the groups was as follows: early initiation use of heated humidifier 7,14 ± 2.4 hours vs. late of initiation 5,25 ± 2.6 hours; RDI: 4 ± 1,2/hour, late of initiation RDI: 3,8 ± 1.4/hour. As regards between high-pressure and low-pressure treatment, values were not significant difference, irrespectively of the time of the initiation to use of CPAP with heated humidifier.
Conclusion: The use heated humidifier of initiation CPAP therapy significantly improved patient compliance irrespectively of pressure treatment. In the latter the value of RDI of these cases, however, improvement was not statistically significant.

0488

THE EFFICACY OF FULL-FACE VERSUS NASAL PAP MASKS

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Introduction: Positive airway pressure (PAP) continues to be the most effective treatment for obstructive sleep apnea(OSA). Untreated OSA has been associated with congestive heart failure, stroke, and hypertension. As a consequence, it is imperative to maximally treat this disease. Potentially, the type of PAP mask used may play a role in the extent to which the OSA is treated. The purpose of this study was to evaluate the effectiveness of full-face mask, standard nasal mask and nasal pillows.
Methods: There were 41 study participants, 17 females, 24 males, ranging in age from 33 - 82. All participants had been previously diagnosed with OSA and had returned for PAP titrations at the Center for Sleep Medicine, Weill Medical College of Cornell University. Participants were randomly assigned to use a full-face mask, standard nasal mask, or nasal pillows. For each patient, the following variables were measured: Final AHI, lowest SaO_2, final PAP, sleep efficiency, and mask leakage.
Results: Controlling for age and gender, patients titrated with full-face masks had significantly higher final AHI's ($F(5,35)$ 2.84, $P = 0.049$) and PAP pressures ($F(4,36)$ 3.39, $P = 0.031$) compared to patients titrated with standard nasal masks or nasal pillows. In addition, patients titrated with full-face masks had the highest mask leakage, while patients titrated with nasal pillows had the least mask leakage ($F(4,35)$ 9.43, $P = 0.001$).
Conclusion: The use of the full-face mask on a PAP titration study may result in a higher final AHI and PAP pressure with higher mask leak. Therefore, caution should be used when considering switching a patient from a full-face mask, nasal mask, or nasal pillows if the other type was used on the titration study.

0489

APNEA DURATION AS A PREDICTOR OF BASELINE COGNITIVE PERFORMANCE AND 3-MONTH ADHERENCE TO CPAP

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Introduction: OSA is a common medical condition with multiple comorbidities. Neurocognitive dysfunction has been demonstrated with OSA, but correlations with apnea severity have not been consistent. There have been no attempts to correlate total time in apneas/hypopneas with cognitive performance or adherence to CPAP. We examined the relation between duration of apnea/hypopnea and cognitive performance and adherence to CPAP.
Methods: We measured duration, in seconds, of scored events (i.e., obstructive apneas, hypopneas, central apneas, and mixed apneas) in 17 newly diagnosed patients. The duration of an event was recorded

from the nadir prior to the first breath meeting scoring criteria to the nadir preceding the next normal breath. Apneas were measured using the oronasal thermal sensor and hypopneas using the nasal air pressure transducer. Cumulative time of all scored respiratory events during the diagnostic study and minimum oxygen saturation while sleeping were recorded. All patients were also given brief cognitive batteries prior to being delivered CPAP. Patients were then provided CPAP to use for 3 months and adherence was monitored objectively.

Results: Total time spent in apnea/hypopnea was related to BMI ($r = .51$, $P < .05$) and anxiety sensitivity ($r = .57$, $P < .05$). Trends were seen with memory and motor speed, but they occurred in the opposite direction than expected (demonstrating an advantage with greater time spent in apnea/hypopnea). Traditionally scored AHI demonstrated all the same correlations with the exception of those with cognitive functions.

Conclusion: Duration of time in apnea/hypopnea does correlate with BMI and anxiety sensitivity, but does not reliably correlate with adherence or any cognitive measure. It shows no particular advantage over traditionally scored AHI. There is some evidence that longer apnea durations might be associated with better memory and motor performance. This could be due to cellular accommodation to when they are of long duration.

Support (If Any): This work was supported by a grant from NHLBI 2R01 HL67209

0490

RISK FACTORS FOR PRESCRIPTION OF BILEVEL AIRWAY PRESSURE FOR OBSTRUCTIVE SLEEP APNEA IN A LARGE VA POPULATION

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Introduction: Bi-level airway pressure (BPAP) may increase PAP tolerability for some patients. Laboratory protocols determine whether a patient should receive a BPAP, but patients diagnosed with obstructive sleep apnea (OSA) via portable home respiratory monitoring are not assessed for a need for BPAP and may be routinely prescribed an autotitrating CPAP (APAP). We examined demographic and co-morbidity correlates of a BPAP prescription in 1489 patients diagnosed in a sleep laboratory and in 36 patients who were switched from CPAP (or APAP) to BPAP.

Methods: Two separate study populations were examined: (1) Data were extracted for 1489 Veterans undergoing a standard laboratory sleep study between April 2003 and September 2006. (2) We also found a total of 36 patients who had received both a CPAP (or APAP) and a BPAP within the 3 ½ year study period. We compared BPAP prescriptions among subgroups using a chi-square test.

Results: Among the 1489 patients diagnosed in the laboratory, patients were significantly more likely to receive BPAP if they were older, male, heavier, co-pay exempt, had a Charlson morbidity index (CMI) > 2, had heart failure (CHF 19.5% vs 9.2% without CHF), COPD, severe OSA (27.6% vs 6% mild/moderate), and O_2 levels < 82%. Compared to patients with only a CPAP record, the 36 patients (1.4% of sleep study sample) who switched from CPAP to BPAP were significantly: More obese, sicker (CMI 2.7 vs 1.7), and more likely to have CHF (48.1 vs 13.4) and severe OSA (70% vs 23%).

Conclusion: Strong correlates for a BPAP prescription include severity of the OSA, morbid obesity and specific co-morbidities. Thus if a patient is diagnosed for OSA without a protocol to assess the need for BPAP, clinicians should these consider patient factors in deciding whether to prescribe auto-BPAP as first line therapy. Other investigators should study cost-effectiveness of this approach.

0491

PRELIMINARY REPORT ON THE IMPACT OF CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) THERAPY ON HEALTH-RELATED QUALITY OF LIFE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA AND CHRONIC OBSTRUCTIVE PULMONARY DISEASE (OVERLAP SYNDROME)

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Introduction: Chronic obstructive pulmonary disease (COPD) and obstructive sleep apnea (OSA) are major causes of morbidity worldwide. 'Overlap syndrome' defines the coexistence of OSA and COPD. This study will address the impact of CPAP therapy on health-related quality of life (QoL) in patients with overlap syndrome.

Methods: This is a prospective observational study of patients with overlap syndrome who were started on CPAP therapy. A control group of patients with OSA only is recruited for comparison. All participants underwent a baseline polysomnography. In addition, patients completed the SF-36 questionnaire and Epworth Sleepiness Scale (ESS) at baseline, 4 months, and 1 year after CPAP initiation. Patients with COPD and OSA also completed St George's Respiratory (SGRQ). Adherence to CPAP treatment was measured at 4 months and 1 year. Univariate analysis, analysis of variance (ANOVA), and Friedman's test will assess impact of different variables.

Results: 15 subjects are currently enrolled in study. Four month follow-up data is available in 10 patients. Mean age was 64.5 years in the overlap syndrome group and 59.7 years in the OSA only group. Patients with overlap syndrome were less overweight compare to OSA only group (BMI 29.4 vs. 35.9 kg/m^2). Patients with overlap syndrome had less severe OSA (AHI 29.4 vs. 41.8) and were less sleepy (ESS 7.5 vs. 12.7) than the OSA only group. After 4 months, mean adherence was poorer in the overlap group (45.4% vs. 60.4% nights use) and there was a smaller improvement in ESS scores (decrease of 0.5 vs. 3.4) compare to the OSA only group. After initiation of CPAP treatment, there was no change in health related quality of life measured by SGRQ and SF36

Conclusion: Based on the preliminary data, patients with overlap syndrome have less severe OSA and are more likely to have poorer initial adherence to CPAP therapy. In addition, CPAP therapy did not positively impact the health-related quality of life in patients overlap syndrome.

0492

A COMPARATIVE STUDY OF THE BENEFIT OF CPAP THERAPY ON HEART ARRHYTHMIA BETWEEN PATIENTS WITH SEVERE AND MILD-MODERATE OSA

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Introduction: Many studies have shown a link between Obstructive Sleep Apnea (OSA) and heart problems - some have even indicated that OSA may be an independent risk factor for hypertension and other heart problems. If this is the case, by eliminating OSA with Continuous Positive Air Pressure (CPAP) therapy, heart problems should be resolved. The current study intends to determine if there is a difference in the benefit of CPAP therapy on subjects with severe OSA (AHI 30+) and heart arrhythmia compared to those with mild-moderate OSA (AHI < 30) with similar problems.

Methods: A sample of 20 patients with a history of heart arrhythmia was taken from the clinic's database and were divided evenly into two groups - severe OSA and mild-moderate OSA. The ECG trace of an initial PSG was compared to one of a CPAP treatment PSG. Arrhythmia was determined to be resolved if it appeared less than 20% of the total ECG recording.

Results: Of 10 subjects with severe OSA, 4 were found to have resolved arrhythmia. Of 10 subjects with mild-moderate OSA, 7 were found to have resolved arrhythmia. A Fisher's exact test analysis was performed on data yielding a P-value of 0.3698, indicating the results are not statistically significant and therefore failing to reject the null hypothesis.
Conclusion: A general trend of results indicated patients with mild-moderate OSA have more of an immediate benefit with CPAP therapy for heart arrhythmia compared to those with severe OSA. This may imply the heart arrhythmia in severe OSA patients stem from more than just sleep apnea, perhaps underlying conditions requiring more than CPAP treatment.

0493

ASSESSMENT OF NEIGHBORHOOD SOCIOECONOMIC STATUS AS A RISK FACTOR INFLUENCING CONTINUOUS POSITIVE AIRWAY PRESSURE COMPLIANCE

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Introduction: Risk factors associated with continuous positive airway pressure (CPAP) noncompliance are not well understood, but it is hypothesized that socioeconomic status may influence treatment acceptance and adherence.
Methods: A retrospective chart review was performed on 62 CPAP naïve, newly diagnosed obstructive sleep apnea hypopnea syndrome (OSAHS) patients from 2005 to 2006. Patients were divided into two groups based upon CPAP compliance (> 4hrs of use > 70% of days). Patients were also categorized into two groups, above or below the median household income by state, according to their neighborhood socioeconomic level index derived from the 2000 U.S. Census Bureau Data for Illinois and Missouri.
Results: 28 patients (48%) were found to be noncompliant with treatment. Of those noncompliant patients, 62% were found to live in neighborhoods ranked under the median state income. Overall, patients in the noncompliant group had a mean neighborhood household income of $40,511 ± $22,218 compare to the compliant group□s earning $47,354 ± $22,162. All patients underwent an in-laboratory, attended polysomnogram and titration. Other characteristics were similar between the noncompliant and compliant groups (age 54.1 ± 14.9 vs. 52.3 ± 14.3, BMI 37.5 ± 9.4 vs. 35.7 ± 6.7, male 55% vs. 56%, optimal CPAP pressure 10.6 ± 3.4 vs. 9.5 ± 2.6, AHI at optimal pressure 1.2 ± 1.4 vs. 1.6 ± 1.6). Noncompliant patients were also more likely to be from ethnic minority decent (39.3% vs. 25%). These patients were found to have a lower income which is consistent with the 2000 U.S. Census Bureau report.
Conclusion: Findings indicate that patients residing in a neighborhood with an overall median household income below the median state income are at higher risk for noncompliance with CPAP. Further investigation is needed to examine the impact of individual household income in addition to other socioeconomic factors upon noncompliance.
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0494

LEPTIN LEVELS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME AND THE EFFECT OF CPAP TREATMENT OVER LEPTIN LEVELS

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Introduction: We examined the profiles of lipid, fasting blood sugar and circulating leptin in obese men with obstructive sleep apnea syndrome (OSAS) and without OSAS. We also measured leptin levels in OSAS subjects before and after treatment with continuous positive airway pressure (CPAP) to understand the relationship between leptin and sleep apneic activity.
Methods: 33 untreated obese patient with moderate-severe OSAS (apnea-hypopne index:AHI ≥ 15) and 24 obese control (AHI < 5) were studied. To confirm the diagnosis, all patients underwent standart polysomnography (PSG). Serum samples were taken at 08:00 h in the morning after overnight fasting. Those subjects who received regular treatment with CPAP were recruited to the reassessment study at 3 months (25 patient).
Results: The mean age (± SD) of the OSAS and control groups were 45.2 ± 8.5 and 40.5 ± 9.5 respectively (P = 0.11), body mass index (BMI) of the OSAS and control groups were 33 ± 4.0 kg/m^2 and 30.7 ± 1 kg/m^2 respectively (P = 0.004). No significant difference between OSAS and control groups were noted in levels of fasting blood sugar , leptin , cholesterol, trygliserid, LDL cholesterol and HDL cholesterol .In OSAS group there was no correlation between AHI and leptin levels (r = -0.231 P = 0.195). After treatment with CPAP; BMI, NREM3 sleep time, neck and waist circumferences did not change significantly. But after treatment with CPAP; there were significant changes in: AHI (before:47.2 ± 21.8 after 3 ± 3), epworth sleepiness scale (before:10.9 ± 5.8, after 9.8 ± 5.7), mean oxygen saturation (SaO_2) (before:88.2 ± 3.13, after:94.1 ± 1.7), minimum SaO_2 (before:71.9 ± 10.3 after:87.7 ± 5.7), percentage of sleep time with SaO_2 > 90 (before:47.7 ± 29.9, after 96.3 ± 6.6) and percentage of REM sleep time (before 11.1 ± 6.8, after 20.4 ± 8.4). After treatment with CPAP only a trend for a decrease in leptin level (10%) was found and the change was not significant (P = 0.279) and no correlation was found between leptin and all above mentioned parameters.
Conclusion: OSAS has no association with serum leptin levels. Also CPAP therapy has no significant change over leptin levels.

0495

THE IMPACT OF PAP EDUCATION AND TROUBLESHOOTING ON 3-MONTH ADHERENCE IN SUBJECTS WITH OBSTRUCTIVE SLEEP APNEA (OSA) PARTICIPATING IN THE HOMEPAP STUDY

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Introduction: While PAP is generally efficacious in the treatment of OSA, resistance and intolerance to treatment limit its effectiveness. We investigated the impact of PAP education and troubleshooting in the HomePAP study, a multi-center clinical trial comparing PAP adherence in subjects with moderate to severe OSA randomized to a standardized Lab- or Home-based evaluation and treatment.
Methods: Encounters with study personnel were prospectively documented. Pearson's correlations between PAP adherence (percent nights use > 4hrs) and PAP education time, number of PAP-related interventions and optimism toward treatment were assessed. Multivariate linear regression tested the association between adherence and education time/

interventions controlling for age, gender, education level, BMI, AHI, baseline ESS, pressure, treatment arm and site.
Results: 138 subjects completing 3 month follow-up were: age 49+12 years, 64% male, 70% white, BMI 38.5+8.8 kg/m^2, ESS 14.3+3.7, and AHI 46+26. Subjects received 45.2+17.9 minutes education and had 1.1+1.4 PAP-related interventions. 78 (57%) subjects had > 1 intervention, 39 (28%) had > 2, and 20 (14%) had > 3. Most common was mask change (33% of subjects), followed by pressure change (25%). Other interventions were addressed in 27% of cases. Education time was slightly greater in the Home arm (47.7 vs. 42.3, P = 0.07). Total interventions (1.12 vs. 1.09) and optimism toward treatment (96 vs. 98%) did not differ between groups. In adjusted analyses, no significant associations were found between adherence and education time, interventions or optimism toward treatment.
Conclusion: Preliminary findings indicate that the majority of patients initiated on PAP require interventions to address treatment-related issues, notably changes in masks or pressure settings. However, the impact of education and troubleshooting on adherence is unclear. Data related to mask leaks and number of healthcare provider/subject contacts during treatment are being analyzed. Further investigation is required to identify specific interventions that improve adherence.
Support (If Any): American Sleep Medicine Foundation 38-PM-07 Grant: Portable Monitoring for the Diagnosis and Management of OSA.

0496

EXPLORING EFFECTS OF CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) ON MIDDLE-AGED AND OLDER ADULTS' COGNITIVE PERFORMANCE

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Introduction: The presence of cognitive deficits in obstructive sleep apnea (OSA) is well-documented. Specifically, short-term memory, attention/vigilance, and executive function (e.g. processing speed) are affected. However, cognitive deficits in aging occur in similar areas. This study investigated whether benefits of CPAP on cognitive performance have a differential effect based on age by comparing middle-aged and older adults with OSA on computer-based measures before and after CPAP treatment.
Methods: Nine middle-aged (age 35-55; 4M/5F) and eight older participants (age 65+; 4M/4F) with OSA recruited from a sleep medicine clinic completed a baseline overnight polysomnography and the Automated Neuropsychological Assessment Metrics (ANAM). Participants had an average AHI of 33.8 ± 18.8 and 32.7 ± 16.5, respectively. Participants then spent an average 37.9 ± 10.1 days with in-home CPAP use, after which they returned for a post-treatment ANAM and had compliance and breathing data downloaded via the CPAP device.
Results: AHI over the treatment period averaged 8.0 ± 11.6 for middle-aged adults and 10.9 ± 4.9 for older adults; average use on nights used did not differ between groups and was 5.7 hours. There was no effect of age and no interaction between age and treatment on response time in milliseconds, although there was a trend for effect of treatment (F (5,10) = 3.7, P = .08). For accuracy, there was no effect of treatment and no interaction, although there was an effect of age (F(5,10) = 5.7, P = .03). However, post-hoc analyses showed that middle-aged adults performed significantly better (92.9%) than older adults (79.7%) on a short-term memory measure only (P = .01).
Conclusion: No differential effect of CPAP treatment based on age was documented for either speed or accuracy on neurocognitive measures. Results suggest that, other than short-term memory, older adults with OSA are capable of performing cognitively at a similar level to middle-aged adults with OSA, and that treatment may improve response time but not accuracy for both.

0497

A NOVEL ORAL MASK IMPROVES CONVENIENCE IN CPAP-TREATED OSA PATIENTS

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Introduction: Compliance with CPAP is the major limiting factor in treating patients with OSA. The novel SomnuSeal mask is an oral self-adaptable mask located between the teeth and the lips. It is more comfortable than existing masks, ensures that there are no air leaks, and merges better with the patient's anatomy. Aim: To evaluate the efficacy and convenience of the SomnuSeal oral mask in patients with moderate to severe OSA.
Methods: Ten healthy volunteers slept with the SomnuSeal mask for 1 night, and 13 patients with moderate-severe OSA (RDI > 20) slept with it for up to 14 nights (1 night in the sleep lab and 3-14 nights at home). In all cases the mask was connected to an Auto-PAP machine. Efficacy, convenience and compliance (usage meter) were monitored.
Results: All healthy volunteers had no problems using the mask. Of the OSA patients (all men, age 48 ± 10years, BMI 29.5 ± 4.0 Kg/m2, RDI 50 ± 17/h), 4 were CPAP non-compliant (untreated patients), 3 struggled with their CPAP treatment, and 6 were well-treated patients. Eleven of the 13 patients adjusted well to the oral mask and used it at home for an average of 5.5 hours per night, with no residual apnea (RDI < 5/h) assessed in the lab by PSG or in their home by the CPAP device. The 2 non-compliant patients were also previously non-compliant with a nasal mask. Six of the 11 compliant patients clearly stated their preference for the new oral mask over the nasal mask. Interestingly, the optimal pressure was reduced from 8.9 ± 2.8cmH2O with the nasal mask to 6.0 ± 0.9cmH2O with the oral mask.
Conclusion: The SomnuSeal oral interface is effective and is potentially more convenient than nasal masks. We speculate it may increase compliance in CPAP treated patients and can potentially be used by patients who are otherwise not treated.

0498

LONG TERM OBJECTIVE POSITIVE AIRWAY PRESSURE (PAP) ADHERENCE IN 784 CONSECUTIVE OSA PATIENTS AT ALL LEVELS OF SEVERITY

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Introduction: The current study assesses long term objective adherence to PAP, at all levels of OSA severity, treated in an integrated sleep management program. Patients are categorized to reflect areas of uncertainty and controversy.
Methods: We retrospectively reviewed adherence data on 784 consecutive patients started on PAP between February 2005 and March 2008. All subjects were included in a structured follow-up protocol involving intensive education, objective adherence monitoring, and modification of PAP as indicated. Enrolled subjects each reached at least 10 months after PAP initiation. Patient were divided into categories of special significance: Group 1 (UARS): AHI 0-5; Group 2 ("surgical success"): AHI 0-20; Group 3 ("traditional OSA"): AHI 5-120; Group 4 ("contemporary OSA"): AHI 0-120. Outcomes assessed include: Result A: purchased PAP; Result B: documented objective long term adherence by CMS/Kribbs definition (use of PAP at least 70% of nights for at least 4 hours per night on nights used). Patients unavailable for objective documentation were contacted by telephone and mail.
Results: The mean time elapsed between PAP initiation and long term follow-up was 1.7 years (SD 0.7). Groups 1 to 4 included 103, 401, 681, and 784 patients, respectively. Result A was achieved by 77%, 83%, 87% and 86% of patients in Groups 1-4, respectively. Of those who pur-

chased PAP and were available for long term follow-up at a minimum or 10 months, Result B was achieved by 78%, 74%, 77%, and 77% of patients in Groups 1-4, respectively. Of patients unavailable for long term follow-up (15%), one third had a disconnected telephone and no forwarding address.
Conclusion: 86% of patients purchased PAP, and 77% of those available for long term follow-up remain adherent after almost two years.

0499

PREDICTORS OF CONTINUOUS POSITIVE AIRWAY EFFECTIVE PRESSURE DURING A SPLIT-NIGHT POLYSOMNOGRAM

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Introduction: Continuous positive airway pressure (CPAP) is recognized as the most effective mode of therapy for Obstructive sleep apnea (OSA). Several formulas have been evaluated to predict the pressure needed during full-night titration studies. We found no study evaluating the predicted effective pressure in split-night studies where a formula is most needed.
Methods: The proposal investigated several variables obtained during the PSG portion of the split night study to predict the effective CPAP pressure. Univariate analysis including means and SDs for continuous data and proportions for nonparametric data were calculated. Multivariate analysis including Logistic regression models was fitted to the data to test PSG and other variables that predict the need for high optimal CPAP. Statistical analyses were performed using the SPSS statistical software.
Results: We included 164 (49 females and 113 males) subjects from two different institutions. Subjects had split-night PSG studies for diagnosis/ treatment of OSA. Mean age was 53 / 13.82, mean ESS was 10.73/ 5.56, mean AHI was 57.4/31.17. Only 78 subjects (48%) had optimal titration defined by having a stage AHI of < 5 in the presence of REM sleep and supine position. Stepwise multiple regression analysis identified minimal O_2 saturation, neck circumference, supine- AHI index, starting pressure and female gender, as independent predictors of optimal CPAP. An equation was constructed to predict the optimal CPAP pressure.
Conclusion: This is the first study to evaluate the predictors of optimal titration in split night studies. We found several factors affecting the optimal pressure and suggested a titration formula. We are in the process of validating this formula on different group of patients

0500

A TREATMENT SUCCESS INDEX FOR POSITIVE AIRWAY PRESSURE THERAPY OF OBSTRUCTIVE SLEEP APNEA

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Introduction: No consensus exists for how to quantify success of positive airway pressure (PAP) treatment of obstructive sleep apnea (OSA). Some suggest that PAP usage alone defines adequate treatment, yet treatment effectiveness is also important. Therefore, we developed a treatment success index (TSI) that incorporates both compliance and in-home effectiveness data.
Methods: TSI (0-100 scale) equals percentage of total sleep time (TST) with PAP treatment in use multiplied by percent reduction of apnea-hypopnea index (AHI) provided by treatment, as follows: TSI = [(% of days PAP used)(h use / days used) / (TST / day)] x [(PSG AHI - AHI on PAP) / PSG AHI]; PSG = polysomnography. We estimated TST / day based on integration of PAP machine data and patient reports. Machine data and/or in-home oximetry provided AHI on PAP. We schedule patients to yearly follow-up after documentation of treatment effectiveness, demonstration of good compliance, and removal of all obstacles to usage within our control.
Results: We studied 226 patients. For patients relegated to yearly follow-up (35%), TSI averaged 86 ± 12 (mean ± SD), compliance averaged 92 ± 11% of TST, and effectiveness averaged 93 ± 6% reduction of AHI. For patients not relegated to yearly follow-up, TSI averaged 49 ± 25, compliance averaged 58 ± 29%, and effectiveness averaged 87 ± 12% (all less than in the yearly follow-up group, $P < 0.0001$).
Conclusion: The TSI assumes that usage and effectiveness are equally important, and that decrements in either impose multiplicative impact on treatment. For example, for a patient who sleeps 8 hours per night and uses 100% effective treatment on 70% of nights for 4 hours per night, TSI equals 35 out of 100. Future work may quantify and integrate insufficient sleep to provide a more global definition of treatment success.
Support (If Any): Sleep Consultants, Inc. and Texas Pulmonary and Critical Care Consultants, P.A. supported this work.

0501

TRIGGERS FOR CLIENTS REQUEST OF REASSESSMENTS AFTER THE IMPLEMENTATION OF LONG TERM NON INVASIVE POSITIVE PRESSURE VENTILATION (NIPPV) FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is a chronic condition that may require close follow up even after establishing a steady long term NIPPV therapy state. We aimed to identify client's major concern that may trigger sleep physician reassessment. This study is part of an ongoing research at sleep disorder center - University of Manitoba.
Methods: A questionnaire was sent to 3732 clients from our data base, who are under long term NIPPV for obstructive sleep apnea. We asked whether the client has a specific concern related to his current therapy and whether a clinician contact is required. In-addition, the questionnaire included questions related to self reported usage, general effectiveness, measures of Epworth Sleepiness Scale and sleep Apnea Quality of life Index.
Results: Out of 3732 clients contacted, a total of 1876 (50.3%) replied. We have reviewed the first 112 clients out of the total 437 clients (23.3%) who requested clinician contact. The mean duration of being on long term NIPPV therapy in this group was 7.37 year. We found out that, the main reason for requesting clinician contact was day as well as night clinical symptoms in 69 clients (61.6%). Mask related issues were identified in 55 clients (49.1%). Complaints related to NIPPV machine malfunction was reported in 24 clients (21.4%).
Conclusion: Our study shows that mask related issues were of major concern for clients who requested clinician contact after the implementation of long term NIPPV therapy for obstructive sleep apnea.

0502

GENDER DIFFERENCES IN PAP-COMPLIANCE IN SLEEP-APNEA PATIENTS

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Introduction: Depending on the study about 1-10% of the German suffer from sleep disordered breathing. In general more men are affected, but many women remain undiagnosed. The main clinical symptom of the sleep-apnea-syndrom is daytime sleepiness which causes limited performance and reduced quality of life. In the long term the risk for cardiovascular diseases increases. Superior therapy is the use of nightly positive airway pressure (PAP). But essential for the therapeutic outcome is the compliance of the patients. Aim of this study is making a

statement about the sleep-apnea-patients and their compliance in using pap and identifying factors which may influence the cooperativeness of the concerned.
Methods: Within one year 1414 patients from six different centres in Germany with diagnosis sleep-apnea and treatment with pap completed a questionnaire regarding different fields of subjective compliance. The questions implied inter alia weekly and daily using time, further diseases, side effects and benefit of the therapy. Additional retrospective collected objective data from 269 patients treated in the Charité contain gender, age, symptoms, AHI before and under therapy and ESS-Score before treatment.
Results: Mean using time is 6,6 +/- 1,1 days per week and 6,4 +/- 1,5 hours per night. 85 % suffer from at least one further disease. 24 % experienced side effects especially irritation of mucosa and mask discomfort. An improvement regarding symptoms reported 84 %. The ratio of women to men is 1:4. Women have significant more symptoms (T = 3,462; df = 189; P = 0,01) and side effects (T = 2,203; df = 52,156; P = 0,032) parallel than men. The regression analysis identified the subjective benefit of the patients as strongest predictor for compliance.
Conclusion: Sleep-apnea-patients are multimorbid. Their compliance is good and corresponds to the recent treatment-recommendations. Most important predictor is the development of symptoms under pap-treatment. It seems that mostly men are effected, but women have more symptoms parallel than men. Reason could be they are undiagnosed and get clinical conspicuous with other or very strong disorders.

0503

A RANDOMIZED PLACEBO-CONTROLLED TRIAL OF CONTINUOUS POSITIVE AIRWAY PRESSURE FOR FATIGUE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Previous studies have shown that continuous positive airway pressure (CPAP) reduces excessive daytime sleepiness in patients with obstructive sleep apnea (OSA). There is evidence that complaints of fatigue (feelings of tiredness or lack of energy independent of sleepiness) are more frequent than complaints of sleepiness in OSA patients; however, the impact of CPAP on fatigue remains unclear.
Methods: Fifty-nine men and women with OSA were randomized, double blind to receive therapeutic or placebo CPAP for a three week intervention period. Outcome measures were fatigue and vigor (The Multidimensional Fatigue Symptom Inventory - Short Form [MFSI -sf] and the Profile of Mood States - Short Form [POMS-sf] fatigue and vigor subscales). Data were analyzed using repeated measures analysis of variance.
Results: Therapeutic CPAP was superior to placebo CPAP at reducing symptoms for all outcome measures (P's < .05). Patients who were treated with therapeutic CPAP showed significant reductions in apnea-hypopnea index (AHI decreased from 38.6 ± 24.3 to 6.2 ± 6.5) as well as decreases in both measures of fatigue (MFSI - sf decreased from 8.8 ± 16.8 to -0.1 ± 14.8 and POMS -sf fatigue decreased from 7.17 ± 6.30 to 4.03 ± 4.46) and increases in vigor (POMS - sf vigor increased from 14.28 ± 7.39 to 16.52 ± 5.97). Neither baseline AHI nor body mass index (BMI) was predictive of treatment response (P > .05).
Conclusion: Results suggest that three weeks of therapeutic CPAP significantly reduced fatigue and increased vigor in patients with OSA. Improvement was not dependent on baseline AHI or BMI.
Support (If Any): This work was supported by grants HL44915 and RR 00827 (University of California San Diego General Clinical Research Center Grant)

0504

ADHERENCE WITH POSITIVE AIRWAY PRESSURE THERAPY IN PATIENTS WITH UPPER AIRWAY RESISTANCE SYNDROME

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Introduction: Upper Airway Resistance Syndrome (UARS) is an entity characterized by repetitive episodes of airflow limitation during sleep associated with increased respiratory effort and subsequent EEG arousal. These abnormalities, despite an Apnea-Hypopnea Index (AHI) < 5, may result in daytime sleepiness and an increased likelihood of hypertension. Currently the condition is categorized under the diagnostic umbrella of "Obstructive Sleep Apnea (OSA)" with the implication that it is not a distinct entity. Important features do however distinguish it. Specifically, the diagnosis cannot be established in the absence of EEG monitoring using type 3 or 4 home testing devices. Furthermore, even after the diagnosis has been established, patients frequently are unable to obtain treatment, as insurance payors may not deem the condition adequate to warrant coverage. We present Positive Airway Pressure (PAP) acceptance and long term adherence data in a series of UARS patients.
Methods: We retrospectively reviewed data on 103 consecutive patients with UARS initiated on PAP therapy between February 2005 and March 2008. All patients were initiated on PAP in the context of our AASM accredited, integrated sleep management program. Data including patient demographics, clinical information, polysomnographic indices, and objective PAP acceptance/adherence were compiled. These data were compared with those from a group of 103 patients with OSA (AHI > 5) matched for age and gender.
Results: Mean age(44 ± 10 vs 45 ± 11 years), gender distribution(50% male vs. 50% male)and Epworth Sleepiness Scores(13 ± 5 vs 12 ± 5) were similar between groups, however, BMI was lower in the UARS group (33 ± 7 vs 39 ± 10kg/m^2; P < 0.0001). On baseline polysomnography, sleep in UARS patients was characterized by less Stage 1 (21 ± 10 vs. 31 ± 23%; P < 0.0001), more Stage REM (15 ± 8 vs. 12 ± 8%; P < 0.01), a lower arousal index (19 ± 8 vs. 39 ± 31/hr; P < 0.0001) and lower AHI (2 ± 1 vs. 33 ± 31/hr; P < 0.0001) than in OSA patients. Fewer UARS patients met adherence criteria for PAP purchase (77 vs. 88%). Long term follow up at ≥ 10 months was established in 76% and 85% of these UARS and OSA patients, respectively. Of patients with continued follow up beyond this duration, a similar percentage of patients used PAP on at least 70% of nights for ≥ 4 hrs/night (78% vs. 74%).
Conclusion: UARS represents a distinct form of sleep disordered breathing. High rates of PAP acceptance and adherence can be achieved in patients with this condition.

0505

CPAP IN SEVERE OBSTRUCTIVE SLEEP APNEA REDUCES PAIN SENSITIVITY

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Introduction: Increasing evidence has shown that variations in sleep modulate pain sensitivity. We hypothesized that pain sensitivity in obstructive sleep apnea (OSA) patients, who have poor sleep continuity due to respiratory related arousals, would be reduced with continuous positive airway pressure (CPAP) treatment.
Methods: Twelve severe OSA (AHI = 50.9+/-14.5) patients, 7 men, 5 women, 50.3+/-12.5 yrs old, with no underlying pain conditions participated. The morning (8-9 AM) after a diagnostic polysomnogram (PSG), the patients underwent a training session of finger withdrawal latency (FWL) testing to a radiant heat stimulus. FWL is a validated human behavioral model of thermal nociception. Latency is tested in index fingers of both

hands at five different, randomly presented, radiant heat intensities. Baseline pain sensitivity was obtained after training. CPAP pressure was set with in-laboratory CPAP titration PSGs on a subsequent night. Two nights after titration, patients returned to sleep in the laboratory at their set CPAP pressure. FWL was tested in the AM after awakening, after 6-8 wks of CPAP use, and finally (within 6-8 wks) after 2 nights of discontinuation of CPAP. Mean FWL over both fingers and the five heat intensities was compared.
Results: With CPAP sleep continuity was improved and AHI was significantly reduced to 1.4+/-1.0; P = 0.001. In parallel, FWL increased significantly from a mean baseline of 9.8+/-1.3 sec to 13.7+/-5.1 sec (P = 0.01) and with continued CPAP use (5.1+/- 2.3 hrs nightly) for 6-8 weeks FWL remained elevated (21.1+/-16.2 sec). After the two-night CPAP discontinuation sleep was fragmented (AHI = 32.6+/-19.8) and FWL decreased significantly to 11.6+/-5.9 sec relative to chronic CPAP use (P = 0.03).
Conclusion: This study demonstrates that CPAP treatment reduces the pain sensitivity of OSA patients. We propose pain sensitivity was decreased in OSA patients because of their improved sleep continuity on CPAP. Future studies will focus on identifying mediating mechanisms.

0506

THE COURSE OF INSOMNIA PRIOR TO AND FOLLOWING TREATMENT OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Insomnia is a common symptom of obstructive sleep apnea (OSA). However, little research exists on the course of insomnia in relation to sleep apnea and Positive Airway Pressure (PAP) therapy. Comorbid and iatrogenic insomnia may potentially interfere with PAP therapy and may warrant independent clinical attention.
Methods: Data were collected as routine care in a behavioral sleep medicine clinic. Patients completed the Insomnia Severity Index (ISI) when receiving their PAP device and at 7, 30, and 90 day follow-up appointments. Objective PAP adherence data was also collected at these visits. Descriptive statistics for the ISI and the frequency of patients with moderately to severely elevated scores (≥ 15) were calculated for each time point. Rates of adherence were calculated for patients with elevated ISI scores. Adherence was defined as average PAP use of ≥ 4 hours per night.
Results: ISI scores declined in patients on PAP. Elevated scores were reported by 60% (N = 87, Mean 16.4; SD 5.6) of patients at pretreatment, 38% (N = 93; Mean 12.5, SD 5.9) of patients at the 7-day follow-up, 30% (N = 93, 10.5, SD 6.3) of patients at the 30-day follow-up, and 27% (N = 43, Mean 10.6, SD 5.7) of patients at the 90-day follow-up. However, ISI scores remained elevated for many patients despite adherence to PAP. Of patients with persistently elevated ISI scores, 58% (N = 26) were adherent to PAP at the 7-day follow-up and 40% (N = 10) were adherent at the 30-day follow-up.
Conclusion: Insomnia reported by 50% of OSA patient's resolves with PAP therapy. However, 27-30% of those with pre-treatment insomnia complaints continue to experience insomnia 30-90 days after initiating treatment. For almost 60% of patients with persistent insomnia, symptoms persist despite adherence to PAP. Although PAP generally improves ISI scores over time, frequent persistent insomnia needs to be addressed in the overall approach to OSA patients.

0507

CLINICAL USE OF AUTOTITRATING CPAP MACHINES - A CASE-CONTROL STUDY

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Introduction: Autotitrating continuous positive airway pressure (APAP) devices can be used in PAP titration studies. In clinical practice, they may also be used in long-term treatment of patients who had an unsuccessful CPAP titration study.
Methods: We explored the indications and outcomes of APAP use in patients who had an unsuccessful CPAP titration. We also compared the compliance with APAP therapy of patients who had unsuccessful PAP titration, and matched patients who were treated with CPAP following a successful titration study.
Results: Forty consecutive patients (31M, 9F), aged 54 (47-62) years with unsuccessful PAP titration (APAP group) were matched for age and AHI with 40 patients who had a successful titration study and were treated with CPAP (CPAP group). PAP titrations were deemed unsuccessful due to persistent hypopneas (9 patients), or persistent snoring/respiratory effort-related arousals at the final pressure (14 patients), lack of REM (4 patients), lack of supine REM (7 patients), or lack of supine sleep at final pressure (3 patients), and high positional variability of PAP pressure (3 patients). There were no differences in body mass index, echocardiographic LV ejection fraction, or apnea-hypopnea index (AHI) on baseline polysomnogram between the groups. Compliance data were available in 27/40 patients from APAP group and in 31/40 patients from CPAP group. Mean nightly use, percentage of nights with greater than 4 hours use, mean pressure, 90% pressure, and residual AHI were not significantly different between groups. Based on the downloads of the compliance device, mean pressure generated by the device was -0.5 (-1.2 to +0.2) cmH2O lower and the 90% pressure was +1.2 (+0.2 to +1.8) cmH2O higher than the final pressure during the titration study.
Conclusion: Use of autotitrating CPAP devices offers a good long-term alternative to CPAP in patients with an unsuccessful CPAP titration and may obviate the need for CPAP retitration.

0508

THE PHYSIOLOGICAL AND PSYCHOLOGICAL DOSE-RESPONSE EFFECTS OF CPAP COMPLIANCE ON SLEEPINESS: INDIVIDUAL PATIENT META-ANALYSIS OF TWO RANDOMISED PLACEBO-CONTROLLED TRIALS

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Introduction: Continuous positive airway pressure (CPAP) improves sleepiness in obstructive sleep apnea (OSA) patients in a dose-dependent manner (Weaver et al. SLEEP 2007). However, some of this effect might be due to a placebo-like expectation of benefit, where conscious knowledge of CPAP use drives reported symptom relief in addition to CPAP's physiological effects on OSA. Analysis of placebo/sham-CPAP controlled trials may help quantify the relative strength of these two effects: physiological and psychological. We hypothesised that there is a significant statistical interaction between CPAP treatment and CPAP compliance indicating both physiologically and psychologically induced improvements in sleepiness, measured by the Epworth Sleepiness Scale (ESS).
Methods: Two controlled cross-over trials comparing the effectiveness of therapeutic vs. sham CPAP were combined in an individual patient meta-analysis. In study 1 (n = 29) mild-moderate OSA patients were randomised to treatment for 3 weeks with a 2 week washout-period (Marshall et al. Thorax 2005). In study 2 (n = 28) moderate-to-severe patients were randomised to treatment for 8 weeks, with a 4 week washout-period. Mixed model analysis of variance was used to quantify the effects of baseline ESS severity, treatment (sham vs. CPAP), compliance with treatment (High vs. Low cut at 4 hours/night) and the interaction between compliance and treatment on ESS improvements with patients and original trial as random factors.

Results: CPAP improved ESS more than placebo/sham (mean = 1.0 points; 95%CI 0.2-1.8, P = 0.02) and high compliance more than low compliance (2.1; 1.0-3.3, P < 0.01). The interaction between treatment and compliance (P = 0.058) was caused by the effect of high compliance with CPAP (3.0; 1.5-4.4, P < 0.001) being greater than the effect of high compliance with sham (1.3;-0.1-2.7, P = 0.06).
Conclusion: The combination of marginally significant effects observed indicates that CPAP use probably confers both physiological and psychological benefits that cause reductions in symptomatic daytime sleepiness.
Support (If Any): This work was supported by an NHMRC project (301936) and a CCRE fellowship grant.

0509

DOES HOME SLEEP TESTING IMPAIR CPAP COMPLIANCE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA?

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Introduction: To reduce costs and increase access to care, Home Sleep Testing (HST) has been recently approved to establish the diagnosis and initiate therapy in patients with Obstructive Sleep Apnea (OSA). However, the limited interaction with a sleep lab may compromise therapeutic adherence. While the diagnostic accuracy of these tests has been validated, their impact on adherence has not been explored. We sought to compare continuous positive airway pressure (CPAP) compliance between those diagnosed by HST and type I polysomnography.
Methods: We included consecutive patients with OSA presenting for initial CPAP follow-up. We compared objective measures of adherence between individuals undergoing type III portable monitors and traditional attended in-laboratory type I polysomnography. Subjects were classified into three groups; Group 1 underwent type I diagnostic PSG and CPAP titration studies; Group 2 underwent type I diagnostic PSG and home Auto-adjustable positive airway pressure (APAP) titrations; and Group 3 underwent home type III diagnostic PSG and home APAP titrations.
Results: We included 180 subjects, 60 in each group. Groups were similar at baseline. CPAP use did not differ between groups. Specifically, CPAP acceptance was 73% in all groups (P = 0.99). No difference was seen in average nightly use of CPAP on all days (3.68 ± 2.17 vs. 3.85 ± 2.14 vs. 3.74 ± 2.20 hours, P = 0.92), CPAP average nightly use on days used (4.61 ± 1.94 vs. 4.65 ± 1.82 vs. 4.65 ± 2.14, P = 0.99), or in compliance (49%, 46% and 50% of subjects, P = 0.83) in groups 1, 2, and 3 respectively.
Conclusion: There was no significant difference in CPAP usage between those undergoing in-lab and home sleep studies. These findings suggest that HST does not impair adherence when compared to traditional methodology. Further studies are needed to confirm these results.

0510

GENDER DIFFERENCES IN ADHERENCE AND SELF-REPORTED OUTCOMES IN THE HOMEPAP STUDY

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Introduction: Few studies have examined gender differences in adherence or outcomes in obstructive sleep apnea (OSA). The goal of this study was to assess gender differences in adherence to continuous positive airway pressure (CPAP) and self-reported improvements in sleepiness and quality of life in participants with moderate to severe OSA.
Methods: Data were drawn from the HomePAP study, a multi-site randomized clinical trial of laboratory versus home based testing for OSA. Participants with AHI > = 15 continued in the trial. Analyses were conducted with t-tests, chi-square, and multivariate regression. Participants with adherence at 1 or 3 months were included in analyses. Sleepiness was measured by the Epworth Sleepiness Scale (ESS) and quality of life was measured by the Functional Outcomes of Sleep Questionnaire (FOSQ). CPAP use variables included acceptance, average hours of use per night, and percent of nights with use > = 4 hours at 1 and 3 months. Covariates included demographics, education, marital status, comorbidities, Apnea Hypopnea Index (AHI), Body Mass Index (BMI), study arm, and site.
Results: The sample included 151 participants, average age 48 (SD = 12) years, 65% male and 66% White. Average AHI was 45 (SD = 26). There were no gender differences in acceptance or adherence at 1 and 3 months or in ESS change. Women reported greater improvement in quality of life including general productivity (P = .01) and activity level (P = .03) compared to men at 3 months in univariate analyses. In multivariate models, women demonstrated greater improvements in sexual activity (P = .03) and vigilance (P = .04) at 1 month and sexual activity (P = .04) and activity level (P = .046) at 3 months. However, despite greater improvements over time, women continued to report lower social outcome (P = .03) and activity level (P = .04) quality of life subscores than men at 3 months.
Conclusion: There were no gender differences in adherence or improvements in self-reported sleepiness. Although, women reported greater improvement in quality of life over time, quality of life remained lower than men in several domains at 3 months.
Support (If Any): American Sleep Medicine Foundation 38-PM-07, 5K12 HD055884

0511

THE EFFECTS OF CPAP ON INSULIN RESISTANCE AND INFLAMMATION IN NON OBESE MIDDLE AGED MEN

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Introduction: It has been well established that sleep apnea in obese and non obese patients is associated with elevation of inflammation and in-

sulin resistance subclinical markers. However, the effects after treatment with continuous positive airway pressure (CPAP) still remain controversial. The aim of this study was to determine whether CPAP reverses hypercytokinemia and insulin resistance in a non obese population.

Methods: Twenty nonobese, middle-aged men with obstructive sleep apnea participated in a four month study. Subjects were assigned on a 2 x 2 crossover design, with half of the subjects randomized to the sham-CPAP/CPAP sequence and the other half to the CPAP/sham-CPAP sequence. The subjects were assessed in the sleep laboratory for four consecutive nights three times: at baseline; 2 months following the use of CPAP; and 2 months following the use of sham- CPAP. 24h blood sampling was done during the fourth day for the assessment of IL-6, TNFR1, CRP, leptin, adiponectin, fasting glusose and insulin.

Results: Treatment with CPAP did not improve inflammatory, metabolic or insulin resistance subclinical markers in the non obese sleep apneic group.

Conclusion: In non obese men with sleep apnea CPAP does not affect inflammation, metabolic or insulin resistance indices. Given that these abnormalities independently affect health and longevity adversely, other therapeutic measures, e.g., weight loss, exercise, pharmacological agents such as drugs that improve insulin sensitivity, should be included in the management of sleep apnea.

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0512

EFFECTS OF CPAP THERAPY ON PULMONARY HYPERTENSION AND RIGHT VENTRICULAR FUNCTION IN PATIENTS WITH SEVERE OSA

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Introduction: Obstructive sleep apnea (OSA) is known to be associated with cardiovascular complications such as pulmonary hypertension, right ventricular dysfunction and cor pulmonale, that all increase morbidity and mortality. Previous studies have demonstrated pulmonary hypertension (PH) and right ventricular dysfunction (RVD) in patients with OSA. We aimed to determine the effects of continuous positive airway pressure (CPAP) therapy on patients with PH and RVD in severe OSA patients.

Methods: We recruited 30 newly diagnosed patients with severe OSA who were administered CPAP therapy for 6 months. All subjects underwent baseline (before CPAP) echocardiographic measurements that were repeated at 3 and 6 months. Additionally, cardiac magnetic resonance imaging (CMR) was performed at baseline and 6 months.

Results: The average age of patients was 51.17 ± 3.54 years, 66% were male, average BMI was 33.84 ± 4.53 kg/m^2. OSA was diagnosed by split night polysomnography. Average apnea-hypopnea index for the group was 55.51 ± 20.86. Most patients (> 85%) were compliant with CPAP therapy. Echocardiographic determinants of PH and RVD improved from baseline to 3 months (Right atrial ventricular index, RAVI: 48.21 ± 4.24 ml/m^2 to 37.17 ± 0.11 ml/m^2, P < 0.001 and right ventricular end-diastolic dimension RVEDD: 40.93 ± 1.41 mm to 36.28 ± 2.12 mm, P < 0.001 and pulmonary artery systolic pressure PASP: 55.34 ± 5.66 mmHg to 40.79 ± 4.24 mmHg. Further improvement occurred at 6 months (RAVI: 48.21 ± 4.24 ml/m^2 to 35.46 ± 2.83 ml/m^2, P < 0.001; RVEDD: 40.93 ± 1.41 mm to 32.57 ± 1.1 mm, P < 0.001 and PASP: 55.34 ± 5.66 to 39.21 ± 2.12, P < 0.001). CMR measurements were congruent with the echocardiographic findings. RAVI improved from 46.72 ± 5.66 ml/m^2 to 31.97 ± 1.42 ml/m^2, P < 0.01 and right ventricular end-diastolic dimension, RVEDD: 44.00 ± 1.41 mm to 32.66 ± 1.40 mm, P < 0.001. CPAP therapy at 6 months resulted in 30.44 ± 7.60 % reduction in RAVI and 24.89 ± 0.71 % reduction in RVEDD by CMR. Compared to baseline PASP decreased by 29.14 ± 6.25 %.

Conclusion: Early recognition and appropriate therapy of right ventricular dysfunction in patients with OSA is prudent to prevent progression to cor pulmonale and death.

0513

A MULTI-SITE RANDOMIZED TRIAL OF PORTABLE MONITORING AND POSITIVE AIRWAY PRESSURE AUTOTITRATION VERSUS LABORATORY-BASED POLYSOMNOGRAPHY FOR THE DIAGNOSIS AND MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA: HOMEPAP STUDY

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Introduction: High level evidence is needed to assess the role of new technologies for obstructive sleep apnea (OSA) diagnosis and management, such as use of home-based portable monitoring (PM) and autotitration.

Methods: New referrals with high probability of moderate to severe OSA [apnea-hypopnea index (AHI) ≥ 15] and Epworth Sleepiness Scale (ESS) ≥ 12 were randomized to either a lab-based (LAB) or PM (HOME) diagnostic and treatment strategy. HOME patients with AHI < 15 "crossed-back" to the LAB arm for repeat diagnostic testing. Outcomes [positive airway pressure (PAP) acceptance, adherence, sleepiness] were evaluated at 1 and 3 months.

Results: Sample characteristics: age 48 ± 12 years, 62% white, 65% male, BMI 38.5 ± 8.7 kg/M^2, 41% college educated, ESS 14 ± 4, and AHI 43 ± 26. Of 187 randomized to the HOME arm, 105 remained study eligible compared to 86/186 in the LAB arm. Ineligibility due to low AHI (< 15) was common: 41% HOME versus 49% LAB. Titration and acceptance of PAP among eligible subjects was high: 91% in each arm. PAP adherence (percentage of nights used ≥ 4 hr) was greater in the HOME compared to the LAB arm at 1 month [54.6 ± 32.6% versus 47.6 ± 31.2%, difference: -6.8% (CI: -17.4, 3.8)] and at 3 months [(62.8 ± 29.2% versus 50.2 ± 35.8%, difference: -12.6 (CI: -23.8, -1.4)]. PAP usage (nightly time at pressure) was also greater in the HOME arm at 1 month [(245.0 ± 140.9 versus 222.6 ± 121.4 minutes, difference: -22.4 (CI: -66.5, 21.7)] and at 3 months [(280.6 ± 126.4 versus 220.6 ± 144.2 minutes, difference: -60.0 (CI: -106.6, -13.3)]. Titration pressures (10.6 versus 10.9 cmH_20), effective titration (87% versus 88% with AHI < 10), time to treatment (31 versus 36 days), ESS score change (-5.1 versus -5.8 at 1 month and -7.1 versus -7.4 at 3 months) for HOME versus LAB respectively, did not differ between arms.

Conclusion: For patients with moderate to severe OSA, a home-based PM approach for diagnosis and management was comparable to the traditional laboratory-based approach in terms of acceptance of therapy and improved sleepiness. Adherence was only moderate and was higher in the HOME compared to the LAB arm.

Support (If Any): American Sleep Medicine Foundation 38-PM-07 Grant: Portable Monitoring for the Diagnosis and Management of OSA.

0514

RANDOMIZED CONTROLLED TRIAL OF AUTOMATICALLY-ADJUSTING POSITIVE AIRWAY PRESSURE IN MORBIDLY OBESE PATIENTS REQUIRING HIGH THERAPEUTIC PRESSURE DELIVERY

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Introduction: Auto-adjusting positive airway pressure (APAP) devices are being increasingly used to treat obstructive sleep apnea (OSA), though the role of APAP devices in the management of patients requiring high pressures has not been systematically studied. We have anecdotally encountered obese patients whose OSA has not been adequately controlled by APAP, and therefore aimed to compare APAP with CPAP (ResMed S8 Autoset II®) in a randomized, single-blinded crossover trial.
Methods: Twelve patients with severe OSA (mean ± SD AHI 75.8 ± 32.7, BMI 49.9 ± 5.2kg/m^2, mean pressure 16.4cmH2O) were consecutively recruited and randomized to receive APAP or CPAP for six nights, separated by a four-night washout. PSG studies took place following each arm.
Results: Both APAP and CPAP substantially reduced the AHI from baseline, with no significant difference between modes (mean ± SD 9.8 ± 9.5 and 7.3 ± 6.6 events/hour respectively; P = 0.35). There were no significant differences concerning a number of oxygen saturation indices (3% or 4% desaturation index; mean desaturation; mean saturation during total sleep time, rapid eye movement or non rapid eye movement sleep; percentage of total sleep time with saturation < 90%). During both the post-CPAP and post-APAP polysomnographies, the machine-scored AHI significantly overestimated the amount of residual disease compared with laboratory-scored AHI (Chicago criteria), however when the machine-scored AHI was ≤ 5 and ≤ 10, this was always confirmed by the polysomnographic data. APAP delivered a significantly lower 95th percentile pressure averaged over the home-use arm than CPAP (14.2 ± 2.7 and 16.1 ± 1.8cmH2O, P = 0.02).
Conclusion: Although neither APAP nor CPAP reduced the AHI to within the generally accepted level (≤ 5 events/hour), our data provides support for the use of either mode for ongoing treatment in these patients. Further objective assessment is recommended if the device indicates a high level of residual disease. This device should not be used as a titration device in these patients.
Support (If Any): This study was funded by the Asthma & Respiratory Foundation of New Zealand.

0515

PERSISTENT SLEEPINESS IN CPAP TREATED OBSTRUCTIVE SLEEP APNEA PATIENTS EVALUATED BY MSLT

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Introduction: Among continuous positive airway pressure (CPAP) machine users (n = 777) by January 2007, the ratio of the patients who showed sleepiness of Epworth sleepiness scale (ESS) ≥ 11 was 72 people (9.3%). The dropout by the two years chase was 17 cases, but the dissatisfaction to sleepiness improvement was not included in this reason. Because it was 27 cases to have shown ESS ≥ 11 for two years among 55 remainder, it was thought that it was around 3.5% of the CPAP user that showed "true sleepiness". About the sleepiness of the CPAP user, we examined the actual situation.
Methods: We evaluated 12 of 98 cases who appeal for excessive daytime sleepiness (ESS ≥ 11 or Japanese version ESS ≥ 14) among 1,161 CPAP users at September 2008 using by multiple sleep latency test (MSLT) on CPAP .
Results: Four patients were excluded because of CPAP suboptimal titration, or cormobid periodic limb movements. Four patients were revealed mean sleep latency (MSL) ≤ 8 minutes, and other 4 patients revealed MSL > 8 min. As for patients of MSL ≤ 8 minutes, the numbers of sleep onset REM period (SOREMP), 0-1; two cases, 2-5; two cases respectively. In addition, age and ESS at the time of the first examination by the doctor were significantly higher in cases of MSL > 8 than cases of MSL ≤ 8, but there were no significant differences in background factors.
Conclusion: In the cases that were able to prove objective sleepiness by MSLT, it is necessary to judge recognized sleepiness from merger of hypersomnia, OSAS essential sleepiness , long sleeper and healthy control those who were reported as 14.3% in general population (Stradling JR: J Sleep Res, 2007; 16: 436-438). On the other hand, future examination is necessary about the handling that cannot prove objective sleepiness.

0516

OBSTRUCTIVE SLEEP APNEA AND ADIPOCYTE SIZE

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Introduction: Obstructive sleep apnea has been associated with increased intra-abdominal fat volume. It is unclear whether this is due to adipocyte hypertrophy or an increased number of adipocytes. This study sought to determine if sleep apnea severity is associated with adipocyte size.
Methods: Patients undergoing ventral hernia repair surgery were recruited to wear a portable sleep monitor for two nights prior to surgery. Biopsies from subcutaneous and omental fat depots were obtained intra-operatively. Samples were fixed in formalin, paraffin embedded, and sectioned. Dewaxed 5 μm sections were labeled with anti-perilipin antibody to visualize intact adipocytes. Automated image analysis was performed to determine adipocyte cross-sectional area.
Results: Eighteen subjects with mean age 55.3 yrs, body mass index (BMI) 34.7 kg/m^2, and apnea hypopnea index (AHI) 10.9 were recruited. On average, 135 cells in omental fat and 116 cells in subcutaneous fat were measured per patient. Mean cross-sectional area was 1509 ± 310 μm2 and 1741 ± 327 μm2 for omental and subcutaneous adipocytes, respectively. In omental fat, adipocyte size was not associated with BMI or apnea severity. In contrast, subcutaneous adipocyte size was strongly associated with BMI. For every 1 kg/m^2 increase in BMI, adipocyte area increased by 43.3 μm2 (P = 0.002). While AHI did not correlate with subcutaneous adipocyte size, a trend was observed with percent time spent with oxygen saturation below 90% (Per90). For every 1% increase in Per90, adipocyte size increased by 10.9 μm2 (P = 0.06). This relationship persisted after BMI adjustment.
Conclusion: Adipocyte size in omental fat does not vary with apnea severity, suggesting any increase in the size of this fat depot is due to adipocyte hyperplasia. However, a trend of increasing subcutaneous adipocyte size with increasing hypoxic exposure was observed, suggesting sleep apnea may induce adipocyte hypertrophy in subcutaneous fat.
Support (If Any): NIH HL081385, HL074223, and the American Thoracic Society.

0517

PREGNANCY OUTCOMES OF MATERNAL OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: Sleep disturbances occur commonly during pregnancy. Many pregnant women report an increased desire to sleep, and complaints of snoring, restlessness, fatigue, and sleep disruption are often

noted. Recent studies suggest that snoring and sleepiness during pregnancy can result in the development of serious adverse conditions, such as pre-eclampsia and intrauterine growth retardation (IUGR) in the fetus. The objective of our study was to determine if snoring and/or excessive sleepiness during pregnancy were associated with unfavorable pregnancy outcomes.
Methods: The study group consisted of post-partum mothers within 24 hours of delivery of a healthy infant at The Valley Hospital in Ridgewood, NJ. Mothers were randomly chosen and they were asked to complete 2 standardized questionnaires, the Epworth Sleepiness Scale (ESS) and the Snoring Symptoms Inventory (SSI). These questionnaires are used to identify symptoms of obstructive sleep apnea (OSA), specifically, snoring and excessive daytime sleepiness. In addition, medical chart reviews were conducted, looking at pregnancy, labor, and delivery information and infant growth and well-being data.
Results: We enrolled 107 mothers in our study. The mean maternal age was 34 years (SD +/- 5). The most common method of delivery was a scheduled Caesarian section (38.7%). The relationship of ESS and SSI scores to pregnancy outcomes (total weight gain, labor duration, maternal systolic and diastolic blood pressure, infant birth weight and gestational age) were analyzed. Higher scores on the ESS and SSI were associated with significantly lower infant birth weight ($P = 0.026$) and younger gestational age ($P = 0.013$). Mothers with pre-eclampsia were found to have higher ESS scores ($P = 0.009$).
Conclusion: In our population, pregnant women who demonstrated excessive daytime sleepiness also had symptoms of snoring disturbances. Elevated scores on the ESS and SSI were associated with adverse maternal and neonatal outcomes. We conclude that OSA symptoms during pregnancy may have serious sequelae.

0518

PREVALENCE AND CLINICAL STATUS OF ADULT PATIENTS WITH OBSTRUCTIVE SLEEP APNEA (OSA) AND/OR INSOMNIA IN A CLINIC-BASED SAMPLE

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Introduction: Little research has investigated the comorbidity of the two most common sleep disorders, OSA and insomnia. The current study examined the prevalence of men and women with OSA and/or insomnia and group differences in clinical status variables in patients referred for sleep laboratory evaluation.
Methods: The sample included 774 consecutive patients who underwent overnight polysomnography study for suspected OSA, completed questionnaires assessing insomnia severity, dysfunctional sleep-related beliefs, sleep inhibitory behaviors, worry, depression, fatigue, sleepiness, and health-related quality of life, and had a chart available for review. Patients were considered to have OSA if the apnea-hypopnea index was ≥ 15 and insomnia if the Insomnia Severity Index was ≥ 15.
Results: The sample was classified as follows: 26.9% with OSA co-morbid with insomnia, 31.1% with OSA, 22.5% with insomnia, and 19.5% with neither OSA nor insomnia. Results revealed that sex was not evenly distributed among these classifications ($\chi^2(3,N = 774) = 42.0$, $P < .0001$). OSA and insomnia groups were composed of more men and women, respectively, than expected. However, the number of men and women with OSA co-morbid with insomnia was similar to expected frequencies. Both the OSA co-morbid with insomnia and insomnia groups had significantly more dysfunctional sleep-related thoughts ($F(3,657) = 72.71$), sleep inhibitory behaviors ($F(3,698) = 41.61$), worry ($F(3,708) = 35.48$), depressive symptoms ($F(3,681) = 55.25$), fatigue ($F(3,726) = 55.61$), and sleepiness ($F(3,734) = 13.06$) and poorer health-related quality of life ($F(3,639) = 16.82$) than the OSA and neither OSA nor insomnia groups (all $P < .0001$).
Conclusion: OSA co-morbid with insomnia is a prevalent co-morbidity for both men and women sleep clinic patients. Moreover, OSA co-morbid with insomnia and insomnia alone were related to poorer clinical status in comparison to OSA alone. Future research investigating ways to better assess/treat patients with OSA co-morbid insomnia is warranted.

0519

SLEEP DISORDERED BREATHING AND ASSOCIATED LONG TERM MORTALITY IN DIASTOLIC HEART FAILURE

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Introduction: The association between sleep disordered breathing (SDB) and systolic heart failure has been described in several studies. We performed a retrospective evaluation of the prevalence and characteristics of SDB in patients with diastolic heart failure (DHF).
Methods: We evaluated patients who underwent polysomnography (PSG) within 6 months of having a Doppler echocardiogram (DE). DHF was defined as ejection fraction > 50% and evidence of Stage II or III diastolic dysfunction by standard DE criteria. Patients with no evidence of DHF were used as controls. The groups were compared for demographics, PSG, and DE parameters using the 2 sample T-test. A P value < 0.05 was considered significant. Long term mortality was followed till January 1st, 2009.
Results: A total of 225 patients ($n = 225$) with concurrent DE and PSG data were identified. Stage 2 or 3 DHF was present in 69 patients, while 156 patients had no DHF (control group). The mean AHI was significantly higher in the DHF group (13 vs 9; $P = 0.02$). Of the 8 cases of Central Sleep Apnea, 5 were in the DHF group and 3 were in the control group. The DHF group had a significantly lower nadir saturation compared to controls (78 vs. 82; $P = 0.002$). BMI values between the two groups were comparable (37 vs. 36; $P = 0.41$). Compared to controls, the DHF group had significantly larger left atrial diameter, interventricular septum size, left ventricular end systolic volume, and inferior vena cava size ($P < 0.05$ for all). There were 14 [of 225 (6.2%)] deaths. Mortality was higher in the DHF group [11/69 (16%)] than in controls [3/156 (2%)].
Conclusion: Our study suggests that patients with DHF are more likely to have SDB and nocturnal hypoxemia and this risk is independent of BMI. In our cohort, patients with DHF had higher mortality compared to patients without DHF. Further studies are needed to better define this association.

0520

IS OBSTRUCTIVE SLEEP APNEA DURING PREGNANCY A RISK FACTOR FOR GESTATIONAL DIABETES?

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Introduction: In the non-pregnant population obstructive sleep apnea (OSA) has been associated with an increased prevalence of impaired glucose tolerance and type 2 diabetes. Although sleep related complaints are common among pregnant women, very few studies have addressed maternal and fetal outcomes in women with sleep disturbances. Our objective was to evaluate pregnancy outcomes of reproductive aged women who have undergone sleep studies in order to examine the relationship between OSA and gestational diabetes (GDM).
Methods: This was a retrospective cohort study. Using ICD-9 codes, we queried our medical records database to find women who had a delivery at our hospital between January of 2007 and June of 2009, and again using ICD-9 codes we determined how many of these women also had a sleep study done at our institution. Charts of identified patients were reviewed and data regarding patient demographics, sleep study results, and pregnancy outcomes were abstracted. We then compared the incidence of GDM in women who received a diagnosis of OSA at the time

of their formal sleep evaluation to that of women without OSA. Between group comparisons were made using the Fisher exact test and chi square analysis, as appropriate.

Results: Seventy-four women who had undergone a formal sleep study as well as a delivery were identified. 66% (49/74) were nulliparous at the time of their first documented delivery at our institution, and 23 subjects (31%) had more than one delivery during the study period. 66% of the subjects (49/74) underwent a sleep study prior to or within a year of their first documented delivery. The mean age at the time of the sleep study was 20 ± 4.7 and the mean BMI was 34.9 ± 12.2. Thirty-two women (43%) received a diagnosis of OSA at the time of their sleep study. After excluding women with incomplete medical records and women with pre-gestational diabetes we were left with 56 subjects, of whom 26 (46%) had OSA. The incidence of GDM was 15% (4/26) in women with OSA vs. 0% (0/30) in women without OSA (P = .04).

Conclusion: These results demonstrate that OSA may increase a women's risk of GDM. While our results were statistically significant, further studies with greater power are required to validate our findings.

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0521

DAYTIME FUNCTION AND PERIOD 3 GENE HAPLOTYPE IN OBSTRUCTIVE SLEEP APNEA/HYPOPNEA SYNDROME (OSAHS)

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Introduction: In OSAHS, the relationship between measures of sleep disordered breathing and sleepiness is poor and suggests there is a differential susceptibility to the same physiological stress. In sleep-deprived healthy subjects, the magnitude of decrement of cognitive performance has been related to differences in variable-number tandem-repeats (VNTR) in the circadian clock gene Period 3 (PER3). The purpose of this pilot study was to determine the effect of PER3 gene haplotype on daytime function in patients with OSAHS.

Methods: PER3 haplotypes were determined in 60 patients (39M/21F, Age 21-79 years) with diagnosed OSAHS (RDI 8.2-138.2/hr) who previously had daytime function assessments as part of other research studies. Subjective measures included the Epworth sleepiness scale (ESS), and objective measures included the psychomotor vigilance test (PVT transformed lapses, PVTslope) and sleep latency from a multiple sleep latency test (MSLT, n = 38) or maintenance of wakefulness test (MWT, n = 12). Haplotypes were determined via buccal swabs and PCR analysis and subjects were divided into three groups based on their PER3 gene haplotype: 4/4, 4/5, or 5/5. Relationships between haplotype and daytime function were examined for the overall group with and without adjustment for RDI.

Results: Haplotype distribution was 27 with $PER3^{4/4}$ (45%), 29 with $PER3^{4/5}$ (48%) and 4 with $PER3^{5/5}$ (7%), similar to that reported by others. Due to the small number of subjects with $PER3^{5/5}$, comparisons were limited to the 4/4 and 4/5 haplotypes. The mean RDI was similar for the $PER3^{4/4}$ and $PER3^{4/5}$ groups (44 ± 30 vs 41 ± 33/hr, and there were no differences in mean ESS (12.1 ± 6 vs 12.5 ± 6), PVT transformed lapses (5.1 ± 3.9 vs 5.3 ± 3.6), PVTslope (-0.015 ± -0.041 vs -0.029 ± -0.033) and sleep latency (55% vs 40% with MSLT < 7 min or MWT < 15 min). However, a significant interaction between RDI and Haplotype on PVTslope was found (P = 0.03), suggesting a greater effect of RDI on PVTslope in the $PER3^{4/5}$ than in the $PER3^{4/4}$. This observation was not supported by the MSLT/MWT latency data.

Conclusion: Our data suggest that OSAHS patients with $PER3^{4/4}$ may perform better than $PER3^{4/5}$ on the PVT, but there is little to suggest that they are subjectively or objectively less sleepy. However these conclusions are limited by our sample size. Furthermore, we were unable to test the effect of the $PER3^{5/5}$ haplotype in our dataset.

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0522

CHANGE IN EXHALED NITRIC OXIDE LEVELS AFTER SLEEP IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA CORRELATES WITH OSA SEVERITY

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Introduction: Oxidative stress and inflammation may be implicated in the pathogenesis of obstructive sleep apnea (OSA) and its cardiovascular consequences. However, inconsistent results were obtained in prior studies that evaluated exhaled nitric oxide (FeNO) as a surrogate marker of airway inflammation and oxidative stress in OSA. We hypothesize that patients with OSA have elevated levels of FeNO at baseline compared to non-OSA individuals, and that FeNO levels increase further after sleep and correlate with the severity of OSA. We studied the levels of FeNO in patients with OSA using a recently FDA approved portable NO analyzer. FeNO levels measured before and after sleep were correlated with various polysomnographic parameters.

Methods: We prospectively enrolled 42 consecutive non-smokers ≥ 18 years without history of cardio-respiratory diseases, or systemic infections, who were scheduled for an overnight sleep polysomnogram (PSG) study. We measured FeNO levels immediately before and after the overnight PSG using a portable NIOX MINO® NO analyzer (Aerocrine; Sweden).

Results: Patients with OSA (n = 31) have elevated levels of FeNO compared to healthy controls (n = 11), both before sleep (16 ± 10 ppb vs. 7 ± 6; P = 0.002) and after sleep (22 ± 11 ppb vs. 8 ± 6; P < 0.001). FeNO levels after sleep were significantly higher than pre-sleep values in patients with OSA (22 ± 11 ppb vs. 16 ± 10; P < 0.001) but not in the control subjects. Across all patients, the increase in FeNO post-pre sleep was correlated with AHI (R^2 0.45, P < 0.001).

Conclusion: Patients with OSA have elevated FeNO levels which increase further following overnight sleep. The increase in FeNO after sleep correlates with OSA severity, suggesting that upper airway inflammation is present at baseline and is intensified in these patients after sleep.

Support (If Any): Grant from the Cleveland Clinic Foundation, Division of Clinical Research, Research Programs Committees (RPC) internal funding amounting USD 25000.

0523

SHORT-LIVED OXYGEN DESATURATION DURING SLEEP IN SUBJECTS WITHOUT DEFINABLE SLEEP-DISORDERED-BREATHING AND ABNORMAL METABOLIC STATUS

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Introduction: Subjects not responding to the criteria of obstructive sleep apnea or sleep related hypoventilation may present oxygen saturation drop below 90% for variable frequency and duration of total sleep time. There is an absence of knowledge of the meaning and associated findings related to such observation.

Methods: The 1042 subjects from the representative sample of the Sao-Paulo Epidemiologic Sleep. A stage probabilistic clustered sample (N = 1,042), by gender, age (20-80), and socioeconomic status, was selected, interviewed, completed questionnaires (demographic/psychological/physical/sleep), and underwent full in-lab PSG, to represent the sleep pattern in Sao Paulo. Saturation was measured with a Nelcor finger oximeter with a 5 heart beats sampling rate, with hand placed at heart level and continuous video monitoring of subject to avoid abnormal hand placement. The oximetric curve was systematically analyzed with deletion of artifactual reading visually and with usage of plethysmographic signal Calibration was performed awake in bed before sleep onset and in the morning at sleep offset All polysomnograms were scored for abnormal breathing during sleep following international criteria.
Results: 137 subjects mean age of 42 years, mean BMI of 26.7 ± 3 Kg/m2, 59% men, with normal awake blood gazes and absence of active cardio- pulmonary diseases presented at least one event of desaturation < 90% during sleep. Compared to non desaturators in the same sample these subjects had significantly higher levels of CRP, Cholesterol, LDL, Tryglicerides, Glycemia, Homocystein and Framingham score (P < .05). Most commonly, desaturations were related to REM sleep and and short decreases in diaphragmatic efforts.
Conclusion: Mildly overweight subjects without SDB as internationally defined, already present short-live SaO_2 drop during sleep associated with awake metabolic abnormalities.
Support (If Any): AFIP/CNPq/Fapesp

0524

UPPER AIRWAY COLLAPSIBILITY AND GENIOGLOSSUS ACTIVITY IN CHILDREN WITH SICKLE CELL DISEASE

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Introduction: Both anatomical and neuromuscular factors contribute to the pathogenesis of obstructive sleep apnea (OSA) in children. Adenotonsillar hypertrophy is thought to be a major contributor to OSAS in patients with sickle cell disease (SCD). However, the effect of neuromuscular factors has not been investigated. We hypothesize that SCD patients with OSAS have a blunted neuromuscular response to subatmospheric pressure loads during sleep, making them more likely to develop upper airway collapse.
Methods: Subjects with SCD with and without OSA underwent pressure-flow measurements during sleep using intraoral surface electrodes to measure genioglossal EMG (EMGgg). Two techniques were applied to decrease the nasal pressure to subatmospheric levels, resulting in an activated and relatively hypotonic upper airway. The area under the curve of the inspiratory EMGgg moving time average was analyzed. EMGgg activity was presented as a percentage of baseline. Changes in EMGgg in response to decrements in nasal pressure were presented as the slope of the EMGgg vs. nasal pressure (slope of EMGgg-PN).
Results: 18 SCD-controls and 4 SCD-OSA were studied. For SCD-controls, median (range); 95% confidence intervals of the slopes of EMGgg- PN were -11.6 (-27.9 to -1.9); -18.5 to -8.1 %*cm H2O-1 using the activated technique versus -1.9 (-11.3 to 1.5); -6.1 to -1.4 %*cm H2O-1 using the hypotonic technique (P = 0.03). For SCD-OSA, slopes of the EMGgg using the two techniques were -3.3 (-2.6 to 3.5); -9.6 to 4.5 versus -3.8 (-4.0 to 3.3); -7.8 to 3.6 %*cm H2O-1, respectively (P = NS). Activated PN-EMGgg was greater in SCD-controls than SCD-OSA (P = 0.01), but hypotonic PN-EMGgg was similar (P = 0.47).
Conclusion: SCD-OSA have decreased genioglossal muscle activity in response to subatmospheric pressure loads compared to SCD controls. We speculate that neurologic impairment, possibly related to vaso-occlusive episodes, may affect upper airway activation during sleep, contributing to OSAS in this population.
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0525

THE PREVALENCE OF OBSTRUCTIVE SLEEP APNEA IN PATIENTS WITH SQUAMOUS CELL CARCINOMA OF TONGUE FOLLOWING ABLATION SURGERY

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Introduction: To determine the prevalence of obstructive sleep apnea in patients with squamous cell carcinoma of the tongue after primary surgical resection. To correlate the presence of obstructive sleep apnea and the occurrence of obstructive apnea in this patient population.
Methods: This is a retrospective study of 30 Taiwanese patients, 28 males and 2 females, age ranges from 37 to 71 years old with squamous cell carcinoma of the tongue after surgical resection. Patients who had a follow-up post treatment period of 6 months to 11 years were eligible for inclusion. During this post treatment period, the occurrence of obstructive sleep apnea is determined in these patients. An overnight polysomnography is used to determine the apnea-hypopnea index. Patients were considered to have OSA if the AHI value is of more than 5.
Results: The mean size of the SSC primary tumour of the tongue is 4.3 cm. The surgical treatment of choice is wide excision of the tongue or hemiglossectomy, however, 85% of the patients had undergone neck dissections. 46% of the patients received radiotherapy and/or chemotherapy. The wounds of the tongue are repaired by split thickness skin graft, pectoral major myocutaneous flap or free flap. Results show that OSA was present in 18 out of 30 patients, yielding a prevalence of 60% in this patient group. The mean AHI for patients with OSA is 18 events per hour, with a lowest mean oxygen saturation of 82.3%, consistent with sleep-disordered breathing. The obstructive sleep apnea and non-obstructive sleep apnea patients, show no statistical significance in terms of age, snoring index, tumor size, local recurrence, neck lymph nodes metastasis, neck dissection, response to radiotherapy or chemotherapy, except for the body mass index (mean ± SD, 26.3 ± 3.8), wherein the obstructive sleep apnea patients showed statistical significance (P = 0.018).
Conclusion: The prevalence of OSA (60%) in the patient population of squamous cell carcinoma of the tongue is found to be significantly higher than that of the general population. Moreover, the findings also proved the association between obstructive sleep apnea and squamous cell carcinoma of tongue after ablation surgery. However, the limitation of this study is the patient sample size which is not enough to evaluate the direct influence of age, snoring index, tumor size, local recurrence, neck lymph nodes metastasis, neck dissection, radiotherapy and chemotherapy on the patients with obstructive sleep apnea after operation.

0526

OSA SEVERITY ASSOCIATED WITH OBJECTIVELY MEASURED PHYSICAL ACTIVITY: A PILOT STUDY

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Introduction: Relationships between obstructive sleep apnea (OSA) and excessive daytime sleepiness (EDS) with functional outcomes have been reported. However, it remains unclear how OSA or EDS affects objectively measured physical activity. The purpose of this study was to examine the association between OSA, EDS, functional outcomes and objectively measured physical activity.
Methods: Subjects being evaluated for suspected OSA were recruited from a sleep clinic. OSA severity (apnea + hypopnea index [AHI])

was determined by an overnight PSG. The Epworth Sleepiness Scale was used to determine subjective daytime sleepiness (ESS ≥ 10). The Functional Outcomes of Sleep Questionnaire (FOSQ) total score was used to examine difficulty in functional outcomes in areas sensitive to sleepiness. Physical activity was defined as mean number of steps per day measured by the Bodymedia SenseWear Pro Armband™ worn for a 7-day period.

Results: The sample (n = 32) was male (53%), middle-aged (mean age = 49.09 ± 11.59 years), White (78%), and overweight or obese (mean BMI = 33.68 ± 6.75kg/m^2). Many subjects reported subjective sleepiness (mean ESS = 9.46 ± 5.16; 25% with ESS ≥ 14) and OSA (75% with AHI ≥ 5/hr; 25% with AHI ≥ 30/hr). Higher ESS scores were associated with lower FOSQ scores (r = -.79, P < .001) but were not significantly associated with mean number of steps per day (P = .777). AHI values were not correlated with FOSQ or ESS scores but higher AHI values were marginally associated with decreased physical activity based on mean steps per day (r = -.34, P = .06). Results of a hierarchical regression analysis show that higher AHI values were significantly associated with lower average number of steps walked per day after controlling for patient's age and sex (incremental R^2 = .17, P = .012).

Conclusion: Sleepiness was associated with increased perceived difficulty in functional outcomes sensitive to sleep disturbances but not with objectively measured activity. OSA severity was not associated with increased sleepiness or lower functional outcomes; it was associated with decreased objective physical activity.

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0527

DETERMINANTS OF NOCTURNAL HYPERCAPNIA IN OSA PATIENTS

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Introduction: Hypercapnia during wakefulness characterizes the Obesity Hypoventilation Syndrome (OHS). As nocturnal elevation of CO_2 may precede the development of OHS, we sought to identify demographic and physiologic factors influencing elevation of end-tidal CO_2 ($EtCO_2$) during sleep in patients with obstructive sleep apnea (OSA).

Methods: We reviewed 44 polysomnograms obtained for suspected OSA and selected such that the maximal $EtCO_2$ during sleep was below 45 mmHg in 15 studies, between 45 and 50 mmHg in 14, and above 50 mmHg in 15. For each cycle of respiratory events, we obtained the ratio of respiratory event (apnea or hypopnea) duration relative to the inter-event duration, and the ratio of pre-event amplitude relative to post-event amplitude. The percents of total sleep time spent at $EtCO_2$ < 45 mmHg (T45), 45-50 mmHg (T45-50), and > 50 mmHg (T50) were determined. "CO_2 load" was calculated as the sum of the products of estimated average $EtCO_2$ at each time interval by percent of total sleep time spent at each corresponding time interval. [(T45*(45 + min$EtCO_2$)/2] + [T50*(50 + max$EtCO_2$)/2] + [T45-50 *47.5]

Results: CO_2 load correlated with apnea duration in relation to the inter-apnea duration (r = 0.73, P < 0.001) and with pre- to post-event (apneas and hypopneas) amplitude ratio (r = 0.69, P < 0.001). Multiple regression showed that pre- to post-event amplitude ratio accounted for 47% of the variance in CO_2 load (P < 0.001) with each of age and BMI contributing an additional 6% (P = 0.04 and 0.02 respectively). There was no significant correlation between the CO_2 load and AHI, neck circumference, daytime sleepiness, or oxygen desaturation.

Conclusion: Longer apnea duration and a smaller post-event ventilation correlated with measures of nocturnal hypercapnia, BMI was a less significant predictor, and age was an unexpected contributor. Interestingly the AHI was not a predictor of nocturnal $EtCO_2$.

0528

SLEEP APNEA IN NON-OBESE MEN: ASSOCIATION WITH VISCERAL ADIPOSITY

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Introduction: We have established that inflammation, insulin resistance, and visceral adiposity play a major role in the pathogenesis of sleep apnea in obese men and the associated cardiovascular morbidities. In non obese apneics, the role of metabolic factors is not well established, whereas anatomic abnormalities are considered of primary pathogenetic importance. The aim of this study was to examine the association between sleep apnea and visceral adiposity in nonobese, middle-aged men.

Methods: Fifteen nonobese men with OSA and 16 nonobese controls matched for age and BMI were monitored in the sleep laboratory for 4 consecutive nights. Objective measures of sleep, sleepiness and sleep apnea were obtained as well as blood pressure that was measured in the evening. Abdominal fat distribution was measured with computed topographic scans at five different levels.

Results: Sleep apneics had a significantly greater amount of visceral fat compared to non obese controls (P < 0.01) in all 5 levels. There were no differences between the two groups in terms of subcutaneous fat. Visceral fat was significantly correlated with sleep apnea indices, and both systolic and diastolic pressure.

Conclusion: We conclude that similarly to obese apneics, non obese apneics have greater amount of visceral fat compared to matched controls. This supports that visceral adiposity even in non obese populations may be a principal culprit progressively leading to worsening metabolic syndrome manifestations and sleep apnea.

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0529

NEURAL CORRELATES OF ADAPTATION TO SLEEP DEPRIVATION IN OBSTRUCTIVE SLEEP APNEA - A PILOT STUDY

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Introduction: Numerous studies suggest that sleep loss impairs human executive and attentional performance. The neural correlates of brain adaptation to sleep loss in patients with chronic sleep fragmentation remain unexplored. We predicted that patients with obstructive sleep apnea (OSA; a form of chronic sleep fragmentation) will show altered brain activation after acute sleep deprivation (SD) when compared to normal controls.

Methods: We used functional magnetic resonance imaging (fMRI) to compare brain activation after normal sleep and 24 hours of SD in two populations: normal controls and patients with chronic sleep fragmentation due to OSA (ages 25-56). We related these changes to perfor-

mance on executive function (color-word Stroop) and to the degree of sleepiness using the Multiple Sleep Latency Test (MSLT).
Results: Seventeen subjects completed the protocol (nine with OSA; mean AHI 34). In region of interest analyses, OSA patients showed no significant differences in activation after SD, while controls showed decreased brain activation in the left anterior cingulate gyrus (BA 32; P = 0.01; Wilcoxon signed-rank test) and in the left inferior frontal gyrus (BA 45; P = 0.02). Across subjects, improved performance after SD positively correlated with increased brain activation. This was consistently observed across regions and reached significance in right BA 32 (r = 0.62; P = 0.01; Spearman correlation) and right medial frontal gyrus (BA 46; r = 0.56; P = 0.02), and was borderline significant in left BA 32 (r = 0.47; P = 0.07). Across subjects, increased sleepiness on the MSLT was correlated with increased brain activation and reached significance for the OSA patients in right BA 45 (r = -0.7; P = 0.04) and borderline significance in right insula (r = -0.62; P = 0.07) and right inferior frontal gyrus (BA 44; r = -0.61; P = 0.08).
Conclusion: Areas of relative increased brain activation during an executive function task after sleep deprivation in OSA subjects may represent adaptive, compensatory networks that develop after chronic sleep fragmentation.
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0530

THE EFFECT OF NOCTURNAL O_2 DESATURATION DURATION ON VARIOUS NOCTURNAL AROUSALS AND AUTONOMIC RESPONSE IN SLEEP APNEA SYNDROME

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Introduction: Sleep apnea syndrome (SAS) has serious effect in many systems of our body. Its pathophysiology is multifactorial; however, its hypoxic effect could be the main force for the consequential results. This study is to see if the nocturnal O_2 desaturation duration is the major factor to various arousals and autonomic response in SAS.
Methods: 717 cases of SAS were enrolled into this retrospective study. All of these cases had received the overnight polysomnographic (PSG) examination with measurement of blood pressure (BP) at night before examination and in the morning after examination. First, these cases were divided by AHI into control (< 5), mild (5-15), moderate (15-30), and severe groups (> 30), and analyzed between AHI and arousal & BP. Then the cases were also divided by O_2 desaturation duration into control (none), minimal (0-5min), mild (5-30min), moderate (30-60min), severe (> 60min) degree, and analyzed on O_2 desaturation durations against spontaneous and respiratory arousals & BP.
Results: When analyzed between AHI and arousals & BP, mild and moderate degree of AHI did not show significant effect to spontaneous arousal or BP; however, when analyzed between O_2 desaturation duration and arousals &BP, various degree of O_2 desaturation (0, 1.30 ± 1.27, 13.20 ± 6.67, 42.84 ± 9.17, 128.79 ± 67.11) reflected the negative correlation to spontaneous arousal index (P < 0.001) of (26.92 ± 15.36, 24.04 ± 15.17, 17.90 ± 13.64, 13.04 ± 11.65, 8.63 ± 9.11 respectively); and positive correlation with respiratory arousals index (P < 0.001) of (7.43 ± 12.32, 12.68 ± 17.53, 25.46 ± 15.43, 33.97 ± 20.67, 53.36 ± 26.64, respectively), and BP of the night before PSG (P < 0.001) of (118.54 ± 17.30/78.01 ± 13.21, 126.84 ± 18.66/82.54 ± 12.52, 133 ± 18.40/86.96 ± 13.15, 132.72 ± 16.02/89.26 ± 12.23, 129.56 ± 16.70/87.18 ± 11.52mmHg, respectively), and the morning BP after PSG (P < 0.001) of (118.70 ± 18.57/80.48 ± 12.82, 127.55 ± 18.93/85.40 ± 12.24, 135.62 ± 20.06/89.99 ± 13.12, 139.83 ± 20.25/92.72 ± 14.51, 139.70 ± 17.53/97.11 ± 11.84 mmHg, respectively).
Conclusion: The mild and moderate degree of AHI does not reveal significant effect to cortical arousal and autonomic response of BP in SAS; however, the O_2 desaturation duration revealed significant correlation to spontaneous and respiratory arousals as well as autonomic response of BP. Therefore, O_2 desaturation duration, not AHI, in intermittent hypoxia could be the most important determinant contributor to SAS consequence.

0531

SLEEP DISORDERED BREATHING AND EMPTY SELLA: A NEW ASSOCIATION

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Introduction: Empty sella (ES) is an MRI finding with herniation of subarachnoid space within the sella with pituitary flattening. ES is reported in 8%-35% in the general population. Sleep-disordered breathing (SDB) is interruptions of breathing during sleep. We report a high prevalence of SDB in ES.
Methods: We retrospectively analyzed data from 9 patients who had MRI finding of total ES (TES) (≥ 50% sella filled with CSF; pituitary ≤ 2 mm) or partial ES (PES) (≤ 50% sella filled with CSF; pituitary ≥ 3 mm) and its relationship with results of polysomnography.
Results: Mean age was 46.1 (SD 8.2) with 89% female. Mean BMI was 34.2 (SD 9.6). All had SDB, either upper airway resistance (UARS) or obstructive sleep apnea (OSA). 56% had OSA with AHI of 25.7 (SD 14.1) and 44% had UARS with RDI of 14.3 (SD 9.4). Among OSA, BMI was 41.4 (SD 5.9) and age was 44.8 (SD 6.5). Among UARS, BMI was 25.3 (SD 2.1) and age was 47.8 (SD 10.8). UARS had a REM RDI of 32.4 (SD 22.7) and PLMI of 24.9 (SD 30.6). The AHI plus RDI was 20.0 (SD 12.3). TES was seen in 44% and PES was seen in 56%. Among the OSA 80% had TES and 20% had PES. All UARS had PES.
Conclusion: This is the first study describing a relationship between SDB and ES. SDB is common among ES. All patients had either OSA or UARS. UARS is very common in patients with PES. OSA is more common in TES with higher BMI. Progesterone, a potent respiratory stimulant is believed to be protective from SDB. SDB is common in states with decreased progesterone such as post menopause and polycystic ovary disease. Our findings might reflect disrupted progesterone pathway in ES. Further studies are needed to elucidate the implications and mechanisms of these findings.

0532

AROUSALS IN OBSTRUCTIVE SLEEP APNEA PATIENTS WITH LARYNGOPHARYNGEAL AND GASTROESOPHAGEAL REFLUX

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Introduction: We hypothesized that differences exist in the effect of apnea severity and those of laryngopharyngeal reflex (LPR) versus gastroesophageal reflex (GER) on arousals during sleep in patients with obstructive sleep apnea syndrome (OSAS).
Methods: Japanese patients having witnessed snoring or excessive daytime sleepiness with a frequency scale for symptoms of GER of 10 or more, or with visualization of inflammatory changes on pharyngolaryngeal endoscopy were undergone polysomnography with pH monitoring using double pH catheter in a sleep laboratory.
Results: Most reflux events in patients with severe OSAS with LPR (n = 16) and GER (n = 21) were accompanied with respiratory arous-

als. On the other hand, among patients with mild-to moderate OSAS, 64.0% and 24.8% of reflux events were accompanied with spontaneous arousals in those with LPR (n = 12) and GER (n = 12), respectively, and 9.4%, and 8.3% of reflux events were not accompanied by arousals. There were no significant differences in other sleep parameters between mild-to-moderate OSAS patients with LPR versus GER, and between severe OSAS patients with LPR versus GER.
Conclusion: Among patients with reflux, the types of arousal differed significantly between those with mild-to-moderate versus severe OSAS. In patients with mild-to-moderate OSAS, LPR induces more spontaneous arousals than does GER.

0533

OBSTRUCTIVE SLEEP APNEA WITHOUT SELF-REPORTED SLEEPINESS IS ASSOCIATED WITH INCREASED RISK OF MOTOR VEHICLE ACCIDENTS: AN EPIDEMIOLOGIC STUDY

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Introduction: Patients with obstructive sleep apnea (OSA) are at increased risk of motor vehicle accidents (MVA). In epidemiologic studies, however, approximately half of those with OSA do not report excessive sleepiness; it is not known whether these non-sleepy individuals are at risk of MVA.
Methods: The Sleep Heart Health Study baseline examination included PSG in 6441 individuals participating in community-based epidemiologic studies. Participants answered questions about daytime sleepiness, including the Epworth Sleepiness Scale and two questions about the frequency of feeling "unrested during the day" or "excessively (overly) sleepy during the day." At a follow-up visit after approximately 2 years, participants were asked about MVA occurring during the preceding year. Logistic regression was used to test the association of MVA with OSA, categorized as none, mild, moderate or severe using cutpoints of 5, 15 and 30 events/hr with a 4% fall in SpO_2.
Results: 4870 participants reported driving at follow-up and are included in this analysis. Median age was 63 (range 39-94) years and 50.5% were women. At least one MVA within the preceding year was reported by 6.7% of participants. OSA was present 45%: mild 28%, moderate 11%, severe 6%. The Epworth score was > 10 in 25%; an additional 12% reported often feeling sleepy or unrested for a total of 37% reporting excessive sleepiness. Adjusting for age and sex, severe OSA was significantly associated with risk of MVA (OR 1.78, 95% CI 1.18-2.71); risk of MVA was not significantly increased in those with mild (OR 1.17, 95% CI 0.89-1.54) or moderate (OR 1.05, 95% CI 0.71-1.55) OSA. Epworth score was significantly associated with risk of MVA; however, the association of OSA with MVA was not attenuated by adjustment for Epworth score. Moreover, this association was present even when the analysis was restricted to those with no self-reported excessive sleepiness (OR 1.92, 95% CI 1.07-3.46).
Conclusion: In a community-based sample of adults, severe OSA is associated with an almost 2-fold increased risk of MVA. This risk is independent of self-reported daytime sleepiness. Whether this reflects failure of these individuals to perceive sleepiness, an effect on vigilance or judgment that is independent of sleepiness, or confounding by unmeasured common risk factors is unknown. No significant increased risk of MVA was seen in those with mild to moderate OSA.
Support (If Any): National Heart, Lung and Blood Institute

0534

OBSTRUCTIVE SLEEP APNEA IS INDEPENDENTLY ASSOCIATED WITH INSULIN RESISTANCE AND CARDIOVASCULAR SINGLE NUCLEOTIDE POLYMORPHISMS

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Introduction: Many studies have confirmed the presence of a genetic basis for Obstructive Sleep Apnea (OSA) with > 30% of its variance attributed to genetic factors. OSA is often accompanied by cardiovascular (CVD) and metabolic disorders including insulin resistance and diabetes. Yet specific mechanisms underlying these associations are poorly understood. Genome-wide scans have consistently found single nucleotide polymorphisms (SNPs) located near CDKN2A/B genes to be associated with insulin resistance, stroke and CVD risk. Our aim was to examine the association of these variants with OSA risk and severity, adjusting for conventional confounders.
Methods: Four SNPs located near the CDKN2A/B gene were genotyped and analyzed in European OSA patients and controls. OSA cases were defined by an Apnoea Hypopnoea Index (AHI ≥ 5) via polysomnography, and controls according to modified Berlin questionnaire results indicating low OSA probability. Subjects were assessed for cardiovascular and metabolic risk factors. Outcomes included OSA severity (quantified by loge[AHI]), hypertension, diabetes, and other CVD associated phenotypes including homeostatic model assessment of insulin resistance (HOMA IR), lipids and metabolic syndrome. Sex-specific multivariate generalized linear modelling was conducted to characterize associations adjusted for age, body mass index (BMI), smoking (and menopause in females).
Results: A total of 891 cases (63% males aged 51 ± 14, 37% females aged 51 ± 13 years) and 1,526 controls (30% males aged 46 ± 19, 70% females aged 46 ± 13 years) were included. The 4 SNPs had minor allele frequencies of 17 to 49%. Case-control analysis indicated that rs10811661:diabetes and rs564398:diabetes interactions were significantly associated with OSA risk in females. Multivariate analysis within cases indicated that these SNPs were associated with measures of OSA severity and various CVD associated phenotypes independently of BMI and other conventional confounders ($P < 0.05$). Variant rs10757278 was significantly associated with diabetes, and a SNP:diabetes interaction was significantly associated with loge(AHI) ($P < 0.05$).
Conclusion: These results suggest that pleiotropic loci near the CDKN2A/B region are associated with OSA severity and susceptibility independently of cardiovascular factors, suggesting the relationship between OSA and cardiovascular disease has both shared and unshared genetic components.

0535

DIFFERENCE OF THE SLEEP FRAGMENTATION ACCORDING TO AGES IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

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WITHDRAWN

0536

PREVALENCE OF LEFT VENTRICULAR DYSFUNCTION, RIGHT VENTRICULAR DYSFUNCTION AND PULMONARY HYPERTENSION IN PATIENTS WITH SEVERE OBSTRUCTIVE SLEEP APNEA

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Introduction: Untreated patients with obstructive sleep apnea (OSA) develop asymptomatic left ventricular dysfunction, pulmonary hypertension and right ventricular dysfunction. Previous studies have shown conflicting data regarding prevalence of these abnormalities in patients with OSA. We investigated prevalence of cardiac dysfunction in patients presenting for evaluation and treatment of OSA.
Methods: We recruited 36 newly diagnosed patients with severe OSA. All subjects underwent echocardiographic measurements and cardiac magnetic resonance imaging (CMR) prior to initiation of CPAP therapy. Each individual was compared to age, sex and BMI matched historical controls [1]-[2].
Results: The average age of patients was 52.09 ± 2.97 years, 66% were male, average BMI was 33.92 ± 4.61 kg/m^2. OSA was diagnosed by split night polysomnography. Average apnea-hypopnea index for the group was 56.71 ± 21.92. Echocardiographic determinants of LVDD, PH and RVD compared to matched controls showed following data: Left ventricular end-diastolic dimension LVEDD: 58.72 ± 1.41 mm vs. 47.20 ± 2.8 mm, P < 0.05; left atrial volume index, LAVI: 44.90 ± 2.89 ml/m^2. 21.7 ± 4.1 ml/m^2; right atrial ventricular index, RAVI: 48.21 ± 4.24 ml/m^2 to 37.17 ± 0.11 ml/m^2, P < 0.001 and right ventricular end-diastolic dimension RVEDD: 40.93 ± 1.41 mm vs. 32.5 ± 3.8 mm, P < 0.05; pulmonary artery systolic pressure PASP: 55.34 ± 5.66 mmHg to 25.2 ± 1.9 mmHg. CMR measurements demonstrated left ventricular end-diastolic volume, LVEDV: 199.24 ± 5.66 ml vs. 169.38 ± 3.54 ml, P < 0.05 and left ventricular mass, LVM: 184.28 ± 1.41 gm/m^2 vs. 137.28 ± 6.36 gm/m^2, P < 0.05.
Conclusion: Our study shows that left/right ventricular dysfunction and pulmonary hypertension is widely prevalent in untreated patients with a severe OSA. Early recognition and appropriate therapy of OSA is imperative to prevent development of congestive heart failure, cor pulmonale and death. < P > [1] Yildirimtruk O, et al. Istanbul Bilim University. [2] Cain PA, et al. Age and gender specific normal values of left ventricular mass, volume and function for gradient echo magnetic resonance imaging: a cross sectional study. BMC Medical Imaging 2009, 9:2.
Support (If Any): Sleep Disorders Center, University of Manitoba

0537

THE PREVALENCE OF SLEEP DISORDERED BREATHING IN PREGNANT WOMEN AT HIGH-RISK FOR PREECLAMPSIA

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Introduction: Sleep-disordered breathing (SDB) describes a group of disorders characterized by abnormal respiratory patterns (pauses) or quality of ventilation during sleep. In the non-pregnant population studies have concluded that SDB is associated with an increased risk of developing hypertension. Few studies have evaluated the consequences of SDB during pregnancy, and there is very little data on the prevalence of SDB in patients at risk for hypertensive disorders of pregnancy. The objective of this study was to determine the prevalence of SDB in a pregnant population at high-risk for preeclampsia.
Methods: Pregnant women with chronic hypertension (CHTN), pregestational diabetes (DM), obesity (defined as pre-pregnancy BMI ≥ 30), and/or a prior history of preeclampsia were invited to participate in an overnight sleep evaluation with the Watch-PAT100, a wrist-mounted, ambulatory device designed to diagnose SDB. SDB was defined as an apnea-hypoxia index (AHI) of ≥ 5. Univariable and multivariable statistical techniques were used to compare the incidence of SDB among women with different risk factors for preeclampsia.
Results: Sixty subjects were recruited. The mean maternal age was 33.2 ± 6.5. The mean gestational age at the time of the sleep study was 16.6 ± 4.1 weeks. Twenty-eight percent (17/60) of subjects had evidence of SDB (AHI of ≥ 5). Women with CHTN had the highest incidence of SDB (54.3% vs. 15.6% P = .001). Obese subjects also had a higher incidence of SDB (41.2% vs. 11.5% P = .02). DM and a history of preeclampsia were not associated with SDB. CHTN remained associated with SDB even after controlling for other coexisting preeclampsia risk factors; OR = 7.9, 95% CI 1.8, 35.6.
Conclusion: SDB is highly prevalent among women at high risk for preeclampsia, with an incidence higher than that of the general premenopausal population. Obese women and women with chronic hypertension have the highest incidence of SDB. Further research is needed to determine if SDB is a significant contributing factor to the development of preeclampsia.
Support (If Any): NIH/NICHD 1K12HD050121

0538

FACTORS INFLUENCING THE RESPIRATORY AROUSAL THRESHOLD IN OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: The respiratory arousal threshold (AT) is important in sleep apnea pathogenesis but the factors influencing AT measurements have been minimally studied. Intrathoracic negative pressure (increasing respiratory effort) is believed to be the key trigger for the AT. Pharmacologically increasing the AT to allow sufficient time to recruit pharyngeal dilator muscles and promote stable breathing has been proposed to be a potential novel therapeutic option for certain patients (ie those with a low AT). For this to be a viable approach it is first important to define: 1) the range of AT values to determine how many patients have a low AT 2) between-night stability of the AT 3) sleep-state effects and 4) the influence of using apneas vs. hypopneas to quantify the AT.
Methods: Thus far, in 30 untreated OSA patients of varying severity (AHI range 8-136 events/hr) AT was assessed using an epiglottic pressure catheter (mean of nadir epiglottic pressure prior to arousal during ~15 replicate respiratory events selected at random) during a standard 8 hr supine PSG. Repeat AT assessment, within 2 weeks, was conducted in 15 patients to define between-night reproducibility. The influence sleep stage (N1 vs. N2/N3 vs. REM) and, using apneas vs. hypopneas to quantify the AT were compared in a subset of patients.
Results: AT varied substantially between patients (range -7 to -52 cmH_2O; Mean -21 ± 11(SD) cmH_2O). 30% had a low AT (defined as < 15 cmH_2O). AT was higher (more negative) in N2/N3 compared to S1 and REM (-18.4 ± 10 vs. -14 ± 10 vs. -12.6 ± 7 cmH_2O; N = 11). Mean N2/N3 AT values were similar between baseline and follow-up (-18.2 ± 9 vs. -18.4 ± 10 cmH_2O, P = 0.85; ICC = 0.94; N = 15) and between apneas vs. hypopneas (-21.2 ± 11 vs. -24.7 ± 13 cmH_2O, P = 0.10; ICC = 0.90; N = 9).
Conclusion: There is substantial variability in AT values between OSA patients. Approximately 1/3 patients have a low AT. Within a patient, mean AT values are similar between nights. AT is influenced by sleep state and, quantifying AT using hypopneas vs. apneas yields similar values. These data suggest a substantial proportion of OSA patients have a low AT and may benefit from strategies to increase the AT. These data also provide insight into the factors influencing AT that are likely to be helpful in designing future AT experiments.

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0539

RELATIONSHIPS BETWEEN COGNITIVE PROFILES AND CHANGES IN BRAIN MORPHOLOGY IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is accompanied by neuro-cognitive impairment, which is likely mediated by injury to various brain regions. We evaluated brain morphology using volumetric measures in OSA vs. matched controls. We further assessed changes in brain morphology in relation to neuropsychological testing and nocturnal oximetry.
Methods: 16 newly diagnosed right-handed patients affected by severe OSA (Apnea/Hypopnea Index: 52.5 ± 26.0/h [mean ± SD] based on cardiorespiratory monitoring) (age: 55.8 ± 6.7 years, 13 males) and 14 control subjects (age: 57.6 ± 5.1 years, 9 males) without known OSA were recruited. They underwent high-resolution 3.0T brain MRI and neuropsychological testing evaluating executive functions, short and long-term memory, language, attention, praxia and non-verbal learning. Cortical reconstruction, volumetric segmentation and manual tracing of subcortical structures were performed using Freesurfer and Slicer image analysis suites.
Results: Clinical and neuropsychological data: Patients and controls differed in Body mass index (mean ± SD 31.7 ± 4.4 vs 25.5 ± 2.4kg/m^2, $P < 0.01$), Epworth sleepiness scale (8.5 ± 4.5 vs 2.6 ± 1.6, $P < 0.01$), Rey's 15-words test (short-term: 40.9 ± 5.4 in patients vs 45.9 ± 6.4 in controls, $P = 0.026$; long-term: 7.7 ± 2.3 vs 9.7 ± 1.4, $P = 0.011$), Stroop test score (1.12 ± 0.31 vs 0.89 ± 0.15, $P = 0.021$), and Digit span backward test (3.8 ± 0.9 vs 4.4 ± 0.6, $P = 0.049$). MRI results: cortex volume (normalized by intracranial volume) was statistically different in patients and controls (0.292 ± 0.059 vs 0.336 ± 0.021, $P = 0.012$). The brain parenchymal fraction (BPF) approached statistical significance (0.837 ± 0.026 vs 0.853 ± 0.023, $P = 0.068$). A negative correlation was observed between desaturation and both hippocampus volume ($r = -0.64$, $P = 0.018$) and amygdala volume in OSA patients ($r = -0.58$, $P = 0.039$). No significant correlations between neuropsychological data and cortical or subcortical volumes were found. We did not observe hippocampal atrophy.
Conclusion: OSA patients showed moderate neuropsychological deficits in verbal memory and executive functions tasks. Imaging results suggest reduction in cortical and total brain parenchyma volume in OSA patients. The length of desaturation time might affect the volume of subcortical structures.

0540

ABNORMAL AFFERENT NERVE ENDINGS IN THE UVULAE OF PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is characterized by repetitive collapses of upper airways (UA) during sleep; however, the pathophysiology of OSA is complex and not fully understood. Maintenance of UA patency and arousal in response to airway occlusion are probably mediated by mucosal receptors via sensory nerve endings. A specific nerve protein, protein-gene product 9.5 (PGP 9.5), and in some cases substance P (SP) and calcitonin gene-related peptide (CGRP) are present in these nerves. The aim of this study is to investigate whether there exist any further signs of afferent neuropathy in the UA mucosa of patients with OSA.
Methods: Uvular tissue samples were obtained during uvulopalatopharyngoplasty from 30 male patients with OSA (apnea-hypopnea index (AHI) > 20). Those from 7 male patients with no related disorders (AHI < 5) were retrieved as a control group. All specimens underwent routine processing, and midsagittal sections were immunohistochemically analyzed using a panel of antibodies to PGP 9.5, SP and CGRP.
Results: PGP 9.5-, SP- and CGRP-immunoreactive fibers were observed within the epithelium and submucosa in control and OSA patients. Quantitative analysis demonstrated that the number of PGP 9.5-, SP- and CGRP-immunoreactive fibers in OSA patients was significantly greater than that in the control group ($P < 0.05$). Furthermore, there were more PGP 9.5-immunoreactive fibers than SP- and CGRP-immunoreactive fibers in OSA patients. These PGP 9.5-immunoreactive fibers appeared thicker, twisted and in the form of ball-like structures. The epithelium was generally thicker in OSA patients compared with the controls.
Conclusion: The increased densities and the morphological changes of sensory nerve endings are interpreted to suggest an afferent nerve lesion. Our results support that the neurogenic lesion plays a contributory role in the development of OSA.

0541

UNIQUE CARDIAC RESPONSE DURING APNEAS IN OBSTRUCTIVE SLEEP APNEA (OSA) PATIENTS

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Introduction: Negative intrathoracic pressure (NIP) is a defining features of OSA that acutely augments demand on cardiac function during apneas. Previous studies have shown distinct hemodynamic changes in healthy subjects undergoing simulated apneas. We sought to investigate the cardiovascular effects of NIP during and after a simulated apnea in awake patients with OSA versus healthy subjects.
Methods: Subjects included 15 healthy males (Mean ± SD: age = 38.6 ± 6.3 yr; BMI = 22.7 ± 5.4; all low risk by Berlin questionnaire; neck circumference = 38.71 ± 2.4) and 10 recently diagnosed OSA patients (age = 44.3 ± 10.7 yr; BMI = 33.3 ± 8.0; AHI = 45.4 ± 37.1). Cardiac function was monitored by non-invasive bioimpedance at baseline and during and 3 minutes after two 30-second Mueller maneuvers (MM).
Results: During simulated apneas, stroke volume (SV) decreased in both groups with no response difference between control and OSA groups (-5.4 ± 6.5 % and -2.7 ± 11.0 %, $P = 0.5$, respectively). When compared on myocardial contractility index (MCI), the OSA group showed an increase (11.8 ± 14.3 %) and controls a decrease (-7.5 ± 4.9%; $P < 0.0001$) during apnea. In the post-apnea period, SV in controls increased in a compensatory fashion and returned to baseline by the end of the 3 minutes. In contrast, SV declined in OSA patients to pre-apnea values 30 seconds after breathing was restored, suggesting a blunted response. Post-apnea, MCI was different only immediately after termination of the MM, when the OSA response was higher than for controls (18.9 ± 27.5 % versus -8.5 ± 11.9 %, $P < 0.004$).
Conclusion: NIP appears to provoke unique hemodynamic changes in patients with untreated OSA. This indicates possible chronic adaptations of left ventricle arising from repetitive nocturnal apneas in untreated OSA.
Support (If Any): Study supported by NeuMeDx Inc.

0542

CLINICAL PRESENTATION OF SHIFT WORKERS TO A SLEEP CLINIC

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Introduction: Shift work is a recognized cause of sleep complaints. How shift work might alter the clinical presentation of patients presenting to a sleep clinic is unknown.
Methods: Self-reported symptoms were assessed in all patients presenting to a university-affiliated comprehensive sleep disorders clinic between February 2007 and October 2009. Analyses were limited to individuals reporting current employment, divided into three groups: those working day shift, those working evening or night shift, and those whose work shift varied.
Results: Of the 1275 employed patients seen in this time period, 884 (69.3%) worked days, 99 (7.8%) worked nights or evenings, and 292 (22.9%) worked variable shifts. The cohort had a mean age of 46.1 yrs, was 47.6% male, and 55.5% Caucasian. Compared to day shift workers, night/evening shift workers had greater sleepiness as evidenced by a greater mean Epworth sleepiness scale (ESS) score (11.9 vs. 10.5, P = 0.02), greater prevalence of drowsy driving (43.9% vs. 28.3%, P = 0.001), and greater prevalence of drinking 6 or more cups of caffeinated beverages per day (8.3% vs. 3.2%, P = 0.01). In addition, night/evening shift workers were more likely to report taking more than 2 hours to fall asleep (12.4% vs. 3.3%, P < 0.001). Variable shift workers did not significantly differ from day shift workers in terms of ESS score or caffeine intake. However, they were more likely to report drowsy driving (34.3% vs. 28.3%, P = 0.05) and difficulty falling asleep (7.8% vs. 3.3%, P = 0.001).
Conclusion: Shift workers presenting to a sleep disorders clinic have greater levels of both sleepiness and insomnia. In particular, drowsy driving is extremely common in this population.
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0543

ASSOCIATIONS BETWEEN CIRCADIAN CHRONOTYPE, BMI AND DIET

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Introduction: Circadian timing has been associated with altered metabolism and obesity in rodent models and humans. The aim of this study was to examine relationships between chronotype, body mass index (BMI) and dietary habits.
Methods: Participants included 25 individuals with evening chronotype that did not meet criteria for DSPD (evening type), 17 with delayed chronotype who also met criteria for DSPD (evening type with DSPD), and 12 control participants with intermediate chronotype. Average age was 32.7 (+ 13.4) and the sample was 53% male. Chronotype was measured by the Horne Ostberg Morningness-Eveningness Questionnaire. Diet was measured by a 7-day food diary. Calories and macronutrients were determined through publicly available nutrition databases. Data were analyzed comparing participants with evening type (with and without DSPD) with intermediate types, and evening types only to evening types with DSPD. Data were analyzed using correlations and t-tests.
Results: Greater eveningness was associated with trend toward higher BMI (r = -.28, P = .066). In categorical analyses, BMI was higher in evening types compared to intermediate types (24.4 versus 22.4 kg/m^2, P = .30) and higher in evening type only vs. DSPD (24.0 versus 25.8, P = .28) but this was not statistically significant. Total calorie intake was not different between evening types and intermediate types or evening types only and DSPD. Evening types had a lower percent of total calories from fat (P = .02), lower percent of breakfast calories from carbohydrates (P = .03), lower percentage lunch of calories from fat (P = .006) higher percentage of lunch calories from protein (P = .01), and lower percentage of snack calories from fat (P = .03) compared to intermediate types. Evening types also had more meals with fast food/junk food than intermediate types (P = .02). Among evening types, DSPD participants had a higher percentage of breakfast calories from protein (P = .04). There was a trend for participants with DSPD to have more meals with fast food/junk food than evening types without DSPD (P = .07).
Conclusion: These data demonstrate that circadian chronotype influences macronutrient type and frequency of convenience and energy dense foods, without affecting total calorie intake. Greater understanding of circadian factors in feeding and metabolism may lead to novel interventions for reducing metabolic risk associated with circadian disruption.
Support (If Any): R01 HL069988, 5 K12 HD055884, 1 K23 HL091508-01A1

0544

CIRCADIAN MISALIGNMENT IS ASSOCIATED WITH DEPRESSIVE SYMPTOMATOLOGY

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Introduction: Various studies suggest an association between circadian misalignment and affective disorders. Disruptions in the sleep-wake cycle and melatonin secretion are common manifestations in individuals with affective disorders. The current study examined the impact of circadian misalignment between endogenous melatonin secretion and the sleep-wake cycle on mood.
Methods: The present study followed 32 individuals and monitored their daily sleep-wake routines using sleep logs as well as weekly mood and sleepiness levels over four weeks while all individuals maintained ad libitum sleep-wake schedules. The study included 10 morning types (M-types), 7 evening types (E-types) and 15 patients with Delayed Sleep Phase Syndrome (DSPS). Outcome measures included the phase angle difference (PAD) between onset of melatonin secretion (DLMO) and mid-sleep as well as depression ratings assessed using the Centre for Epidemiologic Studies Depression Scale (CES-D). The study was completed over one season and none of the individuals were on any medication at the time of the study nor engaged in shift work.
Results: M-types were significantly phase advanced compared to DSPS patients and E-types as evaluated by the DLMO. However, E-types and DSPS patients did not have significantly different DLMO. E-types had the shortest PAD followed by M-types and DSPS patients. Both M-types and E-types scored significantly lower on the CES-D compared to DSPS patients. Correlation analysis between PAD and depression ratings demonstrated that sleeping at a time which is out of phase with the endogenous melatonin rhythm is strongly correlated with depressive symptomatology in healthy individuals (M-types and E-types) as well DSPS patients; however the correlation between PAD and depression scores in DSPS patients is inverse to that found in healthy individuals.
Conclusion: These findings have important implications for treating sleep-wake cycle disorders or altering sleep-wake cycle habits in healthy individuals and potentially those with treatment resistant mood disorders.
Support (If Any): SAR is supported by Canadian Institutes of Health Research Doctoral Award

0545

IMPAIRMENT OF NEUROPHYSIOLOGICAL MARKERS OF ATTENTION CAPTURED IN SHIFT WORK DISORDER PATIENTS: EFFECTS OF ARMODAFINIL

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Introduction: It is not known if symptoms in SWD (sleepiness/insomnia) are differentially related to impaired attention. This ERP study evaluated the mechanisms of involuntary attention triggered by distracting auditory stimuli during visual task performance in SWD subjects compared to asymptomatic night workers (NW). Armodafinil(150mg) was used as a probe to improve alertness while not affecting sleep in participants performing the task.
Methods: SWD subjects were(n = 10) and matched NW(n = 9) screened for other sleep disorders. For SWD subjects, armodafinil(150mg) or placebo was administered in a double-blind, cross-over design, whereas for NW only placebo was administered at 2230. ERP measures of orienting (nP3) and motor detection responses (MDR, at900ms) were collected between 2400 and 0100 in both groups. Polysomnograms (PSG) during habitual bed time(0900 ± 1h to1500 ± 1h) and MSLT from 0130 to 0730 were performed.
Results: PSG, ESS, and ISI showed that SWD subjects had more sleep wake signs and symptoms than controls (WASO:108.7 (± 75.7) vs. 47.3 (± 30.2) ($P < 0.05$); SE: (75% (± 18) vs. (88% (± 7) ($P < 0.05$)) whereas, SOL 10 (± 7) vs. 7.5 (± 5) and MSLT 5 (± 3) vs. 7 (± 4) did not show significant differences between groups. Mean MSLT latency was improved by armodafinil treatment ($P < 0.05$) in the SWD subjects. On placebo, ERP amplitude associated with orienting (nP3) was lower in SWD patients as compared to NW (3.7μV vs. 5.2μV; $P < 0.05$) but did not recover with armodafinil(3.7μV vs. 3.6μV). In contrast, the ERP response associated with motor detection showed significant difference between SWD and NW: 0.9μV vs. 2.9μV ($P < 0.05$) and armodafinil improved that response in SWD to 2.1μV ($P < 0.05$). Additionally, a correlation was found between SOL and nP3 amplitude ($r = -.48$; $P < 0.04$); the MSLT was correlated with motor detection brain response ($r = .5$, $P < 0.04$).
Conclusion: This study shows a benefit of armodafinil in SWD on motor related processes but not on automatic orienting of attention to distracting stimuli, suggesting the later impairment may be related to sleep disturbances.
Support (If Any): This study was supported by Cephalon, Inc (USA).

0546

ADJACENT SOUTHEASTERN VIRGINIA CITIES WITH DISSIMILAR HIGH SCHOOL START TIMES MANIFEST DIFFERENT TEENAGE CAR CRASH RATES

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Introduction: Insufficient sleep in teens is linked to academic difficulties, mood disorders and increased car crashes. Delaying high school (HS) start times by one hour in Lexington, Kentucky associated with decreased car crash rates (16.5% decline) over the following 2 years (Danner, Phillips 2008). Virginia Beach (VB) and Chesapeake are adjoining, demographically similar Southeastern Virginia cities. Per 2000 US Census data, VB's and Chesapeake's racial compositions respectively were 71% and 67% Caucasian; and 19% and 28% African-American. Respective per capita incomes were $22,365 and $20,949. VB HS begins at 0720-0725 with 1400-1414 dismissal. Chesapeake HS begins at 0840-0845 with 1538-1543 dismissal. We hypothesized that among 16-18 year olds, earlier HS start times in VB versus Chesapeake would cause sleep restriction, interfere with delayed circadian rhythms and associate with increased car crashes.
Methods: Virginia Department of Motor Vehicles supplied de-identified data for numbers of drivers ages 16,17,18 years in VB and Chesapeake for 2008, and for number and time of automobile crashes. Crash rates between cities were compared overall, and by time of day to explore circadian propensities.
Results: In 2008, VB had 12,916 and Chesapeake 8459 drivers aged 16-18 years. There were 850 crashes in VB and 394 in Chesapeake. Crash rates were 65.4/1000 and 46.2/1000 respectively (ratio 1.41). Peak morning crash rates in VB were 4.5/1000 from 0700-0759 and 3.8/1000 from 0800-0859 in Chesapeake. Peak afternoon crash rates were 7.1 from 1400-1800 (VB) and 5.8 from 1600-1700 (Chesapeake). 6 hour analysis bins indicated highest car crash rates in the afternoon in both cities, with VB demonstrating the greater rate (35.2 vs. 20.6).
Conclusion: In demographically/geographically similar, adjacent cities earlier school start time associated with increased teenage car crash rates, probably reflecting both sleep deprivation and circadian rhythm disruption. Findings support limited data that later high school start times benefit teens.
Support (If Any): Eastern Virginia School of Medicine Division of Sleep Medicine

0547

LIGHT EXPOSURE IN ADOLESCENTS WITH DELAYED SLEEP PHASE DISORDER

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Introduction: The role of light exposure in conjunction with adolescent delayed sleep phase disorder (DSPD-A) is unknown. The aim of this study was to compare light exposure patterns among DSPD-A patients and controls, and to analyze associations with the sleep/wake cycle.
Methods: Twenty-two healthy controls without sleep complaints (mean age 13.7 ± 2.4) were age- and gender-matched to 17 DSPD-A (mean age 15.1 ± 2.1) subjects who met ICSD-2 and other rigorous inclusion criteria. All participants attended public schools with uniform start times. Both groups wore actigraphs/light monitors (MiniMitter AW-L) and maintained sleep logs for a mean of 14 consecutive days. Evening light exposure (mean lux levels from 20:00-05:59), morning light exposure (mean lux levels from 06:00-12:00), and actigraphically-derived sleep parameters were examined. Data were analyzed using repeated measures models estimating a within-subject covariance which included terms for group, school night status, and sleep parameters. Light exposure outcomes were log-transformed as log (y+1), and ‰ changes were computed.
Results: DSPD-A subjects received 33‰ more evening light ($P = 0.010$; Δ mean max lux = 14) and 38‰ less morning light than controls ($P = 0.026$). Increased total sleep time (TST) was associated with decreased evening and morning light exposure ($P < 0.001$ for both groups). Later sleep onset times were associated with increased evening light exposure ($P < 0.001$). Although cases initiated sleep nearly 1-hour later than controls ($P = 0.007$), they also awoke 1.3 hours later ($P = 0.002$), such that no significant intergroup differences in TST were observed. Outcomes persisted regardless of school night status.
Conclusion: Various interpretations are possible. DSPD-A patients may unwittingly induce or perpetuate their condition via relative over- or under-exposure to evening and morning light, respectively, possibly exacerbated by altered photosensitivity. This appears to contradict some patients' perceptions of "laying in the dark," attempting to sleep. The

persistence of intergroup relationships regardless of school night status alternatively supports the expression of innate timing of sleep/wakefulness, with light exposure functioning as a surrogate measure. It is equally plausible that both factors contribute to the DSPD-A phenotype, and/or that different subtypes exist. Future studies should examine physiological and behavioral explanations for these findings, with the goal of employing preventative therapies.

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0548

A PRACTICAL INTERVENTION BASED ON LIGHT/DARK EXPOSURE FOR POLICE OFFICERS WORKING ROTATING SHIFTS

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Introduction: Working on atypical schedules can lead to performance impairments as a result of circadian misalignment and/or sleep deprivation. The aim of the present study was to assess the physiological and psychometric effects of an intervention based on light/dark exposure in police officers working rotating nights as part of a rotating schedule.
Methods: Police officers (age ± SD; 30.1 ± 5.2) working rotating shifts were assigned to 2 groups (control, n = 9; intervention, n = 8) and underwent an in-lab assessment of their salivary melatonin rhythm (1x/hour x 24 hours) before after a series of 7 consecutive night shifts as part of a rotating schedule. In the intervention group, they were instructed to expose themselves to bright light during the first 6 hours of their night shifts (Litebook device, Alberta, Canada), to wear orange-tinted goggles from sunrise until bedtime and to sleep in darkness for 8 hours following their night shifts. A psychomotor vigilance task (PVT) was scheduled at start and end of shifts during each night. Two-way (factors: Group X visit) and three-way (factors: Group X Day X Time of Day) ANOVAs were used to analyse melatonin phase and PVT data, respectively.
Results: In ambulatory conditions, the average of the fastest reaction speed significantly decreased throughout the 7 night shifts in the control group ($P \leq 0.04$) but not in the intervention group ($P \geq 0.35$). Similarly, median speed was reduced throughout the night shifts in the control group ($P = 0.0008$), but not in the intervention group ($P = 0.47$). A greater phase delay of salivary melatonin was observed in the intervention (-5.93 ± 2.30h) compared to the control group (-4.52 ± 3.21h), although this between-group difference did not reached significance ($P = 0.73$).
Conclusion: Control of ambient light by portable lamps and/or goggles can stabilize psychomotor performances of night shift workers in field operations. The smaller than expected circadian adjustment in the intervention group can be explained by insufficient exposure to portable lamps in the cars.
Support (If Any): This work was supported by the Institut de Recherche Robert-Sauvé en Santé et en Sécurité du Travail (IRSST). P. Boudreau and D. B. Boivin were supported by IRSST and Fond de la Recherche en Santé du Québec (FRSQ), respectively.

0549

EVERYDAY LAMPS INFLUENCE SUBSEQUENT SLEEP

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Introduction: Although industrial progress and life in a 24-hour society are based on the use of artificial light at night, the endogenous circadian timing system (CTS) is synchronized to the solar day by means of the environmental light-dark cycle. The aim of the present study was to demonstrate that light emitted by everyday lamps in a naturalistic setting influences physiology and polysomnographic sleep in healthy human subjects.
Methods: Following a seven-day entrainment period, nine healthy subjects (5 male, 4 female, aged 22-33yrs.) attended the laboratory for five consecutive evenings from 7:00 PM until next morning. During lab hours, subjects were exposed to constant dim light (< 10lx). During evenings two through five subjects were also exposed for a total of 30 minutes to light by dim light or everyday lamps of different intensity (100, 100, 450 lx) and spectral distribution (1500 K, 5100K, 6500K) one hour before habitual bedtime. Melatonin suppression was measured by saliva samples at 30 minutes intervals as well as 10 minutes intervals starting 10 minutes prior light application until 10 minutes after light application. Polysomnography was performed in each of the five nights.
Results: Salivary melatonin concentration increased with dim, orange light and to a smaller extent with low daylight, but decreased significantly with the brighter neutral white light ($X2 = 7.800$, $P < 0.05$). Alertness corresponded to melatonin alterations only following neutral white light ($rho = -0.6333$, $P < 0.067$). TIB, SPT, TST, SE, WASO as well as percentages of sleep stages did not differ following different lighting conditions. In contrast REM-latency was significantly increased (84.00 ± 35.78 resp. 135.11 ± 42.21 minutes, $P < 0.012$) and SWS in the first NREM-REM cycle was decreased after neutral white light (450 lx) compared to dim light while 100 lux orange light showed no effect.
Conclusion: Short-term exposure to everyday lamps influences physiology and subsequent sleep. The role of such influence in the majority of sleep disorders needs to be determined.

0550

EPIDEMIOLOGY OF TIME IN BED: AGE, ETHNICITY, AND GENDER

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Introduction: Little epidemiological data exist in the general population on the behavioral phenomenon of total time spent in bed, particularly with respect to ethnicity and gender. Most research had focused on total sleep time. The present study attempts to address this gap by analyzing the time in bed reported in 2 weeks of sleep diaries from our epidemiological survey.
Methods: 772 participants from a metropolitan community were enrolled using random-digit dialing. The population was nearly equally comprised of males and females. Participant ages ranged from 20 to 98. The majority of the population was Caucasian or African-American. Participant bedtimes for 14 days were obtained via 2 weeks of sleep diaries and analyzed for circadian patterns. Participant demographic data from our database was also included in our analysis. A standard multiple regression was performed to analyze the effects of age, ethnicity, and gender on time in bed.
Results: Age, ethnicity, and gender were entered in step 1 of the standard regression, explaining 7.4% of the total variance of time in bed, $F(3, 742) = 19.71$, $P < 0.001$. All three significantly predicted time in bed, with age being a more potent predictor ($t = 6.70$, $P < 0.001$) than gender ($t = 2.74$, $P < 0.01$) or ethnicity ($t = -3.45$, $P = 0.001$).
Conclusion: There is a linear relationship between age and time in bed, such that individuals tend to have increased time in bed as they age. Although, not as potent predictors for time in bed, there are significant differences between genders and ethnic groups. Males have significantly shorter times in bed than females and Caucasians have significantly shorter times in bed than African Americans.
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0551

SLEEP QUALITY AND MORNINGNESS/EVENINGNESS CHRONOTYPE IN ADULTS FROM AN URBAN AREA IN KOREA

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Introduction: Sleep disturbance resulting from a mismatch between the sleep-wake schedule and individual chronotype can influence work performance as well as health status. Individual chronotype can be genetically determined, and also influenced by environmental factors such as work schedule and social factors. We aimed to examine the self-assessed consistency of individual chronotype from childhood to adulthood, and the sleep quality associated with chronotype in adults of an urban area in Korea.
Methods: One hundred eighty-eight participants (Age: 36.6 ± 10.1 years, range: 18-75 years; F:M = 110:78) were recruited from visitors to the National Museum in Chunchon city, Korea. The Korean version of a Sleep-Wake Questionnaire (SWQ-K) including the Horne-Östberg Morningness-Eveningness Questionnaire (MEQ) and the Pittsburgh Sleep Quality Index (PSQI) was administered. Standard scores on the MEQ were used to categorize subjects as morning types (MT) and evening types (ET). Multinomial logistic analyses were used for the contribution of self-assessed chronotype in childhood to current chronotype, and the influence of sleep quality on morning-evening preference.
Results: Individuals who were self-assessed as ET in childhood showed a greater probability of current ET compared to those who were MT in childhood (OR = 3.8, $P < 0.01$). Those below 30 years of age were more likely to be ET compared to those above 39 years (OR = 20.53, $P < 0.001$), and women were more likely to be ET than men (OR = 5.25, $P < 0.01$). After controlling for age and gender, poor sleepers (PSQI ≥ 5) were more likely than good sleepers (PSQI < 5) to be ET (OR = 5.04, $P < 0.01$).
Conclusion: We found that adult ET were likely to consider that they were ET in childhood, and that with advancing age self-assessed chronotype can change from ET to MT. Adult subjects with poor sleep quality were more likely to be ET.
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0552

SHIFT WORK PREVALENCE IN THE SAO PAULO EPIDEMIOLOGIC SLEEP STUDY

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Introduction: The aim of this study was to evaluate the prevalence of the shift work in the adult population of Sao Paulo city, Brazil, and to investigate its characteristics.
Methods: A population based survey adopting a probabilistic three-stage cluster sample of the Sao Paulo city was used to represent the population according to gender, age (20-80 years), and socioeconomic status. UNIFESP Sleep Questionnaire was face-to-face applied in each randomly selected household and full night in-lab polysomnography was performed.
Results: A total of 1042 volunteers underwent polysomnography (refusal rate = 5.4%). Mean age was 42 ± 14 yrs, 47% were men, and 60% presented body mass index > 25 kg/m2. From the total population, 11% were shift workers (61% men), mean age 40 ± 13 yrs. Shift workers had same frequencies than day workers for body mass index categories, marital status, sleepiness, fatigue, and anxiety symptoms ($P > 0.05$). Regarding PSG variables no differences were observed between groups. Still, shift workers had greater years of scholarship (46% vs. 40%; $P = 0.006$), reported sleep time > 7 hours/day (36% vs. 22%; $P = 0.005$), and less symptoms of depression (3.7% vs. 12.7%; $P = 0,003$). However, shift worker had higher reported disruptive sleep (46% vs. 37%; $P = 0.03$) and Framingham risk (1.1 vs. -0.8; $P = 0.01$). When we repeated analyses selecting only men or women, this difference in the Framingham risk only remained in men (1.7 vs. -0.08; $P = 0.08$) but not in women (0.2 vs.-0.8; $P = 0.42$).
Conclusion: In the adult population of Sao Paulo city, the prevalence of shift worker was similar to other populations. Shift workers had no objective sleep problems in comparison to day workers, but they had higher subjective disruptive sleep and increased Framingham risk, mostly in men than women.
Support (If Any): AFIP, FAPESP, CNPq

0553

ALTERED TIMING OF THE MELATONIN RHYTHM RELATIVE TO SLEEP TIMING IN OLDER SUBJECTS WITH SLEEP COMPLAINTS

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Introduction: Aging is often associated with sleep complaints, including earlier awakening and decreased sleep consolidation at the end of the night. A change in the circadian timing system may contribute to age-related changes in sleep. In a previous study we found that the melatonin rhythm occurs later with respect to sleep in healthy older subjects compared to young subjects. Here we aimed to compare the timing of sleep and melatonin in older subjects with and without sleep complaints.
Methods: Eighteen subjects with sleep complaints and 20 subjects without sleep complaints. (Age: 56-79 years) were included in our analysis. After 2 or 3 baseline days, a circadian phase estimation procedure was conducted. Circadian phase was assessed by dim light melatonin onset (DLMO, 10 pg/ml), relative dim light melatonin onset (DLMOn25%) and offset (DLMOff25%), and the time of the fitted peak of melatonin (Melpeak). Phase angle between habitual bedtime (HB) and circadian phase was calculated. Statistical significance level was tested using the SAS system.
Results: Subjects with sleep complaints had earlier DLMOn25%, longer phase angle between DLMOn25% and HB, and shorter phase angle between HB and Melpeak, compared to subjects without sleep complaints ($P < 0.05$). Among all subjects, all measures of melatonin phase significantly predicted HB (R2: DLMOn25% = 0.40, DLMOff25% = 0.55, Melpeak = 0.63, all $P < 0.0001$; DLMO = 0.31, $P < 0.01$). In predicting HW, DLMOn25%, DLMOff25%, and Melpeak were also significant (R2 = 0.36. 0.58, 0.56, respectively, $P < 0.001$).
Conclusion: The phase angle between the circadian melatonin rhythm and the timing of habitual sleep onset was shorter in older subjects with sleep complaints compared to those without sleep complaints. These findings suggest that alterations in the self-selected timing of sleep with respect to the timing of the underlying circadian system might contribute to sleep disruption in aging.
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0554

IS CIRCADIAN TYPE ASSOCIATED WITH SLEEP DURATION IN TWINS?

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Introduction: The genetic underpinnings of circadian rhythms have been described, but the genetics of sleep duration remain largely unresearched. We used the population based University of Washington Twin Registry to investigate the genetic association between circadian type and sleep duration.

Methods: Habitual sleep duration was obtained by self-reported length of sleep per night and circadian type was ascertained using a reduced 5-item Horne-Östberg Morningness-Eveningness questionnaire. Univariate and bivariate genetic analyses were fit using structural equation models. We used multinomial logistic regression with robust standard errors that account for twin correlation to examine the overall and within-pair effects of circadian type on sleep duration. All results were adjusted for age and sex; statistical significance was based on likelihood ratio and Wald tests.

Results: We surveyed 1,136 twins from same-sex pairs (854 monozygotic, 282 dizygotic), 69% female, mean age 37 years (SD = 15). Twenty-four percent regularly slept < 7 hours, 67% 7-8 hours, 9% ≥ 9 hours per night. Thirty-four percent were morning-type, 51% neither, and 15% evening-type. The heritability of sleep duration was 33% ($P < 0.001$) and circadian type 40% ($P < 0.001$). The bivariate analysis revealed shared genetics of 10% (-0.06, 0.37; $P = 0.50$). Using morning-type twins as the baseline, evening-type twins had higher relative risk of being a short sleeper (< 7 hours/night; RR = 1.7; 1.1, 2.7; $P < 0.05$) and long sleeper (≥ 9 hours/night; RR = 2.5; 1.1,6.1; $P < 0.05$). The within-pair analysis attenuated these associations.

Conclusion: Sleep duration and circadian type do not have substantial genetic overlap in our twin sample. Circadian evening-type was associated with both shorter and longer habitual sleep duration than morning-type twins. These findings are attenuated in the within-pair analysis, suggesting that familial factors (i.e., genetics and common environment) may confound the associations.

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0555

COMPARATIVE ANALYSIS OF THE PITTSBURGH SLEEP QUALITY INDEX ON NIGHT SLEEP/DAY SHIFT AND ON DAY SLEEP/NIGHT SHIFT IN A SAMPLE OF CALGARY POLICE SERVICE OFFICERS

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Introduction: The Calgary Police Service Health and Human Performance Research Initiative (CPS/HHPRI) Phase III is a large scale observational, cross-sectional study of prevalence of poor sleep quality in CPS officers. The prevalence of poor sleep quality in police officers is well established (Vila 2000). It is believed, and has been demonstrated in previous research, that day sleep on night shift is shorter and more disturbed than night sleep on day shift. Samuels (2007) reported in a small group of 30 police officers the prevalence of poor sleep quality on Night Sleep/Day Shift was higher than Day Sleep/Night Shift.

Methods: Data from the first 200 officers who participated in the CPS/HHPRI Phase III was included. Officers were assessed using the Pittsburgh Sleep Quality Index (PSQI), which is a self-rated assessment of sleep quality. Officers completed the PSQI for both night sleep on day shift and day sleep on night shift in an effort to compare night and day sleep quality over the past month. Average age was 34.59 years old, with a range of 21-53. Eighty-three percent were male (98/118).

Results: Descriptive analysis was performed on officers doing shift work (Day Shift and Night Shift) (59%; N = 118). Mean PSQI Global Score (Night Sleep/Day Shift) 7.22 (SD 3.33, range 1-16), mean PSQI Global Score (Day Sleep/Night Shift) 6.466 (SD 3.08, range 1-16).

Conclusion: The results confirm previously reported findings; Sleep quality tends to be worse on Night Sleep/Day Shift and this contradicts a basic, strongly held belief in shift work and circadian rhythm research. While there are substantial limitations to this analysis of the data; The finding suggests the need to explore the clinical significance of the difference in sleep quality between day sleep and night sleep in shift workers.

Support (If Any): Calgary Police Service, City of Calgary, Alberta, Canada

0556

EXISTENCE OF AN ENDOGENOUS CIRCADIAN BLOOD PRESSURE RHYTHM THAT PARADOXICALLY PEAKS AT NIGHT

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Introduction: The risk of adverse cardiovascular events has a day/night pattern with a primary morning peak (~06:00-12:00) and a secondary evening peak (~18:00-22:00), possibly related to blood pressure changes at those times. Thus, we aimed to determine whether or not there exists an endogenous circadian rhythm of blood pressure (BP).

Methods: In 32 normotensive adults (19 men), we repeatedly assessed BP across three complimentary, multi-day, in-laboratory protocols in which behavioral and environmental influences were controlled and/or uniformly distributed across the circadian cycle. We utilized: (i) 38-h Constant Routine protocol, including continuous wakefulness, semi-recumbency, and 2-hourly isocaloric snacks; (ii) 196-h Forced Desynchrony protocol with seven 28-h sleep/wake cycles; and (iii) 240-h Forced Desynchrony with twelve 20-h sleep/wake cycles. Circadian phase was derived from core body temperature (0°, temperature minimum; ~05:00 in these subjects).

Results: Each protocol revealed significant circadian rhythms in systolic and diastolic BP, with almost identical rhythm amplitudes and phase relationships among protocols. The average peak-to-trough amplitudes were 3-6 mmHg for systolic BP and 2-3 mmHg for diastolic BP (always $P < 0.05$). All six peaks (systolic and diastolic BP in three protocols) occurred at 240°, equivalent to ~21:00.

Conclusion: These data demonstrate for the first time—and consistently across three separate circadian protocols—an endogenous circadian rhythm in blood pressure. Surprisingly, the lowest BP occurred across the circadian phases corresponding to the peak of adverse cardiovascular events. Although low blood pressure can be a risk for ischemia in the face of arterial stenosis, high blood pressure is a greater risk factor (e.g., increased vascular wall sheer stresses can lead to ruptured atherosclerotic plaques and thombus formation). Thus, the circadian BP profile may indicate that this rhythm is not involved in the morning peak in cardiovascular events but could be involved in the secondary evening peak of cardiovascular events. Further studies are required to determine

whether the circadian blood pressure rhythm is amplified and/or shifted in populations vulnerable for adverse cardiovascular events.
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0557

LIGHT THERAPY OF DSPD PATIENTS IN A HOSPITAL SETTING

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Introduction: This study investigated the effect of hospitalization and subsequent bright light therapy (LT) on the sleep-wake schedule of patients with delayed sleep phase disorder (DSPD) under a routine hospital schedule.
Methods: Participants (age = 17.7 ± 6.4 years; 7 male, 6 female) were admitted to the psychiatry ward and their sleep-wake schedule was not restricted.
Results: Sleep onset times and wake up times on the second day after admission as well as after subsequent LT were significantly advanced compared with before admission (3h 26min and 4h 38min, 4h 22min and 6h 25min, respectively).
Conclusion: Although the initial phase advance might be a masking effect of the social zeitgebers in a hospital, it obviously helps the subsequent LT. Thus, providing in-patient LT might have a key role for achieving a phase advance in DSPD.

0558

PHARMACOTHERAPY FOR WAKEFULNESS IN PATIENTS WITH EXCESSIVE SLEEPINESS ASSOCIATED WITH SHIFT WORK DISORDER: EVALUATION OF ARMODAFINIL AND MODAFINIL

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Introduction: One primary symptom of shift work disorder (SWD) is the presence of excessive sleepiness (ES) associated with the work shift. We compared the effect of armodafinil, the longer-lasting isomer of modafinil, to modafinil on nighttime sleepiness as these are the only medications studied in large clinical studies of patients with SWD.
Methods: Armodafinil and modafinil were evaluated separately in two 12-week, multi-center, randomized, double-blind, placebo-controlled, parallel-group studies with similar study designs. After 3 or more consecutive night shifts and daytime sleep at home, patients received armodafinil 150 mg (n = 112), modafinil 200 mg (n = 89), or placebo (n = 104 in each of the 2 studies) at 2200h on the evening of in-laboratory testing. A primary outcome measure was the Multiple Sleep Latency Test (MSLT) (average of 4 sessions: 0200, 0400, 0600, and 0800h). Results from individual MSLT sessions were evaluated via *post-hoc* analyses. Mean nighttime subjective sleepiness was also evaluated (Karolinska Sleepiness Scale [KSS]).
Results: Baseline nighttime MSLTs in these patients were comparable to daytime MSLTs in patients with untreated narcolepsy. MSLTs significantly improved from baseline to final visit for patients who received active drug compared with placebo. The change from baseline in the armodafinil group was almost twice that of the modafinil group (armodafinil +3.1[4.46 SD] min vs placebo +0.4[2.87], $P < 0.0001$; modafinil +1.7[3.79] vs placebo +0.3[2.77], $P < 0.01$). The armodafinil group showed statistically significant improvements in wakefulness compared with placebo at all MSLT sessions (all nominal $P < 0.05$); whereas, the modafinil group was statistical significance compared with placebo at 0200 and 0400h (nominal $P < 0.05$). Similar and statistically significant improvements in mean KSS scores were observed for armodafinil and modafinil (nominal $P < 0.05$).
Conclusion: Pharmacotherapy improved wakefulness in patients with ES associated with SWD. Improvement in wakefulness was maintained throughout the nightshift for patients who received armodafinil but not for patients who received modafinil.
Support (If Any): Sponsored by Cephalon, Inc.

0559

THE RELATIONSHIP BETWEEN MOTHERS' CIRCADIAN REST-ACTIVITY RHYTHM PRE- AND POSTPARTUM AND THEIR INFANTS' CIRCADIAN REST-ACTIVITY RHYTHM, WITH A COMPARISON TO AN INFANT WITH FREE-RUNNING RHYTHM

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Introduction: We compared circadian rest-activity rhythm of mothers and infants prepartum and postpartum to see the influence of maternal rhythm on infants. We compared these results with the rest-activity rhythm of another mother with an infant with free-running rhythm.
Methods: Subjects were ten primiparae (mean 31.0 yrs) and their infants. The mothers gave informed consent prior to the study. Actigraphic recordings made over 3-5 continuous days during the 33rd and 36th weeks of gestation and again during the second, sixth, and twelfth weeks after birth. We used autocorrelogram analysis for rest-activity rhythm as in our previous study (Physiol. Behav. 77:91-98, 2002). One infant showed free-running rhythm, so we analyzed that infant-mother pair independently. For the nine circadian rhythm infant-mother pairs, mean correlation coefficients from the autocorrelograms were calculated.
Results: The mean values of the autocorrelograms for the circadian rhythm infants and mothers were the lowest during the second week and increased until the twelfth week, as indicated by our previous study. The mean values of the mothers during the twelfth week did not reach the mean values during the prepartum period. One infant showed a free-running rhythm beginning around the sixth week after birth, and his mother began following his rhythm. During the second week after birth, small peaks on the infant's and his mother's autocorrelograms were observed at around 24-25 hours. During the infant's free-running rhythm, autocorrelogram peaks for the infant's rhythm were broadly distributed from 25 to 28 hours. The circadian peak prepartum for this mother was longer than the mean value for the other mothers.
Conclusion: A mother's longer circadian rest-activity rhythm in late pregnancy may be related to her infant's free-running rhythm.

0560

CHRONOTYPE AS A PREDICTOR OF PERFORMANCE IN MAJOR LEAGUE BASEBALL PITCHERS

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Introduction: The Morningness Eveningness Questionnaire (MEQ) is a method for assessing chronotype. Because Major League Baseball (MLB) players play both during the day and night, it was hypothesized that chronotype might predict optimal pitching performance times.

Methods: MEQ data from 18 MLB pitchers representing 4 teams was collected. A modified MEQ (mMEQ) was obtained by adding the score of question 7 (subject global impression) to the total score. 2009 player statistical performance was logged with game start times adjusted for travel using the convention that for every time zone traveled, it takes 24 hours to adjust. Games were divided into two groups. 'Early' games featured start times prior to 19:00. 'Late' games began at 19:00 or after. This produced 727.7 early innings and 845.2 late innings. 18 players were divided into two groups: 8 'evening type' players [E-types] (mMEQ score of 6-18), and 10 'morning type' players [M-types] (mMEQ of 20-34).
Results: In early games, M-type pitchers had an average ERA of 3.11 compared with E-type pitchers' average ERA of 3.49. In late games, M-type pitchers had an average ERA of 4.11 and E-type pitchers an ERA of 4.07. While M-type pitchers performed best in early games and E-type pitchers during evening games, the study was not powered to show significance. M-type players performed statistically better than the E-type player (P = .007). Individual pitchers showed a trend towards higher ERAs in the late games, but the effect was not significant.
Conclusion: This study demonstrated M-type pitchers performing better than E-type pitchers. Dement and colleagues concluded that peak performance time for most athletes was between 15:00-18:00 with a rapid drop in performance after 18:00. Our results support this finding with both pitching groups as a whole performing better in games prior to 19:00. Knowledge of player chronotype might be useful in player assessment and utilization.

0561

ON PINEAL CALCIFICATION, MELATONIN EXCRETION AND POLYSOMNOGRAPHIC SLEEP MEASURES IN PRIMARY INSOMNIC PATIENTS

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Introduction: Melatonin plays a key role in the proper functioning of the circadian timing system (CTS), and exogenous melatonin has been shown to be beneficial in cases of CTS and sleep disturbances. Nevertheless, the concept of "melatonin deficit" has yet to be defined. The aim of our study was thus to determine the relationship between degree of pineal calcification (DOC) and objective sleep parameters using polysomnography (PSG).
Methods: A total of 31 outpatients (17 women, 14 men, mean age 45.7 years; SD 14.4) with insomnia were included in our study. Following a PSG adaptation night, a PSG recording night was performed. Urine samples were collected at predefined intervals over a 32-hour period that included both PSG nights in the sleep laboratory. 6-sulphatoxymelatonin (aMT6s) levels were determined using ELISA. DOC and uncalcified pineal tissue (UPT) was estimated by means of cranial computed tomography.
Results: UPT was positively associated with aMT6s-production (r = 0.569; P = 0.002). Controlling for age, aMT6s parameters and UPT did not correlate with any of the PSG parameters evaluated. In contrast, DOC was negatively associated with REM-sleep percentage (r = -0.567, P = 0.001), total sleep time (r = -0.463, P = 0.010), and sleep efficiency (r = -0.422, P = 0.020).
Conclusion: DOC appears to be superior to measurements of the absolute amount of melatonin in the circulation as an indicator of melatonin deficit. High DOC values indicate changes predominantly in those PSG parameters that are governed by the circadian timing system. As such, DOC may serve as a marker of CTS instability.

0562

IN-FLIGHT MEDICAL EMERGENCIES IN AIRLINE PASSENGERS USING HYPNOTICS

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Introduction: Sleeping pills are used by many air travelers to manage jet lag, however, the safety of using these agents in-flight is unclear. Several incidents involving airline passengers using sleeping pills have been described in the media ("Justice Ginsberg hospitalized before planned flight" Wall Street Journal 10/15/09; "Some sleeping pill users range far beyond bed". New York Times 3/6/2008). Flight attendants also provide anecdotes.
Methods: From 1995-2009 all 4045 air-to-ground contacts by a major U.S. airline to an U.S. academic medical center were logged into a database. Text word searching used "sleeping" "sleeping pill", "zolpidem", "Ambien", and other generic and trade names, US and international, of the approved hypnotic sleep medications. Data were obtained concerning the passenger demographics, characteristics of the emergency, and unscheduled landings /diversions. This airline had more than 7.5 million flights during the study period (http://www.airlines.org/economics/review_and_outlook).
Results: Twelve medical calls involving sleeping pills were identified. Ten cases involved zolpidem, one zopiclone, and one unspecified sleeping pill. Passengers ranged from age 8-72 years. Medical consultation was sought for persisting unresponsiveness (4), agitation (3), convulsions/spells (4)and one nausea/vomiting (1) Alcohol consumption was noted for 5 and other prescription medications for 7 of the cases. Ten of the flights were international, mostly trans-Pacific. Two flights were diverted to expedite medical care and one passenger was deplaned before take off.
Conclusion: Medical emergencies associated with hypnotics are rare. There likely were additional incidents for which ground based medical consultation was not sought. Passengers taking hypnotic medications should consider the risk of adverse effects when selecting a jet lag strategy. Most commonly the emergencies in this study were associated with zolpidem. Whether this simply reflects widespread usage or this agent has a higher rate of side effects remains unclear. Unfamiliar agents, increased dosage and combinations with other substances should be avoided in-flight.

0563

LACK OF MAJOR INTERSPOUSAL SLEEP DISRUPTION BETWEEN SPOUSES WHO BOTH HAVE INTRINSIC SLEEP DISORDERS

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Introduction: Wives and/or husbands often complain that their spouse disturbs their sleep with snoring, restlessness, etc. Individual nocturnal polysomnograms (NPSG) do not assess such sleep disruption. We hypothesized that spouses with intrinsic sleep disorders also experience significant extrinsic sleep disturbance from each other. We studied sleep of married couples in the same bed at the same time to quantify interspousal sleep disturbance.
Methods: We configured our NPSG system to collect individual yet synchronized data for each spouse. We scored studies with particular attention to "spontaneous" electroencephalographic arousals. These were considered co-arousals (caused by the spouse) if they occurred within 0.5 - 3.0 s after onset of a bed partner stimulus (snore, leg movement, etc.). Co-arousals were categorized according to stimulus. We deemed co-arousals clinically significant if they averaged ≥ 5% of total arousals.
Results: Eighteen couples participated. All had obstructive sleep apnea (AHI range: 24 - 125), 47% met diagnosis with restless legs syndrome, and 22% exhibited periodic limb movements in sleep. On average, only 7 ± 11 (mean ± SD), or 1.9%, of the total of 372 ± 171 arousals could be assigned to the spouse. Intrinsic factors caused the large majority of arousals, as follows: respiratory events: 94.0%, snore arousals: 3.7%, and PLMs: 0.5%. However, a subgroup of five participants, all wives, experienced co-arousals constituting ≥ 5% of their total arousals (11.6 ± 6.5%).
Conclusion: The results largely refute expectations, and instead demonstrate that co-arousals usually constitute a miniscule source of sleep disruption in spouses who both have intrinsic sleep disorders. However, a subgroup of women exhibited significant susceptibility to co-arousal. Nevertheless, the findings indicate that when a wife or husband complains of spousal sleep disruption, it is probably the complainer's intrinsic sleep disorder producing the large majority of their arousals.
Support (If Any): Sleep Consultants, Inc. and Texas Pulmonary and Critical Care Consultants, P.A. supported this work.

0564

MENOPAUSAL STATUS, RACE AND SLEEP DISTURBANCES IN MIDLIFE WOMEN

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Introduction: Problems with sleep are common among midlife women and often attributed to menopause. In addition, evidence exists for sleep differences among ethnic groups. This study examines relationships between menopausal status, race and responses to questionnaires about sleep quality and daytime sleepiness among midlife African-American (AA) and Caucasian women in the Philadelphia area.
Methods: The study sample included 184 women (101 AA, 83 Caucasian) between ages of 40-58 (mean 51.3 yrs, SD 4.2). Participants were classified as pre- (n = 27), peri- (n = 92) or postmenopausal (n = 62) according to bleeding patterns. They completed the Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Questionnaire Instrument (PSQI) and Women's Health Initiative Insomnia Rating Scale (WHIIRS). Kruskal-Wallis one-way analysis of variance tests were used to compare scores among menopausal groups. The Wilcoxon rank sum test was used to compare scores between AA and Caucasian women.
Results: The prevalence of poor sleep was high (35% had WHIIRS ≥ 10). WHIIRS scores were slightly higher among premenopausal than peri- and postmenopausal women [9.52 (5.21), 8.47 (5.60), 7.98 (5.41)]. However, this difference was not significant. PSQI scores were similar across groups [11.6 (2.2), 11.3 (2.3), 11.5 (3.0), P = 0.65]. ESS scores were not different among pre-, peri- and postmenopausal women [7.96 (5.29), 7.25 (5.08), 7.89 (4.58), P = 0.49]. Although WHIIRS scores were similar in AA and Caucasian women [8.52 (5.57), 8.28 (5.30), P = 0.88], PSQI scores were slightly higher among AA women [11.87 (2.89), 10.96 (2.03)], indicating poorer sleep. This association was of borderline significance (P = 0.07). Nevertheless, ESS was similar between groups [7.86 (5.25) in AA, 7.33 (4.58) in Caucasians, P = 0.66].
Conclusion: In these midlife African-American and Caucasian women, sleep disturbance was common. However, we observed few differences by menopausal status and race, nor did subjects differ in reporting daytime somnolences. Further investigations into factors underlying sleep disturbance in midlife women, including the role of reproductive hormones, is needed.
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0565

COMORBID INSOMNIA: RELATIONSHIP OF INSOMNIA WITH WORK PRODUCTIVITY, ABSENTEEISM, AND PERFORMANCE OF DAILY ACTIVITIES

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Introduction: Insomnia is costly for society and most of its indirect costs are due to its consequences on work and daily activities. We examined whether insomnia, when comorbid with a medical or psychiatric disorder, was independently associated with reduced work productivity and higher absenteeism and unemployment rate.
Methods: Participants were selected from an ongoing epidemiological study of insomnia conducted in Canada (N = 1064). Three groups were formed: insomnia comorbid with a medical or psychiatric disorder (INS+CO; n = 387), insomnia without comorbidity (INS; n = 55), and good sleepers with a medical or psychiatric disorder (GS+CO; n = 266). Individuals without insomnia and without comorbid disorders (n = 179), as well as those with missing data (n = 177), were excluded. The dependent variables were current employment (yes/no), number of work hours missed in the last 7 days, and impairment of work productivity and daily activities in the last 7 days (0%-100%).
Results: Compared to the GS+CO group, the INS+CO group reported higher daily activities impairment (33% vs.15%). The INS+CO group also reported greater work productivity impairment and tended to miss more work hours than the GS+CO group (2.00 vs. 0.67). Compared to the group with INS alone, the INS+CO group reported greater daily activities impairments (21% versus 33%) and tended to be at higher risk of being unemployed (P < 0.10).
Conclusion: Among individuals with insomnia comorbid with a medical or psychiatric disorder, insomnia seems to contribute independently to reduced work productivity and impairment of daily activities. These findings suggest that insomnia should be an independent focus of treatment even when it is comorbid with another medical or psychiatric disorder.
Support (If Any): This research was supported by a grant from the Canadian Institutes of Health Research (# 42504).

0566

LONGITUDINAL STUDY OF INSOMNIA IN THE GENERAL POPULATION OF KOREA

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Introduction: Evolution of insomnia has been little documented in general population. Longitudinal information can be gathered by interviewing the same individuals at different times but it can also be obtained by measuring a population at different occasions. This study presents the results related to insomnia in South Korea assessed in a 7-year interval.
Methods: The first study was carried on in 2001 with 3719 individuals aged 15 years or older representative of the general population of South Korea. The second study was performed in 2008 using a representative sample of 2537 individuals in the same age range. The methodology was the same for both studies. The participants were interviewed by telephone using the Sleep-EVAL system. The interviews covered sleep habits, sleep symptomatology, physical and psychiatric illnesses. DSM-IV sleep and psychiatric disorder diagnoses were also assessed.
Results: In 2001; 4.1% of the sample reported having difficulty initiating sleep at least 3 nights per week; the prevalence was down to 2.3% in 2008. Nocturnal awakenings also significantly decreased from 2001 (11.8%) to 2008 (8.3%) as did also early morning awakenings going from 1.9% to 1.0%. Changes in prevalence were significant mostly in middle-aged subjects (35 to 64 years old). Non-restorative sleep remained unchanged: 4.8% in 2001 and 5.1% in 2008. There was, however, a significant increase in Global Sleep Dissatisfaction between 2001 (3.7%) and 2008 (6.1%). Prevalence of DSM-IV insomnia diagnoses remained unchanged: 5% in 2001 and 4.7% in 2008.
Conclusion: Overall, prevalence of insomnia symptoms has slightly decreased over a 7-year period mainly in the middle-aged individuals. However, the prevalence of DSM-IV insomnia diagnoses has remained the same underlying the fact that insomnia disorders remain a true concern in Korean population.

0567

UTILITY, VALIDITY, AND METHODOLOGICAL FACTORS INFLUENCING ASSIGNMENT OF DSM-IV-TR INSOMNIA DIAGNOSES: CONSIDERATIONS FOR DSM-V

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Introduction: Work is underway to revise the DSM-IV-TR insomnia nosology for DSM-V. Yet we know little about the utility and validity of current insomnia diagnoses or factors that influence their assignment. This study was conducted to provide such information.
Methods: We enrolled 352 (67% women; MAge = 46.4 ± 14.4 yrs.) adults who met RDC for insomnia at Duke and Rush Medical Centers. At each site, two clinicians used a structured sleep interview (SI). Another pair conducted a standard clinical interview (CI) and reviewed patients' sleep history questionnaires (SHQ) and sleep diaries (SD). A third pair (CI+PSG) formulated impressions from CI, SHQ, SD and PSG. All then rated how well (0 = "doesn't fit at all"; 100 = "fits extremely well") each of 10 DSM-IV-TR insomnia diagnoses "fit" each patient. When statistically appropriate, we computed mean diagnostic ratings within each clinician dyad for each patient and then computed inter-dyad Spearman correlations of these mean ratings across patients. We then combined correlations across sites to examine convergent validity of the diagnoses. Site and method biases were also tested via ANOVAs.
Results: Primary insomnia (PI), insomnias related to a mental disorder (IMD) or medical condition (MED) and breathing-related sleep disorder (BRSD) were assigned frequently. The validity indices for the IMD (rs = .65-.68) and MED (rs = .52-.60) diagnoses were most promising. Validity indices were more variable for BRSD (rs = .39-.77), and were modest for PI (rs = .33-.56) at Duke and poor at Rush. However, there were significant method-by-site interactions in the assignment of all four diagnoses. At Duke, clinicians using CI+PSG rated IMD, MED, and BRSD diagnoses more highly than did those using SI or CI methods. At Rush, the method associated with the highest and lowest mean diagnostic ratings varied across these 3 diagnoses. The CI method produced the highest ratings of PI at Duke and lowest ratings of PI at Rush.
Conclusion: IMD and MED appear best supported, yet clinicians' diagnostic choices appear influenced by personal biases and assessment methods. A limited number of categories with clear, exacting diagnostic criteria should be considered for a revised insomnia nosology.
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0568

THE RELATIONSHIP BETWEEN DAYTIME SYMPTOM PATTERNS AND CLINICALLY ASSIGNED ICSD-2 INSOMNIA DIAGNOSES: A TEST OF DIAGNOSTIC VALIDITY

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Introduction: Profile analysis via multidimensional scaling (PAMS) identifies prominent profiles derived from a battery of measures in a given population. Herein we used PAMS to: (1) identify core profiles of scores on daytime symptom questionnaires within a sample of insomnia sufferers; and (2) relate these profiles to clinically-assigned ISCD-2 insomnia diagnoses.
Methods: PAMS was conducted with 332 insomnia sufferers (221 women, Mage = 46 yrs.) using measures of sleepiness, fatigue, depression, tension, hostility and sleep hygiene. After completing the measures, participants underwent clinical interviews with 6 sleep specialists at one of two collaborating academic medical centers. Each specialist rated how well each of the five ISCD-2 diagnoses including insomnia associated to a mental disorder (IMD), inadequate sleep hygiene (ISH), psychophysiological (PI), idiopathic (ID) and paradoxical (PXI) insomnia fit each participant. The relationship between each individual's mean rating for each diagnosis and his/her load on each daytime profile was examined via Pearson correlations.
Results: Four profiles were identified. High scores on sleepiness, fatigue and bad sleep hygiene characterized profile 1, whereas its mirror image was marked by depression, anger, and tension. Profile 2 showed elevated scores on fatigue and depression. Its mirror image was characterized by bad sleep hygiene and tension. Correlations between loads on profile 1 and the diagnoses of IMD and ID were statistically significant but negative, r = -0.344 and r = -0.130, indicating that individuals showing a better fit for those diagnoses tended to have daytime profiles resembling profile 1's mirror image. In contrast, statistically significant and negative correlations were found between profile 2 and PI, r = -0.115, and ISH, r = -0.122.
Conclusion: The findings show distinctive daytime symptom profiles for the insomnia subtypes considered. They also suggest at least two forms of insomnia: one characterized mainly by a behavioral component and another one of a more biological nature, thus providing support for their categorical differentiation.
Support (If Any): National Institute of Mental Health, Grant # R01MH067057

0569

IMPAIRMENT AND DISABILITY ASSOCIATED WITH INSOMNIA DIAGNOSED BY DSM-IV, RDC AND ICD CRITERIA AND ASSOCIATED WITH INSOMNIA SYMPTOMS: RESULTS FROM THE AMERICAN INSOMNIA SURVEY

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Introduction: There is a need for systematic examination of impairment and disability associated with well-characterized insomnia disorders/symptoms. Preliminary analyses of the American Insomnia Survey provide insight into impairment and disability associated with insomnia diagnosed by DSM-IV, ICD, and the ICSD as elaborated in the RDC, and by number of insomnia symptoms.
Methods: A nationally representative sample (n = 10,092) of subscribers to a large healthplan, were interviewed by telephone (~40min). Insomnia disorder diagnoses were made according to ICD, RDC and DSM-IV criteria with operational definitions. Symptoms of difficulty initiating sleep (DIS), maintaining (DMS), early morning awakening (EMA) and nonrestorative sleep (NRS) were characterized for frequency and magnitude. Impairment and disability assessments included the Sheehan Disability Scale (SDS), Short Form 12 (SF-12), days out of role, accidents and falls.
Results: On most measures respondents meeting ICD criteria showed greater disability/impairment than those meeting DSM-IV or RDC. Respectively, mean SDS scores were 6.1, 3.8 and 4.0; mean sleep problem-related days out of role were 2.4, 0.9 and 1.0; and SF-12 mental component scores were 43.4, 48.6 and 48.0. Comparing individuals meeting any diagnostic criteria with respondents without insomnia (NI) shows significant differences ($P < 0.05$) on health-related days out of role (1.6 vs 0.5), SF-12 physical (48.9 vs 52.6) and mental (48.9 vs 54.4) component, and 1-year accident (16.1% vs 10.5%) and falls prevalence (5.2% vs 3.2%). Impairment on most measures increased significantly with increasing number of insomnia symptoms (DIS, DMS and/or EMA). Respondents with more than one symptom, NRS only and DIS only tended to be more impaired than DMS only and EMA only; however all insomnia symptom groups were significantly more impaired compared with NI.
Conclusion: Respondents diagnosed with insomnia had more disability and impairment than NI. Impairment and disability were worse for those meeting ICD criteria and increase with number of insomnia symptoms.
Support (If Any): Sanofi-aventis.

0570

MOVING BEYOND AVERAGE VALUES: ASSESSING THE NIGHT-TO-NIGHT INSTABILITY OF SLEEP AND AROUSAL IN DSM-IV-TR INSOMNIA SUBTYPES

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Introduction: Despite the categorical differences between diagnoses implied in the DSM-IV-TR, empirical studies showing distinctive features of insomnia subtypes are scarce and mainly include cross-sectional comparisons. We explored differences between individuals with the diagnoses of primary insomnia (PI) and insomnia related to a mental disorder (IMD) by using serial measurements of self-reported sleep variables (sleep onset latency, SOL; wake after sleep onset; total sleep time, TST; sleep efficiency), and visual analogue scale ratings of various forms of bedtime arousal (somatic, cognitive and emotional). Furthermore, we examined the relationship between sleep and arousal within each diagnostic subgroup.
Methods: One hundred and eighty-seven insomnia sufferers (126 women, average age 47.15 years) diagnosed by sleep specialists at two academic medical centers as PI (n = 126) and IMD patients (n = 61) were included. Between-group differences on average values and on night-to-night instability, calculated by square successive differences, were assessed via Multilevel Models. The relationship between sleep and arousal was examined by weighted correlations coefficients.
Results: IMD patients reported significantly longer SOL, on average, and displayed significantly more instability across nights in their TST (i.e., larger changes) than did PI patients. IMD patients exhibited higher mean levels of somatic, cognitive and emotional arousal as well as more instability on nightly ratings of emotional arousal. The correlations revealed a moderate relationship between arousal and SOL in the PI group (r values from 0.26 to 0.34), whereas the corresponding correlations were negligible and statistically nonsignificant in the IMD group (r values < 0.14).
Conclusion: Despite greater levels of arousal and longer SOLs, there was less correspondence between sleep and arousal in the IMD group relative to the PI group. Furthermore, the greater night-to-night variability in IMD patients' sleep duration and in emotional arousal may indicate distinctive perpetuating mechanisms involved in their ongoing sleep difficulties. The findings support the categorical distinctiveness of these insomnia subtypes.
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0571

THE DAYTIME FUNCTIONING AND SLEEP ATTRIBUTION SCALE (DFSAS): A NEW INSOMNIA-SPECIFIC MEASURE TO PROBE DAYTIME IMPAIRMENT AND POOR SLEEP ATTRIBUTIONS

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Introduction: Current assessments of daytime functioning and health-related quality of life in insomnia rely on tools which are generic and non-specific (e.g. SF-36), or designed to assess a single construct (e.g. depression), or just single non-validated items. The challenge in creating an insomnia-specific scale relates to the influence of co-occurring conditions. Here we present preliminary data on the daytime functioning and sleep attribution scale (DFSAS), a two part measure designed to assess impairment in daytime domains commonly reported by individuals with insomnia (part 1), and, importantly, sleep-related attributions in accounting for such reported daytime impairment (part 2).
Methods: Thirty-nine individuals with primary insomnia (PI), according to DSM-IV criteria, and 31 normal sleepers completed the DFSAS. A sub-set (n = 18) of the PI group completed the DFSAS during a brief 4-week sleep restriction therapy intervention, enabling assessment of sensitivity to change. We report data on internal consistency, discriminant validity, concurrent validity, and sensitivity and specificity.
Results: DFSAS items were selected based on focus group and audio-diary data collected during a previous investigation. Parts 1 and 2 successfully discriminated PI individuals and normal sleepers (both $P < .001$). Both parts 1 & 2 had high sensitivity and specificity (> 87%). Cronbach's alpha was 0.81 for part 1 and 0.89 for part 2. DFSAS scores (part 1) were positively associated with insomnia severity (ISI; rho =

.49) and occupational impairment (OISQ; rho = .76), and negatively associated with several SF-36 dimensions, including vitality (rho = -.51), general health (rho = -.54) and emotional role limitations (rho = -.43). DFSAS part 1 and 2 scores significantly improved over the course of sleep restriction therapy, and these changes were associated with improvements in sleep diary variables.
Conclusion: Preliminary data indicate the DFSAS to be valid, internally consistent, and sensitive to change. The attributional component of the DFSAS adds a new dimension to the assessment of daytime functioning in insomnia, and also permits use with co-morbid insomnia populations. Further testing with larger samples is required.

0572
DEMOGRAPHIC AND BEHAVIORAL RISK FACTORS OF INCIDENCE INSOMNIA

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Introduction: Insomnia is a common sleep disorder. Numerous studies investigated the prevalence of insomnia, however, most of them are cross-sectional and not much is known about the risk factors for future insomnia. In this study we examined the demographic and behavioral factors that may increase the risk of developing insomnia in future.
Methods: Data are derived from a larger epidemiological study conducted in general population of Central Pennsylvania. 16,583(age > 20 yr.) randomly selected individuals were interviewed to assess demographic and sleep related information. A subsample of 1741 underwent comprehensive assessment(history, physical examination and polysomnogram). 1387 of these 1741 subjects were followed-up after an average of 7.5 yr. and structured sleep complaints/disorders and medical/psychiatric history was obtained. Among the 1387 subjects, 1280 without insomnia at baseline were included in the incidence analysis.
Results: Incidence of insomnia at follow-up was 9.6%. More women (12.6%) than men(6.3%) developed insomnia (P = < .0001). Women aged < 65 yr. had higher incidence insomnia (< 65yr-13.8%; > 65yr-6.8%; P = .04) with similar trend in men. Younger(< 35yr.) women (P = .001) and men (P = .047) had highest risk. BMI showed U-shaped increase in risk with higher in underweight(71.4%) and obese(15.3%) and lowest in women with BMI-25-30(7.5%) (P = < .0001) with similar trend in men. Caucasians were less likely to develop insomnia(Females-p < .0001;Males-p = .04). Women drinking 1-2 cups of coffee/day were less likely to develop insomnia(P = .001) with a similar trend in men (P = .09). There was a trend towards low incidence in women drinking 1 alcohol-drink/day(P = .12). Smoking status did not seem to affect incidence insomnia.
Conclusion: Our study is one of the few to examine the risk factors for new onset insomnia in a prospective manner. Female gender, younger age, BMI below 25 or above 30 and non-Caucasian ethnicity increases the risk of new onset insomnia. Among the behavioral factors, 1-2 cups of coffee per day and moderate quantity of alcohol seem to be protective.

0573
A DESCRIPTIVE STUDY OF CAUSAL ATTRIBUTIONS OF INSOMNIA AND THEIR CORRELATES

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Introduction: Causal attributions of insomnia may be instrumental in determining whether a person will seek treatment. The present study examined whether one's perceived cause of sleep difficulties are associated with different factors including gender, age, insomnia severity, consultation for sleep difficulties and prescribed medication use.
Methods: Data were derived from a larger epidemiological study conducted in the Canadian population. A subsample of 389 individuals (68.4 % women) who presented insomnia symptoms and considered they had sleep difficulties responded to a multiple-choice question about what they believed was the main cause of their sleep difficulties. Causal attributions were explored in relation to gender, age, insomnia severity, healthcare consultation and use of prescribed sleep medications using Chi-square tests and ANOVAS.
Results: Causal attributions were distributed as follows: 35.6% attributed their sleep difficulties to mental health problems, 27.7% to physical health problems, 20.4% to aging or hormonal changes, 6.6% to environmental causes (e.g., noise), 5.2% to caring for another family member and 4.5% to work schedule. Significant differences were observed on gender, age and prescribed medication use. Significantly more women attributed their sleep difficulties to mental health problems than to other causes (P < 0.001) while men more often attributed them to physical health problems (P < 0.001). Individuals who attributed their sleep difficulties to physical health problems and to aging and hormonal changes were significantly older than individuals in the other attribution groups (P < 0.001). Significantly more respondents in the mental health attribution group used prescribed medications for sleep compared to the other groups (P = 0.037) and this relationship remained significant when gender was controlled for. However, causal attributions were not significantly associated with occurrence of consultation for sleep difficulties or with insomnia severity.
Conclusion: Causal attributions about sleep difficulties appear to be influenced by gender and age and appear to influence use of prescribed medications. It would be interesting to examine whether they are associated to use of other sleep-promoting strategies and treatment outcomes.
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0574
PERSONALITY DISORDER FEATURES PREDICT THE INSOMNIA EXPERIENCE AMONG HYPNOTIC-DEPENDENT PATIENTS

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Introduction: Previous studies revealed personality disorders are often comorbid with insomnia. Studies suggest Cluster C personality disorders are the most common among persons with primary insomnia. There is little information about the relation between personality disorder features and the insomnia experience. The goal of the current study was to determine how personality disorder features predict the insomnia experience among hypnotic-dependent persons with insomnia.
Methods: Eighty-six hypnotic-dependent young to middle-aged adults with insomnia were administered the SCID-II personality questionnaire, Insomnia Severity Index, Insomnia Impact Scale, Fatigue Severity Scale, Beck Depression Inventory, State-Trait Anxiety Inventory, and two weeks of sleep diaries. Between-subjects t-tests and stepwise regression were conducted.
Results: SCID-II criteria were met most frequently for Cluster C personality disorders. Obsessive-compulsive personality disorder (OCPD) was the most common diagnosis (n = 40). These individuals compared to non-OCPD participants did not differ in depression, insomnia severity, SOL, WASO, SE or TST. Yet, they were more anxious, fatigued, and impacted by their insomnia despite having fewer insomnia nights (P < .05). Out of all the personality disorders, Avoidant and OCPD features were the only significant predictors of insomnia impact, with OCPD having the most predictive power. However, OCPD features did not remain significant after controlling for relevant sleep and affective variables. Schizotypal and Schizoid features were the only significant predictors of insomnia severity, with Schizoid features having the most

predictive power. These disorders remained significant after controlling for the above mentioned variables (P < .0001).
Conclusion: Cluster C personality disorders, especially OCPD, are frequently comorbid with insomnia among hypnotic-dependent patients. Patients that meet criteria for OCPD perceive their insomnia experience as significantly more disruptive to their daytime functioning, whereas Schizotypal and Schizoid features among these insomnia patients predict greater insomnia severity.
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0575

INSOMNIA SEVERITY IN HIV-SEROPOSITIVE PATIENTS IS ASSOCIATED WITH INCREASED FATIGUE

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Introduction: Fatigue is a common early presenting symptom of HIV. However, the etiology of the fatigue is unknown. Insomnia is also highly prevalent in the HIV+ population and frequently causes fatigue in affected individuals. As a result, we carried out this analysis to test the hypothesis that insomnia is correlated with fatigue in HIV seropositive patients.
Methods: Thirty-six HIV+ patients 18-60 years of age with a DSM-IV TR diagnosis of were recruited for a clinical trial of insomnia treatment. At initial visit, subjects were administered the Insomnia Severity Index (ISI), Piper Fatigue Scale (PFS), Hospital Anxiety and Depression Scale (HADS), and the most recent CD4 count was recorded. A regression analysis was carried out with pre-treatment data to determine if there was a relationship between ISI and PFS. In this analysis PFS was the dependent variable and ISI was included as an independent predictor variable along with CD4 count and depression severity scale score in order to control for HIV disease severity and depression.
Results: We found that higher ISI score (greater insomnia severity) was associated with greater PFS score (greater fatigue severity) with R2 = 0.23 (r = 0.48), P = 0.013) after controlling for CD4 count and depression severity. Neither CD4 count nor depression severity were significantly associated with PFS score.
Conclusion: Greater insomnia severity is associated with greater fatigue in HIV+ patients. This relationship persisted after controlling for CD4 count and depression severity. The significant relationship between insomnia and fatigue could reflect that insomnia is an important contributor to the fatigue experienced by HIV infected individuals. The insomnia-fatigue relationship could also indicate that both insomnia and fatigue are driven by a common underlying process in HIV. However, given that prior research suggests that the effective treatment of primary insomnia patients is associated with improvement in fatigue, these findings speak for the need for future studies assessing the affects on fatigue of the treatment of insomnia in HIV+ individuals.

0576

RELATIONSHIP BETWEEN SLEEP AND MARKERS OF DIABETES RISK IN CHRONIC INSOMNIA SUFFERERS

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Introduction: Reduced quantity and/or quality of sleep is associated with increased risk of type-2 diabetes. Controlled laboratory studies also indicate that experimental sleep deprivation results in decreased glucose tolerance. This preliminary report examined whether complaints of chronic insomnia are associated with changes in human glucose homeostasis.
Methods: Ten men in good health with mean age (SD) 43.2 (6.9) y, BMI 24.6 (3.5) kg/m2, and RDI 5 (4) who met DSM-IV criteria for primary insomnia completed a 75-g oral glucose tolerance test (OGTT), insomnia-severity-index (ISI) questionnaire, and one night of full polysomnography. We examined self-reported ISI and recorded total sleep time (TST) as predictors of fasting (FBG) and 2-hour post-challenge blood glucose (2h-BG), and HOMA2-model-based indices of beta-cell function (HOMA-B) and insulin resistance (HOMA-IR) using multiple linear regression adjusted for age and BMI (SPSS 16.0).
Results: Reduced TST was associated with higher FBG (P = 0.03) and 2h-BG (P < 0.05) concentrations, and lower HOMA-B (P = 0.03). Similar relationships with FBG, 2h-BG, and HOMA-B were detected when sleep efficiency or overnight wake time were used as alternative measures of poor sleep quantity and quality. In contrast, there were no significant associations between ISI and any of the selected markers of diabetes risk.
Conclusion: These preliminary data suggest that changes in glucose homeostasis indicative of higher diabetes risk are associated with objective, but not necessarily subjective, measures of poor sleep in chronic insomnia sufferers. Further studies are needed to explore the underlying mechanisms of this relationship and determine whether treatment of primary insomnia may result in improved beta-cell function and glucose tolerance.
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0577

CHARACTERIZATION OF SLEEP AMONG OLDER GOOD SLEEPERS, OLDER ADULTS WITH INSOMNIA, AND FIBROMYALGIA PATIENTS WITH INSOMNIA

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Introduction: Sleep difficulties are common among older adults and individuals with fibromyalgia. Research indicates up to 60% of older adults and up to 70% of fibromyalgia patients complain of poor sleep. However, there is little research comparing the level of sleep disturbance exhibited by these groups. This study aims to better characterize sleep among fibromyalgia patients with insomnia (FM-Insomnia) in comparison to older adults with (OA-Insomnia) and without insomnia (OA-Good Sleepers).
Methods: Participants: 40 FM-Insomnia (Mage = 50.62,SD = 8.9), 70 OA-Good Sleepers (Mage = 72.6,SD = 7.3) , and 54 OA-Insomnia (Mage = 70.1,SD = 7.5) completed demographic information and sleep diaries(2 weeks). Means were computed for sleep efficiency(SE), sleep onset latency(SOL), wake after sleep onset(WASO), sleep quality rating(SQR), and total sleep time(TST). Multiple ANOVAs(Bonferroni adjusted post hocs) were used to compare these sleep variables among the three groups.
Results: Controlling for age and depression, these analyses revealed a significant difference between OA-good sleepers and the insomnia groups on SE, SOL, WASO, SQR, and TST(P's < .05). The insomnia groups reported comparable levels on SE(~76 percent), WASO(~49), and SQR(~2.8). There was a significant difference between the OA-Insomnia and FM-Insomnia groups on SOL and TST. Compared to the OA-Insomnia group (SOL = 40.8,SD = 32.7; TST = 364.1,SD = 76.2), the FM-Insomnia group reported ~25 more minutes of SOL (SOL = 65.9,SD = 52.7) and ~60 more minutes of TST (TST = 434.5,SD = 81.7). Within-person variability analyses indicated a greater amount of variability in SOL, WASO and TST in the FM-Insomnia group compared to the other two groups.
Conclusion: Results suggest fibromyalgia patients with insomnia experience more difficulty with falling asleep but about the same difficulty staying asleep as older adults with insomnia. Preliminary analyses reveal that the insomnia among fibromyalgia patients is more variable

and thus, less predictable for these patients. This has implications for developing targeted insomnia treatments for fibromyalgia patients and the differential impact of fibromyalgia on sleep.

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0578

SPONTANEOUS PAIN IS ELEVATED IN INSOMNIA AND CORRELATED WITH NEGATIVE MOOD AND SLEEP DURATION

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Introduction: The development and augmentation of spontaneous pain under experimental conditions of sleep loss has been reported. Here we investigate the relationship between sleep (using logs and actigraphy) and mood with spontaneous pain reporting in the natural environment.

Methods: 17 participants with primary insomnia were individually matched by sex and age with 17 healthy sleep controls (24 +/- 4yrs, 23.2 +/- 3.2 m2/kg, female:male ratio 2:1), who underwent a 2-week evaluation period by actigraphy and sleep logs. Satisfaction with sleep, as well as mood and well-being, was rated daily (100mm visual analog scales [VAS]). A composite spontaneous pain score was computed from a daily VAS questionnaire consisting of generalized pain and localized pain items such as headache, backache, and muscle ache.

Results: Insomniacs experienced significantly more spontaneous pain than controls ($P < 0.05$). Daily ratings of mood showed that insomniacs reported feeling more loneliness, stress, worry and difficulty concentrating when compared with controls ($P < 0.05$). Actigraphy data shows that insomniacs slept significantly less than controls (5:50hrs +/- 1:20 vs. 7:06hrs +/- 0:55, $P < 0.10$). Spontaneous pain correlated with measures of subjective sleep quality in insomniacs and daily ratings of stress, worry and annoyance (all P-values < 0.05). Spontaneous pain correlates negatively with sleep duration as measured by actigraphy ($r = -.33$, $P < 0.10$) and sleep logs ($r = -0.43$, $P < 0.05$), in the entire group of insomniacs and controls.

Conclusion: These findings suggest that participants with primary insomnia experience more spontaneous pain and negative mood than their matched healthy sleep controls. Lower sleep duration is associated with more spontaneous pain reporting in the natural environment.

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0579

INSOMNIA WITH SHORT SLEEP DURATION IS ASSOCIATED WITH IMPAIRED HRV

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Introduction: Using lower heart rate variability (HRV) as measures of impaired cardiac autonomic modulation (CAM), we investigated whether chronic insomnia is associated with lower HRV, and whether shorter sleep duration in insomniac individuals is associated worsening of CAM.

Methods: We identified 28 individuals who had insomnia and 28 age and sex matched controls from previous studies. We obtained their one-channel EKG recordings during a single night 8-hour polysomnograph recording. Standardized HRV analysis was performed on each 30 minute segment after removing the first and last 30 minutes of the data. Then, we calculated the following frequency domain HRV indices: Low Frequency Power (LF) - the power in the low frequency range (0.04 - 0.15 Hz), High Frequency Power (HF) - the power in the high frequency range (0.15 - 0.40 Hz), and LF/HF Ratio. We also calculated the following time domain HRV indices: SDNN - the standard deviation of all RR intervals (ms), RMSSD - the square root of the mean of the sum of the squares of differences between adjacent RR intervals (ms).

Results: Insomnia cases were associated with significantly lower SDNN, RMSSD, and HF (69 ms, 46 ms, and 5.61 ms2, respectively) than normal controls (77 ms, 51 ms, and 5.61 ms2, respectively, all $P < 0.05$). Among insomnia individuals, every 10% increase in sleep efficiency was associated with increases in 3.83 ms of SDNN, 5.80 ms of RMSSD, 0.344 ms2 of log-HF, and with 0.70 decreases in LF/HF ratio.

Conclusion: This study shows that individuals with insomnia have lower HRV values indicative of impairment of CAM as compared to individuals without insomnia. Lower sleep efficiency, hence shorter objective sleep duration, is consistently associated with lower HRV. These data suggest that shorter objectively assessed sleep duration, which we have proposed as a marker of severity of insomnia, is associated with CAM impairment.

0580

CORRELATION BETWEEN URINE NOREPINEPHRINE AND CORTISOL IN INSOMNIA: EVIDENCE FOR CENTRAL DYSREGULATION

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Introduction: The CRH model of insomnia proposes that central CRH hyperactivity is the proximal cause of the symptoms and signs of primary insomnia. In its role as mediator of an integrated physiologic stress response, CRH is a positive regulator of both the sympathetic nervous system (SNS) and cortisol secretion from the adrenal gland. As a test of our model, we examined the basal profiles of urinary cortisol (CORT) and norepinephine (NE) in patients with chronic primary insomnia and normal controls.

Methods: 95 patients with chronic primary insomnia of at least 1 year in duration and without evidence of comorbid medical or psychiatric disease (50f; avg. age 32.7, range 19-55) and 110 normal controls (65f; avg. age 32.2, range 19-58) underwent a basal laboratory assessment consisting of two days in the sleep laboratory with nightly PSG, daily MSLTs and continuous urine collection. Urine was collected in 8 hour aliquots aligned with scheduled bedtime, and results from the final three aliquots were summed for 24 hour profiles reported here. Assays for NE and CORT were performed using HPLC and specific RIA methodologies, respectively (Warde Laboratories, Ann Arbor, MI).

Results: After controlling for age, sex and race, there was no effect of insomnia diagnosis on 24-hour levels of urinary (free) cortisol or urinary norepinephrine. Insomnia diagnosis did modulate the relationship between NE and CORT, however, with insomnia patients showing a significantly greater positive correlation between the two measures ($r = .43$) than in controls ($r = .22$). After controlling for age, sex and race, the modifying effect of insomnia remained significant ($P < .01$)

Conclusion: These results provide additional support for a central role for CRH in the manifestations of primary insomnia. Control of sympathetic nervous system activity and adrenal glucocorticoid secretion is complex, and activity of hypothalamic CRH is only one factor modulating circulating levels of NE and CORT. It is not surprising, then, that we were unable to replicate previous reports of elevated NE and CORT in insomnia in this large sample, since downstream factors are likely to mitigate excursions outside the normal range in these hormones. Nonetheless, these data provide evidence for increased activity in insomnia of

a factor common to control of both hormones. Hypothalamic CRH is the most plausible candidate.
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0581

THE ROLE OF OBJECTIVE SLEEP DURATION AND CORTISOL LEVELS IN PHENOTYPING CHILDHOOD INSOMNIA

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Introduction: To determine whether objective sleep measures in childhood insomnia lead to a distinction of phenotypes in terms of hypothalamic-pituitary-adrenal (HPA) axis activity and psychological profiles.
Methods: Three hundred eighty-seven school-aged children (5-12 years old) from the general population underwent overnight polysomnography and provided morning and evening saliva samples, which were assayed for cortisol. A parent completed the Pediatric Behavior Scale (PBS) and the Child Behavior Checklist (CBCL). Children were divided into four groups based on presence of insomnia complaint and high or low sleep efficiency (SE).
Results: Children with insomnia and low SE had significantly higher morning ($P < 0.05$) and evening ($P < 0.1$) cortisol levels compared to controls and insomniacs with high SE. Children with insomnia and low SE had significantly and markedly higher scores on attention, behavior and school-based problems than controls or insomniacs with low SE, whereas both insomniac groups scored higher on anxiety/depression compared to their respective controls.
Conclusion: Our findings suggest the presence of two phenotypes of childhood insomnia. The first phenotype is associated with shorter objective sleep duration, activation of the HPA axis and an anxious/depressed psychological profile while the second phenotype is associated with normal objective sleep duration, lack of activation of the HPA axis and an attention/behavior/ school-based problems psychological profile. These two phenotypes may be different in terms of their cause, medical risks and response to treatment.

0582

CORRELATION OF BRAIN GABA WITH EEG SPECTRAL POWER IN PRIMARY INSOMNIA

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Introduction: Reduced global brain GABA as determined using magnetic resonance spectroscopy (MRS) and increased high frequency activity in sleep EEG (moderated by sex and NREM period) may both reflect physiologic hyperarousal in primary insomnia (PI). Our primary hypothesis was that MRS-derived GABA levels negatively correlate with beta EEG power in PI.
Methods: Global brain GABA to creatine ratios (GABA/Cr) were determined with 1-H MRS at 4 Tesla in unmedicated PI subjects (n = 14) during wakefulness. Absolute sleep EEG power from a separate laboratory polysomnography (PSG) visit was calculated for artifact-free NREM sleep epochs from a single (C3-A2) channel using Somnologica Science (Embla). Epochs excluded due to artifact were determined blind to GABA/Cr or subject demographic data. Univariate linear regression compared GABA/Cr and beta power (entire sample and stratified by sex) across total NREM, first episode of NREM (NREM-1), residual NREM (NREM-res), slow wave sleep (SWS) and stage 2 sleep (N2). Correlations of other spectral bands to GABA/Cr were performed on an exploratory basis.
Results: Two subjects were excluded due to excessive PSG artifact. No correlations between spectral bands and GABA/Cr were found in the unstratified analysis. In women (n = 5) beta power trended towards significant correlation with GABA/Cr in total NREM ($r = -0.87$, $P = 0.055$), and significantly correlated with N2 ($r = -0.93$, $P = 0.022$) and NREM-res ($r = -0.93$, $P = 0.023$), but not SWS or NREM-1. Delta ($r = -0.94$, $P = 0.016$) and theta ($r = -0.98$, $P = 0.002$) power significantly correlated with GABA/Cr in total NREM and was statistically significant in all tested NREM sleep stages and periods. In men (n = 7), beta power correlated significantly with GABA/Cr during SWS ($r = -0.83$, $P = 0.020$) but not in total NREM, NREM-1, NREM-res or N2. Sigma power correlated significantly with GABA/Cr during total NREM ($r = -0.84$, $P = 0.017$) and was statistically significant in all tested NREM sleep stages and periods.
Conclusion: Global brain GABA/Cr negatively correlates with beta, delta and theta power in women and beta and sigma power in men with PI. The relationship of beta power with GABA/Cr among women and men differs by stage of sleep and NREM period. These data suggest global brain GABA levels may contribute to sleep microarchitecture in PI, however, given the small number of subjects in this study, future studies examining the role of sex, neurochemistry, and sleep EEG spectral measures are indicated.
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0583

PRIMARY INSOMNIA AND GLUCOSE METABOLISM: CHANGES IN ACTIGRAPHICALLY-DERIVED WAKE AFTER SLEEP ONSET (WASO) RELATED TO CHANGES IN GLUCOSE METABOLISM

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Introduction: Insomnia has been shown to increase longitudinal diabetes risk relative to non-insomniacs. We test the hypothesis that changes in the amounts of Wake after Sleep Onset (WASO) over 2 months in patients with Primary Insomnia (PI) are related to changes in glucose metabolism.
Methods: Adult men and women without diabetes meeting DSM-IV criteria for primary insomnia (n = 20, age 40.2 ± 7.9 years, 9 female, BMI 25.1 ± 2.7 kg/m^2) were studied twice separated by two months of at-home nightly treatment with 3mg eszopiclone or placebo. Findings are reported on outcomes (irrespective of treatment) for changes in WASO (actigraphy) collected for three weeks prior to each of two, 1-day inpatient assessments of glucose metabolism quantified from the results of insulin-modified intravenous glucose tolerance tests (IVGTT). Glucose and insulin profiles from the IVGTT were analyzed with MINMOD Millennium software yielding measures of Insulin Sensitivity (SI), Acute Insulin Response to glucose (AIRg), and the Disposition Index (DI; most strongly related to diabetes risk).
Results: Insomnia treatment for two months did not modify glucose metabolism significantly compared to placebo. When the two treatment groups were combined, increases in WASO (actigraphy) were signifi-

cantly related to changes IVGTT measures: decreases in the Acute Insulin Response to glucose (AIRg; (r^2 = .47, P = 0.0008), and decreases in the Disposition Index (DI; (r^2 = .36, P < 0.01), but not insulin sensitivity (n.s.). Changes in total sleep time over the 2-month span were not related to metabolic changes.
Conclusion: These data support the hypothesis that the metabolic effects of primary insomnia are modulated by sleep disruption (WASO) rather than by changes in total sleep time. WASO-related metabolic changes in PI occur via changes in insulin secretion rather than insulin sensitivity.
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0584

A COMPREHENSIVE CYTOKINE AND CHEMOKINE ANALYSIS IN PATIENT WITH INSOMNIA

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Introduction: Insomnia is a very frequent condition that may be caused by medical, environmental and/or psychological influences. Exposure to one or more of these factors can contribute to the inability to fall sleep or maintain sleep. Recent research on the possible causative factors of insomnia suggests a role of the immune system and inflammation in patients with sleep disturbances. The purpose of this study was to examine the inflammatory status of patients suffering with insomnia utilizing comprehensive cytokine and chemokine analysis and comparing insomniacs to normal healthy controls.
Methods: Comprehensive multiplex analysis measures pro and anti inflammatory cytokines, chemokines and growth factors from insomnia patients (n = 16) and normal healthy control (n = 23). Cytokines were measured from the culture supernatant of the PBMCs in spontaneous release and after the stimulation of PBMCs with PHA and LPS.
Results: The spontaneous release of following pro-inflammatory cytokines (IL-1b, IL-2, IL-6, IL-12, IL-17, IFN-g, TNF-a and chemokines (IL-8, MCP-1, MIP-1b) and growth factors (G-CSF, GM-CSF) were elevated in patient with insomnia compare to normal healthy controls. Anti-inflammatory cytokines IL-5 and IL-13 were reduced in insomnia patients while IL-4 was not different. Upon stimulation of PBMCs with PHA the following pro-inflammatory cytokines: IL-1b, IL-2, IL-6, IL-12; chemokines (IL-8, MIP-1b) and growth factors (G-CSF) were elevated in the patient population. Only the chemokines IL-8 and MCP-1 were elevated upon stimulation of PBMCs with LPS in patients.
Conclusion: Our observations support the hypothesis that insomnia patients have an active immune response. Specifically, the elevated levels of IL-1b, IL-2, IL-6, IL-12, IL-8, MIP-1b and G-CSF substantiate that these measure may be valid biomarkers for inflammation in insomnia patients. The etiology of an active immune response in insomnia patients needs to be explored further to identify treatment regimens that go beyond hypnotic drugs to target inflammation. This study emphasizes the importance of assessing inflammatory biomarkers for sleep disorders in clinical practice with the hopes of improving patient outcomes. Assessment of the immune system may prove to be essential in identifying the true cause of sleep disturbances and may be a good adjunct to current therapeutic practices.

0585

THE RELATIONSHIP BETWEEN ABSOLUTE BETA POWER AND RCMRGLC IN PRIMARY INSOMNIA DURING REM SLEEP

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Introduction: Primary (PI) insomnia is characterized by increased arousal and poor sleep. However, the neurobiological correlates of PI during REM sleep have been scarcely studied. We explored the relationship between whole-night absolute beta power during REM sleep and relative regional cerebral metabolic rate of glucose (rCMRglc) in adults with PI.
Methods: Ten PI subjects (M age = 37.86 ± 9.38 years) were included in this analysis. All were medication-free and completed 3 nights of polysomnographic recordings, and [18F]-fluoro-2-deoxy-D-glucose positron emission tomography scans during REM sleep. Regression analyses were conducted to evaluate the correlations between whole-night REM sleep absolute power spectral values for beta2 activity (16-32 Hz) and rCMRglc.
Results: No significant positive correlation between beta activity and rCMRglc during REM sleep was observed. Significant negative correlations between beta activity and rCMRglc during REM sleep were observed in three brain areas. The first area (x, y, z coordinates: -10, 48, 10, Z = 3.36, P = 0.03) included the left inferior and middle frontal gyri and extended into cingulate gyrus. The largest area (x, y, z coordinates: 52, -66, 14, Z = 4.15, P < .001) encompassed the right inferior, middle, and superior temporal gyri and the fusiform gyrus, parahippocampal gyrus and hippocampus. Bilaterally, it also included the posterior cigulate, precuneus, superior parietal lobule. The last area (x, y, z coordinates: -34, -44, -20, Z = 4.38, P = .04) included the left fusiform gyrus, superior, inferior, and middle temporal gyri.
Conclusion: In adults with PI, decreased whole-night beta activity was associated with increased rCMRglc during REM sleep in bilaterally in temporal and parietal cortices, and in left frontal regions. Posterior brain regions have been related to quiet, resting states. Replication of these preliminary results in large samples is required.
Support (If Any): This research was supported by the National Institutes of Health (MH053035; MH024652; MH66227; RR024153) and the Department of Defense (PT073961-W81XWH-07-PTSD-IIRA).

0586

THE RHYTHM OF SLEEP IN PATIENTS WITH INSOMNIA AND IN GOOD SLEEPERS

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Introduction: Only two studies have evaluated the night-to-night variability of sleep in patients with insomnia (Vallieres, et al. 2005; Perlis et al., 2009). Both studies show that insomnia occurs on an interval basis and that better than average sleep is highly probable after 1-3 nights of poor sleep. In the present study, a replication is undertaken in a larger sample of patients with insomnia (n = 43). Further the temporal patterning of "good and bad" sleep is evaluated in a good sleeper sample (n = 43).
Methods: The analysis was conducted in a sleep diary data set provided by David and colleagues. The frequency analysis method used was the same as that used by Perlis, i.e., how many bad nights accrue before a better than average nights sleep. Subjects were between 25 and 50 and were 67.4% female.
Results: The occurrence of better than average sleep followed intervals of 1-3 nights of poor sleep in both groups (PIs = 89.53%; Control = 89.57). No between group differences were observed for the amount of variance captured within the 1-3 day frequency domain. A finer grain

analysis also did not resolve differences: there were no significant differences in number of poor night's sleep before a better than average night's sleep between the groups ($F(1,10) = 0.11$, $P > .05$).
Conclusion: The present study replicates earlier findings PIs had a better than average night's sleep after 1-3 nights of poor sleep. The fact that good sleepers show a common rhythm suggests that the homeostatic regulation of sleep is working similarly in each of the two groups. That is, each occasion of a poor night's sleep appears to increase the probability of the occurrence of a better than average night's sleep. Further analyses are underway, which take into account amplitude considerations (magnitude of the difference between good and bad night's sleep).

0587

LONG-TERM OUTCOMES FOLLOWING COGNITIVE-BEHAVIOR THERAPY USED SINGLY AND IN COMBINATION WITH MEDICATION FOR PERSISTENT INSOMNIA

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Introduction: Cognitive-behavior therapy (CBT) and hypnotic medications are efficacious for short-term treatment of insomnia. However, there is little information about the impact of maintenance therapy on durability of sleep improvements over time. This study examined long-term outcomes in patients treated with different treatment sequences involving CBT and medication.
Methods: Participants were 160 adults (61% women; mean age = 50.3 years old) with persistent insomnia who were randomized to an initial 6-week treatment consisting of CBT alone or CBT plus medication (zolpidem 10 mg qhs) (CBT+Med). Acute treatment completers (n = 148) were further randomized to an extended 6-month treatment; participants treated with CBT initially received either extended CBT or no additional treatment, and those treated with CBT+Med initially continued with extended CBT plus medication used as needed or extended CBT with no additional medication. Follow-ups were conducted 6, 12, and 24 months after treatment. The main end point was the Insomnia Severity Index total score, which was used to define treatment response (> 7-point decrease relative to baseline) and remission (absolute score < 8).
Results: Both CBT and CBT+Med produced similar response (60% vs. 61%) and remission rates (39% vs. 44%) following acute treatment. After extended treatment, combined CBT+Med produced higher response (72% vs. 58%) and remission rates (58% vs. 44%) relative to CBT alone. These differences were maintained throughout follow-ups. Within the CBT alone condition, extended CBT did not produce better long-term outcomes compared to the no treatment condition. Within the combined condition, participants who continued with maintenance CBT but tapered their medication during extended therapy achieved better long-term outcomes relative to those who continued using medication intermittently.
Conclusion: The addition of medication to CBT during initial treatment produced better long-term outcomes relative to CBT alone. However, among those treated with combined therapy initially, long-term outcome was more favourable when medication was subsequently discontinued during the extended course of CBT. Thus, although medication may provide an initial added benefit, it is preferable to discontinue it while patients are still receiving CBT.
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0588

ADHERENCE AND OUTCOME IN CBT FOR INSOMNIA AMONG PATIENTS WITH HIGH AND LOW DEPRESSION SCORES

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Introduction: CBT for insomnia seems effective in individuals with comorbid depression in improving sleep and depression. Less is known about adherence to CBT and its relationship to outcome.
Methods: Participants were 303 outpatients (57.8% female; age 49 (SD = 14)), who provided baseline and end-of-treatment data on the Beck Depression Inventory (BDI) following group CBT. Participants presented with a chief complaint of insomnia and many had co-morbid psychiatric, sleep, or medical disorders. Use of patient data was approved by the Institutional Human Subjects Review Board in compliance with HIPAA regulations. Treatment consisted of seven group sessions (1.5 hours) and included education about sleep and sleep hygiene, stimulus control, sleep restriction, breathing relaxation, and cognitive restructuring. The measures used in this study were participants' end-of-treatment ratings of how helpful the different CBT treatment components were, the extent to which they were followed and difficulty following them and perceived improvement in insomnia.
Results: Individuals in the HighDep group (BDI > = 14) reported following the behavioral components of CBT to a lesser extent than those in the LowDep ($P < 0.01$) but did not differ in adherence to arousal reduction components ($P = 0.61$). HighDep participants reported lower adherence to a fixed rise time ($P < 0.0001$) and restricting TIB ($P < 0.05$) and greater difficulty restricting TIB ($P < 0.05$) than the LowDep group. Most importantly, among those with high depression scores, greater adherence with restricted TIB was associated with significantly greater improvement in insomnia ($r = 0.4$, $P < .0001$). Overall level of improvement in insomnia did not differ between the HighDEP and LowDEP groups ($P = 0.58$).
Conclusion: The results suggest that CBT for insomnia comorbid with depression needs to target adherence to a fixed rise time and restriction of time in bed. Possible approaches to this issue may include scheduled activities in the morning to increase adherence with morning rise time and in the evening to facilitate time in bed restrictions.

0589

THE DURATION OF EFFECTS OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA IN PATIENTS WITH CHRONIC PAIN

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Introduction: This study assessed the duration of the effects of Cognitive Behavioral Therapy of Insomnia (CBT-I) in patients with non-malignant chronic pain. Pre-post treatment effects from this study have been previously published.
Methods: A parallel-groups, randomized, single blind trial of CBT-I with a contact/measurement control condition. Twenty-eight subjects with chronic neck and back pain were stratified according to gender, age, and ethnicity, and then assigned to one of the two groups. Treatment consisted of 8 weeks of CBT-I including sleep restriction, stimulus control, sleep hygiene instructions and one session of cognitive therapy devoted to catastrophic thoughts about the consequences of insomnia. Sleep diary assessments of sleep continuity (SL, WASO, NWAK and TST) and pre-post measures of insomnia severity (ISI), pain (Multidi-

mensional Pain Inventory), mood (BDI and POMS), and function (SF-36 and Pain Disability Index). GEE analysis was run with group, visit, and group*visit interaction and significant covariates were retained from the model selection.

Results: Subjects receiving CBT-I (n = 19), as compared to control subjects (n = 9), exhibited significant treatment effects with decreases in SL, WASO, and NWAK and a significant increase in SE% post treatment that were sustained at 3 month and 6 month follow-up. Total sleep time was not significantly different between groups over the course of the study but did increase by a mean of 73 minutes from pretreatment to 6 months as compared to 10 minutes increase in control group. The diary findings were paralleled by significant changes in the ISI (p. = 0.05) that were sustained 6 months as well as significant improvement in vigor (p. < 0.05). Significant improvements were also found in function as measured by the SF36 that were sustained through 3 months post treatment. Unfortunately between-group effects were likely diluted by subject attrition in that only 3 subjects were retained in the control group at the 6 month time point.

Conclusion: CBT-I was successful in improving sleep, vigor, and function related to pain and most of these improvements were sustained through six months post treatment.

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0590

AN ALTERNATIVE APPROACH TO MANAGING CHRONIC INSOMNIA

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Introduction: The accepted prevalence of chronic insomnia in adults is approximately 10%. Conversely, up to 30% of the population report symptoms of insomnia. Management of this disorder includes both prescribed and over-the-counter (OTC) pharmaceuticals, herbal remedies, and behavioral interventions. However, current treatment options have limitations, including possible drug dependence. Previous research has demonstrated that vestibular nerve activation (VNA) influences sleep. Many studies have used a 'rocking' sensation to induce VNA and have demonstrated an effect on sleep architecture, sleep onset latency, and rapid eye movement (REM) sleep. It is suggested that an alternative therapy device, which stimulates the vestibular nerve by electrical current to promote sleep onset (SleepWave™; SW) rather than a physical 'rocking force', will improve symptoms of insomnia. The aim of this open-label study was to assess the impact of SW treatment, over a 30 day period, on individuals who self-report chronic insomnia symptoms.

Methods: 118 participants (2:1 Female:Male ratio) with a mean age 43.8 ± 10.0 years were recruited to complete a daily sleep journal for 30 days, and an Insomnia Severity Index questionnaire pre and post intervention. Device usage was dependent on participants' requirements for insomnia management, each stimulation having a 1 hour duration. Five participants (all female), withdrew prior to data collection. Of the 5, 3 reported an inability to tolerate SW treatment and 2 withdrew without giving a reason.

Results: Sleep journal entries for 113 participants showed that the SW device was used once per night during 81% of the nights, twice per night during 15% of the nights, 3 or more times < 3%, and not used at all 1.2% of the total nights. Among the 52 participants with baseline data, there were significant changes between pre and post intervention in Sleep Onset Latency, Total Sleep Time, Wake-After-Sleep-Onset and Sleep Efficiency, as reported in sleep journals, all P < .001. The Insomnia Severity Index (ISI) (n = 101) post-intervention total mean (± S.D.) scores (11.74 ± 5.26) were significantly improved when compared with pre-intervention scores (17.52 ± 3.85) P < .001.

Conclusion: Despite variable use of the SW device, on average, participants reported improvement in a range of insomnia symptoms with treatment. These promising results suggest that a randomized control trial of the SW device is warranted.

Support (If Any): This study was initiated and implemented by Philips Respironics, Monroeville, PA 15146.

0591

EFFICACY AND TOLERABILITY OF THE DUAL OREXIN RECEPTOR ANTAGONIST MK-4305 IN PATIENTS WITH PRIMARY INSOMNIA: RANDOMIZED, CONTROLLED, ADAPTIVE CROSSOVER POLYSOMNOGRAPHY STUDY

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Introduction: Orexinergic activity originating in the lateral hypothalamus plays a critical role in sleep/wake regulation. Drugs that influence orexinergic tone may be useful in the treatment of sleep disorders. MK-4305 is a novel potent and selective dual orexin receptor antagonist (DORA) being studied for the treatment of insomnia.

Methods: A randomized, double-blind, placebo-controlled, 2-treatment (4-weeks per treatment separated by a 1-week washout) cross-over polysomnography (PSG) study was performed to assess the efficacy and tolerability of MK-4305 orally-administered 30 minutes before bed time (10, 20, 40, and 80mg) in the treatment of primary insomnia. PSG was performed on Nights 1 and 28 of each treatment. The primary outcome measure was sleep efficiency. This abstract reports preliminary results for the U.S. cohort; a cohort of 34 Japanese patients is ongoing.

Results: 217 patients were randomized to the U.S. cohort: 208 received MK-4305 at one of 4 doses (10mg N = 53, 20mg N = 51, 40mg N = 51, 80mg N = 53) and 213 received placebo. All doses of MK-4305 were significantly superior to placebo (P-values < 0.005) for the co-primary endpoints of difference from placebo in change from baseline sleep efficiency at Night 1 (LS mean [95% CI]: 10mg = 6.3 [2.6,9.9], 20mg = 6.0 [2.4,9.7], 40mg = 12.7 [9.1,16.3], 80mg = 11.5 [7.8,15.2]) and Night 28 (10mg = 4.4 [1.3,7.4], 20mg = 10.3 [7.2,13.4], 40mg = 8.3 [5.3,11.3], 80mg = 7.2 [4.1,10.4]). Significant dose-related effects were also observed for sleep induction and maintenance parameters. MK-4305 was generally well-tolerated; 3 patients on placebo (1.4%) and 1 patient on 80-mg (1.9%) discontinued due to adverse events.

Conclusion: Results, to date, demonstrate that treatment for 4-weeks with the DORA MK-4305 is efficacious and well-tolerated in patients with primary insomnia.

Support (If Any): Merck Research Laboratories

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TWELVE MONTHS OF NIGHTLY ZOLPIDEM DOES NOT ENHANCE THE LIKELIHOOD OF REBOUND INSOMNIA: A PROSPECTIVE PLACEBO CONTROLLED STUDY

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Introduction: Chronic use of hypnotics may enhance the risk of rebound insomnia, a worsening of sleep following drug discontinuation. Short-term studies show rebound at supra-therapeutic doses, but duration of use does not increase its risk. This study is the first to repeatedly test for rebound insomnia during 12 months of nightly use of a therapeutic dose of zolpidem (10mg).

Methods: Primary insomniacs (N = 29) ages 32-64, meeting DSM-IV criteria and a baseline sleep efficiency (sleep time/bed time) of < 85% with no other primary sleep disorders on a 8-hr sleep recording, without psychiatric diseases or drug dependency and in good general health were

recruited. Participants received 10mg zolpidem or placebo, double-blind, nightly for 12 months. On two laboratory nights in Months 1, 4, and 12 placebo was administered in both groups. Eight-hour sleep recordings were collected and rebound was assessed by comparing change in sleep efficiency from baseline.
Results: Baseline sleep efficiency for the placebo group was 72.7+/-10.1% and for the zolpidem group 75.6+/-8.6%. Rebound, a worsening of sleep efficiency relative to baseline, did not occur at any time point. Change scores (positive scores reflect better sleep) did not differ between placebo and zolpidem groups on the first night in month 1 (7.1% vs. 2.5%); month 4 (6.4% vs. 5.4%); and month 12 (5.6% vs. 0.6%; overall P = 0.492). Percent of subjects whose sleep was worse than baseline also did not differ between placebo and zolpidem groups at any time point (month 1: 31% vs 33%; month 4: 25% vs 31%; month 12; 31% vs 40% P = 0.85). Analyses of sleep latency and wake after sleep onset and the night 2 recordings showed no rebound.
Conclusion: At therapeutic doses zolpidem 10 mg was not associated with rebound insomnia and its likelihood did not increase as a function of chronic nightly administration for 12 months.
Support (If Any): National Institute of Drug Abuse, grant#: R01DA17355 awarded to Dr. Roehrs.

0593

TWELVE MONTHS OF NIGHTLY ZOLPIDEM DOES NOT LEAD TO DOSE ESCALATION: A PROSPECTIVE PLACEBO CONTROLLED STUDY

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Introduction: Long-term management of insomnia with hypnotics is thought to increase the risk of abuse. Some studies suggest that nightly chronic hypnotic use is associated with tolerance development which increases drug self-administration. This prospective study in insomniacs evaluated the abuse liability associated with12 months of nightly use of zolpidem.
Methods: Primary insomniacs (N = 27), ages 32-64, meeting DSM-IV criteria and a polysomnographic sleep efficiency of < 85% with no other primary sleep disorders, without psychiatric diseases or drug dependency and in good health were recruited. Participants received 10mg zolpidem or placebo, double-blind, nightly for 12 consecutive months. In months 1, 4 and 12, self-administration assessments occurred in the laboratory. The zolpidem group had a color-coded zolpidem (10mg) or a placebo capsule on sampling nights 1 and 2 in counter balanced order. The following five nights, participants chose either 1, 2, or 3 zolpidem (5mg each) or placebo capsules. The placebo group self administrated color-coded placebo capsules. All medications were taken 30 min before bedtime.
Results: Overall, the zolpidem group selected zolpidem (80.3%) more often than placebo ($\chi2 = 5.37$; P = 0.020). The percentage of insomniacs in the zolpidem group choosing zolpidem over the 5 nights did not differ significantly from month 1 to month 4 (69% vs.89%; $\chi2 = 0.841$; P = 0.359), month 4 to month 12 (89% vs.83%; $\chi2 = 0.063$; P = 0.802), month 1 to month 12 (69% vs.83%; $\chi2 = 0.477$; P = 0.490). Percentage of zolpidem capsules self-administered nightly (3 per night available) did not differ from placebo self-administration on months 1 (46% vs 53%; $\chi2 = 0.817$; P = 0.366), 4 (43% vs 45%; $\chi2 = 0.021$; P = 0.885), and 12 (55% vs 60%; $\chi2 = 0.279$; P = 0.597). On average, the zolpidem group self-administered a 7.9mg nightly dose in month 12 and 7.5 mg on month 1.
Conclusion: Nightly 10 mg zolpidem use by insomniacs for 12 months was not associated with increased dose or frequency of use.
Support (If Any): National Institute of Drug Abuse, grant#: R01DA17355 awarded to Dr. Roehrs.

0594

USE OF SLEEP AIDES DURING PREGNANCY

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Introduction: Some sleep disruption is often considered a normal part of pregnancy and few women seek treatment for sleep problems. There are a number of sleep aides available but most are contraindicated during pregnancy. To our knowledge there are no published data on the use of sleep aides by pregnant women.
Methods: As part of a larger study of sleep during pregnancy, pregnant women in their last trimester were invited to complete validated questionnaires including the General Sleep Disturbance Scale. Sleep disturbance was considered present if the mean total score or any subscale score was ≥ 3. This scale includes questions regarding the use of alcohol, tobacco, herbal products, pain medications, prescription and over the counter sleeping pills to induce sleep. Frequent use of sleep aids was defined as use of any of these aids ≥ 3 nights/week.
Results: Surveys have been completed by 1396 women (mean age 29.7 ± 5.7 years, gestational age 34.2 ± 3.8 weeks, and 43% primiparous). In total, 71% of women reported poor sleep quality and 14% reported frequent use of ≥ 1 sleep aide. Frequent use of alcohol was reported in 0.4% of women, tobacco in 1.4%, herbal products in 0.6%, pain medications in 4.1%, prescription medications in 3.4%, and over-the-counter sleeping pills in 3.9%. A small proportion reported frequent use of multiple sleep aides (1.4%). Multiparous women were more likely to report frequent use of sleep aides (21% vs. 16%; P = 0.016). In a logistic regression model accounting for age, race, BMI, and parity, both poor sleep quality and poor daytime function independently predicted frequent sleep aide use (O.R. 2.3, 95%CI 1.5-3.5 and O.R.1.5, 95%CI 1.1-2.3; P < 0.001 respectively)
Conclusion: Sleep disturbance is common in pregnant women and a large minority report frequent use of substances to induce sleep. Of concern, several of these sleep aides are contraindicated during pregnancy.
Support (If Any): NHLBI HL089918 University of Michigan Institute for Clinical and Health Research University of Michigan Institute for Research on Women and Gender The Gilmore Fund

0595

GLOBAL SLEEP DISSATISFACTION IS THE MAIN PREDICTOR OF INSOMNIA DISORDER

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Introduction: Insomnia is one of the most prevalent sleep disturbances in the general population. However, epidemiology of insomnia symptoms has been constantly plagued with loose and inconsistent definition of symptoms. In this study, a multidimensional approach was used to help better define how insomnia symptoms could be assessed in general population.
Methods: This is a cross-sectional telephone study using a representative sample consisting of 8,937 non-institutionalized individuals aged 18 or over living in Texas, New York and California. They represented a total of 62.8 million inhabitants. The participation rate was 85.6% in California, 81.3% in New York and 83.2% in Texas. Participants were interviewed on sleeping habits, health, sleep and mental disorders using Sleep-EVAL.
Results: A total of 29.7% of the sample reported insomnia symptoms at least 3 nights per week for at least 3 months. Global Sleep Dissatisfaction (GSD) was reported by as many as 17.2% of the sample. Difficulty Initiating Sleep (DIS) and Non-Restorative Sleep (NRS) significantly decreased with age while Difficulty Resuming Sleep (DRS) and Inca-

pacity Resuming Sleep (IRS) remained mostly unchanged with age. GSD was the strongest symptom to identify individuals who had daytime repercussions due to their sleeping difficulties: As many as 90% of individuals with GSD reported at least 1 moderate daytime consequence. The second stronger symptom was NRS followed with DRS. GSD was also one of the strongest factors that predicted help seeking for sleep disturbances followed with the number of insomnia symptoms.
Conclusion: Better definition of insomnia symptoms in epidemiological studies are essential to identify individuals who are at greater risks of suffering from consequences of insomnia and who are in need for therapeutic support. The high level of association between GSD and daytime consequences is indicative of it relevance for the diagnosis of Insomnia Disorder.
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0596

SLEEP DISTURBANCE IN GERMAN ADOLESCENTS: ASSOCIATED RISKS AND RESOURCES

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Introduction: Sleep disturbance is frequently observed in children and adolescents and may be a precursor of further health sequelae. Therefore, a better understanding of the circumstances under which adolescents develop insomnia is highly relevant. So far, several studies in a limited number of countries investigating risk factors for the occurrence of insomnia were restricted to a small number of factors and potentially protective factors are understudied.
Methods: Therefore, we analyzed data collected in a broader health survey investigating adolescents attending eighth and ninth grade in Stuttgart (capital of Baden-Württemberg), Germany. 546 thirteen to eighteen year old students (corresponds to a response rate of 64%) were evaluated by several standardized questionnaires in 2005.
Results: Univariate analysis revealed a statistically significant ($P < 0.05$ to $P < 0.001$) association between the occurrence of insomnia (problems initiating or maintaining sleep and feeling tired or exhausted during daytime) and sex, smoking, alcohol consumption, TV-usage, usage of cell-phone, physical activity, pain within the last three months, family coherence, personal resources, emotional and conduct problems, hyperactivity, and SDQ-sum score. A trend was seen for computer and internet usage. However, no association between the occurrence of insomnia and age, social status, migratory status, playing computer games, being a victim or actor of violence, overweight, social support, and prosocial behaviour was found. Logistic regression revealed that after controlling for the other above mentioned factors a significant association with an elevated odds ratio for the occurrence of insomnia was found for smoking (3.72), TV-usage over 2 h per day (3.82), physical activity less than once per week (2.27), pain during the last three months (2.93), emotional problems (3.72), and a trend was seen for deficits in family coherence (2.93).
Conclusion: Insomnia in adolescents is associated with a large number of health and behaviour related factors. Although cross sectional data do not permit to draw conclusions about causality, prevention programs for insomnia should incorporate the identified independent risk factors (smoking, TV consumption, pain, and emotional problems) and should incorporate strategies to strengthen resources such as physical activity and family coherence.

0597

INSOMNIA AND ITS CORRELATES IN TAIWAN: RESULTS OF A NATIONAL SURVEY

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Introduction: This study examined the distribution of insomnia and its correlates, focusing in particular on health conditions including self-perceived health status, obesity, hypertension, diabetes and cardiovascular diseases, among the general adult population in Taiwan.
Methods: The sample consisted of 4,005 adult subjects aged 15 years and above (2,018 men and 1,987 women) who were assessed with a nationally representative telephone survey in Oct, 2009. Insomnia was defined as reporting either difficulty falling asleep, maintaining sleep or taking sleeping pills for 3 nights or more per week during the past one month.
Results: There were more than one fifth (n = 873, 21.8%) of the total sample reporting insomnia in the past month, with the prevalence being significantly higher in women (24.1%) than in men (19.5%, $P < 0.001$). Insomnia was significantly associated with aging, poorer self-perceived health status, obesity, hypertension, diabetes and cardiovascular diseases. In spite of the high prevalence of insomnia, only 24.6% of subjects with insomnia have ever consulted doctors for their sleep problems.
Conclusion: The prevalence of insomnia among adults in Taiwan is similar to that in counterparts in Western countries. The relationship between insomnia and health conditions urged health professionals to increase their own awareness of insomnia that their patients may be suffering from. It is important for health professionals to improve communication with their patients about the symptoms and quality of sleep.
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0598

PREDICTORS OF INSOMNIA IN U.S. IMMIGRANTS AND ASSOCIATIONS WITH PROPORTION OF LIFETIME SPENT IN IMMIGRATION IN THE U.S.

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Introduction: Although sleep disorders vary by ethnicity and are influenced by cultural and environmental factors, little is known about the sleep characteristics of immigrants, who are exposed to a change in environment with immigration. Study Objectives: To identify predictors of insomnia in US immigrants and to test the hypothesis that symptoms of insomnia vary with the proportion lifetime in immigration (PLI) in Mexican Immigrants (MI) and Non-Mexican Immigrants (NMI).
Methods: Cross-sectional analysis of adult U.S. immigrants (over 18 years) enrolled in the National Health and Nutrition Examination Survey (NHANES) between 2005 and 2008. Setting: Bilingual interviews in the participants? home using a sleep questionnaire. Participants: 2495 U.S. immigrants (1217 MI and 1278 NMI).
Results: Occasional insomnia was observed in 15 % of MI, 24 % of NMI, and severe insomnia in 5 % of MI and 8.5 % of NMI. Among US immigrants, insomnia was associated with: depression (OR = 4.9 CI: 3.5-6.8, $P < 0.0001$), unsatisfactory health status (OR = 2.6, CI: 2.0-3.3, $P < 0.0001$), female gender (OR = 1.6, CI: 1.2-2.0, $P < 0.001$), and living single (OR = 1.3, CI: 1.0-1.6, $P < 0.05$). Mexican ethnicity was associated with a decreased odds of insomnia (adjusted OR = 0.5; CI: 0.4-0.6, $P < 0.0001$). Among NMI immigrants, a significant increase odds of insomnia was associated with the last quintile (20%) proportion of lifetime

spent in immigration in U.S. (PLI) (OR: 1.7;CI = 1.1-2.6, P < 0.01). This association was not found in MI.
Conclusion: Differences in insomnia among different immigrant and native populations support the importance of socio-cultural and environmental factors in influencing sleep behaviors.
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0599

SUBJECTIVE SLEEP DIFFICULTY INCREASES THE RISK OF NEW ONSET INSOMNIA INDEPENDENT OF DEMOGRAPHIC, PSYCHIATRIC AND MEDICAL DISORDERS

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Introduction: Insomnia is the most common sleep disorder. Numerous studies investigated prevalence of insomnia, however, most of them are cross-sectional in design and not much is known about the risk factors for developing future insomnia. In this study we examined the consequence of current subjective sleep difficulty of any duration on the risk of developing chronic insomnia in the future.
Methods: Data for this study are derived from a larger epidemiological study conducted in Central Pennsylvania. 16,583 (age > 20 yr.) randomly selected individuals were interviewed to assess demographic and sleep related information. A subsample of 1741 underwent comprehensive assessment(history, physical examination and overnight polysomnogram). 1387 of these 1741 subjects were followed up after an average of 7.5 yr. later and structured sleep complaints/disorders and medical/psychiatric history was obtained. Among the 1387, 1280 subjects without insomnia at baseline were included in this analysis.
Results: The incidence of insomnia at follow-up was 9.6%. Subjective sleep difficulty at baseline significantly increased the risk of chronic insomnia incidence at follow-up even after controlling for age, BMI, gender, caffeine, alcohol, depression, diabetes, hypertension, asthma/allergies, and migraines at baseline (P = .015). Individuals with subjective complaints of sleep difficulty of any duration but not having insomnia were 2.03 times more likely to develop chronic insomnia in future.
Conclusion: Subjective complaints of sleep difficulty at baseline increased the risk of future chronic insomnia independent of age, BMI, gender, caffeine or alcohol intake, and current psychiatric or medical disorders. These results underscore the importance of inquiring and addressing subjective sleep complaints of any duration irrespective of comorbid psychiatric or medical disorders.

0600

PREVALENCE AND RISK FACTORS FOR INSOMNIA SYMPTOMS AND DIAGNOSES

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Introduction: Several studies have determined the prevalence of insomnia using various questions about sleep disturbance symptoms as well as a general question(s) about daytime function. The present study determined by structured interview the prevalence of insomnia using specific criteria of DSM-IV, ICD, and ICSD as elaborated in the RDC.
Methods: A nationally representative sample (n = 10,092) of subscribers to a large health plan, participated in a telephone interview (~40min). Insomnia disorder diagnoses were made according to ICD, RDC, and DSM-IV criteria with operational definitions for each. Symptoms of difficulty initiating sleep (DIS), maintaining sleep (DMS), early awakening (EMA), and nonrestorative sleep (NRS) were fully characterized for frequency and magnitude. In addition adequate opportunity to sleep was evaluated and there were nosology specific questions about daytime consequences as well as 14 general questions about daytime function.
Results: The prevalence of insomnia by nosological system was 22.1% DSM-IV, 3.9% ICD, 14.7% RDC and 23.6% for any nosology. The prevalence of the various nocturnal symptoms in the general population was 12.5% DIS, 23.6% DMS, 23.2% EMA, 1.8% NRS and any symptom 42.4%. In terms of daytime function the most common report of daytime consequences among those with any insomnia were: decreased motivation 32.6%, irritability and other mood changes 38.6%, problems with attention and concentration 31.2%, fatigue 49.6% and sleepiness 39.8%. Insomniacs reported these significantly more often than the general population. Risk factors for insomnia included: younger age, female sex, employment status-disabled, work schedule most non-day shifts and increasing BMI.
Conclusion: The prevalence of insomnia varies considerably as a function of different diagnostic criteria. Symptoms of any sleep disturbance are twice as common as insomnia diagnoses. The most common symptoms among people with insomnia are sleep maintenance and daytime fatigue.
Support (If Any): This study was sponsored by sanofi-aventis.

0601

LONGITUDINAL RELATIONSHIP OF INSOMNIA TO SUBSEQUENT TRAIT-ANXIETY IN THE WISCONSIN SLEEP COHORT

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Introduction: Despite insomnia's high prevalence and societal toll, its longitudinal, psychiatric consequences are under-studied. Insomnia and anxiety are prevalent, costly disorders related to significant impairment and diminished quality of life. Although often comorbid with, or secondary to anxiety, insomnia's prospective relationship to subsequent anxiety remains unclear. Thus, we investigated whether insomnia was associated with the development of anxiety in a population-based sample.
Methods: We analyzed data from 588 Wisconsin Sleep Cohort participants who completed baseline and ~4-year follow-up overnight protocols between 1997-2008 including Spielberger State-Trait Anxiety Inventory(STAI), Zung Self-Rating Depression Scale, and questionnaire-based medication data and insomnia items—difficulty falling asleep, difficulty getting back asleep, awakening repeatedly p.m., awakening too early. An insomnia symptom number variable was created from binary classifications of these four symptoms, categorized as ≥ 5/month (symptom present) versus < 5/month (symptom considered not present). To investigate incident trait-anxiety(STAI-T), defined as STAI-T ≥ 38 (highest quartile), analyses excluded baseline participants with trait-anxiety or taking anxiolytics. Poisson regression estimated adjusted relative risks (RR) (95% confidence intervals (CI)) for incident trait-anxiety according to number of insomnia symptoms present at baseline. Further models excluded depressed participants (taking antidepressants or Zung score ≥ 50 without sleep-related items) at baseline and follow-up; adjusted and excluded participants taking anxiolytics (at follow-up).
Results: Trait-anxiety incidence estimates according to number of insomnia symptom were: 5.9%-none; 8.4%-1 symptom; 11.3%-2; 32.4%-3-4 symptoms. After age-, sex-, comorbidity- adjustments, three-four symptoms was most associated with trait-anxiety (RR = 5.1; 95%CI,2.7-9.6), even after hypnotic-adjustment (RR = 4.02; 95%CI,2.1-7.8), with significant trend for increasing symptoms (p-trend ≤ 0.0001). After excluding ninety-six depressed participants, this trend persisted (p-trend =

0.0001), and 3-4 symptoms elevated risk 4.6-fold (P < 0.001). Associations remained similar upon anxiolytic adjustment and exclusion.
Conclusion: In individuals without baseline anxiety, number of insomnia symptoms predicted, in graded fashion, incident trait-anxiety at follow-up. Whether early insomnia recognition and treatment can mitigate or prevent anxiety development warrants further study.
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0602

INSOMNIA WITH OBJECTIVE SHORT SLEEP DURATION IS ASSOCIATED WITH A HIGHER RISK OF DEPRESSION: A GENERAL POPULATION, PROSPECTIVE STUDY

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Introduction: Chronic insomnia is a well-established risk factor for the development of depression. We recently demonstrated that chronic insomnia with objective short sleep duration is the most severe type of insomnia and is associated with significant morbidity and mortality. In this study, we examined prospectively whether this subtype of insomnia is associated with a higher risk of depression.
Methods: 1,741 individuals of the general population underwent a full medical evaluation and 8h polysomnography at baseline. A subsample of 1,300 also completed the Minnesota Multiphasic Personality Inventory (MMPI-2). "Insomnia" was defined as a complaint of insomnia with a duration of ≥ 1 year. Based on the polysomnographic sleep duration, we classified insomniacs and controls into two categories: ≥ 6 hrs of sleep "normal sleepers" and < 6 hrs of sleep "short sleepers". We controlled for age, race, gender, BMI, sleep-disordered breathing, smoking, and alcohol in logistic regression models predicting depression at 5 years follow-up. We further examined the mediating role of baseline depression and MMPI-2 scores.
Results: Compared to the normal sleeping group, both insomniacs with normal and with short sleep duration showed an increased risk of depression at follow-up. After controlling for baseline depression, this association remained statistically significant only for insomniacs with short sleep duration. Similar associations were found after controlling for MMPI-2 scores at baseline in the regression models.
Conclusion: These data suggest that insomnia with objective short sleep duration is associated with a higher risk of depression compared to insomnia with normal sleep duration. The subtype of insomnia with short sleep duration appears to be associated with more severe medical and psychiatric morbidity and its early detection and treatment should become a priority. Furthermore, it appears that in this subtype of insomnia the development of depression is associated with physiologic (i.e., hypercortisolemia) rather than emotional hyperarousal.
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0603

QUALITY-OF-LIFE AND PSYCHOLOGICAL FACTORS ASSOCIATED WITH SHORT SLEEP AND INSOMNIA

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Introduction: Terms like short sleep, sleep loss, and insufficient sleep are often used interchangeably in the literature, although they are referring to distinct constructs. Moreover, most studies exploring correlates of short sleep have not controlled for the presence of insomnia. The aim of the present study was to examine psychological and quality of life factors associated with short sleep and insomnia.
Methods: Respondents were 1604 adults participating in an epidemiological study of insomnia in the Canadian general population. They were selected from two cohorts: cohort 1 (n = 626; response rate = 77%) and cohort 2 (n = 978; response rate = 48%). Participants were categorized into 3 groups: 1) Short sleepers: individuals with a sleep length ≤ 6 hours and no insomnia symptom (n = 81), 2) Good sleepers: individuals with a sleep length between 6.1 - 8.5 hours and no insomnia symptom (n = 635), and 3) Insomniacs: individuals with insomnia and a sleep length ≤ 6 hours (n = 155). The remaining 733 participants were excluded (e.g., sleep duration > 8.5 hours, presence of insomnia symptoms). End-point variables included demographics, fatigue, sleepiness, QOL and psychological variables.
Results: Short sleepers were compared with good sleepers and insomniacs. No significant difference was observed between short and good sleepers on most variables, including gender, arousability, anxiety, depression, and SF-12 subscales except general health. Compared to insomniacs, good sleepers included fewer women and presented a better functioning on those variables. Good sleepers also presented better scores on general health and fatigue than short sleepers, while the latter presented better scores than insomniacs. Last, insomniacs were older and reported more sleepiness than good sleepers. All Ps ≤ 0.001.
Conclusion: Compared to short sleep, insomnia is associated with more impairment of QOL and psychological functioning. Results regarding general health support the premise that short sleep is related to poorer physical health.
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0604

CHANGES IN WORK DEMANDS AND SLEEP QUALITY PREDICT CHANGES IN FATIGUE AND SLEEPINESS

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Introduction: Work demands is an established predictor of cardiovascular disease, fatigue. Also disturbed sleep predicts the same endpoints. There is no knowledge, however, about the effets of suffering from both high work demands and impaired sleep, or whether good sleep may buffer against the effects of high work demands, or vice versa. The present study made use of the longitudinal WOLF-cohort in Sweden to predict new cases fatigue during a 5-year period from various combinations of work demands and high/low sleep quality.
Methods: 5400 individuals participated via their company health care facilities on two different occasions. Questionnaires were used to obtain information on background, work environment and health. The results were analyze through multiple logistic analysis controlling for age, gender and socioeconomic group. Work demands was measured through Demand/Control scale, Sleep quality through the Karolinska Sleep Questionnaire, and Fatigue through a single item on amount of fatigue (one or several days per week).
Results: The results showed that new cases of fatigue were predicted by high demands and disturbed sleep, with an Odds Ratio (OR) = 1.69 (95% Confidence interval (CI) = 1.01-2.97). For low demands and disturbed sleep the result was OR = 1.71 (1.09-2.69) and for high demands and good sleep the results were = R = 1.35 (.93-1.97). For sleepiness the OR and Ci was 2.56 (1.56-4.21) for high work demands and impaired sleep, For low demands and disturbed sleep OR = 1.97 (1.34-2.90) and for high demands and good sleep the results were OR = 1.23 (0.94-1.63).

Conclusion: It was concluded that disturbed sleep predicts fatigue regardless of high or low work demands, whereas high work demands do not predict fatigue in any combination with disturbed sleep. For sleepiness the results were more pronounced.
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0605

ASSOCIATION BETWEEN PHYSICAL ACTIVITY AND INSOMNIA IN RURAL COMMUNITIES OF SOUTHEASTERN MISSOURI, TENNESSEE, AND ARKANSAS

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Introduction: Insomnia symptoms are one of the most frequent sleep complaints in the general population. The adverse individual consequences of insomnia are well documented. The purpose of the present study is to examine whether physical activity has a protective effect against insomnia in the rural communities of southeastern Missouri, Tennessee, and Arkansas.
Methods: The study is based on data from a cross-sectional telephone survey in 2005 for evaluation of a community walking trails intervention to promote physical activity in rural communities. The study sample includes 967 women and 291 men with a mean age of 54. The exposure variable is self-report of currently being physically active regularly. The outcome is insomnia operationalized as having trouble falling asleep, staying asleep, and waking up too early nearly every day. Binary Logistic regression was used to calculate prevalence odds ratios (PORs) and 95% confidence intervals (95% CI).
Results: The study sample includes mostly White (95%), married (62%), overweight/obese (61%) women with high school degree. Participants who were regularly physically active had higher levels of education and less likely to be overweight or obese, compared to those who were not. Fourteen percent of participants reported having insomnia. Self report of currently being physically active regularly is associated with decreased odds of insomnia (adjusted POR: 0.56, 95% CI: 0.40, 0.78), after controlling for age, gender, education level, marital status, and body mass index.
Conclusion: In these rural communities, we observed a significant relationship between physical activity and insomnia. Interventions designed to promote physical activity among individuals who suffer from insomnia are warranted.

0606

COMORBID INSOMNIA: RELATIONSHIP OF INSOMNIA WITH USE OF HEALTH CARE SERVICES AND SLEEP-PROMOTING PRODUCTS

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Introduction: The use of health care services and sleep aids is poorly documented in insomnia comorbid with medical or psychiatric disorders. This study examined whether healthcare consultation and sleep aid use were associated with presence of comorbidity in individuals with insomnia.
Methods: Participants were selected from an ongoing epidemiological study of insomnia conducted in Canada (N = 1064). Three groups were formed: insomnia comorbid with a medical or psychiatric disorder (INS+CO; n = 387), insomnia without comorbidity (INS; n = 55) and good sleepers with a medical or psychiatric disorder (GS+CO; n = 266). Individuals without insomnia and without comorbid disorders (n = 179), as well as those with missing data (n = 177), were excluded. Variables assessed were: healthcare consultation for general health in the last 3 months (yes/no), lifetime consultation for insomnia (yes/no), use of prescribed and over-the-counter medications, and natural products and alcohol used as sleep aids in the last 12 months (yes/no and number of nights/week used).
Results: Compared to the INS group, the INS+CO group was more likely to have consulted a healthcare professional and to have consulted a greater number of professionals; this group was also more likely to have used prescribed medications and natural products and to have used them more frequently. Compared with the GS+CO group, the INS+CO group was more likely to have consulted a healthcare professional for both sleep difficulties and for other health problems, and to have used prescribed and over-the-counter medications, natural products and alcohol as sleep aids.
Conclusion: Insomnia comorbid with a medical or psychiatric disorder was associated with a higher use of health care services and products to promote sleep.
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0607

CHRONIC INSOMNIA AND ALL CAUSE MORTALITY IN THE WISCONSIN SLEEP COHORT STUDY

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Introduction: Although commonly co-occurring with chronic health conditions, chronic insomnia is often reported in the absence of comorbid conditions. This analysis examines the association of chronic insomnia and mortality rate, independent of multiple adverse health conditions, in a population based study.
Methods: We examined participants of the Wisconsin Sleep Cohort Study who completed 3 mailed surveys in 1989, 1994, and 2000. The surveys included insomnia items--difficulty falling asleep; difficulty getting back to sleep; awakening repeatedly; and awakening too early. These were categorized as frequent ($\geq$ 5/month) versus not ($<$ 5/month), as well as overall insomnia (any symptom frequently). Participants were considered to have chronic insomnia (or insomnia symptoms) if they reported insomnia symptoms on at least 2 of the surveys. All-cause mortality was determined through a social security death index search in June of 2009 (i.e., up to 15 years of follow-up for mortality). Cox proportional hazards regression estimated mortality hazard ratios adjusted for body mass index, age, sex, and self-reported physician-diagnosed chronic conditions (emphysema, chronic bronchitis, angina, coronary heart disease, heart attack, stroke, hypertension, or diabetes).
Results: There were 74 deaths among 1872 participants. The adjusted hazard ratio (95% CI) for all cause mortality and insomnia at $\geq$ 2 surveys vs. the absence of insomnia at all surveys was 2.1 (1.2, 3.5). For individual insomnia symptoms, the mortality hazard ratios for specific symptom at $\geq$ 2 surveys vs. the absence of the symptom at all surveys were: difficultly falling asleep, 1.9 (0.9, 4.1); awakening repeatedly, 3.2 (1.8, 5.7); difficulty getting back to sleep, 1.8 (0.9, 3.4); and awakening too early, 2.4 (1.2, 4.5).
Conclusion: Independent of chronic comorbid conditions, chronic insomnia is associated with an increased risk of all cause mortality.
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0608

INSOMNIA AND HEALTH COMORBIDITIES AMONG INDIVIDUALS OLDER THAN 40 YEARS OF AGE

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Introduction: Insomnia is a sleep problem very common in Western societies (Léger et al., 2008). However, little is known about the associations between insomnia and other health conditions (Leblanc et al., 2009).

Methods: In all, 1046 French adults older than 40 years of age filled out a self-administered sleep questionnaire during their annual medical assessment. Severe insomnia was defined by suffering 2 sleep problems (e.g., sleep onset difficulty, frequent nocturnal awakenings, early morning awakenings, and/or non-restorative sleep) with a frequency of > 3 nights/week during 1 years. Sleep characteristics (e.g., sleep duration), environmental conditions (e.g., sex, age, environmental vulnerability conditions, night working), and health problems (e.g., depression treated, diabetes, hypertension treated, hyperglycemia, obesity) were measured during the medical visit. Univariate analyses were used to test the associations between sleep duration (t-test) and environmental conditions (chi-2) and severe insomnia. Logistical models of regression were performed to calculate the associations between severe insomnia and other health problems after controlling for sex, age and body mass index.

Results: The prevalence for severe insomnia was 25.1%. The insomniacs reported sleeping 1 hour less than the non-insomniacs (6h04 (SD = 1h30) Vs 7h07 (SD = 1h06), $P < 0.001$). The females reported significantly suffering more from severe insomnia than the males (females = 32.9% Vs males = 19.0%, $P < 0.001$). A higher proportion of insomniacs lived in a vulnerable environmental conditions (36.0% Vs 28.6%, $P = 0.03$) compared to the non-insomniacs. The insomniacs were 6 times more at risk for being treated for depression than the non-insomniacs (OR = 6.0; 95% CI = 3.4-10.3, $P < 0.001$). The insomniacs had 1.7 times more at risk of being treated from hypertension than non-insomniacs (OR = 1.7, 95% CI = 1.1-2.6, $P = 0.01$). No significant difference was observed for the other variables.

Conclusion: The results suggest that the females living in vulnerable environmental conditions treated for depression and hypertension increased the risk of suffering from severe insomnia.

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0609

PRE-SLEEP COGNITIVE ACTIVITY, SLEEP EFFORT AND INSOMNIA SYMPTOMS IN BREAST CANCER PATIENTS BEFORE CHEMOTHERAPY

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Introduction: Chronic insomnia is prevalent in breast cancer patients both during and following chemotherapy. Psychophysiological models of insomnia suggest that pre-sleep cognitive arousal due to sleep effort and cognitive activity may be both a precipitating and perpetuating factor. This study examined this theory in recently-diagnosed breast cancer patients. We present preliminary analyses on data collected after diagnosis but before the start of chemotherapy.

Methods: 12 women (mean age = 50.5 yrs, SD = 9.5, range: 36-63) diagnosed with stage I-III breast cancer and 11 yoked, age- and education matched healthy controls (mean age = 52.7 yrs, SD = 10.9, range: 38-77) were studied both before (BL) and after 4 cycles of chemotherapy (C4). The Glasgow Sleep Effort Scale (GSES), the Glasgow Content of Thoughts Inventory (GCTI) and the Insomnia Severity Index (ISI) were administered at both time points. We present preliminary analyses using independent t-tests ($\alpha = 0.05$) conducted on BL data.

Results: At BL, patients reported significantly higher insomnia symptoms (ISI; mean = 13.11, SEM = 2.04) as compared to healthy women (mean = 8.08, SEM = 1.22; $t = -2.23$, $df = 19$, $P = 0.04$, $d = 0.96$). Although not statistically significant, patients also reported higher sleep effort (GSES; mean = 5.60, SEM = 1.1) than controls (mean = 3.73, SEM = 0.76) and higher pre-sleep cognitive activity at BL (GCTI; mean = 55.10, SEM = 5.28) than controls (mean = 45.33, SEM = 3.06) at BL.

Conclusion: Preliminary results of this small sample suggest that breast cancer patients may experience more insomnia symptoms compared to healthy women. In addition they may also experience increased sleep effort and pre-sleep cognitive activity prior to the start of chemotherapy, but larger sample sizes are needed to confirm these findings. These results suggest that breast cancer patients may have increased vulnerability to both sleep-interfering cognitions and insomnia symptoms during this period.

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0610

SLEEP DISTURBANCE AND ITS ASSOCIATION WITH SYMPTOMS OF FATIGUE, ANXIETY AND DEPRESSION IN CANCER PATIENTS

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Introduction: One-third of cancer patients experience significant sleep disturbance which is commonly associated with other symptoms like fatigue, anxiety and depression. This symptom cluster is highly prevalent (40-80%) across different tumour types and recent work suggests that each symptom maintains the others, further impairing quality of life. Interventions to treat insomnia in cancer patients yield improvements in these other symptoms suggesting shared common pathways. This study explores the association between disturbed sleep and symptoms of fatigue, anxiety and depression in a sample of cancer patients and investigates changes in these symptoms following Cognitive Behaviour Therapy (CBT) for insomnia.

Methods: 150 individuals from four cancer groups (breast, prostate, colorectal and gynaecological) participated in the study. All had completed anti-cancer treatment and satisfied the diagnostic criteria for chronic insomnia. The mean age of the sample was 61 years and the mean duration of their insomnia was 53 months. A 2:1 randomisation process in favour of the intervention (100 in CBT and 50 in TAU) was in operation.

Results: Baseline assessments indicate significant correlations ($P < 0.05$) between subjectively assessed sleep quality and physical quality of life (QOL) ($r = 0.372$), emotional QOL ($r = 0.248$), functional QOL ($r = 0.398$), fatigue interference ($r = -0.199$) and depression ($r = -0.236$) scores. For the CBT group, post treatment assessments indicated significant correlations between (a) reduction in time awake and (i) reduced depression ($r = 0.263$), (ii) improved physical QOL ($r = -0.215$), (iii) improved functional QOL ($r = 0.367$) and (b) improved sleep quality and (i) reduced fatigue interference ($r = 0.198$), (ii) reduced depression ($r = 0.284$), (iii) improved physical QOL ($r = -0.309$), (iv) improved functional QOL ($r = 0.484$). Comparisons on the same variables within the TAU group produced no significant associations.

Conclusion: Cancer patients experience multiple symptoms which seem to be interrelated. CBT for insomnia results in generalised improvements in sleep and in these other symptoms, lending support to the notion of shared common pathways.
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0611

SLEEP IN CANCER CAREGIVERS: WHAT WE KNOW AFTER A DECADE OF RESEARCH

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Introduction: Sleep is an essential physiologic need that allows the body to restore and rebuild. Unfortunately, for those providing care to a loved one with cancer, sleep is often sacrificed. This year 1.5 million people will provide care to someone with cancer. Caregivers report debilitating insomnia and depression symptoms, and poor quality of life. Researchers have described caregiver sleep, depression, and quality of life, and the relationships between these phenomena, and have developed interventions to improve sleep, mood, and quality of life of caregivers. We present the findings of nearly a decade of research dedicated to generating this knowledge.
Methods: We reviewed available English language empirical reports about sleep, depression and quality of life in family caregivers of persons with cancer. Computerized database searches included Medline PubMed, CINAHL, and PsycINFO from 1999-2009. Search terms included sleep; sleep disturbance; insomnia; caregivers; family caregivers; cancer.
Results: A total of 21 papers were examined, major findings and conceptual issues identified. Major findings include: 1) caregivers report moderate to severe insomnia and depressive symptoms and poorer quality of life than do non-caregivers, 2) caregiver insomnia is more closely linked to caregiving stressors than to patient symptoms, 3) caregiver insomnia, depression, and quality of life scores show great variability over time, 4) family caregivers of persons with cancer do not use many of the pharmacological and behavioral therapies available, and 5) modified behavioral therapies for insomnia show some promise in improving caregiver insomnia, depression, and quality of life.
Conclusion: Many questions have been answered about sleep, depression, and quality of life in cancer caregivers; however, there is still work to be done. Conceptual issues of variable definitions, study design, and instrumentation must be addressed. In order to design interventions to address the complex issues faced by family caregivers, we must use a multi-discipline approach.

0612

UNDERSTANDING NON-REFRESHING SLEEP IN ADULTS WITH SLEEP APNEA

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Introduction: Non-refreshing sleep (NRS), the experience of feeling noticeably unrested upon awakening in the morning, is common in patients with sleep apnea as well as in a variety of other disorders. NRS lacks a uniform definition and its causes are unclear. To properly assess and, ultimately, treat this condition it is necessary to better understand the construct. Currently, the American Psychiatric Association (DSM-IV-TR) nosology considers NRS part of the insomnia diagnosis. But is NRS merely another manifestation of nocturnal sleep problems? Should it be considered a separate disorder?
Methods: Ninety-eight individuals with diagnosed, but as yet untreated, sleep apnea completed measures allowing us to diagnose difficulty initiating and maintaining sleep (DIMS) insomnia as well as how refreshed they felt upon awakening.
Results: Seventy-one percent of the 41 participants who had DIMS insomnia also had NRS. Of the 57 who did not have DIMS, half did (49%) and half did not (51%) experience NRS. The chi-square test shows that DIMS insomnia and NRS are associated, X2 (1, 08) = 4.78, P = .032. Although it may be intuitively obvious that people who report not sleeping well would feel unrefreshed in the morning, the finding that 28 participants, almost a third of the sample, felt unrefreshed in the absence of DIMS suggests that NRS may have causes other than poor sleep.
Conclusion: In a sample of close to 100 individuals with newly diagnosed sleep apnea, 30% of participants suffered neither from insomnia nor NRS. That even sleep apnea compounded by DIMS is only variably associated with NRS highlights the importance of investigating: (1) the nature and correlates of NRS, (2) characteristics of individuals who have NRS in the absence of subjectively poor sleep, and of those who are either (3) vulnerable or (4) resistant to the experience.

0613

NON-REFRESHING SLEEP IN APNEA PATIENTS WITHOUT INSOMNIA

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Introduction: Non-refreshing sleep (NRS) is commonly associated with Apnea particularly in the presence of difficulty initiating or maintaining sleep (DIMS). In apnea patients without DIMS, only 50% manifest NRS. Is NRS, then, linked to daytime phenomena, such as psychological adjustment, sleepiness and fatigue rather than apnea-related sleep fragmentation?
Methods: Participants were recently diagnosed with sleep apnea and had not yet started treatment. Individuals who had DIMS were excluded from the sample. Twenty-eight participants with and 29 without NRS completed a questionnaire battery including measures of sleepiness and fatigue (Empirical Sleepiness and Fatigue Scales, SF-36 Vitality Scale) and psychological adjustment (Beck Depression Inventory (BDI-II), Spielberger State-Trait Anxiety Inventory (STAI), SF-36 Mental Health Scale). Participants were classified as having NRS according to Ohayon and Roth's definition: Complaint of NRS at least 3 times a week, within normal sleep duration (Stone et al., 2008).
Results: Comparing scores on the three sleepiness/fatigue measures showed a significant finding on the SF-36 Vitality Scale (worse for NSR), a trend toward significance on the Empirical Sleepiness Scale (worse for NRS) and nonsignificant results on the Empirical Fatigue Scale. On the three measures of psychological adjustment, results show a significant finding on the SF-36 Mental Health Scale (worse scores for participants with NRS), a trend toward significance on the STAI, and nonsignificant results on the BDI-II. Because these measures may be correlated, we also carried out a discriminant analysis with NRS as the outcome. Only the SF-36 Vitality subscale contributed significantly to the prediction of NRS.
Conclusion: In the absence of DIMS insomnia, the Vitality Scale of the SF-36 quality of life measure (full of pep, having a lot of energy, and not feeling worn out or tired) is associated negatively with NRS. This finding helps to clarify the construct of NRS. Additional research on NRS and its conceptualization is urgently needed.

0614

THE PREVALENCE OF INSOMNIA IN A POPULATION DIAGNOSED WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Insomnia is often overlooked in patients who present to a sleep center for diagnostic evaluation of obstructive sleep apnea (OSA). Previous literature in modest clinical samples suggests an incidence of approximately 50%. The current study attempted to better characterize the prevalence of insomnia and OSA in a large database sample.
Methods: Patients who presented for clinical diagnostic polysomnography evaluation also completed a medical/sleep history questionnaire and the Pittsburgh Sleep Quality Index (PSQI). Presence of insomnia was based upon scoring positively on two of four dimensions assessing insomnia symptoms, which included subjective sleep latency and components 2, 4, and 5 of the PSQI. The sample was divided into normal, mild, moderate, and severe, ranges of OSA as well as overall arousal index as measured by polysomnography. Patients were between the ages of 18-79 and were excluded if a 'split-night" was performed.
Results: A total of 1,155 patients in the database had an AHI > 5. Of all patients diagnosed with OSA, 48.1% were positive for insomnia complaints. There were no significant differences in insomnia incidence based upon OSA severity (48.6% mild, 47.3% moderate, and 46.7% severe). The same incidence was also noted when stratifying for severity of overall arousal index (AI; 48.8% AI = 10-30, 48.5% AI > 30).
Conclusion: The prevalence of insomnia in a large clinical patient population also diagnosed with OSA is consistent with previous findings. The incidence of insomnia did not vary according to the diagnosed severity of OSA. Given the high incidence of co-morbid insomnia in this population, proper identification and management of their insomnia is a critical factor for maintaining ideal CPAP compliance.

0615

CO-OCCURRING INSOMNIA AND OBSTRUCTIVE SLEEP APNEA

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Introduction: Clinicians have often observed the co-occurrence of insomnia and obstructive sleep apnea (OSA), but research investigating this phenomenon has been slow to accumulate. The present study explored archival records from a sleep disorders center to clarify this comorbidity.
Methods: We report data on 55 subjects selected from consecutive patients that had been diagnosed with OSA and/or insomnia as per ICSD-II criteria, and all must have a sleep study. Data on 300 subjects will be available at the meeting: 100 patients with insomnia only, 100 patients with OSA, and 100 patients having comorbid insomnia and OSA. In the present sample, the count in the three diagnostic groups were 12 patients only had insomnia, 11 patients only had OSA, and 32 patients had both.
Results: ANOVA compared the three diagnostic groups on sleep and mood measures. There was a significant difference between groups on SOL ($F = 6.3$, $P < .01$) and WASO ($F = 4.8$, $P < .05$) complaints. Tukey follow-up revealed the insomnia and the comorbid insomnia groups did not differ from each other on these complaints, but both were higher than the OSA group. There were no significant differences between the three groups on all other measures: PSG SOL and WASO, depression, and anxiety. Very low N in two of these groups recommends caution in interpreting these under powered findings.
Conclusion: Preliminary conclusions are the majority of patients with OSA also have clinically significant insomnia. SOL and WASO complaints are common to both insomnia and comorbid insomnia. PSG SOL/WASO and mood/anxiety do not vary between insomnia and comorbid insomnia. Overall, these results are consistent with the conclusion that insomnia appears to be an independent disorder when it occurs in the presence of OSA.

0616

INSOMNIA AND COMORBID HYPERTENSION

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Introduction: Sympathetic nervous system activity and hypothalamic-pituitary-adrenal (HPA) activation are associated with hyperarousal in insomnia, which could have elevated cardiovascular risk. This study examined the link between insomnia and comorbid hypertension and the effects of beta-blocker medications on insomnia.
Methods: Participants were 54 individuals diagnosed with primary insomnia including 27 with comorbid hypertension and 27 without hypertension; they were matched on age, gender, and body mass index. Participants kept a daily sleep log for 2 weeks, followed by 3 consecutive nights of polysomnographic (PSG) recording. A detailed medical history interview was taken by the study physician. In the group with hypertension, 7 patients were taking beta-blockers, while the others were using other anti-hypertensive drugs (e.g. amlodipine, perindopril, irbesartan etc.).
Results: Data from the third PSG night were used for group comparisons on standard sleep continuity and sleep stage variables. The analyses revealed significant group differences between the hypertensive and non hypertensive groups regarding %S3, 4 (3.5% vs. 7.3%) and REML (60.9 vs. 94.4 min), $Ps < 0.05$. There were no significant differences on the other variables assessed. Within the hypertensive group, patients using beta-blockers, compared to those using other anti-hypertensive drugs, tended to have fewer awakenings (2 vs. 3.4), less WASO (48.7 vs. 76.5 min), TWT (58.9 vs. 94.1 min) and a better SE (86.8 vs. 79.5%), but these differences were not significant. No between-group difference was observed on sleep diary data.
Conclusion: Hypertension may contribute to further impair sleep in patients with insomnia by altering slow wave and REM sleep, which may indirectly impact on the HPA axis. The finding that beta-blockers may potentially attenuate insomnia in hypertension needs further investigation on a larger sample.
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0617

PREVALENCE AND SIGNIFICANCE OF INSOMNIA IN SUBJECTS WITH METABOLIC SYNDROME

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Introduction: Epidemiological studies suggest a link between poor sleep and the metabolic syndrome (MS). We sought to assess the prevalence of insomnia among subjects with MS and determine whether this sleep disorder is associated with more profound metabolic, hemodynamic and anthropometric derangements, as well as higher degree of inflammation.
Methods: Sixty-six consecutive subjects (26 F, age 33-69 yrs) fulfilling the criteria for MS (ATPIII criteria) were recruited from the cardiovascular prevention centre of the Montreal Heart Institute. Subjects were free of known coronary artery disease and other major medical and psychiatric co-morbidities. Subjects underwent clinical evaluation and measurement of fasting glucose, lipid profile and serum high- sensitivity C-reactive protein (hs-CRP). The presence of sleep complaints and specific sleep disorders was assessed by a structured interview, 2-week sleep diary and Insomnia severity index questionnaire. Persistent insomnia was defined according to DSM-IV-R criteria as lasting > 6 months, in the absence of sleep apnea and restless leg syndrome.
Results: Sixteen subjects (24%) had persistent insomnia. Seven subjects (10.6%) had sporadic symptoms of insomnia not fulfilling DSM-IV-R

criteria, 8 (12%) had known/treated OSA, and 8 (12%) had symptoms of RLS. No differences in age, body mass index, waist circumference, fasting glucose, full lipid profile or resting blood pressure were observed between subjects with insomnia (n = 16) versus those without sleep complaints (n = 27). However, subjects with insomnia showed higher levels of hs-CRP, compared to good sleepers (3.6 ± 1.9 mg/dl vs 2.7 ± 2.9 mg/dl, P = 0.05).
Conclusion: Insomnia would appear to be highly prevalent among subjects with MS, and associated with a greater degree of inflammation relative to MS subjects without sleep complaints. Further studies are required to establish which mechanisms underlie this association.
Support (If Any): Fonds de recherche en Santé du Québec and Montreal Heart Institute Foundation

0618

PREVALENCE AND SEVERITY OF INSOMNIA IN EPILEPTIC PATIENTS: A QUESTIONNAIRE-BASED STUDY

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Introduction: Sleep-wake complaints are common in people with epilepsy and studies suggest that sleep disorders increase the risk of seizures by causing chronic sleep deprivation and/or frequent sleep-wake transitions. We investigated the prevalence and severity of insomnia in epilepsy.
Methods: This is a cross-sectional, IRB-approved study. 132 adult epilepsy patients without prior sleep disorder diagnoses underwent sleep evaluation at the Cleveland Clinic to investigate the prevalence of sleep disorders. Insomnia was diagnosed by ICSD-2 criteria and severity was measured by the Insomnia Severity Index (ISI, Morin, C.M., 1993). Univariate associations between insomnia and epilepsy type (focal vs. generalized) and mean monthly seizure frequency were tested with chi-squared analysis and t-tests. Multivariate regression was performed to assess for factors associated with insomnia/severity including epilepsy type, seizure frequency, age, gender, BMI, number of AEDs, presence of RLS and Beck depression inventory (BDI).
Results: Sample characteristics (mean + SD): age 39 ± 13 years, 33% male, 87% white, BMI 29.3 ± 7.2 mg/kg2, focal epilepsy 74%, number of AEDs 1.7 ± 0.8, monthly seizure frequency 5.0 ± 9.0, BDI 10.1 ± 7.7. 93 (71%) subjects met criteria for insomnia. Insomnia subjects had higher BDI (95% CI: 1.03-1.24; P = 0.009). No other variables predicted the presence of insomnia. Higher BDI was associated with more severe insomnia (P = 0.004). Among focal epilepsy subjects, temporal lobe epilepsy (TLE) was associated with more severe insomnia than extra-temporal or nonlocalizable epilepsies (P = 0.03).
Conclusion: Preliminary findings indicate that the prevalence of insomnia is high in adults with epilepsy, affecting patients with a wide range of seizure frequency. The prevalence is greatest in patients with co-morbid depression in whom insomnia severity correlates with depression severity. Patients with TLE may be at particular risk for severe insomnia. Further studies are required to understand the impact of insomnia on quality of life and seizure control in epilepsy.

0619

SLEEP, SLEEP QUALITY AND DAYTIME SLEEPINESS IN ESTROGEN DEFICIENT POST-MENOPAUSAL WOMEN

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Introduction: Eighty percent of estrogen-deficient postmenopausal women report sleep disruption. One objective of this study was to provide a comprehensive assessment of measures of sleep architecture and continuity, subjective sleep quality and daytime sleepiness in postmenopausal women.
Methods: Thirty-five women mean age 53.7 (± 5.4) years who were 2.9 (± 1.4) years post- menopause, with a BMI of 28.4 (± 5.4), and an FSH level of 68 (± 23.4 mIU/mL) participated. Each participant reported to the Hutzel Sleep Disorders Center for three consecutive nights to obtain baseline all-night sleep data. The first night was an adaptation night. Measurements included polysomnographic data as well as self-reported sleep quality. Within 30 minutes of final awakening each morning participants completed the Subjective Sleep Quality Scale. At four distinct times during the day, they completed the Stanford Sleepiness Scale.
Results: Data from nights two and three were averaged and analyzed. Sleep efficiency was 84.6 (± 7.1). Sleep onset latency was 25.5 (± 23.3) minutes. The total time participants spent in NREM was 335 (± 37.0) minutes and the time spent in REM sleep was 63 (± 22.9) minutes. Participants spent 49.2 (± 21.0) minutes in Stage 1 sleep and 10.9 (± 13.2) minutes in Stage Delta. Throughout the night, total time spent awake after sleep onset was 52.6 (± 26.5) minutes and the mean number of arousals was 50.2 (± 32.9). The mean Subjective Sleep Quality Score was 3.7 (± 0.9). During the daytime, participants reported feeling the least sleepy at 1 pm (2.5 ± 1.0) and most sleepy at 7 pm (3.5 ± 1.5).
Conclusion: Although their self-reported sleep quality was average, this cohort of estrogen-deficient post-menopausal women experienced several significant sleep disruptions including an average of 50 arousals a night and 52 minutes of wake time after sleep onset. In addition, they obtained only 10 minutes of Delta sleep.
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0620

PAIN SENSITIVITY AND MODULATION IN PATIENTS SUFFERING FROM PRIMARY INSOMNIA

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Introduction: Impairment of central pain-modulatory mechanisms has been implicated in the pathophysiology of chronic pain. Experimental sleep loss adversely affects pain modulation and sensitivity to pain, thereby facilitating the experience of pain. We investigated whether pain modulation and sensitivity to pain are effected in patients suffering with primary insomnia.
Methods: Seventeen patients with primary insomnia were individually matched by age and sex with 17 healthy normal sleepers (24+/-4 yrs, BMI 23.2+/-3.2 m2/kg, female:male ratio 2:1). Following a 2-week actigraphy and sleep log recording phase, participants were invited to come to the Clinical Research Center in a fasted state. Experimental pain testing occurred at 1pm (one hour after lunch) and consisted of measures of heat pain thresholds (HPTh), heat pain tolerance (HPTo), pressure pain thresholds (PPT), and two pain modulatory tests (temporal summation to assess sensitizability of the central nervous system, and defuse noxious inhibitory control [DNIC] to assess pain inhibitory capacity).
Results: Primary insomnia patients reported more spontaneous pain than normal sleepers, as averaged across daily ratings over a 2-week recording period (17 vs. 6 units, P < 0.05). HPTh and HPTo were lower in insomniacs compared to normal sleepers (42.1 vs. 45.7 degree C, P < 0.01, 48.3 vs. 49.2 degree C, P < 0.07), while PPTh did not differ between groups. With respect to temoral summation, insomniacs showed less temporal summation across repetitive painful stimuli than controls (-5 vs. 24 unit change in stimulus intensity in insomniacs vs. normal sleepers, P < 0.05). No between-group differences were found for DNIC.
Conclusion: While patients with primary insomnia appear to have higher ratings of spontaneous pain and higher sensitivity to heat pain, sensitizability of CNS neurons, as measured by temporal summation, is unexpectedly lower in insomniacs, suggesting an increased habituation to repeated noxious stimuli.
Support (If Any): Investigator-initiated grant support, Sepracor Inc.

0621

VALIDITY AND RELIABILITY OF THE DSM-IV-TR AND ICSD-2 INSOMNIA NOSOLOGIES AMONG CAUCASIANS AND AFRICAN-AMERICANS

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Introduction: The existence of two rather disparate sleep disorder classification systems (DSM-IV-TR and ICSD-2) creates substantial variability in the assessment and management of insomnia. Emerging evidence supports ethnic differences in insomnia symptoms that may further contribute to this variability. The goal of the present study was to examine ethnic differences in reliability and validity of DSM-IV-TR and ICSD-2 insomnia nosologies among samples of Caucasian and African-American patients with insomnia complaints.
Methods: Two hundred and nine Caucasians (mean age = 47.3yrs; 65% female) and 112 African-Americans (mean age = 46.7yrs; 68% female) who met research criteria for insomnia participated in the dual-site study. All participants were administered the Structured Clinical Interview for DSM-IV Research Version, Non-Patient Edition, completed a sleep history questionnaire (SHQ) and sleep diaries for a two-week period, underwent polysomnographic (PSG) monitoring for two consecutive nights, and were interviewed by six sleep specialists (3 dyads) who provided diagnostic ratings using different assessment methods. One clinical dyad administered a structured sleep interview, another dyad conducted an unstructured clinical interview (CI) and reviewed the patient's SHQ and sleep diaries, and the third dyad derived diagnostic impressions from CI, SHQ, diaries and PSG data. Clinicians then rated how well each participant fit each of the 10 DSM-IV-TR and 37 ICSD-2 insomnia diagnoses. Spearman correlations within each dyad and across dyads were computed and averaged for each insomnia diagnosis to assess inter-rater reliability and convergent validity of the two nosologies.
Results: Results showed that Caucasians and African-Americans displayed relatively similar inter-rater reliability for most DSM-IV-TR insomnia diagnoses with the exception of alcohol-induced sleep disorder (Caucasians: ρ = .37 to .62 vs. African-Americans: ρ = -.07 to .28). Among ICSD-2 diagnoses, there appeared to be ethnic differences in reliability for insomnia related to a medical condition (Caucasians: ρ = .54 to .54 vs. African-Americans: ρ = .29 to .68). In addition, much greater variability was noted for reliability and convergent validity indices within the African-American sample.
Conclusion: Clinicians show some variation in diagnosing insomnia among Caucasians and African-Americans. Further research investigating the influence of ethnicity on the diagnostic classification of insomnia is needed.
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0622

IS ANXIETY A 'FLY IN THE OINTMENT' WHEN USING THE PITTSBURGH SLEEP QUALITY INDEX?

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Introduction: The Pittsburgh Sleep Quality Index (PSQI) is a commonly used retrospective, subjective rating tool for sleep quality. This relation to existing prospective measures of sleep quality (i.e., sleep logs) is unknown. Additionally, it is unknown as to whether one method is more susceptible to influences of current mood states (e.g., anxiety).
Methods: Participants (N = 197) met DSM-IV-TR criteria for an insomnia diagnosis, but not for any other primary sleep disorders on the basis of: the Duke Structured Interview for Sleep Disorders (DSISD), 2 weeks of sleep logs, and 2 nights of polysomnography. The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID) assessed for the presence of Axis I mental disorders. As part of the baseline assessment, participants completed the Beck Anxiety Inventory (BAI) to assess general anxiety and the PSQI for sleep quality. For two consecutive weeks they completed prospective morning 10-point Likert ratings of sleep quality on the sleep logs.
Results: Regression analyses revealed that while anxiety ratings on the BAI predict scores on the PSQI (β = .41; P < .001), sleep quality ratings on logs do not predict PSQI scores (β = -.11; P = .091). ANOVAs revealed that those with an Axis I disorder (M = 13.7) differed from those without a disorder (M = 12.2) on the PSQI (P = .002), but not on mean sleep log sleep quality (P = .073).
Conclusion: The best predictor of the PSQI score was actually anxiety, not prospective sleep quality ratings. This suggests that the PSQI may be influenced by anxiety, rather than sleep quality. Since the presence of an Axis I disorder significantly affected the PSQI scores, but not the sleep log sleep quality, it appears that the PSQI is tapping into something inherently related to an Axis I disorder whereas sleep quality may be less susceptible to this influence.
Support (If Any): National Sleep Foundation Pickwick Fellowship and Classifying Psychiatric, Medical, and Primary Insomnias (NIH R01, MH067057).

0623

CONFIRMATORY FACTOR ANALYSIS OF THE PRE-SLEEP AROUSAL SCALE IN A SAMPLE OF INSOMNIACS AND IN A SAMPLE CONTROLS

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Introduction: Individuals with insomnia are more likely to endorse cognitive arousal, rather than physiological arousal during the pre-sleep period, as a determinant of disrupted sleep. Inducing physiological arousal among normal sleepers (i.e. caffeine, stimulant drug, or psychosocial stressor) can mimic acute insomnia. It is unclear whether physiological arousal is an epiphenomenon or plays a causal role in sleep disruption. The present study examined how ratings on the pre-sleep arousal scale (PSAS) following acute stress among normal sleepers compared to ratings provided by insomniacs.
Methods: Eighty-four normal sleepers (52% male) were asked to recall a recent stressor during a laboratory session and to rate pre-sleep arousal online prior to bedtime. Paired samples t-test demonstrated that the stress task resulted in increased ratings of negative affect (NA), t = 2.82, P < .05. Sixty-four insomniacs (64 % female) provided ratings of cognitive and physiological on the PSAS during an initial appointment at the University of Utah Sleep-Wake Center. Confirmatory factor analysis was used to test the hypothesis that ratings of both physiological and cognitive arousal prior to bedtime would better characterize the normal sleepers when compared to the insomniacs.
Results: Bayesian structural equation modeling (SEM) was used to perform a confirmatory factor analysis on PSAS ratings. Chi-Square analysis indicated that a two factor model (cognitive and physiological arousal), based on ratings provided by either the insomnia (χ2,105 = 309.35, P < .05) group or the control group (χ2,105 = 329.35, P < .05) was not supported. When compared to ratings from the insomnia group (DIC = 1129, RMSEA = .137) ratings from the control group provided better model fit (DIC = 230. RMSEA = .144) to a two factor solution on the PSAS.

Conclusion: Pre-sleep arousal among insomniacs is not characterized by a two factor model including both physiological and cognitive arousal.

0624

A PSYCHOMETRIC INVESTIGATION INTO TWO INSOMNIA-SPECIFIC MEASURES OF WORRY/ RUMINATION: THE PRE-SLEEP AROUSAL SCALE AND THE ANXIETY AND PREOCCUPATION ABOUT SLEEP QUESTIONNAIRE

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Introduction: The aim of this investigation was to psychometrically evaluate two insomnia-specific measures of worry/rumination: the Pre-Sleep Arousal Scale (PSAS; cognitive subscale) and the Anxiety and Preoccupation about Sleep Questionnaire (APSQ).
Methods: Participants (n = 2,333) from a randomly selected sample of the general population (N = 5,000) completed a survey on sleep, daytime impairment, PSAS-C, and APSQ.
Results: Exploratory factor analyses showed that for both PSAS-C and APSQ only one factor was retained (total variance: 64% and 69%). One of the PSAS-C items fitted less well in the solution ('being distracted by sounds, noise in the environment'). The internal consistency for PSAS-C was .92 and for APSQ .95, and the two measures were highly correlated (r: .67). Both measures were correlated with sleep onset latency (r: .43-.50), wake time after sleep onset during night (r: .44-.46) and morning (r: .31-.34), sleep quality (r: .55-.60), and with sleep restoration (r: .51-.54). The two measures were correlated with daytime symptoms and function (r: .27-.57). On both measures, significant mean differences were noted between three groups which differed on insomnia symptomatology; the insomnia disorder group (n = 122) reported significantly higher scores than the poor sleep (n = 221) and normal sleep groups (n = 1,004), and poor sleep group exhibited significantly higher levels than normal sleep group.
Conclusion: The PSAS-C and APSQ are both psychometrically sound measures for assessing worry/rumination in insomnia.
Support (If Any): This study was supported by the Swedish Council for Working Life and Social Research.

0625

WHAT IS THE VOCABULARY PATIENTS USE TO DESCRIBE THE INSOMNIA EXPERIENCE: RESULTS FROM A SURVEY OF INSOMNIA EXPERTS

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Introduction: This survey is part of efforts to study insomnia experience description and measurement. This survey is to help inform research vocabulary development for the subjective insomnia experience.
Methods: Insomnia experts (N = 76) had insomnia publications and/or a history of insomnia clinical practice. 58 experts completed the survey. The experts were asked 3 questions about 8 categories of insomnia experience descriptor. The 8 Categories: 1. partly awake & partly asleep for long periods, 2. thinking too much, 3. worrying, 4. physically not ready for sleep, 5. unpleasant emotion, 6. environmental factors, 7. sleep-preventing visual imagery, 8. awakening from a dream or nightmare.
Results: Q1: Which categories have you ever heard used by people with primary insomnia? The rank order (and percents endorsed): (1) Category 3. (100 percent), (2) 2. (98%), (3) 5. (95%), (4) 6. (93%), (5) 4. (91%), (6) 1. (84%), (7) 8. (74%) and (8) 7. (19%). Q2: Which categories are often used by people with primary insomnia? The rank order (and percents endorsed): (1) Category 2. (100 percent), (2) 3. (95%), (3) 5. (69%), (4) 1. (66%), (5) 4. (60%), (6) 6. (29%), (7) 8. (14%), (8) 7. (0%). Q3: What are the 1st, 2nd, 3rd, and 4th most characteristic categories of insomnia experience descriptor? (Weights: 1st = 4 points, 2nd = 3 points, 3rd = 2 points, 4th = 1 point.) The rank order (and total points from 1st-4th ratings): (1) Category 2. (190 points), (2) 3. (150), (3) 1. (79), (4) 5. (70), (5) 4. (65), (6) 6. (11), (7) 8. (1), (8) 7. (zero).
Conclusion: Insomnia experience descriptor categories 2 and 3 were heavily endorsed. Five additional categories (1, 4, 5, 6 and 8) were validated as part of the insomnia experience vocabulary. Descriptor category 7 appears rarely relevant for describing the insomnia experience.
Support (If Any): National Institute on Drug Abuse Grant DA13574

0626

EVALUATING THE COGNITIVE MODEL OF INSOMNIA: A GENERAL POPULATION APPROACH

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Introduction: The purpose of this study was to examine the cognitive model for insomnia cross-sectionally in the general population. Associations between three groups (insomnia disorder, poor sleep, and normal sleep) and theory-derived psychological processes (safety behavior, monitoring, worry/rumination, autonomic arousal, emotional distress, and unhelpful beliefs) were explored.
Methods: Participants (n = 2,333) from a randomly selected sample of the general population (N = 5,000) completed a survey on sleep, daytime impairment, health, and psychological processes. Multivariate analysis of variance, discriminant analysis, and logistic regressions were used as statistical methods.
Results: Group differences were demonstrated on all the psychological processes ($\eta 2$ = .17-.39); the insomnia disorder group (n = 122) reported higher scores than the other two groups and the poor sleep group (n = 221) exhibited more elevated levels than the normal sleep group (n = 1,004). A discriminant analysis demonstrated a similar pattern; the psychological processes differentiated the three sleep status groups. When all the psychological processes were entered simultaneously in logistic regression analyses, safety behaviors, worry/rumination, autonomic arousal, depression, and monitoring were significantly associated with sleep status (25-65% of the total variance). Approximately 70-90% of the participants in the sleep status groups were correctly classified.
Conclusion: These results suggest that the cognitive model for insomnia has heuristic value and warrants prospective and experimental research.
Support (If Any): This study was supported by the Swedish Council for Working Life and Social Research.

0627

TOWARDS INSOMNIA-SPECIFIC MODELS AND ASSESSMENT OF RUMINATION

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Introduction: While rumination has been implicated in cognitive models of insomnia (Harvey, 2002), empirical rumination studies have been largely absent from the literature. Carney and colleagues (2006) found that rumination relates to sleep disruption, and the type of rumination most important for insomnia is rumination about daytime symptoms such as fatigue or concentration problems. This study also found that rumination is not accounted for by levels of depressed mood. However, previous studies have relied on rumination measures from the depression literature, so this study investigates rumination via an insomnia-specific measure.
Methods: We developed a 20-item rumination scale based on the 8-item Symptom-Focused Rumination Scale used in Carney et al. (2006).

Psychology undergraduate students (N = 287) completed the Daytime Insomnia Symptom Response Scale (DISRS), the Insomnia Severity Index (ISI) and the Beck Depression Inventory (BDI-II). A hierarchical regression was used to determine whether the BDI-II (entered in Block 1) and ISI (entered in Block 2) were significant predictors of the DISRS.
Results: Cronbach's alpha was 0.93. In Block 1, depression was a significant predictor of insomnia symptom rumination (beta = .71). In Block 2, insomnia significantly predicted insomnia symptom rumination (beta = .17) even after controlling for levels of depression (beta = .62).
Conclusion: The regression analysis suggests that while depression is a factor in this type of rumination, insomnia is also significantly and uniquely related to rumination about daytime symptoms such as fatigue. While more psychometric work will be needed to validate this measure in clinical populations, this study provides important preliminary support for its use in insomnia research. In addition, this study supports prevailing cognitive conceptualizations of the importance of ruminating on the daytime sequelae of insomnia as a risk factor in insomnia (e.g., Harvey, 2002).

0628

SLEEP-RELATED ATTITUDES, BELIEFS AND PRACTICES IN BLACK AND WHITE ADULTS

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Introduction: There have been very few explorations of how social and cultural factors influence sleep, especially with respect to culturally-determined sleep-related beliefs and practices.
Methods: Forty-one Black/African-American(BAA) and 32 White/European-American(WEA) completed a questionnaire on beliefs/attitudes/practices regarding sleep. Groups were compared using Mann-Whitney U.
Results: Groups were equivalent for age (M = 65(WEA);72(BAA)), gender (92%F WEA; 88%F BAA), and income. Groups differed for education, with more college-educated WEA (72%WEA; 17%BAA). For complaints, BAA reported more snoring(P = .002). There were no differences in obtained TST or perceived sleep need, but the difference ([need]-[obtained]) was significant(P = .004). Only 3.1% of WEA reported needing more sleep than they received, while 29.2% of BAA reported needing more. BAA were more likely to read/watch TV(P = .0003), drink alcohol(P = .004), or start their day(P = .0007) if they could not sleep. In bed, BAA were more likely to read/watch TV(P = .000007), eat/drink(P = .0003), worry/think(P = .0002), and argue/be angry(P = .006). Fewer BAA report being motivated to make time for sleep(P = .0005). Trends for sleepiness being due to laziness and bad habits(P = .04) or boredom(P = .02) were found in BAA. BAA were more likely to believe that lying in bed with eyes shut was as good as sleeping(P = .004). WEA were more likely to believe that sleep is related to health(P = .005) and ability to enjoy daytime(P = .004). BAA were less likely to "Strongly Agree" that dozing while driving a vehicle is serious(P = .00005). When asked if sleep is related to health problems such as obesity, blood pressure, diabetes, and depression, Most WEA(71.8%) and BAA(85.4%) were "Unsure" or disagreed(P = .52). No differences for exposure to sleep-related information were found(P = .41), and both groups reported that they did not discuss sleep problems with their doctor(P = .81) and their doctor did not discuss sleep with them(P = .29).
Conclusion: Important cultural differences in knowledge and perception were found. These findings have important public health implications in terms of developing effective sleep education interventions that include consideration of cultural factors.
Support (If Any): This study was supported by T32HL007713 and the University of Pennsylvania Resource Center of Minority Aging Research (RCMAR) supported by P30-AG-031043-01 (NIH/NIA).

0629

IS ACCEPTANCE A POTENTIAL BUFFER BETWEEN PRESLEEP COGNITIVE AROUSAL AND INSOMNIA SEVERITY?

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Introduction: Cognitive therapy interventions as well as third-wave treatments for insomnia are focused on reducing presleep cognitive arousal. Lundh (2005) proposed that mindfulness should theoretically initiate the cognitive deactivation process. However, to our knowledge, this proposed mechanism of mindfulness has not yet been empirically tested. We sought to empirically examine the relationship between mindfulness (i.e. awareness/acceptance), presleep cognitive arousal and insomnia severity. Specifically, we were curious about the differential relationships among acceptance, awareness, presleep cognitive arousal and insomnia severity.
Methods: As part of a larger study, a convenience sample of college students (N = 122) completed a series of sleep and quality of life questionnaires, including insomnia severity (Insomnia Severity Index; ISI), presleep cognitive arousal (Presleep Arousal Scale; PSAS-C) and mindfulness (Philadelphia Mindfulness Scale; PHLMS).
Results: Preliminary analyses indicated that PSAS-C and ISI were positively correlated (r = .57, P = .00). Interestingly, acceptance was negatively correlated with ISI (r = -.247, P = .01), whereas awareness was not correlated with ISI (P > .05). Furthermore, acceptance was negatively correlated with PSAS-C (r = -.38, P = .00) and awareness was positively correlated with PSAS-C (r = .21, P = .02). Additionally, those high in acceptance reported significantly fewer ISI symptoms, t(119) = -3.5, P = .001.
Conclusion: Acceptance appears to have a negative relationship with presleep cognitive arousal, and may potentially act as a buffer between cognitive arousal and insomnia severity. Rather, awareness was positively correlated with presleep cognitive arousal. Perhaps our mindfulness-based interventions for insomnia should explore acceptance as the mechanism by which we can potentially decrease arousal and insomnia severity.

0630

SHOULD ANXIETY ASSESSMENT MAKE US ANXIOUS? ISSUES IN ASSESSING ANXIETY IN CLINICAL INSOMNIA PATIENTS

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Introduction: Assessing for clinical levels of anxiety is crucial, as comorbid insomnias far outnumber primary insomnias (PI). Such assessment is complex as those with Anxiety Disorders (AD) and those with PI have overlapping symptoms (e.g., tension, reduced sleep, catastrophizing). Because of this overlap, we need studies that examine the assessment of anxiety in clinical insomnia groups.
Methods: Participants completed a clinical interview, 2 weeks of sleep logs, and polysomnography to verify a DSM-IV-TR insomnia diagnosis, and rule-out other sleep disorders; the Structured Clinical Interview for DSM-IV disorders (SCID) assessed for AD diagnoses. Participants (N = 207; M age = 51; 68 % female) were classified as having insomnia: 1) without an anxiety disorder (I-ND), or 2) with an anxiety disorder

(I-AD). Mean Beck Anxiety Inventory (BAI) item responses were compared using multivariate analysis of variance (MANOVA) and follow-up ANOVAs. The accuracy rate for the BAI suggested clinical cutoff was evaluated using a Receiver operating characteristic (ROC) curve.
Results: The I-ND had lower mean BAI scores (M = 10; SD = 8.2) than I-AD (M = 16.3; SD = 9.8). There was a significant group effect on the MANOVA on BAI items (F = 3.1, P < .001); subsequent follow-up ANOVAs revealed significant group (I-ND vs. I-AD) differences on seven items. The ROC curve analysis revealed the BAI cutoff (> 16) had 55% sensitivity and 78% specificity, and the "mild" cutoff (< 8) had 88% sensitivity, but 55% specificity.
Conclusion: While anxiety scores were highest in I-AD; the I-ND scores were in the mild range. The 7 discriminating items were face-valid anxiety symptoms such as an inability to relax. The 14 nondiscriminating items (e.g., parathesia, dizziness) were atypical/unusual anxiety symptoms and may relate to something else (e.g., medical conditions). Published cutoffs for the BAI were not optimal for identifying ADs. Such limitations must be considered before using the BAI in those with insomnia.
Support (If Any): National Sleep Foundation Pickwick Fellowship and Classifying Psychiatric, Medical, and Primary Insomnias (NIH R01, MH067057).

0631

RELATIONSHIP BETWEEN ANXIETY AND INTERNATIONAL CLASSIFICATION OF SLEEP DISORDERS - II INSOMNIA SUBTYPE

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Introduction: During the last 50 years, the relation between insomnia and anxiety has been largely studied. It is has been described that a hyper-arousal condition (physiological, psychological and behavioral) could be a causal factor of insomnia; specifically diurnal and anticipatory anxiety symptoms have been related to sleepless. In the other side, in DSM-IV-R primary insomnia is the unique insomnia category included versus in the ICSD-II in which there are different insomnia subtypes.
Methods: Our Objective was to compare diurnal with anticipatory anxiety in Insomnia Patients; and to compare anxiety between insomnia sub-groups (Inadequate Sleep Hygiene, Insomnia Secondary to Hypnotics Addiction and Insomnia Secondary to Sleep Disordered Breathing). We studied 90 Insomnia Patients (42.1 mean age +/- s.d. 13.7, 56.7% male) age matched to a Healthy Group, 30 subjects by each group. Spanish validated versions of Beck Anxiety Inventory and Athens Insomnia Scale were applied along to a clinical interview to determine anxiety, Insomnia, Insomnia severity as well as insomnia subtype according to ICSD-II.
Results: There were no differences between Diurnal and Anticipatory Anxiety in any Insomnia Subgroup; however, we identified a significant diminishment in nocturnal anxiety in healthy group. Insomniacs secondary to hypnotic addiction had the largest severity of anxiety. The most severity of anxiety was related with a significant increase of insomnia severity and duration.
Conclusion: Our data supports the presence of a hyper-arousal condition as causal factor of insomnia. Compared with healthy group, Insomnia Patients had sustained level of anxiety during morning and evening (diurnal and anticipatory anxiety). Insomnia secondary to hypnotic addiction group showed the most severity of anxiety. According to our results, each insomnia subtype had different level of anxiety, therefore have different necessity for coping with anxiety.

0632

THE INTERACTIVE EFFECTS OF ANXIETY AND GENDER AMONG INSOMNIACS ON FUNCTIONAL OUTCOMES

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Introduction: Insomnia is associated with impairments in daytime functioning, poor attention, reduced productivity, fatigue, increased decision making errors, decreased quality of life and increased health care utilization. The incidence of insomnia increases with age, and is greater in women. Higher levels of anxiety are also associated with insomnia, and there is a higher incidence of affective disorders in women. The objective of this investigation was to examine the independent and interactive effects of anxiety and gender among insomniacs on functional outcomes of sleep.
Methods: Sixty-four insomniacs (mean age = 42.59 years, 64 % female) completed the functional outcomes of sleep questionnaire (FOSQ), and the Beck Anxiety Inventory (BAI) during an initial visit to the University of Utah Sleep-Wake Center.
Results: Regression analyses indicated that there was a first order effect for gender, $\beta = .281$, $P = < .05$, and a negative first order effect for anxiety, $\beta = -.293$, $P = < .05$ on functional outcomes of sleep among insomniacs. Moreover, gender moderated the association between anxiety and functional outcomes of sleep among insomniacs, $\beta = .685$, $P < .01$, $\Delta R2 = .11$, such that anxiety had a significant association with functional outcomes of sleep among females, $\beta = .628$, $P = < .001$, but not males, $\beta = .082$, $P = .738$.
Conclusion: These results suggest that anxiety and gender differences impact ratings of daytime functional outcomes among insomniacs. These findings present another aspect by which the differential effects of gender contribute to the negative psychosocial sequeale associated with insomnia.

0633

THE EFFECT OF GENDER ON SUBJECTIVE SLEEP COMPLAINTS OF INSOMNIA

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Introduction: Gender differences in subjective sleep complaints may influence scores on insomnia severity scales, possibly due to differences in insomnia severity or style of responding.
Methods: Item responses to the 65-item Pittsburgh Insomnia Rating Scale (PIRS) scores were reviewed in subjects of both control (N = 71) and insomnia groups (N = 216) for gender differences in inter item correlations. Items with correlation differences of 0.20 were identified, and those with ≥ 8 differences were selected for focused study, with item score as the dependent variable in the insomnia group only (M = 116 and F = 171). Gender, age group (cutpoint 50 years), and Total PIRS score were dependent variables. These models were used to determine if gender was an independent factor for item score ($P < 0.05$) after adjusting for age & severity.
Results: Eight variables were identified as possibly influenced by gender. Models adjusting only for age and sex identified only two items as potentially gender-biased. The past-week "most nights sleep latency" item had only a gender effect (P value = 0.02) , but the "worst night sleep latency " item had a both a gender ($P < 0.03$) + gender: age effect (P value = 0.01). These effects remained after additional adjustment for total PIRS score ($P < 0.0002$).
Conclusion: Though no firm conclusions can be made regarding objective measurement, these data suggest that premenopausal female insomniacs report more severe prolongation of sleep latency compared with

their post-menopausal counterparts, and that female insomniacs tend to report worse sleep latencies on most nights compared with men. Further study may clarify whether these differences are due to actual objective differences in sleep latency or due to different reporting styles.

0634

THE RELATIONSHIP BETWEEN LONELINESS, COGNITIVE AROUSAL, AND INSOMNIA SEVERITY

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Introduction: Compromises in social relationships are commonly associated with insomnia, yet understudied. Loneliness, or the discrepancy between the individual's desired and actual relationships (Peplau & Perlman, 1982), is onse such variable that positively correlates with insomnia severity (Cacioppo, Hawkley, & Berntson, 2003). Additionally, cognitive arousal predicts insomnia severity (Harvey, 2002; Jansson & Linton, 2007). Taken together, we chose to further investigate the interrelationships between loneliness, cognitive arousal, and insomnia severity.
Methods: As part of a larger study on predictors of insomnia severity, data were collected from a convenience sample of 122 undergraduates. The Insomnia Severity Index (ISI), Pre-Sleep Arousal Scale- Cognitive subscale (PSAS), and UCLA Loneliness Scale-Revised (UCLA-R) served as primary measures.
Results: Preliminary analyses indicated that loneliness and cognitive arousal were positively correlated with insomnia severity, (rs = .35, and .64, respectively, both Ps < .0001). Interestingly however, hierarchical regression analyses revealed that cognitive arousal significantly accounted for insomnia severity (b = .36, SE = .06, t = 6.20, P < .0001), but loneliness failed to significantly account for ISI above and beyond cognitive arousal (b = .05 SE = .04, t = 1.31, P = .19).
Conclusion: The relationship between cognitive arousal and insomnia severity was reaffirmed. Additionally, loneliness and insomnia severity were positively correlated. However, this study did not find that loneliness accounted for insomnia severity when cognitive arousal was controlled for. It may be that the aspect of loneliness that influences sleep quality is the individual's cognitive rumination about his or her lack of social connection and relationships when attempting to fall asleep. Alternatively, we may consider a bi-directional relationship between insomnia and loneliness, where having a poor night of sleep leads one to withdraw from social interactions the following day, resulting in increased loneliness.

0635

SLEEP STATE MISPERCEPTION IN INSOMNIA PATIENTS

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Introduction: Sleep state misperception (SSM) or paradoxical insomnia is a subtype of insomnia category, where patients complaint of little or lack of sleep without objective evidence of this or complaint of day time impairment. Normally, there is an overestimation of sleep latency. The prevalence of SSM is not known and there are few Brazilian studies about it. The aim of this study is to evaluate the presence of SSM and presence of depression and anxiety in these patients.
Methods: We reviewed data of patients that complaint of insomnia how went to the sleep laboratory, in 2008. Patient should be between 20 and 75 years old, and they need to be free of stimulant medication, alcohol or hypnotic medication. We compared patients' self report questionnaire and there polysomnographic exam result.
Results: A total of 143 patients were included in this study. The sleep complaints were Sleep Fragmentation (42.7%), difficulty falling asleep (16.1%), decrease of Total Sleep Time (6.3%) and nonrestorative sleep (51%). Depressive mood, anxiety or daytime sleepiness was present, respectively in 31.5%, 58% and 51% of these patients. Independent of the sleep complaint anxiety was more present in patients with SSM.
Conclusion: In our study, we observed that anxiety is more frequently in SSM patients, than we believe that theses patients should be investigated for anxiety and they should be evaluated for possible specific treatment.

0636

PSYCHOSOCIAL FEATURES OF BRAZILIAN PATIENTS WITH PARADOXICAL INSOMNIA

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Introduction: Sleep State Misperception (SSM) is the current diagnostic term for the intriguing group of insomnia patients who appear unable to discriminate sleep from wakefulness. Historically it has been among the most challenging to understand and manage clinically. According to International Classification of Sleep Disorders (ICSD), SSM, recently renamed 'Paradoxical Insomnia', is a disorder in which a complaint of severe insomnia occurs without objective evidence of sleep disturbance, and without a significant impairment of daytime function. The present study aims to identify psychosocial features of patients with SSM.
Methods: We studied SSM patients from the Neuro-Sono Sleep Center, Department of Neurology, Universidade Federal de São Paulo, Brazil. Semi structured interviews were conducted following a script of questions about birthplace, family, childhood, sleep, moves, present life and perceptions. We performed content analysis on the interviews searching interviewees' feelings, thoughts, and social and familiar insertion.
Results: In this study, we identified 60 patients (33 females, 23 to 76 years old) with confirmed SSM diagnosis among 2000 medical files and 1735 PSG studies. We observed that 80% was not native of Sao Paulo City. The severity of the nocturnal complaint is not matched by evidence for pathologic sleepiness, marked performance decrements, and other severe functional impairments during the day that typical in cases of such marked sleep deprivation. Sleep stages 1 and 2 were longer than among people without such complaints. We observed one autoimmune disease and two syndromes affecting perception. Data of 20 interviews revealed similar features of these patients: unsafe and threatened environment, uprooting feelings, complacence and methodical behavior; proactivity, resilience, rootlessness; and, recurrent feelings of loss and grief. These patients related concerns about long-term effects of their perceived sleep deficits on general health and longevity.
Conclusion: Psychosocial features of SSM patients are important information to diagnosis and for the treatment, which could potentially help determine a psychological and clinical profile of SSM patients. We suspect that the psychosocial features disclosed in our study are not restricted to Brazilian culture, but probably to a broader trait of patients with SSM, granting equivalent studies in different cultures.

0637

TIME MONITORING BEHAVIOR IN PTSD PATIENTS WITH INSOMNIA

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Introduction: Difficulty falling asleep and staying asleep (Insomnia) are diagnostic criteria for PTSD. Time Monitoring Behavior (TMB) is common among Insomnia patients, but TMB has not been investigated in PTSD patients. This retrospective study analyzed relationships among Insomnia, TMB, and PTSD.
Methods: Maimonides Sleep Arts & Sciences is a sleep medical center, specializing in sleep patients with mental health disorders. We conducted a chart review on 1078 patients seen between 2003 and 2009 who completed questionnaires on posttraumatic stress symptoms (PSS), Insomnia (ISI), Time Monitoring Behavior (TMB), including TMB subscales

falling asleep (FA) and staying asleep (SA). We divided our sample into three PSS groups: Minimal (n = 728), Moderate (n = 194), and Severe (n = 156). We hypothesized that TMB would positively correlate with PSS and Insomnia.

Results: PSS means were significantly (P = .0001) different among the three severity groups: Minimal, 4.38 (3.24), Moderate 14.98 (2.90), Severe, 28.69 (6.03). PSS groups showed significant (P = .0001) worsening of Insomnia (ISI): Minimal, 14.17 (5.92), Moderate, 18.04 (5.36), Severe, 20.47 (4.01) as did TMB (P = .0001): Minimal, 12.09 (7.84), Moderate, 15.24 (7.92), Severe, 19.21 (8.10). PSS correlated significantly (P = .0001) with ISI (.45) and TMB (.36); and ISI and TMB correlated (.46). Of the three PSS subscales (Intrusion, Avoidance, Arousal) PSS Arousal achieved the highest significant correlations (P = .0001) with ISI (.52), TMB (.42), FA (.41), SA (.40). Socio-demographics revealed that women suffered significantly greater severity of PSS, ISI, and TMB than men and were nearly twice as likely to be in the severe PSS group (P = .0001).

Conclusion: Total PSS, PSS subscales, Insomnia and Time Monitoring Behavior demonstrated medium correlation coefficients indicating potential clinically relevant associations. These findings need to be replicated in different environments such as PTSD clinics or other psychiatric or sleep centers.

Support (If Any): Maimonides Sleep Arts & Sciences

0638

IMPAIRED FEAR RECOGNITION ACCURACY IN PRIMARY INSOMNIA: PRELIMINARY RESULTS FROM AN EMOTIONAL FACIAL EXPRESSION PARADIGM

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Introduction: Recent experimental work suggests an important role for sleep in emotional regulation. Primary insomnia, a disorder of persistent subjective sleep disturbance, is associated with heightened emotional arousal, and acts an independent risk factor for the development of subsequent psychopathology. To the best of our knowledge, no published study has examined objective emotional processing, involving affective value judgments, in primary insomnia. In the present study, we compared individuals with primary insomnia and normal sleepers on facial expression recognition accuracy, across six basic emotion categories: fear, sad, happiness, neutral, anger, and disgust.

Methods: Individuals meeting DSM-IV criteria for primary insomnia (PI; n = 28, mean age = 46, 9 male/19 female) and normal sleepers (NS; n = 31, mean age = 32, 13 male/18 female) completed a touchscreen computerised facial emotion paradigm. This consisted of participants viewing black and white images of eight individuals (4 male; 4 female) expressing facial emotions across the categories of fear, sad, anger, neutral, happiness and disgust. Images were taken from a standardised database. Participants were instructed to identify the emotion by pressing the corresponding category-label on the touchscreen interface.

Results: Both groups had similar recognition accuracy rates for the categories sad, happiness, neutral, disgust and anger. However, the PI group made significantly more errors when categorizing fearful faces compared with normal sleepers (P < .005; Cohen's d = 0.79). This group effect remained after controlling for both age and gender.

Conclusion: For the first time, we show that primary insomnia is associated with impairments in the correct identification of human emotions, namely fear. Although speculative, our findings may indicate altered neural systems sub-serving the processing of emotional and salient cues, which may be linked to acute or cumulative sleep loss.

0639

INSOMNIA: PREVALENCE AND PREFERENCE FOR TREATMENT AS PREDICTED BY SLEEP IMPAIRMENT, SELF-EFFICACY TASK AND REGULATION FOR INSOMNIA, AND DYSFUNCTIONAL BELIEFS AND ATTITUDES ABOUT SLEEP

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Introduction: This study examined the prevalence of insomnia and whether a preference for treatment of insomnia, behavioral or pharmacological, could be predicted based on sleep impairment, task and regulation self-efficacy for insomnia, and dysfunctional beliefs and attitudes about sleep.

Methods: An adult sample of military veterans (n = 98), seeking primary health care at a veteran's administration community based outpatient clinic, completed self-report instruments. Two multiple regression analyses were conducted; one for predicting a pharmacological preference for the treatment of insomnia and a second for predicting a behavioral preference. The Insomnia Treatment Acceptability Scale (ITAS) measured the preferences. The Sleep Impairment Index (SII), Self-Efficacy for Insomnia (SE-I), and Dysfunctional Beliefs and Attitudes about Sleep (DBAS-16) measured the predictor variables, respectively.

Results: Results indicated both regression equation prediction models were statistically significant overall; not all predictors were significant. The regression equation produced a more effective model for predicting pharmacological preference for treatment of insomnia (R2 = 0.222; F = 6.618, P < 0.001) than for behavioral preference (R2 = 0.106; F = 2.742, P < 0.05). For the pharmacological prediction regression equation model, sleep-specific distortion was the statistically significant predictor (P < 0.01). For the behavioral model, task related self-efficacy for insomnia was a statistically significant predictor (P < 0.05). A preference for pharmacological treatment was significantly correlated with sleep impairment (r = 0.354, P < 0.01) and sleep-specific distortions (r = 0.438, P < 0.01). A preference for behavioral treatment was significantly correlated with task self-efficacy (r = 0.301, P < 0.01). A significant correlation was found between sleep impairment and sleep-specific distortions (r = 0.583, P < 0.01). Using the Sleep Disorder Symptom - Check List (SDS-CL), symptoms of insomnia prevalence for the sample was 49% with a subscale score > / = 8 and 39% with a subscale score of > / = 9.

Conclusion: Results suggest that, for veterans with greater sleep impairment, a cognitive behavioral treatment approach for insomnia may be more beneficial after, brief, short-term pharmacological treatment.

0640

CHASING SLEEP AND COMPELLING WAKE: INSOMNIA, CAFFEINE, CANNABIS, AND COCAINE AMONG COLLEGE STUDENTS

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Introduction: Sleep in college represents the first opportunity for many students to choose their own sleep schedules, and therefore understanding more about sleep during college could help students make better choices. Frequently students use substances to help themselves wake or sleep, and this, too, can become problematic during this time. Our study examined beliefs about sleep, prevalence of insomnia, substance use patterns, and circadian preference in a sample of students at a small, liberal arts university.

Methods: 122 college students (67 women) completed informed consents and questionnaires, including questions about weekday and week-

end sleep and substance use. Measures included: Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), Owl-Lark Circadian Preference, and Dysfunctional Beliefs and Attitudes about Sleep (DBAS-16).
Results: Participants' mean age: 19.0 (1.1). Mean (sd) ISI scores: 8.5 (sd = 4.7); 47.5% of the sample had sub-threshold insomnia; 8% had scores indicating clinical insomnia. Students' bedtimes averaged 13:25 a.m. on weekdays and 14:21 weekends; wake times were also delayed two hours on weekends. Mean TST was 6.8 (sd = 1.2) hrs. Mean Owl-Lark scores: 43.4 (8.4); DBAS-16 score mean was 63.1. Mean PSQI was 6.7, above the cut-off point for pathological sleep. Univariate regression for ISI scores ($F = 10.71$, $P < .001$) showed significant variance predicted by reported BT last night, DBAS-16, Evening circadian preference, higher Global-PSQI, and number of substances reported "ever" used. Most common substances reported used were, in order, caffeine (94%), cocaine (84%), cannabis (48%), nicotine (44%), and ADHD prescriptions (29%).
Conclusion: College students may have insomnia at rates that equal or exceed those of the general population; substance use greatly complicates this problem. This pattern may set the stage for increased difficulty with insomnia later in life.

0641

RELEVANCE OF POLYSOMNOGRAPHY IN CHRONIC INSOMNIA

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Introduction: According to standard recommendations polysomnography (PSG) is not routinely recommended in insomnia patients. Several data suggest neurophysiologic abnormalities in insomnia in terms of brain activities, of sleep macrostructure and microstructure. From alertness to sleep, delta and theta EEG sources become more posterior, and alpha and beta sources more anterior (Tsuno2002). A significant decrease in the fronto-occipital and in the inter-frontal coherence values in the alpha range was observed with the falling of alertness (Cantero1999). Patients with primary insomnia did not experience a gradual decrease of their alpha and beta power during the sleep onset and had a lower delta activity in the 5 min preceding it (Staner2003). Cyclic alternating pattern is increased; abnormal EEG features and abnormal proportions of sleep stages are also common. The objectives of this work were: 1) to evaluate the benefit of polysomnography in chronic insomniacs, both in terms of pathophysiologic and treatment ; 2) To establish patterns of clinical neurophysiologic dysfunction in insomniacs
Methods: 200 chronic insomniacs were evaluated: clinically; sleep questionnaire and standard PSG. The information concerning clinical features, polysomnographic data in terms of macrostructure, microstructure, spectral EEG components in what concerns delta, alpha and beta activity, heart rate variability, myoclonia and respiration was gathered and analysed statistically.
Results: PSG was considered useful in 85% of the cases of chronic insomniacs; the benefits were: confirmation of periodic limb movements or sleep apnea ; diagnosis of misperception; presence of abnormal EEG activities (alpha and beta bands); abnormal temporal organization of sleep stages; abnormal macrostructure features; presence of sympathetic/ parasympathetic imbalance. In a significant number of cases PSG data was important for treatment strategy. Multivariate analysis by logistic regression showed 5 clusters of patients.
Conclusion: PSG is a valuable method in the evaluation of chronic insomniacs and should be considered at the initial steps of the clinical evaluation

0642

AROUSAL PERCEPTION IN PATIENTS WITH SLEEP DISORDERS

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Introduction: Previous data from our institution showed that patients with the greatest sleep misperception had the fewest number of stage shifts on the polysomnography (PSG) and that there were no differences in sleep perception amongst varying diagnostic, sleep-disordered, groups. Arousal misperception is a discrepancy between the number of perceived arousals relative to objectively defined arousals. To date, no studies have examined arousal perception in obstructive sleep apnea (OSA) or other sleep disorders. The aim of this study was to evaluate the factors that affects subjects' perception of arousals and if these factors are similar to subjects who misperceive their total sleep time (TST).
Methods: A retrospective study was conducted with review of over twenty five hundred (2500) charts. Two hundred and ten (210), otherwise healthy patients were divided into five groups: primary insomnia; upper airway resistance syndrome (UARS)/primary snoring; mild, moderate and severe OSA. Subjective arousals, as documented by the patients after their PSG, were compared to objectively defined PSG arousals. The subjects' age, BMI, TST, TST sleep perception, sleep efficiency, stage shifts, REM and delta time were compared. The inclusion criteria were normal percentage of REM sleep and TST $\geq$ 4.5 hours on the diagnostic PSG.
Results: The groups were compared on the continuous PSG variables using Bonferroni corrections for multiple comparisons. The UARS/primary snoring group differed significantly from the moderate and severe OSA groups in terms of perceived arousals relative to TST and perceptual arousal percentage. The UARS/primary snoring group perceived more arousals than the moderate and severe OSA groups. The UARS/primary snoring group had more non-respiratory arousals compared to the other apneic groups but fewer than the insomnia group. For, the total number of scored arousals, there was a linear increase in arousals as OSA severity increased with the insomnia groups and UARS groups having fewest total arousals. The differences in total number of arousals was also significant. Stage shifts were not or very weakly correlated with arousal perception. The number of perceived arousals was weakly and negatively correlated with perception of TST.
Conclusion: Although patients with UARS/primary snoring have fewer arousals, they perceive their arousals more than patients with moderate or severe OSA. The non-respiratory related arousals are probably perceived differently than respiratory arousal related perception.

0643

SLEEP PERCEPTION AND ITS ASSOCIATION WITH POLYSOMNOGRAPHIC PARAMETERS IN PATIENTS WITH PRIMARY INSOMNIA

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Introduction: Patients with primary insomnia tend to underestimate sleep duration. We aimed to further compare them between severe under-estimators (SUs) and moderate ones (MUs).
Methods: In each of 110 consecutive patients diagnosed as primary insomnia with NPSG (nocturnal polysomnography), Pittsburgh Sleep Quality Index (PSQI) and Morning Questionnaire, we calculated the ratio of perceived sleep duration to total sleep time (TST) from NPSG (cut-off at 0.6) and organized 2 groups: SUs (< 0.6) and MUs (≥ 0.6). Comparisons were made on clinical characteristics and NPSG parameters. Independent t-test and $\chi 2$-test were used for analyses (two-tailed, $P < 0.05$).
Results: Fifty-five subjects (19 males, 36 females) belonged to SUs and 55 subjects (32 males, 23 females) to MUs. SUs were significantly older than MUs (54.5 ± 16.3 vs. 44.2 ± 18.0 yrs, $t = 3.1$, $P < 0.05$), with more women than men in SUs ($\chi 2 = 6.1$, $P < 0.05$). On NPSG, SUs slept significantly shorter (TST: 357.9 ± 92.0 vs. 423.3 ± 62.9 min, $t = -4.3$, $P < 0.01$), less deeply (slow wave sleep: 4.2 ± 4.8 vs. $9.2 \pm 10.3\%$, $t = -3.2$, $P < 0.05$) and spent less time in REM sleep (13.6 ± 8.4 vs. $17.0 \pm 7.1\%$, $t = -2.2$, $P < 0.05$). No significant differences between SUs and MUs were found in body mass index and latencies (to sleep, REM, and

slow wave sleep). SUs scored significantly higher in PSQI than MUs (14.1 ± 3.7 vs. 9.7 ± 4.5 t = 5.3, P < 0.01).
Conclusion: Primary insomniacs generally under-estimated sleep duration. Severe under-estimators were older and had poorer sleep on NPSG vs. moderate ones.

0644

SLEEP MISPERCEPTION IN CHRONIC INSOMNIA: THE ROLE OF OBJECTIVE SLEEP DURATION AND PSYCHOLOGICAL PROFILES

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Introduction: Sleep misperception is considered by some investigators a common characteristic of chronic insomnia, i.e. DSM-IV, whereas others propose it as a separate diagnosis, i.e. ICSD-2. The frequency and the determinants of sleep misperception in general population samples are unknown. Recent studies showed that objective sleep duration may be a useful marker in phenotyping insomniacs. In this study we examined the role of objective sleep duration and psychological profiles on sleep misperception in a large, general population sample.
Methods: 142 insomniacs and 724 controls selected from the Penn State Adult Sleep Cohort a general random sample of 1,741 individuals (age ≥ 20 years) were studied in the sleep lab, completed the Minnesota Multiphasic Personality Inventory, and were split into two groups based on their objective sleep duration: "normal sleep duration" (≥ 6 hours) and "short sleep duration" (< 6 hours).
Results: Insomniacs with normal sleep duration, in contrast to their respective controls, underestimated their sleep duration, whereas insomniacs with short sleep duration, similarly to their respective controls, overestimated their sleep duration. Insomniacs with normal sleep duration showed high depression and anxiety, and low ego strength, whereas insomniacs with short sleep duration showed emotional distress commonly associated with medical disorders.
Conclusion: Underestimation of sleep duration is prevalent among insomniacs with objective normal sleep duration but not in those with short sleep duration. Anxious-ruminative traits and poor resources for coping with stress appear to mediate the underestimation of sleep duration. These data further support the clinical utility and validity of objective sleep measures in phenotyping insomnia.
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0645

A PROSPECTIVE STUDY ON AWAKENINGS IN CHRONIC INSOMNIACS: SELF-REPORTED CAUSES VS. PSG FINDINGS

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Introduction: Chronic insomniacs suffer nighttime awakenings, yet the etiology of awakenings is not well researched. In comparing patients' subjective explanations for awakenings to PSG data, we hypothesized insomniacs would predominantly report "no known cause" and some psychological or physiological causes; and, PSG would show primarily "spontaneous" awakenings.
Methods: This prospective study collected data on psycho-physiological insomniacs from Maimonides Sleep Arts and Sciences; all met AASM criteria for Insomnia Disorder, ISI ≥ 15, and all PSG studies were scored by a blinded, independent entity. To enhance study design, we excluded patients with risks for co-morbid sleep-disordered breathing (SDB) (obesity, apnea report, choking, gasping, heroic snoring) other than mild snoring to avoid potential confound due to awakenings related to breathing. Prior to PSG, patients underwent a qualitative interview regarding perceptions on insomnia and awakenings. One week later, patients were informed about PSG results, including any sleep disorder diagnoses, and then the qualitative interview was repeated.
Results: Seventeen insomniacs completed the protocol [mean (SD)]: age 42.82 (15.31); ISI 22.71 (3.00); ESS 6.00 (5.362); sex 5m, 12f. Subjective awakening causes: 18% reported mental causes (racing mind, stress, nightmares); 18% reported physical causes (nocturia, pain, discomfort); 29% reported mental and physical causes; 35% indicated no known cause. No patient reported breathing difficulty as a cause. Contrary to our hypothesis, SDB was present in all 17 patients, AHI 9.52 (14.47), RDI 35.34 (17.36). Mean SDB awakenings were 3.6/hr; mean spontaneous awakenings were 1.2/hr. After PSG review, 16 of 17 patients reported breathing may cause their awakenings; 13 were interested in sleep breathing treatments.
Conclusion: Though our sample had roughly zero probability of comorbid SDB, it was present in 100% of patients, and SDB-awakenings were three times that of spontaneous awakenings. SDB may be a causal yet covert factor for awakenings in chronic insomniacs. Other mental or physical causes also need further investigation.

0646

SLEEP FRAGMENTATION, EXCESSIVE DAYTIME SLEEPINESS, FATIGUE AND ALERTNESS

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Introduction: Sleep fragmentation has been linked to sleepiness in patients with OSA and during experimentally-induced sleep fragmentation. However, little is know about the contribution of sleep fragmentation to excessive daytime sleepiness (EDS), fatigue and poor alertness in sleep clinic patients.
Methods: Consecutive chart of 629 patients who were referred for sleep assessment and who underwent polysomnography (PSG) and MSLT testing and completed questionnaires (Epworth Sleepiness Scale - ESS; Stanford Sleepiness Scale - SSS), fatigue (State Fatigue Scale - FS), and alertness (ZOGIM-A alertness scale and THAT alertness scale) were used in this study. EEG arousals were defined as > 3 sec changes in EEG frequency to alpha rhythm.
Results: Patients were diagnosed with a variety of sleep disorders including obstructive sleep apnea, narcolepsy, insomnia, periodic limb movements and idiopathic hypersomnia. 53% were found to have EDS on the MSLT; 43% and 21% reported symptoms of EDS on the ESS and SSS, respectively; and, 35% reported being excessively fatigued. Arousal index was not correlated with sleepiness (MSLT, r = -0.002; ESS, r = 0.13; SSS, r = -0.05), fatigue (FS, r = -0.09) or alertness levels (ZOGIM-A, r = 0.12; THAT, r = 0.10). There was no difference in arousal indices for patients with EDS based on the MSLT (P = 0.43) or ESS (P = 0.49) versus those without EDS. Percentage wakefulness on the PSG was also not found to be correlated with EDS (MSLT, r = 0.05; ESS, r = 0.04; SSS, r = -0.002).
Conclusion: EDS, fatigue and poor alertness are common symptoms in sleep clinic patients but sleep fragmentation (arousal index or % wakefulness) have a very small impact on sleepiness, fatigue or poor alertness in patients with sleep disorders. The findings of this study support that the etiology of EDS, fatigue and poor alertness are multifactorial in nature. In certain patients, increased arousals may be a necessary and sufficient cause of EDS. However, a sleep quality scale that incorporates multiple facets of sleep architecture may be a more useful approach.

0647

ARE WE MISSING OUT ON PATIENTS WITH SLEEP COMPLAINTS: THE PREVALENCE OF INSOMNIA COMPLAINTS IN A CLINICAL POPULATION AND RELATED VARIABLES

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Introduction: The prevalence of primary insomnia is estimated at 10%, but an estimated 50% of patients with co-morbid medical conditions present with symptoms. There is limited data of insomnia incidence in large clinical populations. This study attempts to measure prevalence of insomnia symptoms in a large database of patients presenting for clinical diagnostic sleep evaluation.
Methods: As part of a large database review for all night clinical diagnostic polysomnography, patients from November 2006 through April 2009 who underwent all night diagnostic polysomnography evaluation, were between the ages of 18-79, and did not perform shift work were included in the analysis. As part of their evaluation, all patients completed a medical/sleep history questionnaire, the Pittsburgh Sleep Quality Index (PSQI), and various daytime functioning scales. Presence of insomnia symptoms was based upon reported sleep latency and component scales 2, 4, and 5 of the PSQI. An individual was determined positive for insomnia complaint if scoring positive on at least 2 of the 4 dimensions.
Results: A total of 1854 patients were included. Based upon the scoring criteria, 48.6% were positive for insomnia complaints. In comparison, those with insomnia had a significantly higher BMI (34.4 vs. 32.1), higher incidence of affective disorders (31% vs. 25%), hypertension (40% vs. 35%), diabetes (16% vs. 10%), and higher pain scores (19.1 vs. 12.6) than those without insomnia symptoms. Those with insomnia complaints also scored significantly worse on the PSQI (12.1 vs. 6.5) and had more fatigue (4.6 vs. 4.1). In fact, controlling for AHI > 5, those with insomnia complaints still reported significantly higher fatigue complaints (67.4%; $\chi 2 = 12.9$, $P < .001$).
Conclusion: There are a high proportion of undiagnosed insomnia patients who present for sleep evaluation. There are several similar co-morbid factors present in both insomnia and sleep apnea populations, such as daytime functioning impairments, hypertension, and depression that often get overlooked as solely attributable to sleep apnea during diagnostic evaluation.

0648

HYPNOTIC USE IN INSOMNIA PATIENTS DURING POLYSOMNOGRAPHY: RELATIONSHIP WITH SLEEP DISORDERED BREATHING

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Introduction: Patients with insomnia under regular hypnotic prescription, who undergo polysomnography may interrupt medication in the night of the exam. The effects of hypnotics on breathing during sleep in insomnia patients are insufficiently understood. We compared sleep disordered breathing measured during polysomnography in patients with insomnia using or not hypnotics.
Methods: Before undergoing conventional polysomnography to investigate insomnia, patients answered a questionnaire disclosing medication use and were divided in three groups: 0-no previous use of hypnotics; 1-regular use of hypnotics for at least one month, but suspended in the polysomnography night; 2-regular use of hypnotics and in the polysomnography night.
Results: We analyzed polysomnography results from 150 patients with chief complaint of insomnia. (40% men) who answered the questionnaires; 83 reported regular hypnotic use, being 54 in the night of the study. Sleep efficiency in group 0 was 68 ± 14%; In group 1, 71 ± 18%; And in group 2, 81 ± 12% (ANOVA; P = 0.000006). The mean apnea-hypopnea-index in group 0 was 4.0 ± 4.9/hour; In group 1, 14 ± 15/hour; And in group 2, 12 ± 12/hour (P = 0.000005). The minimum O2 saturation (SaO2min) in group 0 was 90 ± 3.5%; In group 1, 86 ± 4.9%; And in group 2, 84 ± 7.7% (P = 0.000003). apnea-hypopnea-index and SaO2min were not different between groups 1 and 2.
Conclusion: Insomnia patients taking hypnotics in the night of the polysomnography have significantly higher sleep efficiency, validating the hypnotic effect. Higher apnea-hypopnea-index and lower minimum O2 saturation confirm the hypothesis that hypnotic is associated with increased sleep disordered breathing. No difference in sleep disordered breathing between patients who interrupted or not hypnotic use in the polysomnography night, suggest either residual effect of the medication or preexistent sleep disordered breathing not being affected by hypnotics.
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0649

BIASED PROCESSING OF SLEEP-RELATED STIMULI IN CHILDREN AT-RISK OF INSOMNIA

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Introduction: Recent research has consistently suggested that poor sleepers are more likely to respond to sleep-related cues more quickly and interpret ambiguous stimuli as sleep-related more often than their good sleeping counterparts. Underpinning these findings is the assumption that poor sleepers have an attentional bias towards sleep; however, the mechanisms that drive and maintain this bias are poorly understood. Research in the attentional bias field, specifically aimed at those with depression and anxiety disorders, has recently demonstrated that this bias can be seen to predate the disorder, suggesting that an attentional bias may be a predispositional factor in the development of illness. The aim of this study was to examine whether 'predispositionally vulnerable' children (i.e. those whose parents have insomnia) are more likely to demonstrate an attentional bias towards sleep than children of good sleepers.
Methods: A sleep-state induction was given to 89 children between the ages of 9-12 (44 'vulnerable children' and 45 'controls') before they completed a modified Emotional Stroop task. The children were recruited through the Glasgow Science Centre. After testing the children completed the Sleep Self Report and were asked whether they could guess at the aims of the experiment.
Results: A MANOVA showed no difference between the groups on response latency overall ($F(1,87) = 1.88$, $P = .17$). Additionally a t-test examining differences in response latencies between sleep-related and neutral words within the 'vulnerable' group showed no significant differences ($t = 0.87$, $N = 44$, $P = .38$). Interestingly, the 'vulnerable' children were more likely to guess the aim of the experiment compared to controls.
Conclusion: These results may in part be explained by the fact that there were no significant differences on the Stanford Sleepiness Scale between both groups after the sleep-state induction, suggesting it may have had a limited effect. Similarly, the results could reflect a difference between disorders that are expressed predominately throughout the day (depression and anxiety) and those that are expressed at night (insomnia). The results are also discussed in terms of the literature on attentional bias in insomnia, including the effect of a priming bias.

0650

FRONTAL HYPERACTIVATION AND ENHANCED SIMULTANEOUS SYNCHRONIZATION IN THE FRONTO-PARIETAL ENDOGENOUS ATTENTION NETWORK DURING SOP IN INSOMNIACS

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Introduction: Trouble falling asleep and sleep misperception are core symptoms of psychophysiological and paradoxical insomnia and have been associated with increased cognitive arousal and cerebral hyperactivation. Synchronization between Fronto-parietal regions, involved in controlling endogenous attention, might be implicated in these symptoms.
Methods: We analyzed EEG activity for every two seconds during the sleep onset period (SOP) in 9 right-handed non-medicated primary insomniacs (19-34 years old), carefully screened for psychophysiological/paradoxical insomnia with no other sleep/medical condition (psychiatric, medical and sleep examination, and PSG) and in 9 controls matched for age, dexterity and education. Standard PSG and EEG of the first night in the laboratory were analyzed taking advantage of "the first night affect" as a challenge for promoting insomnia. EEG from SOP from lights out to consolidated sleep (3 consecutive minutes of delta sleep), was digitized (1024 Hz). Power, coherent activity and source density (VARETA) were obtained for every artifact-free two-sec non-overlapping EEG epochs. Participants also evaluated subjective sleep latency and sleep quality.
Results: Compared to normals, patients exhibited significantly higher power ($P > 0.01$), fronto-parietal coherence ($P < 0.0005$) and current density ($P < 0.05$) in gamma oscillations in left middle frontal gyrus during SOP, differences that disappeared in consolidated sleep coincident with subjective sleep latency estimation indicating frontal hyperactivation and enhanced synchronization linking the endogenous fronto-parietal attention network during SOP in insomniacs.
Conclusion: These findings suggest that frontal deactivation and disengagement of brain regions involved in endogenous attention are impaired in psychophysiological/paradoxical insomnia and contribute to subjective sleep latency overestimation and sleep misperception.
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0651

ASSOCIATION BETWEEN SUBJECTIVE DAYTIME COMPLAINT AND BOLD ACTIVATION IN PATIENTS WITH PRIMARY INSOMNIA

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Introduction: The diagnosis of Primary Insomnia (PI) requires a subjective report poor sleep and subsequent daytime impairment. Despite this requirement, studies to date have shown limited evidence of objective daytime impairment in PI. Prior published work postulated that the daytime complaint might be explained by a neurobiological compensation model. Furthermore, it was proposed that the daytime complaint might result not from an inability to do a task ("output") but rather from the perception that doing so is more difficult than would be the case if one had slept well ("effort"). The current investigation attempted to examine this hypothesis
Methods: 13 PIs (7F; 39.8+/-7.9yrs) were tested on three cognitive tasks: Verbal Learning (encoding), NBACK (working memory), and GO-NOGO (attention/inhibition) during functional MRI. Scores from the Insomnia Severity Index (item #3) were regressed on BOLD signal to assess the relationship between daytime complaint and activation.
Results: For the Verbal Learning analyses significant associations were found in three regions (two negative/one positive). For NBACK, 21 significant areas of association (19 negative/2 positive) were revealed. For the attention component of the GO-NOGO, 40 areas of significant association (all negative) were found. For the inhibition component of GO-NOGO, 20 areas of significant association were found for correct stops (14 negative/6 positive).
Conclusion: Analyses from this investigation demonstrated, for the most part, that greater daytime complaint was associated with decreased activation on the tasks. Contrary to a priori hypotheses, these results suggest that PIs with greater complaints of daytime dysfunction may actually exhibit diminished cerebral responses to cognitive demands. Thus, rather than daytime complaints representing an interpretation of need for greater cognitive resources during task performance, such complaints may represent an accurate intrinsic understanding of the difficulty PIs have in responding to task demands.
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0652

NREM ERPs FOLLOWING BRIEF SPONTANEOUS AWAKENINGS DURING THE NIGHT IN PATIENTS WITH PRIMARY INSOMNIA: A PRELIMINARY STUDY

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Introduction: The neurocognitive model of primary insomnia hypothesized that the sleep difficulties in insomniacs may result from enhanced information processing during sleep. Previous studies also found that insomnia patients have smaller N350 amplitude in the beginning of night, indicating poorer inhibition of information processing during the beginning of sleep. However, insomnia patients complain not only difficulty initiating sleep but also difficulty maintaining sleep. Therefore, this study aims to explore NREM ERPs during the sleep following spontaneous awakenings during the night to further understand the pathologies of primary insomnia.
Methods: 13 patients with primary insomnia (7F 6M; mean age = 37.8) and 11 normal sleepers (5F 6M; mean age = 36.1) participated in the study. NREM ERPs were elicited with an oddball paradigm during the first 5 minutes of sleep following spontaneous nighttime awakening that lasted longer than one minutes. N350 and P900 in stage 1 and stage 2 sleep were analyzed.
Results: As expected, both N350 and P900 were significant larger in responding to target tones than non-target tones. They were also shown to be larger during the first half of the night than the second half on most of the comparisons of N350 (Target: stage2: $F = 14.23$, $P = .001$; Non-target: stage1: $F = 8.98$, $P = .011$, stage2: $F = 19.73$, $P < .001$) and on stage 2 target tones only for P900 (S2: $F = 4.60$, $P = .043$). There is a near significant group difference with smaller N350 in stage 1 sleep for target tone ($F = 4.47$, $P = .056$). No other group main effects or interactions with group were indicated.
Conclusion: The results indicate a possible deficit in inhibitory process during sleep/wake transition following nighttime spontaneous awakenings in patients with primary insomnia. However, this deficit was not evidenced after getting into more stable sleep. This issue warrant further study in the future.

0653

BEAT TO BEAT HEART RATE ASSOCIATED WITH EEG AROUSALS IN INSOMNIA PATIENTS AND CONTROLS

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Introduction: Much is known about EEG arousals and overall heart rate in primary insomnia patients compared with controls. This study examined beat by beat acceleration in heart rate following arousals (controlled for sleep stages) to determine differential cardiac responsiveness during arousal in insomnia patients versus controls.
Methods: Eleven patients with primary insomnia and age-matched normal sleepers had a 2-night polysomnographic evaluation. The first night ruled out clinical sleep disorders and demonstrated study requirements (latency greater than 30 min or sleep efficiency < 85% in insomnia patients). Heart rate data preceding and following EEG arousals from stages 1, 2 (early and late), REM (early and late), and SWS were downloaded from the digitized recordings and analyzed by ANOVA.
Results: The Insomnia group did not differ from the normal group in age (39.8 versus 35.7 years; t = 1.23,NS). ANOVA showed a significant beat after arousal by group interaction (F = 2.55; P < .005) and a significant sleep stage by time of night by group interaction (F = 6.40; P < .001). The first interaction showed that both groups had similar heart rate acceleration after arousals that did not return to baseline by the 10th beat, but normals recovered more quickly (significant for beats 7-10) so that by the 10th beat, normals were at 96% of their baseline while insomnia patients were at 89% of their baseline. The significant stage interaction showed that the insomnia patients had significantly higher heart rate than normals during arousals from REM throughout the night but not during stage 2 sleep.
Conclusion: These data indicate that normal sleepers and insomnia patients have similar heart acceleration from EEG arousals during sleep except insomnia patients have longer lasting acceleration that is more pronounced in arousals from REM. Longer arousal responses could be either the cause or result of longer awakenings or difficulty in returning to sleep commonly found in insomnia.
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0654

DOSE RESPONSE RELATIONSHIP OF LY2624803 ON SLEEP INITIATION AND MAINTENANCE IN A MODEL OF TRANSIENT INSOMNIA

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Introduction: LY2624803 (HY10275) is a novel and selective centrally active H1 inverse agonist and 5HT2A antagonist with a profile designed to improve sleep initiation and maintenance by encouraging natural sleep. The effects of LY2624803 on sleep have been explored in a 5-hour phase advance model of transient insomnia.
Methods: Data were pooled from two single-dose, double-blind, placebo-controlled, randomized, crossover studies of LY2624803 (LY) oral doses of 0.3, 1.0, 3.0, and 6.0 mg. A total of 83 healthy M/F subjects without history of insomnia between the ages of 18 and 69 years with a BMI of 19 to 30 kg/m2 and a WASO score ≥ 45 minutes during placebo (Pbo) lead-in phase were randomized. Wake time after sleep onset (WASO), total sleep time (TST) and latency to persistent sleep (LPS) were determined from 8-hour PSG. WASO was the primary endpoint in each study. The raw data is described here using descriptive statistics. Model-based analysis of pooled data is not shown.
Results: PSG-derived parameters for 83 evaluable subjects were as follows: Numbers of administrations for each treatment were Pbo = 61, LY0.3 = 24, LY1.0 = 50, LY3.0 = 72, LY6.0 = 23. WASO (MEAN+/-SEM) minutes were: Pbo = 128.4 ± 10.9, LY0.3 = 107.8 ± 13.4, LY1.0 = 82.6 ± 9.5, LY3.0 = 61.4 ± 5.9, LY6.0 = 42.2 ± 9.4. TST (MEAN+/-SEM) minutes were: Pbo = 323.8 ± 11.5, LY0.3 = 346.9 ± 13.8, LY1.0 = 374.5 ± 10.2, LY3.0 = 399.4 ± 6.9, LY6.0 = 423.3 ± 10.0. LPS (MEAN+/-SEM) minutes were: Pbo = 36.5 ± 6.8, LY0.3 = 37.8 ± 8.0, LY1.0 = 27.3 ± 4.6, LY3.0 = 24.9 ± 4.3, LY6.0 = 17.0 ± 2.0. Other observations include increased percent slow wave sleep and no impact on percent time in REM sleep. All doses of LY2624803 were well-tolerated.
Conclusion: LY was dose-dependently better than Pbo in WASO (LY6.0mg was 67% smaller than Pbo), TST (LY6.0 mg was 31% larger than Pbo), and LPS (LY6.0 mg was 53% smaller than Pbo) when evaluated in 5-hr phase-advanced subjects. Ongoing investigations in patients with insomnia seek to corroborate these effects with patient-reported outcomes.

0655

EPLIVANSERIN INCREASES SLOW WAVE ACTIVITY AND DECREASES BETA POWER IN PRIMARY INSOMNIA

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Introduction: Some investigations indicate that primary insomnia patients have reduced slow wave sleep and increased fast frequency activity in NREM. Eplivanserin, a 5-HT2A antagonist under development as a treatment for chronic insomnia, has been shown to increase slow wave sleep (SWS). The present analysis compared the spectral NREM EEG profile of eplivanserin versus placebo in a large sample of chronic primary insomnia patients.
Methods: A sub-sample of primary insomnia patients randomized to a six-week period with either eplivanserin 8mg or placebo was randomly selected from the entire study sample. Spectral analysis (Vitascore 1.50) was performed on PSGs for screen nights (with placebo) and nights 41 and 42 of treatment (with eplivanserin or placebo) for 102 eplivanserin patients (52f, 50m) and 111 placebo patients (60f, 51m). Absolute power in quarter-Hz bins was obtained for NREM central EEG and summed into 1-Hz bins, as well as delta, theta, alpha, sigma, and beta bands. Spectral power from the treatment nights was then expressed relative to baseline (screen nights).
Results: Compared to the placebo group, relative spectral power for the eplivanserin group was significantly higher in the 1-3, 6, and 7-Hz bins and significantly lower in the 13-15, 17-22-Hz bins (P < 0.05 for all). Eplivanserin relative spectral power was also significantly higher than placebo in the sub-delta (0.25-0.75 Hz) and delta (0.75-4.75 Hz) bands, while relative spectral power in sigma (12-15 Hz) and beta-1 (15-20 Hz) bands was significantly lower (P < 0.05 for all).
Conclusion: Changes in relative NREM spectral power with eplivanserin can be characterized as an increase in slow wave activity and a decrease in beta activity in the NREM spectral profile of primary insomniacs.
Support (If Any): Sanofi-Aventis

0656

PHASE-I STUDY OF THE SAFETY, TOLERABILITY, PHARMACOKINETICS AND SLEEP PROMOTING ACTIVITY OF Neu-P11, A NOVEL PUTATIVE INSOMNIA DRUG IN HEALTHY HUMANS

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Introduction: Neu-P11 is a combined melatonin MT1/MT2/MT3 and serotonin 5-HT1A/1B,5-HT2B receptor agonist. In rats Neu-P11 demonstrated potential anxiolytic and antidepressant effects and significant hypnotic effects with slow wave sleep enhancing activity. The aim of the double-blind randomized placebo-controlled first-in human study was to investigate safety, tolerability, pharmacokinetics and sleep promoting activity of single ascending oral doses of Neu-P11 in humans.
Methods: Within each of 4 dosage groups of 8 healthy male adult subjects, 2 subjects were randomized to receive placebo and the remaining 6 subjects were randomized to receive Neu-P11 (5, 20, 50 and 200 mg) at 14:00 h (T0). Safety, tolerability and pharmacokinetics were assessed for 24 hours. Subjects were given nap opportunities at T+2h, T+3h and T+4h with EEG and sleep scale recordings.
Results: The extent of systemic exposure to Neu-P11 increased in an approximately dose-proportional manner. Maximum plasma concentrations of Neu-P11 were attained (tmax) at 0.8 to 1.3 h post dose; thereafter, plasma concentrations declined with a mean apparent terminal half-life of 2.3+0.6 h. All adverse events were mild in severity and the incidence was similar between all treatment groups, including placebo. There were no serious adverse events. Evidence of sleep promoting activity of Neu-P11 was indicated by significant increases in sedation assessment scores (Stanford Sleepiness Scale) at T+2h and T+4h and trends (both dose-dependent and time-related) of decreases in number of awakenings and wake after sleep onset (WASO) during the T+2h and T+3h EEG recording periods with an increase in relative Theta band activity.
Conclusion: This study demonstrates a good safety and tolerability profile in the tested single dose range of Neu-P11 and provides the first indication for clinical activity of Neu-P11 in sleep maintenance and consolidation.
Support (If Any): Neurim Pharmaceuticals Ltd

0657

OPEN-LABEL STUDY OF YOKUKANSAN USING CYCLIC ALTERNATING PATTERN AS AN OBJECTIVE MARKER OF SLEEP INSTABILITY IN PATIENTS WITH PSYCHOPHYSIOLOGICAL INSOMNIA

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Introduction: The efficacy and safety of the Kampo medicine Yokukansan (YKS, TJ-54) in the treatment of insomnia were investigated in an open-label study.
Methods: Six subjects diagnosed as having psychophysiological insomnia were administered YKS (7.5 g/day) for one week, and their sleep status was evaluated objectively and subjectively before and after treatment. For the objective evaluation, cyclic alternating pattern (CAP) was analyzed in addition to R&K (Rechtschaffen and Kales) methodology using polysomnography (PSG) to investigate the effect of YKS on sleep quality (stability).
Results: In the subjective evaluation, the Visual Analog Scale (VAS) and Saint Mary's Hospital Sleep Questionnaire (SMH) were used, and the Psychomotor Vigilance Test (PVT) was used for evaluation of mental work capacity. The results showed that YKS had no influence on sleep parameters based on R&K, but the CAP rate, CAP cycle frequency and subtype A2 frequency decreased significantly after YKS treatment (CAP rate: 47.5→35.4 %, $P < 0.05$, CAP cycle frequency: 295.8→223.7 times, $P < 0.05$, subtype A2 frequency: 124.7→82.5 times, $P < 0.05$). In terms of VAS, a significant improvement was seen in 5 items; "feeling of tension", "feeling of peace", "feeling of fatigue", "feeling of heaviness of head" and "feeling of lassitude". Neither adverse reactions nor adverse events were noted.
Conclusion: In this study, YKS improved sleep quality (stability) without influencing sleep macro structure and caused no adverse reactions, suggesting that YKS is an effective insomnia-curative drug with good tolerability.
Support (If Any): Tsumura & Co.

0658

PHASE I, RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED, CROSSOVER STUDY TO COMPARE THE PHARMACOKINETICS OF A SINGLE ORAL DOSE OF A NEW ZALEPLON FORMULATION (SKP-1041) AND OPEN-LABEL ZALEPLON IN HEALTHY ELDERLY SUBJECTS

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Introduction: Insomnia symptoms increase with age, especially problems with sleep maintenance. A novel formulation of zaleplon (SKP-1041) that releases active drug via proprietary Geoclock® technology provides an extended plasma concentration profile compared to commercially-available zaleplon 10 mg (Sonata®). This study compared the pharmacokinetics of a single oral dose of SKP-1041 15 mg and commercially-available zaleplon 10 mg (ZAL), and next-morning neurobehavioral effects when administered to healthy elderly subjects.
Methods: This was a single-center, double-blind, randomized, three-way crossover study with three treatment periods of two nights each when subjects randomly received SKP-1041, ZAL, or placebo. Neurobehavioral testing within 2 hours of awakening the morning after Night 1 included the digit symbol substitution test, the psychomotor vigilance test, 4-lead EEG, driving simulation, Karolinska sleepiness scale, the digit span test, and paired associate word list task (PAWT).
Results: Twenty-two subjects (13 males, 9 females; ages 65 - 73) were evaluated. Median Tmax was 3.75h (range: 2-5.5h) for SKP-1041 and 2.0h (range: 1-4h) for ZAL. Drug exposure (AUC) was greater with SKP-1041 (74.6 ± 7.2 ng.h/mL) compared to ZAL (50.3 ± 4.8 ng.h/mL), this was explained by the dosage difference. Kinetic profiles resembled those reported for young subjects. Pharmacodynamic assessments of neurobehavioral functions showed no impairment with SKP-1041 vs placebo on any test. Memory consolidation, as measured by PAWT, was significantly ($P < 0.05$) impaired vs placebo with ZAL, but not with SKP-1041. SKP-1041 was well-tolerated, with 8 adverse events (most unrelated to study drug) reported in 7 subjects.
Conclusion: The time profile and AUC of SKP-1041 15 mg in these elderly subjects were consistent with previous results in young subjects. There were no next-morning neurobehavioral effects or cognitive impairment with SKP-1041.
Support (If Any): Study supported by Somnus Therapeutics, Inc.

0659

PHASE I, RANDOMIZED, CROSSOVER STUDY TO COMPARE THE DAY VS. NIGHT PHARMACOKINETICS OF A SINGLE ORAL DOSE OF A NEW ZALEPLON FORMULATION IN HEALTHY YOUNG VOLUNTEERS

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Introduction: The majority of insomnia patients report sleep maintenance difficulty. A novel formulation (SKP-1041) of zaleplon that releases active drug via proprietary Geoclock® technology has been shown to have a pharmacokinetic profile consistent with drug release during the middle hours of the night. The present study evaluated the effect of daytime versus nighttime dosing on the pharmacokinetics of SKP-1041 15 mg (primary objective), and assessed noise-induced arousability during a nighttime sleep period (secondary objective).
Methods: Single-center, randomized, open-label, crossover study in healthy young volunteers. To evaluate time-of-day effects on pharmacokinetics, subjects randomly received SKP-1041 at 9:00 AM or 10:30 PM during two counterbalanced study periods with a between-period 4-day washout. In each period blood was drawn -2h and -1h predose; postdose at 1h, 2h, every 30min through 9h, then hourly through 12h. During a third period subjects randomly received SKP-1041 or placebo at 10:30 PM; polysomnography arousals and wake-after-sleep-onset were measured during 30-minute exposures (1:00, 2:30, 4:00, and 5:30 AM) to car/truck noise with decibels increasing from 40 to 55 dB.
Results: Twenty-three subjects (8 males, 15 females; ages 20 - 46) were evaluated. For both day and night dosing, zaleplon Cmax occurred at 3.5-4.0 hr postdose (medians). Zaleplon plasma AUC was similar after both day (84.6 +8.7 ng.h/mL) and night (85.4 +10.2 ng.h/mL) administration. During the 2:30 AM noise session, at zaleplon Cmax, subjects on SKP-1041 spent significantly less time awake and had significantly fewer arousals in the 60sec following noise exposure. Logistic regression analysis revealed that subjects on SKP-1041 had approximately 4 times less chance to present an arousal after noise exposure. SKP-1041 was well-tolerated in all (N = 24) subjects.
Conclusion: There was no effect of day versus night administration on the pharmacokinetics of SKP-1041. Proof-of-concept for sleep maintenance was observed in the second noise session at zaleplon Cmax.
Support (If Any): Study supported by Somnus Therapeutics, Inc.

0660

CHRONIC USE OF ZOLPIDEM IS NOT ASSOCIATED WITH LOSS OF EFFICACY

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Introduction: Hypnotics are frequently only used in treating insomnia for the short-term because of concerns about loss of efficacy. However, insomnia is a chronic disorder. A number of self-report studies have now shown that benzodiazepine receptor agonists (BzRAs) remain effective for 6-12 months of nightly use. This is the first PSG study to assess the efficacy of a BzRA following long-term nightly use.
Methods: Participants (N = 61), ages 23-70 yrs, meeting DSM-IV criteria for primary insomnia, and a polysomnographic sleep efficiency of < 85%, with no other primary sleep disorders, without psychiatric diseases or drug dependency and in good general health were recruited. Participants were randomly assigned to receive 10mg zolpidem or placebo, double-blind, hs for 8 consecutive months. To assess zolpidem efficacy, 8-hr PSGs were collected on each of two nights after 8 months of nightly use of placebo or active drug.
Results: At screening, sleep efficiency in the placebo group was 73.5+/-8.8% and in the drug group 74.8+/-8.8%. After 8 months of nightly use zolpidem was associated with a significantly higher sleep efficiency relative to placebo (85.1+/-9.9 vs 76.6+/-11.9; P = 0.004). This sleep efficiency change represents an effect size of 0.86 compared to placebo. The zolpidem group also had a significantly reduced sleep latency (13.9+/-18.6 vs 35.8+/-36.5 min; P = 0.001) and a significantly decreased wake after sleep onset (63.6+/-45.2 min vs 95.4+/-51.0 min; P = 0.046) relative to the placebo group. Similar effects on sleep induction and maintenance were found on night 2. No significant effects on standard sleep stages were observed on either night.
Conclusion: After 8 months of nightly zolpidem (10mg) use the drug remains efficacious at both sleep induction and maintenance.
Support (If Any): National Institute of Drug Abuse grant#: R01DA17355 awarded to Dr. Roehrs

0661

CHAMOMILE HIGH GRADE EXTRACT FOR CHRONIC PRIMARY INSOMNIA: PRELIMINARY RESULTS FROM A RANDOMIZED CONTROLLED PILOT STUDY

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Introduction: Chronic insomnia is a prevalent condition with associated personal and societal costs. Few well-controlled studies have evaluated complementary treatments despite widespread use by insomnia sufferers. We assessed the efficacy and safety of high-grade chamomile extract for chronic primary insomnia in a double-blind placebo-controlled randomized pilot study.
Methods: Twenty participants with DSM-IV primary insomnia (13 women, mean age 47.0 ± 13.2 years) who were otherwise healthy have so far been recruited via advertisement. Eligibility required a total sleep time (TST) of < 6.5 hours and sleep onset latency and/or wake after sleep onset of > = 30 minutes on 3 or more nights per week for at least 6 months. Participants were randomized to 28 days of 3 tablets twice daily of Chamomile High Grade Extract (n = 8), standardized to 0.4% of (-)-α-bisabolol (MediHerb) or matching placebo (n = 12). Participants completed a 7-day sleep diary, Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), and Fatigue Severity Scale (FSS) pre- and post-treatment. Toxicity evaluation/adverse events were recorded weekly and compliance was assessed with tablet count at post-treatment.
Results: Sleep diaries indicated no significant improvements with chamomile versus placebo after 28 days of treatment for total wake time (-15.7 ± 22.6 vs. -29.2 ± 39.1 mins, P > .05), TST (19.3 ± 60.6 vs. -1.2 ± 50.4 mins, P > .05), or sleep efficiency (5.4 ± 7.7% vs, 4.0 ± 7.5%, P > .05). Post-treatment scores on the ISI (8.9 ± 3.8 vs. 10.8 ± 3.3), PSQI (5.8 ± 2.8 vs. 6.8 ± 2.1), and FSS (28.5 ± 11.2 vs. 28.9 ± 9.7) were also not different between the two conditions (all Ps > .05). Chamomile was well-tolerated with no drop-outs in either group.
Conclusion: Despite being well-tolerated, chamomile has minimal benefit relative to placebo for chronic primary insomnia. We are continuing to recruit an additional 14 participants to optimize study power for our primary sleep outcomes.
Support (If Any): University of Michigan Family Medicine CAM Seed Grant

0662

GROUP CBT FOR INSOMNIA: TREATMENT SATISFACTION AND MOST HELPFUL COMPONENTS PERCEIVED BY PATIENTS

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Introduction: Chronic insomnia is associated with high degree of medical and psychiatric co-morbidities, and it's common in sleep clinic patients. CBT-I, a multi-component treatment is now recognized as a first line treatment. We report patient satisfaction with respect to CBT-I delivered in group format and what elements of treatment that the patient perceived to be most helpful.
Methods: 207 consecutive sleep clinic patients (56.5% female; age 41.6 ± 12.3 years) received 9-week, 7-session group CBT-I delivered by a behavioral sleep medicine psychologist. Questionnaires were completed at baseline and at the last session. Patients were asked on a treatment satisfaction questionnaire to rate the extent to which various treatment elements were helpful.
Results: Patients reported accomplishing 63.4 ± 23.8% of their personal treatment goals at the end of 9-week program. 19.9% of patients rated being unsatisfied with the treatment while 58.1% rated being very or completely satisfied. With respect to their insomnia, the program was perceived as "helped a lot" by 20.3%, and "somewhat" by 37.7% of patients. 19.1% of patients thought the program made their insomnia worse. 93.5% of patients gave "moderately," "very" or "completely" satisfied ratings with respect to the treatment provider. The top 5 most helpful components were: learning about sleep and insomnia, maintaining the prescribed rise time, being able to trust my treatment provider, feeling that insomnia is being taken seriously and understood, and feeling hopeful that insomnia can improve. Patients identified that delaying going to bed until the prescribed bedtime, getting out of bed when unable to sleep, use bed only for sleep, change the way I think about not sleeping, and decrease use of sleep medications were the most difficult to do.
Conclusion: Patients who received group CBT-I are highly satisfied with the treatment and achieved significant clinical improvement. Common therapeutic factors such as rapport with treatment provider and imparting hope were identified by patients as most helpful. These findings highlight the importance that the therapeutic elements of CBT-I go beyond instructions to change patient's sleep behaviors and cognitions. Rather, the therapeutic relationship between patient and the treatment provider appeared to be an important key to reduce patient's distress, foster adherence to behavioral interventions (stimulus control and sleep restrictions) and cognitive restructuring, and for facilitating a favorable clinical outcome.

0663

CHANGES IN COGNITIVE AND BEHAVIORAL FACTORS ASSOCIATED WITH TREATMENT EFFECTS FOLLOWING COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA

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Introduction: Cognitive Behavioral Therapy for Insomnia (CBTI) consists of multiple components that are designed to change the psychological and behavioral factors that are associated with the pathology of insomnia. The goals of this study is to 1) investigate the changes in beliefs about sleep, sleep-related practices, and pre-sleep arousal levels following CBTI treatment, and 2) examine the associations between these changes and treatment outcome.
Methods: Forty-one patients (29 females, aged 37.5 ± 10.9) with primary insomnia received 6 sessions of CBTI. Dsyfunctional Beliefs and Attitude about Sleep Scale (DBAS), Sleep Hygiene Practice Scale (SHPS), and Presleep Arousal Scale (PSAS) were administered before and after treatment to assess changes in sleep-related cognition, maladaptive sleep-related behaviors, and level of pre-sleep arousal, respectively. Insomnia Severity Index (ISI) and sleep logs were also given to assess treatment effects.
Results: Paired-samples t-tests showed that almost all psychological and behavioral variables improved significantly after CBTI treatment. Pearson correlations showed that change of scores on the factor I (perceived consequences of insomnia, r = .33, P = .036), factor II (predictability of sleep, r = .28, P = .073) subtests of the DBAS, and both Somatic (r = .28, P = .078) and Cognitive (r = .29, P = .067) subscales of the PSAS correlated significantly or near significantly with the changes of the ISI score. Regression analysis shows that only changes in DBAS factor I was entered as a predictor for ISI and account for 10.8% of the changes in ISI.
Conclusion: CBTI was shown to change sleep-related cognitions and behaviors. The changes in dysfunctional sleep beliefs and pre-sleep arousal level were associated with reduction of insomnia severity. The change in beliefs about the consequences of insomnia was found to be the major variable that can predict reduction in insomnia severity.
Support (If Any): This study is sponsored by the National Science Council of Taiwan (Grant # NSC95-2413-H-004-020-MY3)

0664

AN INTERPRETIVE PHENOMENOLOGICAL ANALYSIS OF PATIENT AND PRACTITIONER PERCEPTION OF ADHERENCE TO COGNITIVE BEHAVIOUR THERAPY (CBT) FOR INSOMNIA

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Introduction: Cognitive Behavioural Therapy for insomnia (CBT-I) is an established effective treatment intervention, however adherence remains relatively unexplained. This study sets out to examine the experience of patient adherence from both patient and practitioner perception.
Methods: Interviews were conducted with 5 participants (2 female, age range = 44-63, mean = 52) who had recently completed group CBT-I. Practitioners experienced in treating insomnia (n = 4, average years of experience = 12), took part in a focus group discussion. Topics covered in the interviews included: the experience of insomnia and participation in CBT-I, what influenced their decision to adhere/not adhere, what factors influenced general adherence and relating these to their CBT experience and what they would have changed in the process to facilitate adherence. Topics covered in the focus group were: What practitioners did to ensure patient adherence during the treatment, what facilitated/impeded patient adherence and what factors were perceived as unimportant in adherence. Audio files were transcribed and explored using Interpretive Phenomenological Analysis (IPA). A second reviewer ensured inter-rater reliability.
Results: Key themes in both interviews and the focus group included: patient motivation, barriers to adherence (increased tiredness with interventions/other commitments), being in a CBT group, internalising rationale ("getting your head around it"), and support from others. Themes unique to the focus group discussion were clinician's skills

and preparing the patient for potential difficulties of treatment implementation. Patients reported a continuous evaluation of the CBT components in relation to individual's needs; however this topic did not emerge as a key theme in the focus group.
Conclusion: This study provides novel insight into the experience of patient adherence to CBT-I from both patient and practitioner perspective. Additionally, this study has revealed commonalities, but also differences between these perspectives. Data collection is currently ongoing and will continue until no new themes emerge.

0665

A CLOSER LOOK AT PATIENTS WITH DIFFICULTY FOLLOWING THE BEHAVIORAL INTERVENTIONS IN CBT FOR INSOMNIA

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Introduction: CBT for insomnia (CBTI) is a very effective non-pharmacological treatment although less is known about patients that have difficulty implementing the behavioral portion of the treatment.
Methods: Participants were 235 outpatients (55.7% female; mean age 48.7, SD 13.8) who presented with the chief complaint of insomnia although many had co-morbid sleep, psychiatric and medical disorders. Participants completed the Insomnia Group Treatment which consisted of seven group sessions. The Behavioral components of the treatment that were combined as a behavioral factor included postponing bedtime until a prescribed time and not until sleepy, adhering to a prescribed wake time, getting out of bed if cannot sleep, returning to bed only when sleepy, using bed for sex and sleep only and decreasing time spent in bed. The measures examined for this study were patients' ratings of difficulty following treatment components, baseline Beck Depression Inventory (BDI) and Insomnia Severity Index (ISI). The use of patient data was approved by the Institutional Human Subjects Review Board in compliance with HIPAA regulations.
Results: Individuals that reported they had a high degree of difficulty implementing the behavioral components of CBTI had significantly higher Pre-Treatment BDI scores (r = .148) and ISI scores (r = .221). Participants with a high degree of difficulty following the behavioral components also had difficulty keeping a sleep diary (r = .146), implementing breathing relaxation (r = .324), changing expectations about sleep (r = .361), changing the way they think about sleep (r = .377), changing the way they handle daytime stress (r = .271) and decreasing use of sleep medication (r = .335).
Conclusion: The results suggest that patients with a higher insomnia severity and depression may have difficulty following the behavioral treatment recommendations of CBTI. The results also suggest that patients that have difficulty following the behavioral components of CBTI also have difficulty following other treatment components such as cognitive and relaxation.

0666

EXERCISE-BASED COGNITIVE THERAPY AS A NOVEL TREATMENT FOR INSOMNIA AND DEPRESSION

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Introduction: The present study introduces a new treatment modality for comorbid insomnia and depression that combines cardiovascular exercise and elements of cognitive behavioral treatment: Exercise Based Cognitive Therapy (EBCT). While simultaneously performing moderate - high intensity cardiovascular exercise, participants were instructed to focus on problems, goals and negative automatic thoughts. The key principal of EBCT is the combination of focused problem solving with physical activity. This intervention targeted individuals in a common workplace who self identify as needing assistance with stress management.
Methods: Study participants completed the Hospital Anxiety and Depression Scale, Pittsburgh Sleep Quality Index, Insomnia Severity Index, Automatic Thought Questionnaire, and Coping Self Efficacy Scale, physical fitness assessments, and actigraphy, pre- and post-intervention. The intervention involved 12 sessions, increasing in intensity with each successive session. After three months, participants completed qualitative feedback of their overall experience.
Results: A total of 18 individuals participated in the intervention; all female, mean age 39.4 years (SD = 9.04). On average, participants attended 5.00 (SD = 3.74) sessions. Participants were predominantly Caucasian (72.2%), and a majority had a college education or beyond (55.5%). ANCOVAs were conducted to assess changes in the outcomes of interest. Tests of within-subjects effects demonstrated significant improvements in anxiety ($F(1,13) = 11.62$, $P < .01$), depression $F(1,13) = 8.25$, $P < .05$), perceived stress ($F(1,13) = 13.85$, $P < .01$), sleep latency ($F(1,7) = 6.65$, $P < .05$), and resting heart rate $F(1,14) = 88.36$, $P < .0$). Significant interactions for time*sessions were observed for sleep latency ($F(1,7) = 8.80$, $P < .05$), total sleep time ($F(1,14) = 5.07$, $P < .05$), resting heart rate ($F(1,14 = 7.59$, $P < .05$) and exercise minutes ($F(1,15) = 5.03$, $P < 0.05$). Qualitative feedback had a 78.6% response rate; 100% of the respondents indicated the intervention was beneficial.
Conclusion: Participants experienced significant improvements in sleep quality, depression, and anxiety symptoms. Although the participants demonstrated significant improvement in the variables of interest, the number of sessions attended did not predict the magnitude of these changes.

0667

THE ROLE OF MINDFULNESS IN ADDRESSING DYSFUNCTIONAL BELIEFS ABOUT SLEEP IN THE TREATMENT OF INSOMNIA IN CANCER SURVIVORS

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Introduction: Up to 50% of cancer patients report treatment-related sleep disturbances, which will persist for years in approximately 1/3 of the population. Insomnia, a very common sleep disorder, appears to have a subjective component, suggesting that cognitions may play a role in its etiology and maintenance. Dysfunctional beliefs and attitudes about sleep are one set of cognitions that appear to be particularly salient. Mindfulness Based Stress Reduction (MBSR), a program that teaches the application of mindfulness to daily life (including sleep) through meditation and yoga, has demonstrated positive effects on sleep disturbance. However, it is not understood how or why this may work. This pilot study examined the effects of an 8 week MBSR program on dysfunctional beliefs and attitudes about sleep and general sleep disturbance in a sample of 10 heterogeneous cancer patients.
Methods: Participants treated for cancer between stages I-III who were at least one month post-treatment were eligible and recruited through the Tom Baker Cancer Centre in Calgary, Canada. All participants were screened for the presence of insomnia and the absence of other sleep disorders and/or DSM-IV Axis I disorders. Participants completed the Five Facet Mindfulness Questionnaire (FFMQ), the Insomnia Severity Index (ISI) and the Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS) pre and post treatment. The data were analyzed using repeated measures t-tests of pre and post scores on all scales. Effect size was also calculated.
Results: Participants reported a significant improvement on the ISI ($P = .005$, $d = 0.94$) and on the "Observe" facet of the FFMQ ($P = .001$ $d = 1.06$). Likewise, there was improvement on the total FFMQ score

(P = .04, *d* = 1.07). Although not statistically significant, there were large effect sizes for the "non-judging" (*d* = .93) and "non-reacting" (*d* = .87) subscales on the FFMQ and a medium effect size for the "acting with awareness" (*d* = .69) subscale of the FFMQ and "worry about sleep" (*d* = 0.53) subscale of the DBAS.

Conclusion: The results support previous findings indicating that participation in the MBSR program is associated with improvement in overall subjective sleep disturbance. They also suggest that mindfulness may play a role in reducing dysfunctional beliefs and attitudes about sleep which could lead to decreased insomnia severity.

Support (If Any): Alberta Cancer Board In House Grant, Francisco J. Varela Research Grant, Canadian Breast Cancer Research Alliance Operating Grant

0668

THE EFFECTS OF MEDITATION ON SLEEP IN INDIVIDUALS WITH CHRONIC INSOMNIA

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Introduction: Insomnia is conceptualized to be a 24 hour problem of hyperarousal, and elevated measures of arousal are seen throughout the day. In a previous abstract, we reported subjective improvement in sleep quality. This study reports changes in evening cortisol levels in patients who meditate.

Methods: Meditation is a state of focused internalized attention, and has been shown to reduce measures of arousal. Cortisol levels correlate with stress and are considered an indirect measure of arousal. Kriya yoga is a type of meditation which is a synthesis of different yogic techniques.11 healthy subjects between the ages of 25-45 with chronic primary insomnia were randomized to Kriya Yoga (N-7) or Health Education (N-4) group for 2 months. Both groups received sleep hygiene education. Measures of sleep (sleep logs, Pittsburgh Sleep Quality Index) were collected at baseline and post-intervention. Objective measures included salivary cortisol values measured every 30 min from 4:00 pm until bed time at both visits. The area under the curve(AUC) for the cortisol (nanograms/ ml) was calculated and data was analyzed using paired t-test.

Results: In separate pre-post comparisons of data from subjects in the Meditation group [Med] [N = 4 for cortisol analysis and N = 7 for PSQI analysis], significant improvements were seen in subjective sleep quality measure [PSQI before Med: Mean ± SD = 9.5 ± 0.58 and PSQI after Med: Mean ± SD = 4.7 ± 2.1 (P = 0.009)] and an insignificant positive trend was seen for reduction in AUC cortisol levels [AUC before Med: Mean ± SE = 17.7 ± 2.6 and AUC after Med: Mean ± SE = 13.0 ± 4.1 (P = 0.37] . In the control group [health education - HE], [N = 3 for cortisol analysis and N = 4 for PSQI analysis], the change in PSQI was not significant [PSQI before HE: mean ± SD = 10.0 ± 2.2 and PSQI after HE: Mean ± SD = 8.0 ± 2.4 P = 0.43]and the change in AUC was not significant [AUC before HE: mean ± SE = 43.00 ± 12.28 and AUC after HE: mean ± SE = 39.6 ± 25.12 (P = 0.76].

Conclusion: Results of this small pilot study indicate that meditation is an effective behavioral intervention in improving sleep quality and may contribute to reducing evening cortisol levels. Future research is needed to validate these effects with a larger sample size.

Support (If Any): 1. Northwestern University Clinical Research Center 2. Northwestern Woman's Memorial Board

0669

TREATMENT EXPERIENCES AND TREATMENT PREFERENCES OF VETERANS WITH SLEEP DISTURBANCES IN VA PRIMARY CARE

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Introduction: Sleep disturbances are common, but under-recognized and under-treated, in the general population. The VA has the largest single healthcare system in the U.S. and has implemented the integration of mental health services in its' primary care settings. This study is focused on gathering preliminary information to enhance and guide such efforts with respect to managing sleep disturbances.

Methods: A subsample of 92 veterans (mean age 61.6 (16.3); 96% male; 88% White, 9% Black, 3% Native American, Mixed, or Other) from a larger IRB-approved study (N = 211) examining health behaviors and treatment preferences of patients receiving care in a VA primary care office were asked to complete the Insomnia Severity Index (ISI) and a health behavior questionnaire (HBQ), with items addressing sleep disturbances, their actual treatment, patients' treatment preferences, and a 0-10 readiness-to-change question.

Results: The mean ISI score (n = 92) was 5.9 (6.0) with 25%, 12% and 0%, respectively falling into the mild, moderate, and severe insomnia categories. Of the 88 patients completing the HBQ, 51% endorsed having issues with sleep. Only 14 patients reported that their treatment provider discussed sleep interventions with them. Among patients reporting a sleep problem, 29% were ready to change (score of 5-7) and 40% were trying to change (score of 8-10). The most popular treatment options (up to 3 could be chosen) were work it out on my own and talk to a doctor, each chosen by 80%; talk to a therapist, take a medication, talk to a friend, talk to clergy were chosen by 43%, 36%, 33% and 2% of respondents, respectively. In terms of treatment format, there was also a preference for meeting individually with a doctor (77%) or therapist (41%) as opposed to reading a self help book (25%) or attending a group (12%).

Conclusion: Sleep disturbance rates in this older VA sample was high. The prevalence and severity of insomnia was not especially pronounced, which requires further evaluation. This descriptive study is limited by its cross-sectional nature and the absence of information about medical conditions, medications, and sleep disturbances other than insomnia. Nonetheless, the results suggest that physicians are addressing sleep in fewer patients than are ready to address sleep. It is also interesting that patient preferences lean more towards physicians than psychotherapists. These factors need to be considered in designing integrated approaches to care.

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0670

BRIGHT LIGHT THERAPY AND MATERNAL SLEEP AND WELL-BEING: A PILOT RANDOMIZED CLINICAL TRIAL

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Introduction: Having a low birth weight (LBW) infant cared for in the intensive care unit (ICU) can intensify sleep disturbances and deteriorate the mother's well-being. The purpose of this pilot randomized clinical trial study was to examine whether a bright light therapy would lead to clinically significant improvements in sleep, fatigue, depressive symptoms, and health-related quality of life (QOL) of mothers of LBW infants.
Methods: Twenty-five mothers were randomly assigned to two groups: the treatment group mothers received a 10,000 lux blue-green bright light therapy (n = 13) for 3 weeks and the control group mothers received a placebo dim red light therapy (n = 12). Data collected at baseline and after the 3-week intervention period included: 1) General Sleep Disturbance Scale (GSDS), Numerical Rating Scale for Fatigue, Edinburgh Postnatal Depression Scale (EPDS), and Medical Outcomes Short Form-36version 2 (SF36v2). Total sleep time (TST) during the day and night was measured by averaging the data obtained from three consecutive days of wrist actigraphy monitoring. Cosinor analysis was used for circadian activity rhythms (CAR), and Cohen's d (d) by using t-values was calculated for the effect size.
Results: After the 3-week treatment, a medium to large effect size was found between groups: nocturnal TST was increased (d = 1.05), CAR was improved (d = .43), less sleep disturbances self reported from GSDS (d = 0.37) and its daytime functioning subscale (d = .35), less evening fatigue severity (d = .77), and better emotional health QOL from the SF36v2 (d = .36).
Conclusion: Results indicate that bright light therapy may improve a mother's nocturnal sleep and be beneficial to her well-being. The positive findings of this pilot study warrant a larger randomized clinical trial testing the effects of bright light therapy in this population.
Support (If Any): This study is supported by NIH/NINR: 1R15NR010152-01A1.

0671

CIRCADIAN ACTIVITY RHYTHMS AND SLEEP AMONG POSTPARTUM WOMEN WITH A LOW BIRTH WEIGHT INFANT IN THE ICU

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Introduction: Circadian activity rhythms (CAR) have been found to be altered among dementia, seasonal affective disorder, and cancer patients during chemotherapy. To date, studies exploring CAR in postpartum women are rare. The purposes of this study are to 1) describe the characteristics of CAR, and 2) explore the relationships between CAR and sleep disturbances among mothers with a low birth weight infant cared for in the intensive care unit.
Methods: Twenty nine mothers (mean age = 26.7; SD = 6.5) were enrolled during their 7-10 day postpartum period. Two sets of data were collected: 1) 72-hour consecutive wrist actigraphy data, including total sleep time (TST), wake after sleep onset (WASO), and activity levels; and 2) General Sleep Disturbance Scale (GSDS) and Numerical Rating Scale for Fatigue (NRS-F). Cosinor analysis was used for computing the CAR, including the mesor (fitted activity mean), the acrophase (time of the peak of the fitted activity curve), and the amplitude (magnitude of the activity oscillation).
Results: The average amplitude was 90 (SD = 25.8), the mesor was 137 (SD = 22.1), and the circadian quotient (amplitude/mesor) was .68 (SD = .22). The acrophase in military time format was 17:19. The average nocturnal TST was 375 minutes (SEM = 21), and WASO was 18.6% (SEM = 2.1). Mothers reported a clinical significant of poor sleep quality and daytime functioning from the GSDS. The morning NRS-F was 4.3, indicating a moderate fatigue severity for mothers. A low circadian quotient was statistically significant correlated with a late acrophase (r = .44), less nocturnal TST (r = .88), high WASO (r = .66), and more self-reported sleep disturbances (r = .41).
Conclusion: Results indicated that the postpartum women's sleep and CAR were disturbed, and they were also experiencing fatigue. It appears that poor CAR leads to more sleep problems and more severe fatigue. Factors responsible for these rest and activity rhythm disturbances require further study.
Support (If Any): This study is supported by NIH/NINR: 1R15NR010152-01A1.

0672

PREVALENCE, INCIDENCE, AND REMISSION OF PARASOMNIAS AMONG ADOLESCENT CHILDREN IN THE TUCSON CHILDREN'S ASSESSMENT OF SLEEP APNEA STUDY (TuCASA)

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Introduction: Longitudinal assessments of parasomnias in the adolescent population are scarce. This analysis aims to identify the prevalence, incidence, and remission of parasomnias in the adolescent age group.
Methods: The TuCASA study is a prospective cohort study that initially enrolled children between the ages of 6 and 11 years (Time 1) and subsequently re-studied them approximately 5 years later (Time 2). At both time points parents were asked to complete comprehensive sleep habits surveys that included questions about enuresis (EN), sleep terrors (TR), sleep walking (SW) and sleep talking (ST).
Results: There were a total of 310 children included. The mean interval between measurements was (4.6 years). The prevalence of EN, TR, SW, and ST in these 10-18 year old children was 2.6%, 3%, 2.6%, and 22.3% respectively. Incidence rates were < 1%, 2.6%, 1% and 15.2% respectively. Remission rates were 5.2%, 4.8%, 1.9%, and 3.5%. The percent of children who were unchanged between assessments was EN 94%, TR 92%, SW 96%, and ST 81%, which represents 92%, 92%, 95%, and 74.2 % answering "no" both times, and 2.2%, 0%, < 1%, and 7.1% who answered "yes" both times.
Conclusion: With the exception of ST, incident parasomnias are uncommon as children progress into adolescence. In contrast, parasomnias present in preadolescents generally persist into adolescence.
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0673

FREQUENCY OF SEXOMNIA IN SLEEP CLINIC PATIENTS

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Introduction: Sexsomnia, defined as a parasomnia-like behaviour characterized by individuals performing sexual acts (e.g., masturbation, sexual intercourse with a bed partner) during sleep, has been used as a defense for a sexual act with a minor victim in criminal court. However, the frequency of sexomnia in a sleep clinic population is unknown.
Methods: A retrospective chart review of patients undergoing polysomnographic evaluation was conducted. Patients were queried about symptoms of parasomnia, motor behaviours during sleep, sleepiness, fatigue, depression and insomnia. Patients answering yes to having initiated sexual activity with a bed partner while asleep were considered to have symptoms of sexomnia.
Results: Charts from 832 consecutive patients (428 males and 404 females) were reviewed. The frequency of reported sexsomnia was 7.6% (63/832; males - 11.0% vs females - 4.0%). This is in line with the known rates of parasomnia in adults. Only 6% of patients reporting sexomnia also had symptoms of parasomnia. Patients reporting sexomnia had symptoms of insomnia, fatigue and depressed mood. However, there were no differences in the severity of insomnia or level of sleepiness, fatigue or depression in those reporting sexomnia compared to the other sleep clinic patients. There were no differences in caffeine (P = 0.4) or cigarette (P = 0.1) use in patients reporting sexomnia versus those who did not, but those endorsing sexomnia admitted to greater usage of illicit drugs (sexomnia:15.9% vs. no sexomnia:7.7%) and alcohol (sexomnia:41.3% vs. no sexomnia:27.4%).
Conclusion: This is the first study to systematically investigate complaints of sexual acts during sleep. Sexomnia is not usually discussed during sleep consultations but almost one out of 12 sleep clinic patients had an experience of sexomnia. Most patients reporting sexomnia do not endorse a concurrent complaint of other parasomnia or involuntary motor behaviours during sleep, but illicit drug and alcohol use were more common in patients reporting sexomnia.

0674

REM SLEEP WITHOUT ATONIA IN PARKINSONS DISEASE

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Introduction: REM sleep behaviour disorder (RBD) is a parasomnia characterized by the loss of normal skeletal muscle atonia during REM sleep with prominent motor activity accompanying dreaming. The combination of heightened cerebral activity and muscular tonicity results in physically acting out dreams that involve excited and sometimes violent movement. The aim of our study was to determine the frequency of REM sleep behavior disorder (RBD) among patients with PD using both history and polysomnography (PSG) recordings and to further study REM sleep muscle atonia in PD.
Methods: Consecutive patients with PD (n = 30, age: 71,3 ± 8,9 year) and healthy control subjects (n = 28, age: 67,1 ± 7,3 year) were studied. Each subject underwent PSG recording. REM sleep was scored using a method that allows the scoring of REM sleep without atonia. More leads are placed on the anterior tibialis, soleus, biceps off each leg and arm to measure limb movements.
Results: 6 of 33patients with PD met the diagnostic criteria of RBD detected by history. 17 of 33 patients with PD we found REM sleep without atonia. 11 of them did not present with behavioral manifestations of RBD, and their cases may represent preclinical forms of RBD associated with PD. The percentage of time spent with muscle atonia during REM sleep was higher among patients with PD than among healthy control subjects (61,5% vs 95,6%; P = 0.004). In patient with RBD the limb movement index in REM was 18,6 ± 4,39 event/hour vs. control 4,4 ± 2,3 event/hour, P = 0,0001. Slow wave sleep percent in RBD patients was 2,64 ± 1,31% vs control 0,76 ± 0,27%, P = 0,004. REM sleep percent in RBD patients was also higher than control 12,8 ± 3,19% vs. 8,6 ± 1,67%, P = 0,01.
Conclusion: RBD and REM sleep without atonia are frequent in PD as shown by PSG recordings. REM sleep without may represent preclinical forms of RBD associated with PD.

0675

SEX RATIO, ANTIDEPRESSANTS, AND AUTOIMMUNITY IN REM SLEEP BEHAVIOR DISORDER

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Introduction: While rapid eye movement sleep behavior disorder (RBD) has been described predominantly in elderly men with neurodegenerative disease, an increasing proportion of cases do not fit this description. This study describes demographic and clinical features of a current RBD population, to demonstrate that the sex ratio in RBD is more equal than previously reported, and to identify new subgroups with RBD that may account for this change.
Methods: Retrospective case series (n = 115) at a single academic sleep medicine center.
Results: Male to female ratio was 2:1, and 1.25:1 for those diagnosed before age 50. Mean age at diagnosis was 53.7 ± 16.4 years. A majority (60%) of cases were idiopathic. Neurodegenerative disease was associated with RBD primarily in older men. Narcolepsy was coincident in 10% of both men and women. Autoimmune disease was unexpectedly common in women (20%)

particularly in the 30-49 age range (40%), but absent in men. Antidepressant use was frequent in all groups, but more so in younger patients.
Conclusion: We identified 115 cases of RBD confirmed with polysomnography. This series has a higher proportion of female cases, younger average age, and less association with neurodegenerative disease than earlier reports in the literature. High prevalence of antidepressant use in this series, particularly among the female and younger groups, suggests a strong and potentially causal role for antidepressants and RBD. Autoimmune diseases were unusually common in the female cases, pointing to an intriguing link between immune dysfunction and RBD.

0676

BRAIN PERFUSION ABNORMALITIES IN IDIOPATHIC RAPID EYE MOVEMENT SLEEP BEHAVIOR DISORDER IN ASSOCIATION WITH MILD COGNITIVE IMPAIRMENT

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Introduction: Mild cognitive impairment (MCI) is frequent in idiopathic rapid eye movement sleep behavior disorder (iRBD). Fifty percent of iRBD have MCI (Gagnon et al., Neurology, 2009). The purpose of this study was to investigate the regional cerebral blood flow (rCBF) in iRBD patients with MCI.
Methods: Twenty patients with polysomnographically confirmed iRBD, including 10 patients with MCI (7 men; mean age: 64.45 ± 7.15 years; mean education: 10.30 ± 3.86 years; mean disease duration: 15.00 ± 10.80 years; mean UPDRS-III score: 3.89 ± 3.52) and 10 patients without MCI (5 men; mean age: 65.64 ± 8.22 years; mean education: 13.50 ± 4.72 years; mean disease duration: 8.00 ± 5.75 years; mean UPDRS-III score: 4.15 ± 3.92) were studied by means of single photon emission computerized tomography (SPECT). None of the patients have received a diagnosis of another neurological disorder or dementia. Two-samples t-tests were made between the two groups using SPM2. Significance was set at 0.01 for at least 50 contiguous voxels.
Results: No between-group differences were observed for age, education, UPDRS-III, or disease duration. Bilateral decreased rCBF was found in occipital gyrus (Brodmann 17,18) and in posterior region of superior and middle temporal gyrus in iRBD patients with MCI compared to iRBD patients without MCI. Moreover, increased rCBF was found in iRBD patients with MCI in precentral gyrus (Brodmann 6,4), medial orbitofrontal gyrus, anterior cingulate gyrus and putamen bilaterally.
Conclusion: The main result of this study is the presence of brain posterior regions hypoperfusion in iRBD patients with MCI. These results are similar to those found in Parkinson disease with dementia and in Lewy body dementia. This suggests that iRBD patients with MCI might be at higher risk to develop neurodegenerative disease and progress toward dementia. A follow-up study should be performed to confirm this hypothesis.

0677

OBSTRUCTIVE SLEEP APNEA (OSA) SELECTIVELY SUPPRESSES REPORTED NIGHTMARE RECALL

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Introduction: While several studies have suggested that both dream and nightmare recall are affected by OSA, most studies directed towards the evaluation of milder OSA patients have shown inconclusive results. This study was designed to clarify and compare the association of reported nightmare and dream recall with polysomnographically defined OSA in the sleep laboratory population including patients with more severe apnea. This study included consecutive patients evaluated in a sleep laboratory over a two year period including those undergoing split-night studies (204/393 [51.9%]).
Methods: Patients completed a general intake questionnaire on their arrival in the sleep laboratory rating dream and nightmare recall frequency on a scale varying from 1 = never, 2 = monthly, 3 = weekly, 4 = 2X/week, to 5 = nightly. Apnea-Hypopnea Index (AHI), Low Oxygen Saturation, Apnea Index (AI) and Periodic Limb Movement Index were analyzed relative to reported dream and nightmare recall frequency.
Results: Mean AHI for this study population was 34.9 (std = 32.0). 205 patients (52%) reported dream recall at least weekly and 134 patients (34%) reported at least weekly nightmare recall. Reported dream and nightmare recall frequency were not associated (Chi2 = 0.31, n = 350, P = 0.33). None of the evaluated variables significantly affected the reported frequency of dream recall in this study. AHI and AI were significantly higher (P = 0.000) for the grouping reporting infrequent nightmare recall. 71.4% of individuals in the grouping with an AHI < 5.0 reported nightmares occurring more than once/week. As the AHI score increased, the percent of participants with such frequent nightmare recall decreased linearly.
Conclusion: Sleep laboratory patients with OSA of greater severity, as based on higher AHI, report a significantly lower frequency of nightmares. This finding indicates that OSA selectively suppresses the cognitive experience of nightmare recall, an effect that occurs independently of OSA effects on reported dream recall frequency.

0678

SLEEP-RELATED EATING DISORDER IS COMMON IN PATIENTS WITH RESTLESS LEGS SYNDROME

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Introduction: Sleep-related eating disorder (SRED) is characterized by a disruption of the nocturnal fast with episodes of feeding after an arousal from nighttime sleep. Restless Legs Syndrome (RLS) is characterized by a motor restlessness during periods of quiescence, it interferes with sleep onset and is relieved with movement. We have previously noted a high incidence of RLS in patients with SRED. However, conversely the incidence of SRED in patients with RLS has not been fully evaluated.
Methods: We surveyed 40 consecutive RLS patients for SRED by ICSD-2 criteria. We then characterized the subjects nocturnal feeding behaviors with the Night Eating Questionnaire.
Results: 25 patients with RLS met the ICSD-2 criteria of SRED (62.5%). There was no significant difference in Body Mass Index (BMI) between those with SRED (mean 30.8 kg/m2; CI = 2.99) versus those without SRED (31.4kg/m2; CI = 3.21). 6 of 25 noted that the nocturnal eating began with the prescription of a benzodiazepine receptor agonists prescribed for presumed insomnia. Those with SRED described awareness of the nocturnal eating, except in the cases of medication induced SRED who all described complete or partial amnesia. 7 of 7 patients who had been treated with dopaminergic agonist therapy noted diminished nocturnal eating with initiation of therapy.
Conclusion: SRED is common in patients with RLS and nocturnal eating often improves with RLS treatment. Many patients with medication induced SRED may have RLS instead of insomnia as the cause of their poor sleep. Further investigations should consider the neurochemical relationship between motor restlessness and dysfunctional nocturnal eating.

0679

SLEEP BREATHING DISORDER AND BRUXISM

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Introduction: Sleep bruxism (SB) is reported by 8% of the adult population and is mainly associated with rhythmic masticatory muscle activity (RMMA) characterized by repetitive jaw muscle contractions (3 bursts or more at a frequency of 1 Hz). The purpose of this study was to evaluate the nature of sleep bruxism and to discuss its consequences.
Methods: We prospectively studied 20 patients who were referred to the clinical sleep apnea laboratory for study. They underwent standard nocturnal polysomnographic examination; in addition, masticatory activity was measured with a masseter electromyogram. Patients slept in the supine and lateral decubitus positions.
Results: Nocturnal clenching was higher in patients with higher respiratory disturbance index. 15 among 20 patients were included in the criteria of obstructive sleep apnea; average respiratory disturbance index (RDI) was 12.7 280 clenches demonstrated in all patients.
Conclusion: We conclude that there is an association between sleep related breathing disorder and bruxisms that sleep position affects the incidence of both sleep disordered breathing and bruxisms, and that analysis of apneas and hypopneas and clenching events in both supine and lateral decubitus sleeping positions may be helpful.

0680

NORMAL RAPID EYE MOVEMENT SLEEP ELECTROMYOGRAPHIC FEATURES IN YOUNG ADULTS WITH AUTISM SPECTRUM DISORDER

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Introduction: A few cases of rapid eye movement (REM) sleep behavior disorder (RBD) have been reported in children with autism. The aim of the present study was to evaluate the integrity of REM sleep electromyographic (EMG) features in young adults with autism spectrum disorder (ASD).
Methods: Eighteen young adults with ASD (nine with high-functioning autism and nine with Asperger syndrome; one woman; mean age, 21.8 ± 3.6 years; age range, 15-27 years) and 18 healthy controls matched for age and gender (one woman; mean age, 20.8 ± 4.3 years; age range, 16-27 years) were studied in a sleep laboratory for two consecutive nights. Inclusion criteria were a stringent diagnosis of autism; exclusion criteria were mental retardation or epilepsy. Polysomnographic recording included electroencephalogram, electrooculogram, chin EMG, and ultraviolet video monitoring. A standard method for RBD was used to identify REM sleep and to quantify REM sleep tonic and phasic EMG activity. The cutoff for excessive tonic or phasic EMG activity during REM sleep was defined as two standard deviations above the mean of controls.
Results: No significant between-group differences were observed for tonic (11.31 ± 14.52% for ASD vs. 10.69 ± 11.62% for controls) or phasic (10.51 ± 7.09% for ASD vs. 11.47 ± 6.59% for controls) REM sleep EMG activities. Two of the 18 patients with ASD (11%) and one of the 18 control subjects (6%) showed excessive EMG activity during REM sleep. None of the participants had a clinical history of RBD or behavioral manifestations during REM sleep in the laboratory.
Conclusion: This study shows the absence of RBD and normal REM sleep EMG features in young adults with ASD. Our results suggest that RBD in ASD is either rare, restricted to a younger age group, related to non-autistic comorbidity, or atypical in terms of standard diagnostic criteria.
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0681

PERIODIC LIMB MOVEMENTS IN A REFERRED SAMPLE OF CHILDREN WITH SICKLE CELL DISEASE

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Introduction: Periodic limb movements during sleep (PLMS) are unusual in children. Elevated PLMS were unexpectedly identified in a study of children with sickle cell disease (SCD) referred for sleep-disordered breathing. This new finding has unknown causes and significance. Studies have shown associations between PLMS and elevated blood pressure, arousals, sleep fragmentation and sleep loss. These events could impact physiologic and cognitive functioning in children with SCD. The aim of this secondary data analysis was to explore associations of PLMS with clinical and polysomnographic variables.
Methods: Children aged 2-18 years with genotypes HbSS or HbSC, having polysomnography 2003-2008 were included (N = 59). Data on clinical, polysomnography and health care utilization data for vaso-occlusive crises over 1 year pre- polysomnography and 1 year post- polysomnography or post-adenotonsillectomy (post-PSG/AT) were collected from the medical record.
Results: The PLMS index averaged 4.3 ± 8.5/h, and was > 5/h in 24.6%. It did not differ significantly between genotypes; HbSS tended toward a lower PLMS index than HbSC (3.3 ± 5.2 vs. 7.1 ± 14.6, respectively). The PLMS index positively correlated with the limb movement arousal index ($P < .001$), and negatively correlated with REM latency in the asthma-positive subset ($P = .018$), approaching significant negative correlation in females ($P = .056$). Health care utilization was not associated with PLMS except in the 6-10 year age group where the PLMS index increased as health care utilization increased (pre-PSG, $P = .033$; post-PSG/AT, $P = .028$). Unassociated with the PLMS index was age, sex, blood pressure, respiratory parameters, sleep architecture or measures of iron store (MCV or hemoglobin). BMI-z score was unrelated to PLMS index, but approached significant negative association in certain subsets: OAHI < 1 ($P = .052$), 11-17 year age group ($P = .067$).
Conclusion: Correlates of PLMS in children with SCD may differ from those of unaffected children. Preliminary data suggest that PLMS may influence sleep and SCD severity in specific subsets of children.

0682

PAIN EVALUATION OF BRUXISM AND OSAS TREATMENT. A LITERATURE REVIEW

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Introduction: Pain is characterized as an unpleasant sensorial and emotional experience, and can be present in sleep disturbances, such as bruxism, or even associated to the treatment of Snoring and obstructive sleep apnea syndrome (OSAS) with oral appliances (OA). In both cases, pain is frequent and brings distress and sleep privation, and the understanding of pain mechanisms and its physiopathology in sleep bruxism and current intraoral devices are indispensable when handling with patients that display such symptoms. Sleep bruxism affects an important share of the general population. Its etiology continues to be unknown, and, up to this point, there is no consensus about how to treat it. On the other hand, its clinic manifestations are well-known and, ironically, happen with a high pervasiveness among the general population. Examples are toothaches, pain due to temporo-

mandibular joint (TMJ) dysfunction, orofacial pains and headaches. Even though sleep bruxism is considered to be the risk factor for pain and jaw dysfunction, current evidences point to the fact that they are associated illnesses, and that on these patients, bruxism occurrences are reduced.

Methods: The literature review shows that OSAS can be treated successfully with OA, however side effects have not yet been systematically evaluated. Dental side effects occur in a significant proportion on patients using the OA. In most cases there are only minor consequences, and their importance must be balanced against the efficacy of the OA.

Results: The device may occasionally exacerbate TMJ dysfunction and pain, or induce minor occlusal changes. These conditions, if unrecognized and untreated, can be sources of significant morbidity.

Conclusion: This vision enhances the necessity to evaluate patients suffering with OSAS, bruxism and associated pain in a similar manner to the evaluation made on patients with other chronic pains.

0683

DEVELOPMENTAL CHANGES IN SLEEP MAY DIFFER IN ADOLESCENTS WITH AFFECTIVE PSYCHOPATHOLOGY

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Introduction: Because affective disorders involve sleep disruptions and increase in incidence sharply around the same time sleep patterns shift in early adolescence, characterizing sleep in adolescents with psychopathology is highly relevant. This study characterized sleep changes in relation to age and puberty in adolescents with major depressive disorder (MDD), anxiety disorders, and co-morbid MDD and anxiety.
Methods: 411 participants (Age mean = 11.3; range = 6.0-17.0 years) completed a polysomnography (PSG) study, and were evaluated using the K-SADS for diagnosis: healthy (n = 189), MDD (n = 122), anxiety (n = 54) and co-morbid MDD/anxiety (n = 46). Participants spent at least two nights in the lab and completed sleep diaries. Tanner staging was performed by trained research nurses, and participants were classified as pre/early (Tanner breast/genital score = 1-2) or mid/late (3-5) pubertal status. PSG data were scored by coders trained to reliability. Only results from night one were included because of procedural differences in the subsequent nights. Statistical analyses used linear models with pubertal status, age and diagnosis (MDD, ANX, MDD/ANX and healthy) as predictor variables for each sleep variable. Sleep variables included were sleep latency, time spent in each stage of non-REM sleep (1-4), total REM sleep, REM activity (RA), REM latency, sleep efficiency, and self-reported sleep quality and ease of waking.
Results: As in other studies of adolescent development, stage 3 and stage 4 sleep decreased with age. Clinical status predicted stage 2 sleep, sleep quality, and ease of waking. The puberty X diagnostic interaction predicted RA ($F = 3.655$, $df = 3$, $P = .013$), with healthy pre/early-pubertal subjects exhibiting greater RA (Mean = 148.1, SD = 87.5) than healthy mid/late-pubertal (Mean = 68.9, SD = 83.4).
Conclusion: This study allows us to evaluate how pubertal development and its relationship to sleep may differ among adolescent clinical populations, elucidating sleep-related developmental psychopathology issues.

0684

RELATIONSHIPS BETWEEN SLEEP AND MOOD IN ADOLESCENTS WITH BIPOLAR DISORDER

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Introduction: A growing body of research suggests strong relationships between sleep and mood in adult bipolar disorder (BD), with multiple studies documenting that changes in sleep duration predict subsequent changes in the polarity of mood. However, very little is known about the relationships between sleep and mood functioning in individuals with early-onset BD. We sought to prospectively examine the associations between sleep and morning mood in a sample of adolescents with BD and matched comparison groups of youth with attention-deficit hyperactivity disorder- combined type (ADHD-C) and those without psychopathology.
Methods: Participants included 13 adolescents (ages 11-17) diagnosed with BD who were between mood episodes, 14 diagnosed with ADHD-C, and 21 healthy controls. Sleep diaries were collected over four consecutive nights. A modified version of the Positive and Negative Affect Scale (PANAS) was used to collect parent-report ratings of Negative Affect (NA), Positive Affect (PA) and Irritable Affect (IA) each morning. Random coefficient regression was used to examine associations between nightly total sleep time (TST) and subsequent morning mood.
Results: Total sleep time was a significant predictor of morning NA, $F(1, 162.29) = 5.99$, $P = .015$, with reductions in TST associated with increases in NA. This effect was not statistically different between groups. TST was also a predictor of morning IA, $F(1, 160.33) = 5.47$, $P = .021$. The interaction term was significant for those with BD, $b = -.009$, $t(1, 161.00) = -2.20$, $P = .030$, indicating that the negative association between TST and IA was particularly strong in this group. TST was not a significant predictor of morning PA.
Conclusion: These results support the hypothesis that adolescents with BD may be particularly sensitive to slight sleep alterations and are more likely than their peers to experience negative morning mood as a result of decreases in sleep time.
Support (If Any): This project was supported by an Elizabeth Munsterberg Koppitz Child Psychology Fellowship from the American Psychological Foundation awarded to BCM, and National Institute of Mental Health Grant No. R34 MH080958 awarded to AGH.

0685

SLEEP-WAKE BEHAVIOUR IN YOUNG PATIENTS WITH BIPOLAR DISORDER AND ADHD

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Introduction: The early stages of bipolar disorder (BPD) and attention deficit hyperactivity disorder (ADHD) share a number of common traits, making an accurate diagnosis problematic. Diagnostic recognition at the earlier stages of symptom progression, provide for specific sets of targeted interventions. In order to identify potential distinct biomarkers between these two disorders, we have first examined sleep-wake patterns using actigraphy.
Methods: To date n = 10 patients with BPD (6m, mean age 23.13 ± 4.08) and n = 7 patients with ADHD (7m, mean age 18.43 ± 5.59) were recruited from 2 community based mental health clinics. All participants completed at least 2 weeks of actigraphy and sleep diaries. Differences in sleep variables between the two groups were analysed using t-tests.
Results: Average sleep duration was 530.7 ± 55.2mins in patients with ADHD and 568.3 ± 59.3mins in patients with BPD. Compared to patients with BPD, patients with ADHD had significantly greater average WASO ($t = 2.63$, $P = 0.019$) and a trend for less variability in sleep duration across the data collection period ($t = -2.21$, $P = 0.050$). The patients with BPD experienced a mixture of short and long sleep durations throughout the assessment period. In addition, there was a trend for patients with ADHD to have greater activity levels during waking periods: 506.0 ± 129.6mins versus 399.7 ± 94.9mins ($t = 1.96$, $P = 0.069$).
Conclusion: Even in this small sample, differences in sleep-wake behaviour between patients with BPD and ADHD is evident. The decreased stability in sleep duration in patients with BPD may reflect underlying neurobiological mechanisms, including reports of circadian disturbance that are typically observed in BPD. Increased activity levels, both during wake and sleep periods in patients with ADHD, would appear characteristic of symptoms of this disorder.

0686

COMORBIDITY AND PSYCHOSTIMULANT USE AS POTENTIAL MODERATORS OF THE RELATIONSHIP BETWEEN ADHD AND SLEEP IN CHILDREN

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Introduction: It has been suggested that the presence of psychiatric comorbidity and the use of psychostimulant might moderate the relationship between sleep disturbances and Attention-Deficit/Hyperactivity Disorder (ADHD) in children. However, support for this hypothesis

has been inconsistent. The objective of this study was to assess the moderating role of psychiatric comorbidity and use of psychostimulant on the relationship between sleep and ADHD.
Methods: Children with ADHD (24 boys, 17 girls, mean age = 117 months ± 20) were matched for age and gender to a healthy control sample (24 boys, 17 girls, mean age = 115 months ± 19). Parents of children from both groups completed the Children's Sleep Habits Questionnaire (CSHQ), the Conners' Rating Scales-Revised (CRS), and the Child Behavior Checklist (CBCL). Children wore a wrist-actigraph for seven nights in order to estimate sleep onset latency (SOL), wake after sleep onset (WASO), sleep efficiency (SE), and total sleep time (TST). Three sets of MANOVAs were conducted separately for CSHQ subscales and actigraphic measures of sleep to compare (a) ADHD children and controls; (b) unmedicated ADHD children, medicated ADHD children, and controls; and (c) ADHD children with and without comorbidity, and controls. Comorbidity was defined with the recommended cut-off scores on the CRS and CBCL. These analyses were followed by ANOVAs and Bonferroni adjusted post hoc tests where appropriate.
Results: Children with ADHD significantly differed from the control group on parental ($P < .001$) and actigraphic ($P < .001$) measures of sleep, with higher scores on the CSHQ, higher SOL, and lower SE and TST. MANOVAs involving medication-based subgroups revealed significant differences on parental ($P < .001$) and actigraphic ($P = .001$) measures of sleep as well. Subsequent comparisons showed that both the medicated and unmedicated ADHD subgroups had higher CSHQ scores and higher SOL than the control group. MANOVAs involving comorbidity-based subgroups revealed significant differences on parental ($P = .001$) and actigraphic ($P = .001$) measures. Subsequent comparisons showed that both ADHD subgroups had higher CSHQ scores than the control group, but only the comorbid subgroup had a higher SOL and lower SE.
Conclusion: Results suggested that children with ADHD had more sleep disturbances as reported by their parents and as measured by actigraphy. The presence of psychiatric comorbidity, but not the use of psychostimulant, was associated with more severe sleep disturbances.
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0687

COMPARISON OF SLEEP TIME AND DURATION BETWEEN SLEEP DIARY AND WRIST ACTIGRAPHY IN A POPULATION WITH MENTAL HEALTH PROBLEMS

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Introduction: Actigraphy and sleep diaries are typically used concurrently. On occasion it may be preferable to use only diaries, however, some individuals may not accurately record their sleep. We evaluated agreement in sleep measures using wrist actigraphy and sleep diaries in mood disorder patients and healthy controls.
Methods: N = 60 (26M, aged 39.3 ± 21.6) clinical participants were recruited from an outpatient clinical centre. Participants completed the Pittsburgh Sleep Quality Index and a daily sleep diary with wrist actigraphy for at least 7 days. The healthy control group (N = 42, 18M, aged 37.3 ± 16.4) had no known medical or psychiatric diagnosis. Regression analyses assessed agreement between self-reported and actigraphically assessed sleep, controlling for age, gender, subjective sleep quality, and diagnosis.
Results: Subjective sleep quality was a significant predictor of reliability between actigraphic and self-reported bed time ($\beta = .36$, $P < .05$), wake time ($\beta = .36$, $P < .05$), and total sleep time ($\beta = .35$, $P < .05$). The clinical population showed lower reliability between the two assessment methods; the effect was significant above and beyond when age, gender and subjective sleep quality were controlled ($P < .05$). Significant age ($\beta = -.21$, $P < .05$) and gender ($\beta = -.23$, $P < .05$) effects were observed on wake time only. An interaction effect between gender and subjective sleep quality was significant ($P < .05$).
Conclusion: The results suggest that self-reported sleep time, wake time and sleep duration were similar to wrist actigraphy. However, reliability between the two measurement methods decreased as a function of increasing subjective sleep complaints. The clinical population showed higher discrepancies between actigraphic and self-reported sleep times. The significant interaction effect suggests females were less susceptible to the effect of subjective sleep complaints on reliability of self-reported sleep times. Higher reliability was observed on wake time among females and older participants. We concluded that self-reported sleep time should be interpreted with caution if other objective measures such as actigraphy are unavailable.

0688

PRELIMINARY STUDY: EFFECT OF TREATMENT OF SLEEP DISORDERS ON OUTCOMES OF PSYCHIATRIC DISORDERS

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Introduction: Sleep and psychiatric disorders are common, and often co-morbid. Sleep disorders may predispose to development or exacerbation of psychiatric disorders. Authors hypothesized that treatment of sleep disorders improve outcomes in psychiatric illnesses.
Methods: Charts of patients diagnosed with sleep disorders from October 2007 to December 2007 were reviewed. Outcomes in patients with co-morbid psychiatric disorders were recorded at 6, 12 and 22 months after initiation of sleep disorder treatment. These patients received a baseline psychiatric status score of 0. Change in status at each subsequent time point was scored as: -2 (marked worsening), -1 (mild worsening), 0 (no change), +1 (mild improvement) or +2 (marked improvement). We individually compared change in average score at each time point to baseline using the signed rank test. We compared provider documented compliance to sleep therapies between patients with and without psychiatric disorders using Fisher's exact test.
Results: Of 127 charts reviewed, 10 were excluded as patients died within follow-up period. No death was reported as suicide. Of 117 patients, 97.64% were men, 2.36% were women. Age range: 21-40: 7.69%, 41-60: 42.74%, 61-80: 47.87%, > 81: 1.70%. 58 patients (45.67%) had coexistent psychiatric diagnoses. There was no difference in provider documented compliance rate to sleep therapies between patients with and without psychiatric disorders at 6, 12 and 22 months, (Fisher's P value 0.1031, 0.2290 and 0.2248 respectively). Psychiatric status progressively improved compared to baseline (Change in average score by +0.45, +0.56, and +0.79 at 6, 12, and 22 months, respectively, $P < 0.0001$).
Conclusion: Psychiatric disorders did not affect compliance to sleep related treatment. Treatment of co-morbid sleep disorders is associated with improvement in psychiatric disorders. Authors recommend need for study with control and more subjects.

0689

CLINICAL CHARACTERISTICS AND PSYCHOSOCIAL FUNCTIONING IN DEPRESSED OUTPATIENTS WITH OR WITHOUT SEVERE INSOMNIA

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Introduction: Depression is among the most common reasons why individuals present for psychiatric treatment. Insomnia symptoms are common, although not ubiquitous, in the clinical picture of depression.

The present investigation examines whether there are differences in psychosocial functioning and the clinical presentation of depression, when severe insomnia symptoms are present among outpatients with major depressive disorder (MDD).
Methods: Data were examined from 2900 individuals presenting for treatment at the Outpatient Psychiatry Practice at a large academic medical center. All patients were evaluated using the Structured Clinical Interview for DSM-IV Disorders (SCID), Schedule for Affective Disorders (SADS), and self-report measures of mood and functioning. A total of 1081 of these patients had a MDD as their primary diagnosis, based on the SCID. SADS Insomnia ratings were used to determine the presence of severe insomnia symptoms (rating of 4 or 5). Clinical characteristics of patients' depressive illness, demographic factors, and psychosocial functioning were determined from information obtained through the SCID and self-report measures.
Results: Among the patients with a primary MDD diagnosis, 24.7% endorsed symptoms of severe insomnia. These individuals were older at time of presentation ($P < .01$), were less likely to be married ($P < .01$), had a longer duration of the current depressive episode ($P < .05$), were rated as more severe on the CGI, and had poorer current functioning via GAF (both $P < .001$). Depressed individuals with severe insomnia symptoms were also more likely to have poorer social functioning, both currently and over the past 5 years, and lower scores (indicating poorer functioning) on 6 of the 8 SF-36 subscales.
Conclusion: These findings suggest that severe insomnia symptoms are associated with poorer psychosocial functioning and a more severe clinical presentation in patients with MDD. This argues for addressing severe insomnia symptoms among depressed patients, either via behavioral treatment or pharmacologic treatment options.

0690

OBJECTIVELY-ASSESSED SLEEP VARIABILITY UNIQUELY PREDICTS INCREASED SUICIDE RISK IN A PROSPECTIVE EVALUATION OF YOUNG ADULTS

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Introduction: Preliminary evidence suggests that self-reported sleep disturbances—independent of depression—may constitute an important and modifiable risk factor for suicide. A study has yet to prospectively examine whether this association exists using an objective measurement of sleep. We hypothesized that actigraphically-assessed sleep indices would uniquely predict increases in suicidal ideation. Mood lability was examined as an explanatory risk factor.
Methods: Participants (aged 19-23) included 49 undergraduates (71% female), prescreened for active suicidality. Subjects were assessed at three time points (T1, T2, T3): baseline, one week, and three weeks. Symptom severity was assessed using the Beck Depression Inventory (BDI) and Beck Scale for Suicide (BSS) at T1, T2, T3. Actigraphy use (T1-T2) generated the following statistics: WASO, sleep onset latency (SOL), total sleep time (TST), sleep variability (SV; standard deviation of sleep onsets/offsets, summed). Alongside actigraphy (T1-T2), mood lability was evaluated using daily visual analogue scale (VAS) mood ratings.
Results: Mean actigraphy statistics revealed delayed (bedtime 02:08), restricted (6.3h), and highly variable (3h SV for onsets, 2.8h for offsets) sleep schedules. Hierarchical linear regressions, controlling for T1 BSS and BDI scores, indicated that actigraphy sleep variables together predicted BSS increases at T2 ($P < .001$; $R2 = .75$) and T3 ($P < .001$; $R2 = .57$). Accounting for BDI, SV individually predicted BSS increases at T2 and T3 ($P < .05$, $\beta = .18$; $P = .06$, $\beta = .21$), whereas SOL, WASO, and TST did not ($P > .05$). Finally, compared to all other sleep variables, only SV predicted greater mood lability ($P = .002$; $\beta = .43$).
Conclusion: To our knowledge, this is the first longitudinal investigation to demonstrate that objectively-assessed sleep irregularity uniquely predicts an elevated risk for suicide. Mood lability, versus depressed mood, may play a central role in this relationship. As an assessment tool, risk factor, and target for treatment, a more rigorous evaluation of sleep may represent an important opportunity for suicide prevention.
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0691

SLEEP DISTURBANCES IN PATIENTS WITH CHEST PAIN AND PANIC DISORDER RECRUITED IN AN EMERGENCY DEPARTMENT

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Introduction: Chest pain is the panic symptom most likely to prompt consultation in an emergency department (ED). Accordingly, one third of patients who consult an ED with chest pain have Panic Disorder (PD). PD is associated with sleep problems, including insomnia and nocturnal panic attacks (NPA). This study examined sleep problems among PD patients consulting ED for noncardiac chest pain who received one of four treatments.
Methods: The present sample included 42 patients (16 women, mean age = 42), assigned to one of four treatment conditions: 1) a one-session intervention on panic management; 2) a seven-session biweekly cognitive-behavior therapy (CBT) for PD; 3) a 14-week pharmacological treatment (40 mg paroxetine daily), or 4) usual care. Before and after treatment, participants underwent a structured clinical interview to determine the presence of insomnia and NPA, and completed the Insomnia Severity Index (ISI), the Dysfunctional Beliefs and Attitudes about Sleep scale (DBAS), and sleep diaries.
Results: At baseline, 20 (48%) participants reported at least one NPA within the past month and 23 (55%) met criteria for insomnia. After treatment, 6 out of 20 (30%) still reported NPA, and 13 out of 23 (57%) still had insomnia. Significant improvements were observed on the ISI and the DBAS, but not on diaries (TWT, TST, and SE). Among individuals with insomnia, significant improvements were only observed on the DBAS. There was no differential effect of the treatment condition.
Conclusion: Treatment of PD had a positive effect on the perception of sleep disturbances, with greater impact on NPA than on insomnia. Improvements observed on self-report questionnaires but not on sleep diaries suggest that the nature of sleep remained unchanged after the treatment of PD. Individuals with insomnia showed the least improvement, indicating a need to offer them sleep management strategies in addition to CBT for PD.
Support (If Any): This research was supported by a postdoctoral grant from the Fonds de Recherche en Santé du Québec awarded to the first author.

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A COMPARATIVE STUDY OF PATIENTS WITH AND WITHOUT POSTTRAUMATIC STRESS SYMPTOMS PRESENTING TO A SLEEP MEDICAL CENTER

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Introduction: Posttraumatic sleep disturbance is largely conceived as insomnia and nightmare problems, but emerging evidence points to a more complex array of sleep problems with effects throughout the 24-hour sleep-wake cycle involving four distinct periods: bedtime, nighttime, morning, and daytime. We hypothesized these effects would most strongly correlate with the Arousal component of PTSD in a retrospective study of 1078 adult patients.

Methods: Three groups of patients with varying post-traumatic stress symptom (PSS) scores [Minimal (n = 728), Moderate (n = 194), Severe (n = 156)] presented at Maimonides Sleep Arts and Sciences. All patients completed questionnaires on sleep history, nightmares, sleep indices, sleepiness and fatigue VAS, ISI, FOSQ (impairment), QLESQ (quality of life), and PSS (PTSD).
Results: Mean age = 50.11yrs with 587 males, 491 females. Compared to Minimal PSS, Moderate and Severe groups reported more frequent arousal activity at bedtime [losing sleep over losing sleep, racing thoughts, time monitoring, RLS (P values < .05)] and at night [nightmares, parasomnias, time monitoring, and PLMS (P values < .02)] coupled with worse subjective sleep indices [SOL, TST, WASO, SE (P values < .02; mean d = .33)]. For morning retrospective assessments, the same two PSS groups reported more negative perceptions of sleep quantity and quality [based on ISI, sleep depth, sleep vitality, overall sleep quality (P values = .001;mean d = .64)]. Daytime measures showed worse impairment, sleepiness, fatigue and quality of life (P values < .003;mean d = .66). PSS Arousal subscale showed the highest correlations (P < .001) with: time monitoring (r = .42), nightmare severity (r = .36), ISI (r = .51), subjective sleep indices (mean r = .27), subjective sleep quality measures (mean r = .35), FOSQ (r = .50), and QLESQ (r = .27). PSS Avoidance showed the second highest correlations.
Conclusion: PSS severity correlated with a number of sleep factors that promote excess arousal activity. Prospective studies should be performed to determine whether solving sleep disorders would decrease arousal activity and influence PTSD outcomes.

0693

SLEEP DISORDERS AMONG OIF AND OEF SOLDIERS

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Introduction: Current operations in Iraq and Afghanistan involving U.S. military personnel in combat, hazardous security duty, and stressful non-combatant roles have, by necessity, changed their individual sleep wake cycles during months of deployment. Previous research has suggested an association between sleep disordered breathing and non-combat related post-traumatic stress disorder (PTSD), traumatic brain injury (TBI) and other psychiatric diagnoses. To our knowledge there have been no studies to examine these variables in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) soldiers post-deployment.
Methods: A retrospective chart review was completed to examine the prevalence of sleep disordered breathing among OIF/OEF soldiers referred to the Walter Reed Army Medical Center (WRAMC) Sleep Clinic and the association between sleep disordered breathing (SDB) and psychiatric and neurologic co-morbidities such as PTSD, depression and TBI.
Results: The records of 69 participants were evaluated for this study. There was a high prevalence of OSA (76.8%) among OIF/OEF patients who were referred to WRAMC sleep clinic and underwent overnight polysomnography (PSG). As expected, there was also a high rate of psychiatric co-morbidities in this population with 41.2% being diagnosed with PTSD, 44.9% with depression, 23% with anxiety and 17.4% with TBI. However, there was no significant association between OSA and PTSD, depression, anxiety or TBI. In contrast, age and BMI were strongly associated with higher rates of OSA for all diagnostic categories.
Conclusion: While there appears to be a high prevalence of OSA and PTSD among military patients who were referred to the WRAMC sleep clinic for overnight PSGs, there does not appear to be an association between psychiatric co-morbidity and SDB in this combat population. In contrast to studies of civilian populations, which link psychiatric co-morbidities such as PTSD to SDB, the present data find no such association in military personnel returning from combat duty.

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SLEEP DISTURBANCES IN U. S. SOLDIERS RETURNING FROM WARTIME DEPLOYMENT: PRELIMINARY FINDINGS

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Introduction: Over one million U. S. military personnel have been deployed since 2001 in support of overseas operations in Iraq and Afghanistan. The deployment environment is filled with uncertainty and a heightened sense of awareness for survival that may impact sleep quality. Epidemiologic studies have identified sleep disturbances (SD) as both a risk factor for and a manifestation of psychiatric and physical problems. Research on deployed military personnel has focused on the prevalence of psychiatric problems, but few data are available on the extent of disturbed sleep that may place soldiers at risk both for psychiatric and physical morbidity. The frequency of SD and associated factors in U. S. soldiers were assessed at two different time points after return from deployment.
Methods: A convenience sample of 58 U. S. soldiers (ages 23-58 years) completed the Pittsburgh Sleep Quality Index (PSQI), Post Deployment Health Assessment, perceived stress scale, and combat exposure scale immediately upon return from deployment (PD1) and 1.5 months later (PD2).
Results: Eighty-six percent (50/58) of participants had PSQI scores > 5, indicative of significant SD, at both assessments. SD was associated with: personal history of SD prior to deployment at PD1 (r = 0.52, P < 0.01) and PD2 (r = 0.43, P < 0.01); depression at PD1 (r = 0.34, P < 0.05); perceived stress at PD1 (r = 0.53, P < 0.01); symptoms of physical illness (PI) at PD1 (r = 0.38, P < 0.01) and PD2 (r = 0.56, P < 0.01); and symptoms of traumatic brain injury (TBI) at PD1 (r = 0.45, P < 0.01) and PD2 (r = 0.56, P < 0.01) after controlling for age, gender, and rank.
Conclusion: The findings from this small preliminary sample indicate an extremely high prevalence of SD in soldiers returning from wartime deployment. Individuals with a personal history of SD and symptoms of PI/TBI are likely to be at risk for persistent SD after deployment; thus, continual follow-up, and possibly treatment, are warranted.
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0695

LOW CORTICAL GABA LEVELS IN PTSD ARE MEDIATED BY POOR SLEEP QUALITY

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Introduction: Primary insomnia is associated with low brain GABA levels. We hypothesized that PTSD is associated with low brain GABA levels and that reduced GABA is mediated by poor sleep quality.
Methods: We studied 27 patients with PTSD (PTSD+, 35 ± 11 years) and 18 trauma-exposed controls (PTSD-, 37 ± 13 years). Sleep quality was assessed with the Insomnia Severity Index. Magnetic resonance spectroscopy at 4 Tesla used single volume acquisition in three cortical brain regions and concentrations of GABA, glutamate, and N-acetylas-

partate (NAA, a neuronal marker) were calculated. We tested a model in which the relationship between PTSD status and GABA concentration is mediated by insomnia severity.
Results: In parieto-occipital and temporal cortices, PTSD+ had lower GABA concentrations than PTSD-. As expected, PTSD+ had higher depressive and anxiety symptomatology, as well as higher scores on the ISI (14.8 ± 6.4 vs. 2.4 ± 2.6, P = < 0.0001). Within the parieto-occipital cortex, higher ISI correlated with lower GABA and higher glutamate concentrations ($r > 0.49$, $P < 0.02$). In the anterior cingulate cortex, higher ISI tended to correlate with lower GABA ($r = 0.41$, $P = 0.06$). Within the ACC, higher arousal scores correlated with lower NAA and Glu concentrations ($r < -0.41$, $P < 0.05$). The depression and anxiety measures were not correlated with metabolite concentrations. The relationship between PTSD status and GABA was found to be fully mediated through insomnia severity (indirect effect beta = -.42, $P < .03$; direct effect beta = .12, $P = .64$).
Conclusion: Low brain GABA levels in PTSD are consistent with studies of brain GABA in panic and social anxiety disorder. Low GABA associated with poor sleep quality is consistent with the hyperarousal theory of both primary insomnia and PTSD. The data demonstrate that low GABA in PTSD is mediated through poor sleep quality.
Support (If Any): This research was supported in part by grants from the Department of Defense (DJM: DAMD17-03-1-0532), the Mental Illness Research and Education Clinical Center (MIRECC) of the US Veterans Health Administration, and the National Institute for Mental Health (TCN: R01 MH73978). This material is the result of work supported with resources and the use of facilities at the Veterans Administration Medical Center, San Francisco California.

0696

SELECTIVE SLOW WAVE DEPRIVATION AS A POSSIBLE ACUTE TREATMENT OF MAJOR DEPRESSIVE DISORDER

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Introduction: Sleep deprivation can acutely reverse depressive symptomatology, but only in about half of patients and the underlying mechanisms are not clear. Many of the observations regarding sleep deprivation and depression can be explained by abnormal slow wave homeostasis. The purpose of this study was to test a recent prediction that selectively reducing slow waves during sleep (slow wave deprivation; SWD), while maintaining total sleep time and not waking the subject, will have an antidepressant effect.
Methods: Patients with major depressive disorder (N = 14) slept in an AASM certified sleep lab for three nights (adaptation, SWD, recovery). During the SWD night, acoustic stimuli were played to selectively disrupt slow waves without waking the subject up. To asses the effect of SWD on mood the inventory of depressive symptomology, self-rated (IDS-SR) was collected.
Results: Compared to baseline, sleep time and efficiency were not affected by SWD, whereas the slow wave activity was reduced by 50% ($P < 0.01$). During the recovery night there was a homeostatic rebound of SWA. Depressed subjects showed a 10% ($P < 0.05$) improvement in mood following SWD compared to baseline. Upon recovery sleep, mood values returned to baseline values.
Conclusion: These preliminary results suggest selective slow wave deprivation may hold promise as a non-pharmacological, rapid antidepressant treatment. This also suggests that slow waves may play a causal role in the antidepressant efficacy of sleep deprivation.
Support (If Any): NIMH: F30MH082602 to EL NIMH: P20MH077967 to RMB and GT

0697

SLOW WAVE SLEEP ENHANCEMENT AND POSITIVE MOOD IN DEPRESSIVES AND CONTROLS

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Introduction: This study aims to explore the relationship between slow wave sleep enhancement and mood in participants diagnosed with major depressive disorder (MDD) and healthy controls (HC).
Methods: 8 HC and 4 MDD participants maintained a regular sleep schedule of 11pm and 6 am for at least one week at home and during the baseline night. Sleep was subsequently delayed for 3 hours in an attempt to enhance slow wave sleep. In the morning following the baseline and enhancement nights, participants completed a Visual Analog Scale (VAS) assessing their positive and negative moods on a scale from 0-100.
Results: A repeated measures ANOVA conducted with the positive item on the VAS as the dependent variable revealed a significant Condition (Baseline, Slow-Wave Enhancement) by Group (Controls, MDDs) interaction, $F(1,10) = 14.771$, $P < .01$. A one-way simple effects ANOVA demonstrated that the HCs positive mood was greater following the delay but not following the baseline night condition $F(1,11) = 23.870$, $P < .001$. Furthermore, the HCs positive mood marginally increased following enhancement, $F(1,7) = 5.374$, $P = .054$ and the MDDs mood marginally decreased, $F(1,3) = 7.452$,$p = .072$. There were no main effects or interactions in the negative mood condition.
Conclusion: Sleep delay has differential effects on positive mood in depressives and controls. Further, sleep delay marginally increases positive mood in healthy controls, but marginally decreases positive mood in subjects with MDD. There were no differential effects of sleep delay on negative mood. This finding may be significant when considering the influence of slow-wave sleep on affect and mood in Major Depression, especially in the context of treatment and intervention.

0698

FRONTAL DELTA EEG ACTIVITY DURING NREM SLEEP OF ADULTS WITH AUTISTIC SPECTRUM DISORDER

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Introduction: Adults with Autism spectrum disorder (ASD) show decreased slow-wave sleep (SWS: stages 3+4) compared to controls. Since Delta EEG activity dominates in SWS, we tested whether this frequency band is also diminished in ASD.
Methods: Sixteen adults with ASD (15 M, 1 W, 22.0 ± 3.8 years old) and 18 comparison participants (17 M, 1 W, COM: 21.0 ± 4.2 years old) were recorded for two consecutive nights. Spectral amplitude of NREM Delta EEG activity (0.75-3.75 Hz) was computed for the first seven hours of sleep of night 2. Data is expressed as mean ± sem. Groups were compared using One Way ANOVA.
Results: Minutes of NREM sleep was the same in the two groups. When considering the whole first 7 hours of sleep in NREM sleep, Delta EEG activity was marginally significantly *decreased* for ASD compared to controls for Fz (ASD = 2.7 ± 0.06, COM = 2.9 ± 0.06) and F3 (ASD = 2.7 ± 0.06, COM = 2.8 ± 0.06). A closer stage-by-stage analysis of Delta activity confirmed this finding and further disclosed *increased* Delta activity for F7 in ASD (ASD = 296.13 ± 52.06, COM = 158.22 ± 11.43). An hour by hour breakdown of the data indicates that the same trend appears throughout the whole night.

Conclusion: ASD display decreased Delta activity during stage 2 for the midline frontal cortex (F3 and Fz) and increased Delta activity during stage 2 for the left anterior temporal lobe (F7). These results further support the hypothesis of an atypical cortical connectivity in ASD. The results may also reflect an inability to restore homeostasis in the midline-left frontal cortex and increased effort to reach homeostasis in more lateral left frontal cortex. Further analyses with larger samples will be performed, together with correlation analyses with frontal related cognitive tasks performed the morning following the recording.
Support (If Any): Supported by the Canadian Institutes of Health Research and the Fonds de la recherche en santé du Québec.

0699

QUANTITATIVE EEG ANALYSIS IN REM SLEEP IN OEF/OIF COMBAT VETERANS WITH AND WITHOUT PTSD

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Introduction: REM sleep disturbances have been associated with Posttraumatic Stress Disorder (PTSD), but PSG studies have yielded inconsistent findings. In this study, we used quantitative EEG (qEEG) to compare beta activity (16-32Hz) as a measure of central arousal during REM sleep in combat-exposed veterans with and without PTSD. We hypothesized that PTSD would be associated with greater beta activity.
Methods: Participants were combat veterans of Operations Enduring/Iraqi Freedom (OEF/OIF) drawn from an ongoing clinical trial. Assessments included 2 PSG nights, and questionnaires on sleep quality and psychiatric symptoms. Participants using psychotropic medications were excluded from this analysis. The second PSG night was used for qEEG analysis. Artifacts were rejected in 4-second epochs using an automated algorithm for EMG-twitches, and manually to remove eye-movement and pulse artifacts. Artifact-free REM epochs were subjected to spectral analysis using a fast Fourier transform model. T-tests were used to compare groups. Spearman correlations were performed between beta activity and clinical variables.
Results: No group differences were observed on PSG measures. The number of 4-second REM epochs rejected for qEEG analysis did not differ between groups. The PTSD group showed lower beta activity in REM sleep than the non-PTSD-group (mean (SD): 0.060 (0.02) vs. 0.096 (0.03), $P = 0.013$). No differences were observed in other qEEG activity bands. In the combined sample, REM beta activity was negatively correlated to PTSD symptom severity (rho = -0.52, $P = 0.04$), PTSD avoidance symptoms (rho = -0.57, $P = 0.02$), but not to hyperarousal symptoms (rho = -0.09, $P = 0.75$).
Conclusion: Contrary to our hypothesis, beta activity was lower during REM sleep in combat veterans with PTSD compared to those without PTSD, and was not related to hyperarousal symptom severity. This small study raises the possibility of a complex, non-linear link between central hyperarousal, REM sleep, and PTSD symptom severity.
Support (If Any): This research was supported by the National Institutes of Health (HL082610; RR024153; MH083085) and the Department of Defense (PR054093-W81XWH-07-PTSD-IIRA).

0700

POSTTRAUMATIC STRESS DISORDER IS HIGHLY PREVALENT IN VETERANS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Posttraumatic stress disorder (PTSD) is common among combat veterans with prevalence estimates of 5-15%. Chronic sympathetic hyperarousal is a major contributor in the pathophysiology of PTSD. Sleep disturbance is a hallmark and a key precipitating factor of PTSD. Obstructive sleep apnea (OSA) causes significant sleep disturbances and heightens sympathetic tone that may trigger the development of PTSD among those who are at risk. Our goal is to evaluate the prevalence of PTSD and its polysomnograhic effect in veterans with OSA.
Methods: We performed a cross-sectional study of patients with OSA based on polysomnography at Southeast Louisiana Veterans Health Care System from February 2007 to July 2008. A diagnosis of PTSD was made by a primary care or mental health provider. Patients with severe psychiatric or neurologic disorders, central sleep apnea, and severe periodic limb movement were excluded. Demographic data and polysomnographic parameters were reviewed and analyzed.
Results: A total of 316 patients met the criteria for the study. The mean age was 55.6 ± 5.27. The mean apnea/hypopnea index (AHI) was 43.1 ± 35.8 events/hour. Of those patients, 91 patients (28.7%) had a diagnosis of PTSD and 226 patients (71.3%) were used as control. There was no significant difference in age, gender, race, and body mass index between the two groups. The prevalence of depression was higher in the PTSD group compared to control (78% vs. 33%, $P < 0.05$). Polysomnographic parameters were similar between the two groups in regard to sleep efficiency, sleep latency, sleep stage distribution, AHI, and arousal index.
Conclusion: The prevalence of PTSD in veterans with OSA from our study is strikingly higher than previously reported prevalence in combat veterans. Patients with OSA and PTSD are associated with an increased prevalence of depression. There was no significant difference in polysomnographic parameters between OSA patients with and without PTSD.

0701

ACTIGRAPHIC SLEEP MEASURES IN MILITARY VETERANS WITH PTSD AND INSOMNIA

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Introduction: Sleep disturbances are common in military veterans with Post-Traumatic Stress Disorder (PTSD), and are also frequent in veterans without full PTSD. The main objective of this study was to explore actigraphic sleep disturbances between military veterans with posttraumatic stress disorder (PTSD) (n = 17) and military veterans with insomnia but who did not meet DSM-IV criteria for PTSD (n = 13). The second objective was to explore the relationships between actigraphy sleep parameters, sleep quality, and PTSD symptom severity.
Methods: All military veterans completed the Clinician-Administered PTSD Scale to assess PTSD status (CAPS), a locally-developed structured interview for sleep disorders, the Pittsburgh Sleep Quality Index (PSQI), and the PTSD Checklist-civilian version (PCL). DSM-IV criteria were used to diagnose insomnia. All participants wore an actiwatch (AW-64, Phillips Respironics) for 9 consecutive days and concurrently completed a sleep diary. All participants also completed a locally-developed clinician-administered structured interview to assess sleep disorders, including insomnia using DSM-IV criteria.
Results: Age, ethnicity, education, BMI, and PSQI scores did not differ between the two groups of veterans. On actigraphy measures, military veterans with PTSD presented longer sleep duration (Cohen's d = 0.744) and longer time in bed compared to military veterans with insomnia (Cohen's d = 0.743). Actigraphy estimates of sleep onset latency, wake after sleep onset, sleep efficiency, sleep fragmentation index, and diurnal activity level did not differ between groups. A positive correlation was observed between actigraphic estimates of total sleep duration and the PTSD symptom severity (rho = 0.36, $P = 0.05$). No correlation was found between other actigraphy parameters or sleep quality.
Conclusion: Contrary to expectations, military veterans with PTSD showed longer sleep time and increased time spent in bed compared to veterans with insomnia. In the total sample, PTSD symptom severity

was positively correlated with total sleep time. Compensatory behaviours in veterans with PTSD may explain this observation.
Support (If Any): This research was supported by the National Institutes of Health (MH080696, MH081003, RR024153) and the Department of Defense (PR054093-W81XWH-07-PTSD-IIRA)

0702
CBT FOR SLEEP DISTURBANCES IN COMBAT VETERANS: PRELIMINARY FINDINGS
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Introduction: Sleep disturbances are common in patients exposed to trauma with rates among combat veterans reaching as high as 80%. Cognitive behavioral therapy (CBT) approaches for both insomnia and nightmares have shown some preliminary efficacy in trauma survivors. We report preliminary findings of an ongoing open label trial of CBT for combat-related sleep disturbances conducted in combat Veterans.
Methods: This ongoing IRB-approved study is enrolling Veterans with combat experience from the Vietnam War era forward with a current complaint of insomnia with or without current nightmares. Eligibility criteria allow participation by Veterans with or without major depression (MDD) or post-traumatic disorder (PTSD) as well as those with other co-morbidites not interfering with study participation. Outcome measures include the: Insomnia Severity Index (ISI); Nightmare Frequency Questionnaire (NFQ); Fear of Sleep Inventory (FoSI); sleep diary variables (SL, WASO, SE and TST); Clinician Administered PTSD Scale (CAPS); Center for Epidemiologic Studies-Depression Scale (CES-D); Scale for Suicidal Ideation (SSI). CBT was comprised of 8 individual sessions including sleep education, sleep restriction, stimulus control, cognitive therapy, and imagery rehearsal therapy for nightmares. Six subjects (5 Vietnam Veterans and 1 Iraq War Veteran, all with PTSD and MDD) have complete pre and post data; data on additional subjects including follow up data will be forthcoming. Analyses were conducted using paired student t-tests.
Results: Improvements in sleep were noted on all sleep diaries and sleep instruments with significant improvements ($P < .05$) on SL, SE, TST, and ISI with trends ($P < .10$) for WASO and the NFQ. There was a mean reduction of 9 points on the CAPS and 8 points on the CES-D, although these did not achieve significance. The mean reduction on the SSI was minimal due in part to low baseline values. Importantly, despite improvements, 4 of 6 subjects continued to have ISI scores consistent with ongoing insomnia. Data on 3 participants with 1 month follow-up data suggest that gains are maintained and continue to grow with 2 additional participants reporting no insomnia on the ISI.
Conclusion: These preliminary data suggest that a CBT approach for insomnia and nightmares is feasible and efficacious in patients with combat-related trauma and PTSD. The clinical significance and durability of the improvements remain to be determined from follow-up data.
Support (If Any): This project was funded in part by the National Institutes of Health (K23NR010408) and the VA Center of Excellence at Canandaigua. The authors' views or opinions do not necessarily represent those of the NIH or the Department of Veterans Affairs (VA).

0703
SLEEP PROBLEMS IN CHILDHOOD INCEST SURVIVORS
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Introduction: Sexual abuse and pedophilia is becoming increasingly prevalent in the public eye. As adults, survivors struggle with insomnia and other sleep disorders.
Methods: From the Marilyn Van Derbur Institute's database of incest survivors, 500 subjects were randomly selected. These subjects were mailed both a Sleep Disorder Questionnaire (SDQ), and a questionnaire on their abuse. The SDQ contains a total of 218 questions regarding sleep history, common sleep complaints, past medical history, daytime sleepiness, and quality of life. Subjects answered the SDQ with 1 of 5 responses (never, rarely, sometimes, usually, or always), and 175 questionnaires were returned (161 women, 14 men). The survivors were divided into 3 groups for analysis: abuse by immediate family (immediate group), abuse by extended family (extended group), and unrelated abusers (unrelated group). A control group of 20 subjects (19 women, 1 man) was also randomly selected and they also completed a SDQ.
Results: The immediate (57% of responses) and extended (52%) groups were more likely to have disturbed and restless sleep vs. the unrelated group (18%). The extended group (74%) had the most frequent complaint about "thoughts racing through their minds" at bedtime, followed by the immediate group (62%) and the entire group (59%) of survivors experiencing this as a recurring problem. The sleep of the unrelated group (62%) was continually affected by nightmares, however, they (65%) were able to sleep the most at night when compared to the immediate (37%), extended (39%), and control (40%) groups.
Conclusion: The immediate group experienced the most problems associated with sleep compared to in descending order: extended, unrelated, controls; the immediate group answered most of these questions with "usually" and "always". Although the unrelated group had the least amount of sleep complaints and reported the most sleep at night, interestingly, they reported that their sleep was frequently disturbed by nightmares.

0704
CORRELATES OF DAYTIME SLEEPINESS IN PATIENTS WITH LIFETIME PTSD AND SLEEP DISTURBANCE
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Introduction: Sleep related problems are common in patients with post traumatic stress disorder (PTSD) and may include: Insomnia, daytime sleepiness, repetitive awakenings, nightmares and daytime dysfunction. The purpose of the study was to assess the correlates of daytime sleepiness in patients with lifetime PTSD and on-going sleep disturbance not due to sleep apnea or other diagnosed sleep disorders.
Methods: We collected data on 26 veterans receiving mental health care at the Minneapolis VA Medical Center. The veterans who responded to posters about the study were screened for the study. Daytime sleepiness as scored by Epworth Sleepiness Scale (ESS) which was the primary outcome measure. Other sleep-related instruments consisted of the Pittsburgh Sleep Quality Index (PSQI), a daily Sleep Log, and daily Sleep Actigraphy. In addition, data included three symptom ratings scales: the Posttraumatic Checklist, the Clinician Administered PTSD Scale, and the Beck Depression Inventory.
Results: On univariate analysis, daytime sleepiness scored by the ESS was associated with the daytime dysfunction subscale on the Pittsburgh Sleep Quality scale ($r = +.67$), less use of sleeping medication ($r = - .48$), and more self-rated posttraumatic stress symptoms ($r = +.40$). Within posttraumatic stress symptoms categories, hypervigilance symptoms were more correlated with daytime sleepiness ($r = +.44$) than were re-experiencing and avoidance symptoms ($r = +.33$ for each).
Conclusion: In this selected sample of patients with lifetime PTSD and sleep disturbance, daytime sleepiness was most strongly and independently associated with daytime dysfunction subscale on PSQI.

0705

SNOOZING IS ASSOCIATED WITH WORSE MOOD REGULATION IN PATIENTS WITH COMORBID PTSD AND DEPRESSION

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Introduction: The Negative Mood Regulation (NMR) scale assesses expectancies about one's ability to alter negative mood, with higher scores signifying stronger expectancies. To our knowledge, no studies have examined NMR and sleep. We hypothesized that patients with comorbid PTSD/MDD with lower NMR would have worse sleep as determined by actigraphy.
Methods: The NMR scale and actigraphs were administered to a total of 40 subjects (31 males; M age = 51.3 years, SD = 12.1 years). Subjects were asked to wear actigraphs for one week. Zero-order correlations and linear regression techniques were used to examine the relationship between NMR scores and actigraphy data.
Results: Subjects with lower NMR scores had longer "snooze time," or time spent in bed after their final awakening from sleep ($r = -.34$, $P < .05$). Gender correlated significantly with NMR ($r = -.31$, $P < .05$). This finding suggests that NMR may function as a mediator between gender and snooze time (a*b = 6.26, CI.90 = .88, 13.78), although this finding was significant only at a trend level ($\alpha = .10$). No significant correlations were observed between NMR and wake time after sleep onset, mean duration of awakenings, number of awakenings, sleep/wake percent, total sleep time, or sleep efficiency.
Conclusion: Subjects with comorbid PTSD/MDD and lower NMR scores had more difficulty rising from bed in the morning. Spending more time in bed after waking may be a means of avoiding actively coping with negative mood. This finding is consistent with previous research showing that individuals with lower NMR scores are more likely to avoid versus engaging in behaviors such as problem solving and seeking social support.
Support (If Any): Institute for Mental Health Research, American Sleep Medicine Foundation and Department of Defense (W81XWH-08-2-0121)

0706

THE EFFECT OF BRIGHT LIGHT THERAPY ON PTSD RELATED SLEEP DISTURBANCES

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Introduction: Sleep disturbance is perhaps the most common complaint of Posttraumatic Stress Disorder (PTSD) patients, and may play a role in precipitating PTSD and in perpetuating the symptoms of PTSD. Treatment of disturbed sleep could provide an important means of improving mental health in PTSD patients. The objective of our ongoing study is to examine whether bright light therapy will elicit reductions in clinical and self assessment of PTSD symptom severity, and related morbidity, including depression and disturbed sleep.
Methods: Following a 1-week baseline, sixteen Operation Enduring Freedom or Operation Iraqi Freedom veterans with combat PTSD were randomized to one of two 4-week treatments: (1) bright light (daily 10,000 lux for 30 min; n = 8) or (2) a placebo inactivated negative ion generator (NIG; n = 8). A Clinician-Administered PTSD Scale (CAPS-2) was administered at baseline and immediately following completion of the study. At weekly intervals, depression was assessed with the Beck Depression Inventory (BDI-II), and sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI) with addendum for PTSD (PSQI-PTSD).
Results: Preliminary results showed a significantly greater reduction in the PSQI-PTSD ($P = 0.03$) following bright light (effect size: $d = -1.13$) compared with NIG ($d = -0.07$). A moderate treatment effect was seen for the CAPS-2 ($d = -0.53$ vs. -0.06 following bright light vs. placebo, respectively), and BDI-II ($d = -0.59$ vs. 0.41) measures, but no treatment effect was seen for global PSQI measures ($d = 0.10$ vs. 0.03).
Conclusion: Results of this ongoing study show significant effects of bright light on sleep disturbances associated with combat PTSD, and the potential for the use of bright light therapy in the treatment of PTSD symptoms and associated morbidity.
Support (If Any): This study is supported by VA Merit Award.

0707

ADHERENCE TO CONTINUOUS POSITIVE AIRWAY PRESSURE TREATMENT OF OBSTRUCTIVE SLEEP APNEA IN PATIENTS WITH POSTTRAUMATIC STRESS DISORDER

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Introduction: Comorbid obstructive sleep apnea (OSA) in patients with posttraumatic stress disorder (PTSD) is becoming increasingly recognized. Unfortunately, the insomnia and sleep fragmentation in PTSD may impair continuous positive airway pressure (CPAP) adherence. These issues may be neglected with focused CPAP follow-up. We hypothesized that patients with posttraumatic stress disorder would have poorer compliance with CPAP therapy than a matched control group without PTSD.
Methods: Retrospective case-control study. Patients matched for age, BMI, gender and AHI. Consecutive adult patients newly diagnosed with OSA who presented for CPAP follow-up. Compliance was objectively measured. Primary endpoints were measures of CPAP compliance.
Results: 50 patients were studied (25 control and 25 PTSD, mean age 41.8 ± 10.3, mean BMI 31.3 ± 4.1, mean Epworth Score 14.9 ± 5.1, mean AHI 25.8 ± 24.5). Groups did not differ at baseline. CPAP was used on 70.1% of nights in the controls and 68.1% of nights in the PTSD group ($P = 0.09$). CPAP was used for > 4 hours per night 44% of the time in controls and 31% of the time in the PTSD group ($P = 0.18$). 44% of control patients used CPAP > 4 hours per night on > 70% of nights and 21% of patients with PTSD did the same ($P = 0.09$). CPAP was used for 5.34 hours per night used in the control group and for 3.75 hours per night used in the PTSD group ($P = 0.02$).
Conclusion: Patients with PTSD used CPAP for fewer hours per night used than controls, but did not differ in other measures of CPAP compliance. PTSD negatively impacts CPAP use. However, its impact was minimal and should not preclude CPAP use in patients with PTSD and OSA. More research is needed in this area and care must be taken to address all aspects of sleep in addition to sleep disordered breathing.

0708

INSOMNIA SEVERITY AND SLEEP ADEQUACY AS PREDICTORS OF DEPRESSIVE AND ANXIOUS SYMPTOMS IN A PSYCHIATRIC TREATMENT SEEKING POPULATION

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Introduction: Sleep disruption is gaining attention among mental health professionals and the assessment of sleep disruption becoming a staple

of clinical intake interviews. However, there is much to learn regarding the impact that sleep disruption may have on psychiatric illness. Specifically, in addition to insomnia symptoms what is the unique impact that subjective concerns about sleep may have on depressive and anxiety symptoms? The current study investigated the relation between insomnia severity, subjective sleep adequacy and symptoms of depression and anxiety in an adult treatment seek population.

Methods: As part of a research and treatment outcome protocol, patients (N = 352) completed a set of questionnaires designed to assess psychiatric symptoms: Patient Health Questionnaire-9 (PHQ-9), Penn State Worry Questionnaire (PSWQ), Insomnia Severity Index (ISI), and a supplemental unvalidated measure of sleep concerns labeled the Sleep Assessment Questionnaire (SAQ). All patients completed the protocol on the day of their initial intake appointment at an Ambulatory Psychiatry Outpatient Clinic. Regression analyses were used to determine the relation between patients' ISI, SAQ scores and their PHQ and PSWQ scores.

Results: The results suggest that the ISI accounted for 27% of the variance in the PHQ scores at initial intake. Further, the SAQ scores added an addition 3% of unique variance in predicting PHQ scores (i.e., significant $\Delta R2$; $F(1, 347) = 13.52$, $P < .001$). In addition, the ISI accounted for 14% of the variance in PSWQ scores and the SAQ scores contributed 2 % of unique variance to the model (i.e., significant $\Delta R2$; $F(1, 342) = 5.94$, $P < .05$).

Conclusion: Subjective concerns about sleep adequacy may be partially contributing to the psychiatric symptoms cluster associated with depressive and anxiety symptoms. In addition to assessing insomnia severity, patients' concerns about sleep may also need to be assessed and adequately addressed in treatment for symptom reduction.

0709

AN ASSOCIATION BETWEEN RESTLESS LEGS SYNDROME (RLS), SELECTIVE SEROTONIN REUPTAKE INHIBITORS (SSRIs) AND ATYPICAL ANTIPSYCHOTICS IN ANXIETY DISORDERS

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Introduction: Restless Legs Syndrome (RLS) is a sensorimotor disorder, affecting 5-10% of the population. RLS is characterized by uncomfortable sensations in the lower extremities with an urge to move, usually worse in the evenings. Epidemiological studies suggest an association between RLS and anxiety disorders. Anxiety disorders are commonly treated pharmacologically with Selective Serotonin Reuptake Inhibitors (SSRIs). However, there is conflicting evidence regarding whether SSRIs exacerbate RLS. We hypothesize that RLS is over-represented in patients with anxiety disorders, and that SSRIs exacerbate RLS symptoms.

Methods: Patients referred Cognitive Behavioural Therapy (CBT) at the Royal Ottawa Mental Health Center (ROMHC) Anxiety Disorders Clinic completed a brief standardized questionnaire published by the International Restless Legs Syndrome Study Group (IRLSSG) to assess RLS. Demographic data and current medications including psychotropics were also documented. Anxiety diagnosis was assessed with the Mini-International Neuropsychiatric Interview (MINI), and anxiety rating scales. Results were analysed to assess a) the frequency of RLS in patients with anxiety disorders, and b) correlations between psychotropic use and RLS. This protocol was approved by the Research Ethics Board at ROMHC.

Results: Preliminary data (n = 16): Mean age = 41 (SD = 12), M:F ratio 5:11. RLS frequency was 3/16 (18.8%). SSRI use occurred in 4/16 (25%) patients, and in 2/3 (66%) of RLS patients (OR = 2.7). Atypical antipsychotic use was identified in 3/16 (18.8%), and in 2/3 (66%) of RLS patients (OR = 4). In 10 patients not taking psychotropic medications, RLS was absent. Anxiety diagnoses in RLS patients included Generalized Anxiety (GAD) in 2/3 (67%), and Panic Disorder (1/3, 33%).

Conclusion: Our RLS frequency (18.8%) in patients with anxiety disorders was above the estimated 5-10% prevalence in the general population. SSRI and atypical antipsychotic use were over-represented in RLS patients. Anxiety severity remains a confounding variable, which may increase RLS vulnerability. Statistical significance is limited due to current sample size.

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0710

INSOMNIA SYMPTOMS AS PREDICTORS OF DEPRESSIVE AND ANXIOUS SYMPTOMS IN PERINATAL WOMEN PRESENTING FOR MENTAL HEALTH TREATMENT

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Introduction: Depression and anxiety are common in perinatal women. Sleep is often disrupted during pregnancy and can remain problematic postpartum. However, little is known about the sleep of perinatal women who present for outpatient mental health treatment.

Methods: Two hundred fifty-seven women (114 pregnant, 143 within 6 months postpartum) who presented to the University of Michigan's Depression Center for outpatient mental health treatment completed measures assessing symptoms of depression (Edinburgh Postnatal Depression Scale; EPDS), anxiety (Penn State Worry Questionnaire; PSWQ), and sleep (Insomnia Severity Index (ISI) and questions about sleep habits) at their initial evaluation. Regression analyses were used to examine relationships between psychiatric symptoms and sleep.

Results: Most women (87%) had EPDS scores ≥ 10, indicating significant symptoms of depression; similarly, 85% had PSWQ scores > 40, indicating significant symptoms of anxiety. Half of the sample had ISI scores ≥ 15 ($M = 14.3 \pm 6$). Seventy percent reported ≤ 6 hours of sleep per night, and 73% said they had too little sleep over the past two weeks. Mean ISI score was not significantly different between pregnant and postpartum women ($t = -4.2$, $P = .68$). After adjusting for maternal age, the ISI accounted for 25% of the variance in EPDS score ($F(1, 248) = 42.67$, $P < .001$) and 47% of the variance in PSWQ score ($F(1, 255) = 112.38$, $P < .001$).

Conclusion: In this sample of perinatal women who presented to an outpatient psychiatric clinic for evaluation and treatment, 50% reported symptoms of clinically significant insomnia. Furthermore, many described not getting adequate sleep. Insomnia symptoms accounted for a significant proportion of the variance in depressive symptoms and anxiety symptoms. These results suggest that sleep is dysregulated in women who present for mental health care, and this dysregulation is clearly linked to their psychiatric symptoms.

0711

ANXIETY CORRELATES WITH SLEEP LATENCY AND REM SLEEP beta2 EEG ACTIVITY IN PATIENTS WITH FIRST-EPISODE SCHIZOPHRENIA NEVER TREATED WITH ANTIPSYCHOTICS

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Introduction: Anxiety has been related to increased sleep latency and increased beta EEG activity during sleep. We have observed an increase in REM sleep relative beta2 EEG activity in the occipital region in patients with first-episode schizophrenia. The present study aims at verifying if anxiety is related to sleep latency and REM sleep beta2 EEG activity in patients with schizophrenia.

Methods: Ten patients with first-episode schizophrenia never exposed to antipsychotics (5 M, 5 W, mean age = 24.6 ± 10.0 years) were recorded for two consecutive nights in a sleep laboratory. Clinical symptoms were assessed by the Brief Psychiatric Rating Scale (BPRS) and the

anxiety-depression subscale scores were extracted. All participants had a 12-electrode EEG montage. Night two was visually scored according to Rechtschaffen and Kales (1968). Fifteen four-second epochs (60 sec) of artefact-free EEG were selected from the first three REM sleep periods and submitted to Fast Fourier Transform. Power amplitude was calculated and absolute and relative beta2 EEG activity (20.00-30.75 Hz) was extracted. Sleep latency and REM sleep beta2 absolute and relative EEG activity were correlated with BPRS anxiety-depression scores using Spearman's Rho.
Results: REM sleep absolute beta2 EEG activity was positively correlated with anxiety-depression scores in the occipital region (O1 + O2) ($r = .63$, $P < .05$). More specifically, a positive correlation was obtained for the right occipital electrode (O2, $r = .73$, $P < .02$), but was non-significant for the left occipital electrode (O1). A positive correlation was also observed between sleep latency and anxiety-depression subscale scores ($r = .67$, $P < .03$).
Conclusion: These results show that increased REM sleep beta2 EEG activity may not specific to schizophrenia itself but could reflect the anxiety of being in an acute psychotic state. This raises the possibility of hypervigilance being central to the pathophysiology of first-episode psychosis.

0712

INTERMEDIATE SLEEP IN DRUG-NAIVE PATIENTS WITH SCHIZOPHRENIA: A MATTER OF EMG LEVELS DURING REM SLEEP

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Introduction: Several abnormalities of sleep structure are found in schizophrenia, including high rates of "intermediate sleep." This sleep pattern is more frequently reported during acute phases and corresponds to epochs of NREM-REM mixed patterns predominantly occurring at the transition between these two sleep phases. Our aim was to address this topic in drug-naïve patients.
Methods: We used polysomnograms of 10 acute patients never exposed to neuroleptics (5 M, 5F, mean age = 24.5 ± 10) and 10 healthy controls (6 M, 4 F, mean age 23.0 ± 8), who all accepted to sleep in the laboratory for two consecutive nights. Patients were recorded during their first week of hospitalization, four of them could complete only one night of recording. Diagnosis of schizophrenia was confirmed for all patients within 6 months, according to DSM-IV. Sleep stages were scored blind by two independent raters, according to Rechtschaffen and Kales and using 20-second epochs. A complementary scoring of intermediate sleep, defined by both chronological and morphological criterions, was performed. Proportions of intermediate sleep over total sleep time in both groups were compared using the Wicoxon test.
Results: The total proportion of intermediate sleep over total sleep time did not significantly differ between patients and controls (patients: 8.5% ± 2.5; controls: 6.3% ± 3.2). Proportions of specific subtypes of intermediate sleep did not differed either, with the only exception of "REM sleep without atonia," which was significantly increased in patients (0.23% ± 0.33 vs. 0.03% ± 0.05; $P < 0.02$).
Conclusion: These results do not confirm prominence of intermediate sleep in acute schizophrenia, but raise questions about motor control during REM sleep in acutely-ill drug-naïve patients with schizophrenia
Support (If Any): Supported by the "Fonds de la Recherche en Santé du Québec" and the Canadian Institutes of Health Research.

0713

LOW POWER OF FAST FREQUENCY EEG IN AUTISM IS NOT SPECIFIC TO REM SLEEP IN AUTISM

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Introduction: We have already shown that, compared to controls, adults with autism display lower fast frequency EEG activity during REM sleep (but not during wake) over the primary cortical visual area (O1,O2), a region involved in the pathophysiology of this syndrome (Daoust et al., 2004). The aim of the present report is to test whether these results are specific to REM sleep or if they are shared with nonREM sleep.
Methods: Seventeen adults with autism (16 men, 1 woman; 22.0+/-3.6 years) and normal intelligence and 15 matched controls (14 men, 1 woman; 20.6+/-4.4 years) were recorded for two consecutive nights. The spectral amplitude of beta1 (13.0-19.75 Hz) and beta2 (20.0-30.0 Hz) frequencies during nonREM sleep were computed for the first six hours of nights 2. Groups were compared with Student's t-test.
Results: Participants with autism showed less Beta-2 activity in stage 2 during the last three hours of the night for O1 and the last (6th) hour of the night for O2. No differences were found in the first three hours of the night.
Conclusion: These results show that decreased fast EEG activity over primary visual areas of persons with autism is also found during non-REM sleep but not during wake. They suggest that atypical patterns of primary visual areas EEG are not restricted to an activated state but best manifest themselves when the cortex is relatively isolated from the outside world. Moreover, the fact that such differences are found at the end of the night in both sleep states also suggests that circadian or homeostatic factors may be involved.
Support (If Any): Supported by Canadian Institutes of Health Research (CIHR)

0714

ALCOHOL DEPENDENT PATIENTS IN RECOVERY SHOW DISTINCT DIM LIGHT MELATONIN ONSET PROFILE COMPARED TO CONTROLS

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Introduction: Sleep disturbance is common and associated with alcoholic relapse. Circadian abnormalities may contribute, since one study found delayed onset in melatonin secretion in alcoholics vs. controls (Kuhlwein et al 2003). We sought to replicate that finding and investigate correlates.
Methods: 22 alcohol-dependent participants (AD) & 14 healthy controls (HC) participants (10 F) mean age 34 [20-55] were studied. ADs stopped drinking 3-12 weeks before the study. Participants adhered to an 11pm - 6am sleep/wake schedule and completed nightly Stanford Sleepiness Scales (SSS) for 2 weeks prior to lab assessment. Laboratory dim light melatonin onset (DLMO) was assessed via saliva every 30 minutes between 7:30 p.m. and 2 a.m.
Results: AD's reported significantly worse sleep than HC's. DLMO secretion in both groups increased simultaneously until 8 pm after which HC's increased more rapidly than AD's. Repeated measures ANOVA revealed a significant effect for melatonin, ($F(14,7) = 23.9$, $P = .00$), but no interaction with diagnostic group. Melatonin volume, time of onset, peak secretion, time of peak secretion, and area under the curve (AUC) did not differ between groups. Cohen's d effect sizes comparing individual time points between groups were medium, ranging from .21 at 8:30

pm to .68 at 10:00 p.m. Multiple regression found that melatonin volume predicted 32% of the variance (β = .56) in mean SSS score in AD ($F_{1,19} = 8.3$, $P = .01$) but not in HC ($F_{1,12} = 1.1$, $P = .32$).
Conclusion: Although most melatonin parameters did not differ between groups, DLMO profile was distinct in the AD group. Low power and adherence to a regular sleep schedule may have obscured some differences, but mechanisms other than circadian regulation may account better for AD's sleep complaints.
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0715

SLEEP OF ALCOHOLICS WITH AND WITHOUT INSOMNIA COMPARED TO HEALTHY CONTROLS

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Introduction: Insomnia is common during recovery from alcohol dependence and has been implicated in relapse. Little is known about the relationship between insomnia and objective sleep measures in alcohol-dependent individuals. We examined sleep in recovering alcoholic participants with and without insomnia to controls and the relationship between sleep and drinking-related measures.
Methods: Thirty-six abstinent alcoholic participants (mean age 35.4 ± 11.0 years, 6 women), classified with (AWI, n = 23) or without (ANI, n = 13) insomnia from clinical interviews, and 14 controls (HC, mean age 34.2 ± 11.4 years, 5 women) participated. Following a 2300 - 0600 hours at-home sleep schedule and screening, participants underwent baseline (2300 - 0600 hours) and sleep delay (0200 - 0900 hours) nights with polysomnography (PSG). Self-report measures included the Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), Obsessive-Compulsive Drinking Scale (OCDS), a craving measure, and Short Inventory of Problems (SIP) to quantify alcohol consequences.
Results: AWI had more diary-rated wake after sleep onset than ANI and HC (33.6 ± 24.4 vs. 16.3 ± 10.3 vs. 8.6 ± 5.7 mins, $P = .003$) and higher PSQI (9.3 ± 3.5 vs. 4.3 ± 3.0 vs. 2.9 ± 1.4, $P < .001$) and ISI (10.3 ± 5.5 vs. 4.1 ± 4.3 vs. 2.1 ± 1.7, $P < .001$) scores. AWI had shorter total sleep time ($P < .05$) and lower sleep efficiency ($P < .05$) than HC on baseline PSG. OCDS and SIP scores were positively correlated with diary-rated sleep onset latency (SOL, $r = .49$, $P = .01$ for OCDS, $r = 0.54$, $P = .007$ for SIP). Multiple regression indicated that diary-rated SOL and age at onset of problem drinking accounted for 33% of the variance in baseline SIP score ($F_{2,20} = 5.0$, $P = .02$).
Conclusion: AWI reported more sleep problems than ANI and HC. Longer diary-rated SOL, regardless of insomnia status, was associated with more alcohol-related craving and adverse drinking consequences. Initial insomnia may reflect anxiety about drinking desire and the problems created.
Support (If Any): NIH R01 AA016117 & K24 AA00304 (K Brower)

0716

PHARMACOLOGIC TREATMENTS FOR SLEEP DISRUPTION OCCURRING AFTER CESSATION OF ALCOHOL USE: A SYSTEMATIC REVIEW

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Introduction: Patients with alcohol dependence have significant sleep disorders and polysomnographic changes. Insomnia in these patients is associated with increased rates of relapse. Treating sleep disturbances may promote abstinence. We aim to conduct a systematic review of pharmacologic treatments for insomnia during abstinence.
Methods: In accordance with the Quorum Statement, we searched PubMED, EMBASE, PsychInfo and Medline databases using the terms alcohol, insomnia/sleep and treatment/management with no year/language restrictions. We reviewed references from relevant articles and from recent journals in Sleep Medicine and Addiction Medicine/Psychiatry. Trials with information on sleep outcomes in patients with alcohol dependence who were experiencing sleep disruption after cessation of alcohol use were included.
Results: The search revealed 1239 articles and 20 met inclusion criteria. Trazodone was compared against placebo and found to be superior in two trials in subjective measures and on PSG. Gabapentin improved sleep in an open label trial but was no better compared to placebo/valproate in other trials. Trazodone and gabapentin improved sleep measures with gabapentin performing significantly better in one study. A placebo controlled study showed that a combination of gabapentin and flumazenil resulted in lower daytime sleepiness evidenced by lower EPS scores. Gabapentin and lorazepam were effective in improving sleep measures but gabapentin resulted in lower EPS scores in another trial. A randomized study showed lormetazepam was better than zopiclone. In single, small, mostly open label studies quetiapine, triazolam, ritanserin, bright light and magnesium have shown efficacy while chlormethiazole, acamprosate, scopolamine and melperone showed no difference or worsening. In one randomized trial, topiramate performed worse than placebo.
Conclusion: Trazodone has the most data suggesting efficacy, however, this must be tempered with caution as there are indications that it might lead to a return to heavy drinking in some patients. More research is urgently needed in this field.

0717

STOP-BANG SLEEP APNEA SCREENING EVINCES A HIGH RISK AMONGST PATIENTS ADMITTED TO PSYCHIATRIC UNITS

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Introduction: Sleep disturbance is an established sign of uncontrolled mental diseases. As a consequence, it is difficult to establish if a sleep disorder is a promoter or sequela of uncontrolled mental disease. This study was conducted to assess the association of sleep apnea and mental diseases in an inpatient setting.
Methods: In 2009, the STOP-BANG sleep questionnaire(SBSQ) was surveyed prospectively to 100/123 patients admitted consecutively to an adult psychiatric inpatient unit. Patients that scored 3 or more on the questionnaire were considered to be at risk for sleep apnea. Patients were compared for axis diagnoses, as well as demographics, comorbidities, and the SBSQ parameters. Fisher's exact test, Mann-Whitney test, and multiple Spearman regression analyses were utilized. Where appropriate, data are presented as median (mean ± SD).
Results: 100 consecutive patients (55% males) were of age 35 years (38 ± 13.7). 56 patients had been admitted involuntarily vs. 14 consensual voluntary and 30 voluntary. 53 patients scored 3 or more on SBSQ. Overall SBSQ score was 3 (3 ± 1.7). Patients' SBSQ score did not differ between involuntary or voluntary admissions. Patients with Borderline Personality traits had significantly lower SBSQ scores compared to patients without Axis II diagnoses ($P < 0.04$). SBSQ scores of patients with comorbid substance abuse did differ from patients without substance abuse. Higher risk of sleep apnea was associated with higher number of comorbidities ($P < 0.0001$) and the number of none psychiatric medications ($P = 0.0001$). Psychiatric medications, individually or collectively, did not correlate with higher SBSQ scores.
Conclusion: Patients admitted to psychiatric inpatient units are at a high risk of having sleep apnea. The patient's risk of sleep apnea does not differ for voluntary vs. involuntary admissions. Affective disorders, psychotic disorders, comorbid substance abuse, and psychiatric medications did not change the risk of sleep apnea. Psychiatric inpatients have the highest risk of sleep apnea when there are many comorbidities.

0718

AN E-MAIL DELIVERED UNIVERSAL AND TARGETED CBT FOR SLEEP-HEALTH PROGRAM TAILORED FOR COLLEGE STUDENTS

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Introduction: College students often have erratic sleep schedules and poor sleep. Poor sleep may be a modifiable risk factor for significantly depressed mood. We examined the effects on sleep-health and depression of a sleep-health promotion program (Refresh) delivered by e-mail to first year college students.
Methods: Students in one residence hall (64) participated in Refresh and 71 students in another residence hall participated in an equal-length emotional health promotion program (Breathe). Participants completed the Pittsburg Sleep Quality Index (PSQI) and the Center for Epidemiological Studies-Depression Scale (CES-D) at baseline and post-intervention. We used t-tests to determine the statistical significance of group differences in changes in PSQI scores and CES-D scores.
Results: There were no significant overall differences between the two interventions' effects on sleep or mood. However, Refresh produced greater improvements in sleep among students with poor sleep (PSQI > 5) and among students with depression symptoms (CES-D > 15). Refresh also produced greater improvements in depression severity among poor sleepers.
Conclusion: Sleep-health education delivered by e-mail may be a cost effective way to help students improve their sleep. Internet delivery is likely to produce similar effects but this assertion needs to be tested.

0719

THE EFFECT OF SLEEP TIME RELATED INFORMATION AND COMMUNICATION TECHNOLOGY (STRICT) ON SLEEP PATTERNS AND DAYTIME FUNCTIONING IN CHILDREN AND YOUNG ADULTS: A PILOT STUDY

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Introduction: European studies suggest that widespread use of information and communication technology (ICT) among school-aged children and young adults may be associated with poor sleep hygiene and increased behavioral problems (J. Van Den Bulck, 2003; 2007). The impact of SRICT has yet to be evaluated in the United States.
Methods: Studying the effects of SRICT on mood, cognition, quality of life, and daytime functioning. A modified version of the School Sleep Habits Survey was distributed to children and young adults presenting to the JFK Sleep Medicine Clinic, Edison, NJ. The survey included standard items regarding sleep/wake patterns, ICT use, measures of daytime sleepiness, cognition, and mood.
Results: 14 students (50% Males, 50% Females) completed the survey from September till December 2009. Mean age was 16.8 years. 62% had persistent sleep initiation problems. A gender difference was noted in preferred type of SRICT, with boys more likely to surf the internet and game on-line and girls more likley to text message or use a cell phone. Average number of texts/emails per night was 62. Average number of people texted at night was 3.7. The average number of awakenings involving SRICT was 1.4. Monthly number of text messages sent per person averaged 8,800. Among adolescents, older age correlated with later bedtimes and the more time spent in SRICT use. High rates of daytime cognitive and mood problems were associated with SRICT and include Attention Deficit Hyperactivity Disorder, anxiety, depression, and learning difficulties. Nighttime problems included excessive movements, insomnia, and leg pain.
Conclusion: SRICT may have an adverse impact on sleep hygiene and daytime functionig. The association between SRICT and cognitive/mood dysfunction may be significant and questions regarding SRICT should be incorporated into the routine evaluation of the sleep patient.

0720

DSM-IV DIAGNOSES IN CHILDREN BEFORE AND SIX MONTHS AFTER ADENOTONSILLECTOMY

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Introduction: Previously we reported high rates of DSM-IV attention deficit disorders (ADHD) and oppositional defiant disorder (ODD) among children scheduled for adenotonsillectomy (AT). Diagnoses for many of these children reverted to normal one year after surgery. Here we report similar findings in a larger cohort, including pre-school children, evaluated six months after surgery.
Methods: 140 children from age 3 to 12 who had been scheduled for AT were recruited. Children with intellectual disability, autistic disorder, or serious medical problems were excluded. The computerized DISC-IV, parent version, was administered by a child psychiatrist, a child psychologist, or a developmental pediatrician, each of whom made a final diagnosis based upon DISC findings, additional history if relevant, and direct observations of the children. This protocol was administered at baseline and approximately six months following AT. Change from baseline to follow-up was assessed with McNemar's test (one-tailed).
Results: 49/140 children (35%) met criteria for some form of ADHD at baseline; 27 (19.3%) had some form of ADHD at six month follow-up. Ten children (7.1%) met criteria for ADHD-inattentive type at baseline, whereas five (3.6%) met criteria at follow-up (NS). Ten children (7.1%) met criteria for ADHD-hyperactive type at baseline, while four (2.9%) met criteria at follow-up ($P < .05$). Twenty-nine children (20.7%) met criteria for ADHD-combined type at baseline, while 18 (12.9%) met criteria at follow-up ($P < .05$). Twenty-six children (18.6%) were diagnosed with ODD at baseline, whereas only five (3.6%) were similarly diagnosed at follow-up ($P < .0001$). Enuresis was present in 26 of 137 children (19%) before surgery and in 18 (13.1%) after surgery ($P = .06$).
Conclusion: These data replicate and expand previous findings of high baseline rates of ADHD and ODD in children scheduled for AT. Substantial improvement occurred as early as six months after intervention at rates similar to those previously reported after twelve months.
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0721

PSYCHIATRIC COMORBIDITY IN CHILDREN WITH RESTLESS LEGS SYNDROME

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Introduction: Attention deficit hyperactivity disorder (ADHD) is commonly observed in children with restless legs syndrome (RLS). Uncertainty exists over the co-occurrence of other psychiatric disorders in children with RLS. Our objective was to assess the prevalence of psychiatric disorders in children with RLS.
Methods: Records of subjects aged 2-18 years, seen between 2003 and 2009, who had been diagnosed with RLS based upon the 2003 NIH

Consensus Conference criteria were reviewed. Definite and probable RLS categories were combined. Medical records were reviewed for encounters with a licensed child psychiatrist or psychologist. Demographics, serum ferritin, and DSM-IV based psychiatric comorbidities were tabulated. A subset of patients underwent cytochrome P-450 genomic testing to assess psycho-genomic profile for various clinical reasons.
Results: We found 376 patients with definite or probable RLS. The mean age of the subjects was 10.6 years (range 2 to 18); 298 of 376 subjects (79%) were Caucasian. Overall, 241 / 376 (64%) of subjects had one or more comorbid psychiatric condition. ADHD was found in 93/ 376 (24.73%) of the subjects, mood disorder (MD) in 79/376 (21%), anxiety disorder (AD) in 48/376 (12.76%) and disruptive behavior disorder (DBD) in 39/376 (10.4%). ADHD and DBD were more common in males with RLS (OR = 2.2 and 2.67 respectively), MD were more common in females (OR = 1.83) and AD was equally prevalent in both genders; 12 out of 15 patients showed genetic derangement at one of three cytochrome P-450 enzymes- 2D6, 2C19, and 2C9 which are important in psychotropic drug metabolism. 355 patients had ferritin levels checked- mean was 27.78 (range 4-189).
Conclusion: Psychiatric comorbidities occur in two thirds of children with RLS necessitating a comprehensive multidisciplinary approach that involves child psychiatry and psychology. Results from psycho-genomic testing provide an impetus for future studies in patients with RLS and psychiatric symptoms.

0722

SLEEP AND SLEEPINESS IN CHILDREN WITH ATTENTION DEFICIT/HYPERACTIVITY DISORDER AND CONTROLS

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Introduction: Sleep complaints are pervasive among children with Attention-Deficit/Hyperactivity Disorder (ADHD) and can lead to increased daytime sleepiness, often further affecting daytime functioning in these children. In the present study, we examined the association between objective measures of sleepiness with both objective measure of sleep and subjective measures of sleepiness for children with ADHD and Controls, in order to examine reliability, as well as possible differences between these groups.
Methods: One night of Actigraphic (AW) and in-home Polysomnographic (PSG) evaluation was undergone by 23 children with ADHD and no sleep-disordered breathing and 51 Controls, 7-11 years old. Sleepiness was assessed the following day using a modified Epworth Sleepiness Scale (ESS) and the Multiple Sleep Latency Test (MSLT). Separate correlations were conducted for ADHD and Controls on MSLT indices with sleep and with the ESS.
Results: MSLT sleep latencies negatively correlated with scores on the ESS, both for children with ADHD and Controls ($P < .05$), showing that as time to fall asleep increases, the propensity towards subjective sleepiness decreases. As well, MSLT latencies correlated positively with PSG sleep latency and AW total time awake in both children with ADHD and Controls, although they only correlated positively with PSG sleep duration, AW total activity score and AW fragmentation index in children with ADHD and with AW sleep latency in Controls ($P < .05$), showing that more sleep disturbance is associated with increased sleepiness in all children and that activity during sleep is only related to sleepiness in children with ADHD.
Conclusion: The ESS appears to be reliable for both children with ADHD and Controls. Also, the relationship between measures of sleep quality and objective sleepiness the following day seems more sensitive for children with ADHD than for Controls, suggesting all aspects of sleep need to be addressed in sleep interventions for children with ADHD.

0723

PUBERTAL STATUS AFFECTS SLEEP IN CHILDREN WITH ADHD

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Introduction: Attention Deficit Hyperactivity Disorder (ADHD) is one of the most commonly diagnosed childhood psychiatric disorders, affecting 3-7.5% of the population. ADHD impairs many areas of childhood functioning (school, family, and peer domains) and frequently continues into adolescence and adulthood. Research has shown that pubertal status affects sleep patterns by shifting sleep-wake cycles later as puberty progresses. Few studies have examined the relationship between sleep and pubertal stages in children with ADHD and Controls, therefore, the objective of the present study is to examine the association between puberty and sleep in children with ADHD and Controls.
Methods: The sample consisted of 20 children with ADHD and 44 Controls, aged 7-11 years. Sleep duration was measured with actigraphy, a measure that uses a watch-like device to monitor ambulatory movement during the night, over 5 consecutive nights. An adaptation of Petersen's self-administered rating scale for pubertal development was administered to parents to measure children's pubertal status.
Results: Sleep duration was compared using a 2 (Pubertal Category: Early or Mid) x 2 (Group: ADHD or Control) ANOVA. An interaction was found, where Mid-pubertal children with ADHD had increased sleep duration, while Mid-pubertal Controls had decreased sleep duration, compared to Early pubertal children ($P < .05$).
Conclusion: These findings indicate that pubertal status is differentially related to sleep duration in children with ADHD and Controls. Previous findings that sleep duration decreases as pubertal status increases in healthy children were supported. However, it was also found that children with ADHD sleep more as pubertal status increases, suggesting that these children have different sleep needs that need to be considered when looking at treatment.
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0724

REM SLEEP AND FACE PERCEPTION IN CHILDREN WITH AUTISM

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Introduction: Adults with high functioning autism (HFA) show atypical REM sleep characteristics, including less rapid eye movements (rems). Since rems are generated by a limbic system-based neural network and since children with ASD show an atypical pattern of neural responses to emotional stimuli, including faces, we measured rems density REM sleep and tested whether this measure would correlate with face recognition performance.
Methods: Thirteen male children with HFA (10.3 ± 1.9 years) and six comparison children (COM) (10.0 ± 2.1 years) were recorded for two consecutive nights. Before and after night 2, participants were administered an unfamiliar face recognition task showing positive, negative or neutral emotions. REM sleep time and rems were computed for night 2. Results from the two groups were compared using Mann-Whitney U-tests. The correlation between REM sleep measures and face recognition was tested using Spearman's rho. Data are shown as mean ± S.D.

Results: REM sleep time (HFA = 97.2 ± 23.5, COM = 87.9 ± 17.0) and number of rems per hour of REM sleep (HFA = 514.5 ± 133.5, COM = 462.2 ± 116.4) were not different between the two groups. Children with HFA made more errors than COM children in immediate recall of positive emotions (HFA = 3.8 ± 2.1, COM = 1.3 ± 1.0, P < .01). Only COM children showed a significant correlation between the number of rems and face recognition (rho = 0.88).
Conclusion: 1) These results suggest that, contrary to what is found in adults, the neural substrates of rapid eye movements during REM sleep may function in a typical manner in children with autism. 2) The absence of a significant correlation between REM sleep measures and face recognition in children with HFA suggests that both sets of variables do not share a common substrate, contrary to typically developing children.
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0725

USING ACTIGRAPHY TO MEASURE THE EFFECTS OF SELECTIVE SEROTONIN REUPTAKE INHIBITORS ON NIGHT-TO-NIGHT VARIABILITY IN AWAKENINGS

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Introduction: Selective serotonin reuptake inhibitors (SSRIs) have been associated with various sleep disturbances, including increased awakenings. However, studies have typically employed polysomnography to examine this relationship. Actigraphy affords the benefit of collecting information over a longer duration, allowing for the observation of nightly variation in sleep parameters.
Methods: Twenty-four subjects with posttraumatic stress disorder and major depressive disorder (63% male; M = 51.95, SD = 10.20) wore actigraphs over a period of one week. Approximately one-third of these patients were prescribed SSRIs, including citalopram, fluoxetine, paroxetine, and sertraline. These cross-sectional data were analyzed using ANOVA techniques.
Results: There were significant differences between individuals who were and were not taking SSRIs. Individuals prescribed SSRIs were more likely to have an increase in the night-to-night variability in the frequency of awakenings $F(1,21) = 7.117$ ($P = 0.02$), and a tendency towards more nightly variability in the percentage of time spent awake in bed $F(1,21) = 4.159$ ($P = 0.06$). As expected, individuals who received SSRIs had more frequent awakenings $F(1,23) = 7.553$ ($P = 0.01$), more wake time after sleep onset $F(1,23) = 4.634$ ($P = 0.04$), and a trend towards a higher percentage of time spent awake in bed $F(1,23) = 3.299$ ($P = 0.08$).
Conclusion: Interestingly, SSRIs were associated with an increase in both the nightly variability of awakenings and percentage of time spent awake. Patients on SSRIs also experienced a greater number of awakenings, and spent (on average) more time awake than those not on SSRIs. These results extend and confirm polysomnography findings showing that SSRI use contributes to fragmented sleep. From a behavioral perspective, SSRIs may additionally hinder patients' abilities to establish a routine sleep/wake pattern.
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0726

SLEEP-RELATED MOTOR MEMORY CONSOLIDATION IN PATIENTS WITH DEPRESSION

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Introduction: The role of sleep in memory consolidation is well established. In depressed patients memory and sleep are frequently impaired. REM sleep is thought to be related to procedural memory consolidation. Most antidepressants suppress REM sleep. A recent study showed that REM suppression by antidepressants did not impair consolidation of skills in healthy volunteers. Astonishingly there is a lack of studies on memory consolidation in depressed patients. We studied whether sleep-dependent motor memory consolidation is impaired during antidepressive therapy.
Methods: Motor learning was examined by a sequential finger tapping task before and after a night of sleep in 50 medicated inpatients with a major depressive episode and in 50 matched normal controls. Furthermore 12 remitted inpatients were included in the study.
Results: During daytime practice-dependent learning did not differ between patients and controls. A marked overnight improvement in tapping performance of 18 % was found in healthy subjects, whereas the total group of patients did not show any improvement. When subjects were divided by a threshold of 30 years of age this pattern became even more distinct. In the 30+ years group a -10 % overnight decrease was found in the patients, whereas there was a 16 % overnight increase in the controls. Patients and controls ≤ 30 years, remitted patients (all 30+ years) and controls (30+ years) all showed a distinct overnight improvement. In the 30+ years patients the decrease of performance was significantly more distinct after antidepressants without REM suppression than after REM-suppressing drugs.
Conclusion: Our data suggest a strong synergistic impairing effect of age and acute depression on sleep-dependent procedural learning. Overnight motor memory consolidation is severely impaired in older, but not in young patients. This impairment seems to recover after remission. It is unlikely that REM suppression by antidepressants impairs procedural learning.

0727

SLEEP DIMENSIONS IN DEPRESSED AND CONTROLS: HOW MANY STUDY NIGHTS DO WE NEED?

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Introduction: Sleep measures may be affected by the number of nights of EEG recordings, particularly when comparing sleep in depressed patients and controls. Due to the "first night-recovery effect" many studies record two nights of EEG, discarding the first night. We assessed whether a single second night of EEG recording was optimal to differentiate depressed and controls in the three sleep dimensions of duration (TST, TSA), continuity (SL, WASO, SE, number of awakenings) and architecture (REM %, REM density, REM latency, Delta %, and Delta counts).
Methods: 500 out-patients with major depression and 204 healthy controls underwent a three-night PSG recording. The second and third night were used for this study. Group and night main effects and group by night interaction were evaluated using an ANCOVA co-varying for age, gender and age*group and sex*group interactions.
Results: Duration: Depressed patients had shorter TST and TSA. There was no significant night or group*night interaction for either TST or TSA Continuity: A group by night interaction was present for all sleep continuity measures except SL. Depressed patients showed increased WASO from second to third night and controls showed decreases. The control subjects also showed greater overall improvement in sleep in the third night with increases sleep efficiency and decrease in number of awakenings. There was a significant decrease in sleep latency from

night 2 to 3 in both groups. Architecture: REM density was higher and Delta % and Delta counts were lower in the depressed group. REM % significantly increased from night 2 to 3. There was no night by group interaction on any of the measures of sleep architecture.
Conclusion: One or two-night studies may not be optimal when exploring differences in continuity between depressed and controls, while the number of nights studied does not critically affect sleep duration and architecture.
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0728

CYCLIC ALTERNATING PATTERN (CAP) DURING NREM SLEEP IN PATIENT WITH BIPOLAR DISORDER

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Introduction: The cyclic alternating pattern (CAP) is known to the EEG marker of arousal instability. CAP consists of transient arousal complexes (phase A) which interrupt periodically the tonic theta/delta activities of NREM sleep (phase B). Absence of CAP (None CAP) reflects a condition of consolidated and stable sleep. Sleep disturbance of bipolar disorder (BPD) is well known. Therefore, CAP in NREM sleep of BPD was compared to normal comparisons.
Methods: Six bipolar disorder patients, diagnosed by DSM-IV criteria, and age- and sex- matched normal comparisons were included in this study. Each participant underwent a polysomnographic overnight recording, after an adaption night. Sleep stages were scored manually, and CAP and NCAP sequences were scored by Somnologic program at first, and visually corrected in each recording, during NREM sleep. Average spectra were obtained for each CAP condition from the signal recorded from C3/A2 or C4/A1 for each subject.
Results: Generally, CAP A1, A2 and A3 showed clear spectral differences in both groups. CAP subtypes are characterized by clearly different spectra between bipolar and normal comparisons during NREM sleep. The analysis of the relative power density in both groups showed that in NREM sleep CAP A1, A2, A3 subtypes had a higher power in all frequency ranges in normal comparisons than bipolar patients.
Conclusion: This study shows that bipolar patients who had sleep disturbance as a symptoms, are also characterized by clearly different by clearly different spectra and different power spectrum during sleep stage 2 and SWS

0729

EMOTION REGULATION, NIGHTMARES, AND SLEEP QUALITY

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Introduction: Individuals with emotional difficulties have difficulties regulating mood, but to our knowledge, the relationship between mood regulation and sleep (nightmares, sleep quality) has not been examined in a severe mentally ill population. We hypothesize that a greater belief in one's ability to regulate mood would be correlated with fewer nightmares, less distress from nightmares, and better subjective sleep quality in patients with PTSD and depression.
Methods: Cross-sectional data were obtained from 35 participants (M = 50 years, SD = 10.8 years) with PTSD and depression. Mood regulation expectancy was assessed by the Negative Mood Regulation Scale (NMR). Nightmare frequency and distress were assessed by daily sleep diaries (DSD). Sleep quality was assessed by the DSD and by the Pittsburgh Sleep Quality Index (PSQI).
Results: A trend towards more difficulties regulating mood were associated with: (a) more nightmares (DSD, r = -.33, P = .08), (b) worse overall sleep (global PSQI scores, r = -.35, P = .05),(c) worse subjective sleep quality in the past month,(question 6 on the PSQI , r = -.30, P = .10) but not in the following week (DSD, r = .19, P = .30). No relationships emerged between NMR and nightmare distress, although nightmare distress was negatively correlated with sleep quality averaged over the following week (DSD, r = -.55, P = .005) but not in the past month (PSQI, r = .28, P = .19)
Conclusion: Patients with PTSD and MDD who have difficulties regulating their mood may have worse sleep quality and more nightmares than patients without these difficulties. Distress due to nightmares may also be associated with lower sleep quality. While the causal direction is unclear, helping patients feel more confident about regulating their moods may help reduce the number of nightmares they experience, which in turn may decrease the distress they feel during the night.
Support (If Any): Institute for Mental Health Research American Sleep Medicine Foundation

0730

BIOCHEMICAL AND POLYSOMNOGRAPHIC STUDY OF PATIENTS WITH MAJOR DEPRESSION AND SOMATOFORM PAIN DISORDERS: DAYTIME SLEEPINESS AND FATIGUE

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Introduction: Daytime sleepiness and fatigue is reported by patients with somatoform pain disorders (SPD). This study is the first to compare physiological sleepiness to self-reported sleepiness and fatigue in patients with SPD and Major Depression Disorders (MDD) and to correlate it with biochemical parameters like cortisol and interleukin-6 (IL6).
Methods: Self-reported sleepiness was assessed using the Epworth Sleepiness Scale (ESS) and fatigue was assessed using one item of BDIS. Physiological sleepiness was assessed after the baseline NPSG with a standard MSLT (1000, 1200, 1400, and1600 hrs).7:30 A.M serum plasma levels of cortisol and interleukin-6 (IL6) were measured.
Results: MSLT scores were higher in SPD patients (10.7 ± 5.01) than in MDD patients (7.4 ± 4.7) (P < .04). Latency to sleep was significantly higher in first nap in SPD (10.7 ± 5.8) than MDD (6.8 ± 6.6) (P = 0.05) and in third nap (12.2 ± 6.9) than MDD (7.4 ± 5.4) (P = 0.02) Self-ratings of sleepiness (ESS) were higher scores in patients with SPD (11.1 ± 5.4) and MDD patients (11.2 ± 5.1) than NC (5.7 ± 2.9) (P < .000). Fatigue scores in SPD patients (1.46 ± 0.68) as well as MDD were higher (1.5 ± 0.88) than NC (0.05 ± 0.22) (P < .000). Cortisol was correlated with the average latency in SPD (r = 0.45, P < .02) and IL6 was correlated with the average latency in MDD patients (r = 0.46; P < .02), while MSLT scores did not correlate with ESS in either patient group.
Conclusion: These data show that, although SPD patients report higher levels of sleepiness and fatigue, they are physiologically less sleepy than MDD. MSLT does not correlate with self-reported sleepiness and fatigue in either SPD or MDD. Cortisol is highly correlated to the average MSLT in SPD patients which might explain their being less sleepy than MDD patients due to HPA activation.
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BIOCHEMICAL AND POLYSOMNOGRAPHIC STUDY OF PATIENTS WITH MAJOR DEPRESSION AND SOMATOFORM PAIN DISORDERS: NIGHTTIME SLEEP

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Introduction: Chronic pain, a frequent reason for seeking medical care, causes disability accounting for half of outpatient visits. Fifty percent of depressed patients report multiple unexplained symptoms including chronic pain. Sleep is disturbed in both groups and we sought to explore the differential nature of the sleep disturbances.

Methods: We studied three groups: Depression (MDD) (N = 20; age M = 35.65), Somatoform pain disorders (SPD) (N = 20; age M = 54.05) and Normal controls (NC) (N = 19; age M = 39.95) all without co morbid psychiatric disorders. All underwent 8 hour NPSGs, and 7:30 A.M serum plasma assays for cortisol and interleukin-6. Patients were administered the SCID-IV, Hamilton Depression Rating Scale (HDRS), and Screening of Somatoform Symptoms (SOS). Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI) assessed sleep problems.

Results: REM% was higher in MDD (25.3 ± 6.9) than NC (20.1 ± 4.4) ($P < 0.05$). REM Lat was longer in SPD (149.8 ± 101.1) than NC (113.9 ± 50.9) and MDD (92.9 ± 51.2) ($P < 0.05$). Number of REM periods was higher in MDD (5.4 ± 1.6) than the SPD (4 ± 1.5) and NC (4.6 ± 6) ($P < 0.03$). Sleep efficiency was lower in SPD (77.1 ± 14.8) than NC (86.8 ± 6.6) and MDD (82.8 ± 12) ($P < 0.02$). TWTASO was higher in SPD (84.5 ± 53.5) than MDD (47.5 ± 35.9) and NC (43.7 ± 32.8) ($P < 0.006$). Cortisol was higher in SPD (17.9 ± 5.8) than MDD (13 ± 5.4) ($P < 0.02$). IL6 was higher in SPD (5 ± 5.1) than NC (2.4 ± 0.5) ($P < 0.05$). PSQI was higher in SPD (27 ± 6) than MDD (22 ± 6.2) and NC (8.4 ± 4.4) ($P < 0.001$). ISI was higher in SPD (17.8 ± 6.1) and MDD (18.1 ± 4.8) than NC (4 ± 3.3) ($P < 0.001$).

Conclusion: Cortisol was higher in SPD than MDD patients possibly reflecting stimulation of the arousal system and explaining their poor sleep efficiency. IL-6 was elevated in SPD patients which may be a useful disease marker. MDD patients had more frequent shorter REM periods which may also explain the unrestorative quality of their sleep.

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0732

CHANGES IN POLYSOMNOGRAPHY FOLLOWING COGNITIVE-BEHAVIORAL THERAPY FOR INSOMNIA IN PATIENTS WITH MAJOR DEPRESSIVE DISORDER

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Introduction: Insomnia is pervasive in Major Depressive Disorder (MDD) and may contribute to relapse and recurrence. Studies of sleep using polysomnography (PSG) in MDD patients have consistently shown abnormalities in both sleep continuity and architecture. In this study, we examined whether changes in polysomnography were evident following a nonpharmacological treatment for insomnia in MDD patients.

Methods: Thirteen participants with MDD and chronic insomnia (mean age 43.4 ± 12.3 years, 11 women) were randomized to 6 sessions of group cognitive-behavioral therapy for insomnia (CBT-I, n = 8) or to wait list control (WLC, n = 5). Daily sleep diaries were completed throughout treatment. The Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), self- and clinician-rated Quick Inventory of Depressive Symptomatology (QIDS-SR16), and clinician-rated Hamilton Rating Scale of Depression (HRSD-17) and Clinical Global Impressions (CGI) were completed pre- and post-treatment. Before and after treatment, participants underwent two nights of PSG.

Results: No changes in sleep or mood (self- and clinician-rated) were evident for the WLC before starting treatment (all P's > 0.05). Daily diaries indicated post-CBT-I improvements in total wake time (58.9 ± 24.4 vs. 117.8 ± 57.0 mins, $P < 0.001$) and sleep efficiency (86.6 ± 5.6 vs. 76.8 ± 10.8%, $P = 0.001$) but not total sleep time. PSQI and ISI scores decreased from, respectively, 11.3 ± 4.1 to 7.5 ± 1.2 ($P = 0.001$) and 16.8 ± 4.5 to 10.9 ± 4.8 ($P < 0.001$). Clinician ratings of mood on the HRSD-17 and CGI improved following CBT-I ($P < 0.05$) with a trend for improvement on the self-rated QIDS-SR16 ($P = 0.059$) and clinician-rated QIDS-SR16 ($P = 0.064$). Only Stage 2 increased significantly (54.7 ± 8.0 vs. 48.0 ± 9.4%, $P < 0.05$) on PSG after CBT-I.

Conclusion: Self- and clinician-rated mood and sleep improvements following CBT-I were not reflected in most objective sleep continuity and architecture changes. We will evaluate whether sleep changes may be evident using quantitative sleep EEG measures.

0733

PREVALENCE OF SUICIDAL IDEATION IN ADULTS SEEKING TREATMENT AT A COMMUNITY-BASED SLEEP MEDICAL CENTER

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Introduction: Sleep disturbances are associated with suicidal ideation; but to our knowledge no study has examined this relationship in patients presenting to a sleep medical center. We hypothesized suicidal ideation would be present at rates higher than the general population, and that a broad array of sleep complaints and related symptoms would be associated with suicidal ideation.

Methods: This was a retrospective chart review of sleep treatment seeking patients (n = 1584) with [SI (n = 211)] and without [NSI (n = 1373)] suicidal ideation presenting to Maimonides Sleep Arts and Sciences. Through an intake questionnaire set, data on pertinent sleep, medical, and psychiatric histories were collected. Scales included insomnia (ISI), nightmares (DDNSI), anxiety and depression (HSC), and suicidal ideation (DSI-SS).

Results: Suicidal ideation was present in 13.3% of this sample, with a mean DSI-SS score (2.92+1.68) for the SI group equivalent to the clinical cut point for patients needing further assessment. Compared to the NSI group, the SI group showed significantly longer duration of sleep problems, worse insomnia on the ISI, and worse subjective perceptions of sleep quality with medium effect sizes (P values = .001; mean d = .40). Subjective sleep indices (TST, SE, SOL, WASO) showed worse albeit small outcomes in the SI group (P values < .04; mean d = .21). Greater nightmare severity was seen in the SI group ($P = .001$;d = .52). Patient reports of psychiatric conditions were significantly more common in the SI group for: anxiety, depression, and PTSD (P values = .001). HSC scores indicated more severe anxiety and depression in the SI group with large effect sizes ($P = .001$; mean d = 1.16).

Conclusion: Among these sleep-treatment seeking patients, the suicidal ideation rate was more than four times greater than the 3% prevalence estimated for the general population. In our sample, SI was systematically associated with worse sleep measures. These findings must be corroborated by testing at other sleep medical centers.

0734

SCREENING FOR SUICIDAL IDEATION DURING SLEEP APNEA ASSESSMENT

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Introduction: Suicide is a dreaded complication of depression which is also associated with sleep apnea. The point prevalence and correlates of

suicidal ideation in community-based sleep apnea patients are not well known. Our aim was to prospectively assess suicidal ideation, symptoms of depression, and other related demographics in primary care patients referred for sleep apnea assessment.
Methods: 1123 patients completed a questionnaire and ambulatory sleep apnea testing. The questionnaire included items on suicidal thought, DSM IV TR major depressive episode criteria, multiple sleep disorders, and other medical conditions. Patients underwent ambulatory testing using Remmers Sleep Monitor (Sagatech) or Stardust (Phillips Respironics) sleep apnea monitors. All questionnaires were reviewed by trained support staff and a sleep physician (NS). A two-tailed Fisher's exact test was used to compare the rates of sleep apnea, major depressive episode symptoms, and problematic alcohol use between those reporting and those not reporting suicidal ideation.
Results: Of 1123 patients screened for sleep apnea six (6) reported suicidal ideation (0.5%) of whom all (6, 100%) reported symptoms of a major depressive episode, five (5, 83%) had sleep apnea (RDI > 5 / h), and none reported problematic alcohol use. Of the 1117 subjects not reporting suicidal ideation 148 (13.3%) had symptoms of depression, 401 (35.9%) had sleep apnea, and 70 (6.3%) reported problematic drinking. Suicidal ideation was associated with sleep apnea ($P = 0.03$) and major depressive episode symptoms ($P < 0.001$) but not problematic drinking ($P = 0.01$).
Conclusion: Suicidal ideation is rare in community primary care patients referred for sleep apnea assessment. Suicidal ideation was associated with sleep apnea and major depressive episode symptoms.

0735

PREVALENCE OF DEPRESSIVE SYMPTOMS IN AN ACADEMIC SLEEP CLINIC

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Introduction: Depressive symptoms are often seen in patients seeking treatment for a sleeping disorder. We sought to examine the prevalence of depression, both diagnosed and undiagnosed, using a validated screening instrument.
Methods: A total of 50 clinical patients were recruited from a tertiary academic sleep laboratory. Patients were screened for depression using the self administered Patient Health Questionnaire-9 (PHQ-9).
Results: Of the 50 patients screened for depression, 48% reported a history of depression. Currently, 36% were positive for major depression and 5 responded positively to suicidal ideation within the past two weeks. 3 of these subjects were ≤ 35 years of age, resulting in 30% prevalence in this age category. 46 of the 50 subjects underwent an attended, in-laboratory polysomnogram and 70% were diagnosed with OSA. The subgroup exhibiting suicidal ideation; however, resulted in a 40% prevalence of OSA, 40% insomnia, and 20% hypersomnia.
Conclusion: These findings demonstrate the need for sleep center physicians to evaluate patients of all age groups for depression. The PHQ-9 can be a useful diagnostic tool for the evaluation of depression and suicidal ideation during a sleep consultation. In our population, suicidal ideation was associated with a total symptom score > 15 indicating major depression.
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0736

SLEEPINESS AND SLEEP APNEA RISK AMONG MAJOR DEPRESSED PATIENTS

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Introduction: Excessive daytime sleepiness (EDS) is a common symptom in general population. Factors that might increase EDS include sleep disorders and major depression. Because obstructive sleep apnea syndrome shows a higher prevalence in depressed patients, proper identification of these disorders based on sleepiness severity may become a clinical challenge with diagnostic and therapeutic implications. In this way, the aim of this study was to compare sleepiness severity between major depressed patients with and without sleep apnea risk.
Methods: Patients were recruited from the National Institute of Psychiatry at Mexico City. To be included, subjects were required to be females or males, older than 18 year-old, with major depression (DSM IV), have not underwent drug treatment during last month, and to sign informed consent. Participants underwent structured diagnostic interview to establish diagnosis. Berlin Questionnaire was used to assess sleep apnea risk and the Epworth Sleepiness Scale to measure EDS.
Results: Seventy-six patients were included. Thirty-three percent (n = 25) had sleep apnea risk. This group showed a tendency to be significantly older than the group without sleep apnea risk (38.0, DE 12.2 vs 32.9, DE 10.6, respectively; t = -1.8, df 74, P = 06); there were no significant gender differences among groups (females, 80% vs 88%, respectively; Fisher Exact Test = .48). ESE scores of the group with sleep apnea risk were not significantly higher (12.5, DE 5.7 vs 11.0, DE 5.4; t = -1.1, df 74, P = .25); however, this group showed a higher body mass index (29.1, DE 5.6 vs 23.5, DE 3.1; t = -5.5, df 74, P = .0001).
Conclusion: Our results suggest that prevalence of sleep apnea risk is high among depressed patients. However, sleepiness does not seem to be clinically useful to distinguish this risk. Some other clinical data, such as age and BMI may be of help to establish sleep apnea risk

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ASSOCIATION BETWEEN SELF REPORTED MOOD DISTURBANCE AND SLEEP

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Introduction: Sleep disturbance is a typically associated with mood disorders. The link between clinician rated mood and sleep disturbance has been previously acknowledged. Self recognition changes in these variables maybe useful in identifying markers of relapse. This analysis aims to examine the link between subjective ratings of mood and sleep.
Methods: 55 participants (24M,31F, SD = 20.8, r = 73) with a history of mood disorders were recruited from an outpatient psychiatry clinic. All participants completed the Pittsburgh Sleep Quality Index (PSQI) and the Depression, Anxiety and Stress Scale (DASS-21) questionnaires. Multiple regression models were used to examine the relationship between these variables.
Results: We observed a significant association between PSQI defined daytime dysfunction and both self reported depression ($\beta = .51, p < .05$) and stress ($\beta = .43, p < .05$) when all other variables were controlled. Age appeared to have a moderating effect on the relationship between stress rating and daytime dysfunction. An increase in age predicted an increase in the magnitude of stress on daytime dysfunction ($P < .05$). Age did not have an effect on depression or anxiety when compared to sleep quality. Subjective anxiety ratings predicted increased use of sleeping medication ($\beta = .42, p < .05$). Stress also indicated moderate to strong effects with sleep quality ($\beta = .52$, $P < .05$), and sleep disturbance ($\beta = .46$, $P < .05$) components of the PSQI when all other variables were controlled.
Conclusion: Subjective stress had the greatest influence on sleep, causing a significant decrease in subjective sleep quality. We further examined individual components of the PSQI scores to ascertain more specific associations. This highlighted the high correlation of stress with sleep quality, sleep disturbance and daytime dysfunction in particular. Depression and anxiety had less influence on the global PSQI score and therefore had a less substantial effect on sleep quality, however as previously mentioned were both linked with component PSQI scores.
Support (If Any): NHMRC Program Grant

0738

INSOMNIA PREDICTS SUICIDAL IDEATION DURING A DEPRESSION CLINICAL TRIAL

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Introduction: Insomnia is linked to suicidal ideas and suicide death in cross-sectional studies and longitudinal population-based studies. A link between insomnia and suicide has not been previously examined in the setting of a clinical trial. We describe the relationship between insomnia, other symptoms of depression, and suicidal thinking during the course of a clinical trial for depression with insomnia.
Methods: Sixty patients aged 41.5 +/- 12.5 years (2/3 women) with major depressive episode and symptoms of insomnia received open label fluoxetine for 9 weeks, and also received blinded, randomized eszopiclone 3 mg or placebo at bedtime after the first week of fluoxetine. Insomnia symptoms were assessed with the Insomnia Severity Index (ISI), suicidal ideation with The Scale for Suicide Ideation (SSI), and non-insomnia and non-suicide symptoms were assessed with the Hamilton Rating Scale for Depression (HRSD20). Measurements were taken at baseline and weeks 1, 2, 4, 6, and 8 during randomized treatment. SSI was examined in statistical models as the outcome, with ISI and HRSD20 as independent variables, with adjustment for age, gender, treatment assignment, and baseline SSI.
Results: Higher levels of insomnia corresponded to significantly greater intensity of suicidal thinking during the randomized portion of the study ($P < 0.01$). Similarly, higher levels of non-insomnia depression symptoms corresponded with significantly greater intensity of suicidal thinking ($P < 0.001$). When both ISI and HRSD20 were considered together in the same model, only HRSD20 remained a statistically significant predictor of SSI score.
Conclusion: The results support the concept that insomnia may be a useful indicator for suicidal ideation, and now extend this idea into clinical trials. However, insomnia is not as powerful a predictor as the combined effect of 20 other depression symptoms. The complaint of insomnia during a depression clinical trial might indicate that more direct questioning about suicide is warranted.
Support (If Any): NIH MH70821 and M01-RR07122, as well as funding and medications from Sepracor, and funding and material support from Mini Mitter ClinicalTrials.gov Identifier: NCT00247624

0739

ASSOCIATION BETWEEN SHORT SLEEP DURATION AND DEPRESSIVE SYMPTOMS IN RURAL COMMUNITIES OF SOUTHEASTERN MISSOURI, TENNESSEE, AND ARKANSAS

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Introduction: Sleep disturbance is common in psychiatric disorders, and individuals with insomnia are at increased risk of depression. However, the relationship between sleep duration and depression is less well described. It has been widely documented that short sleep duration is detrimental to our physical and mental health. The purpose of the present study is to examine whether short sleep duration is associated with depression in the rural communities of southeastern Missouri, Tennessee, and Arkansas.
Methods: The study is based on data from a cross-sectional telephone survey in 2005 for evaluation of a community walking trails intervention to promote physical activity in rural communities. The study sample includes 967 women and 291 men with a mean age of 54. The exposure is a binary indicator of self-reported short sleep duration (< 7 hours at night on weekdays). The outcome is a binary indicator of depressive symptoms, measured by Patient Health Questionnaire-2 using a cutoff value of 3. Binary Logistic regression was used to estimate prevalence odds ratios (PORs) and 95% confidence intervals (95% CI).
Results: The study sample includes mostly White (95%), married (62%), overweight/obese (61%) women with high school degree. Thirty six percent of participants reported usually getting less than 7 hours of sleep on weekday nights and 17% reported elevated depressive symptoms. Short sleep duration is associated with increased odds of depressive symptoms (adjusted POR: 2.05, 95% CI: 1.49, 2:82), after controlling for age, gender, education level, marital status, and body mass index.
Conclusion: In these rural communities, short sleep duration among study participants is common. We observed a two-fold increase in the likelihood of elevated depressive symptoms among those who reported short sleep duration. Additional research to examine whether the relationship is causal or bidirectional may lead to focused interventions to increase sleep time among individuals with depression.

0740

COGNITIVE BEHAVIORAL SOCIAL RHYTHM THERAPY IS ASSOCIATED WITH SIGNIFICANT IMPROVEMENT IN CAPACITY TO REGULATE NEGATIVE MOOD

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Introduction: Cognitive Behavioral Social Rhythm Therapy (CBSRT) is an integrative group therapy in which individuals with post-traumatic stress disorder (PTSD) and depression are taught to increase the frequency and consistency of habitual daily behaviors (e.g., increase regular light exposure, set morning wake-up time, regular meals) as part of a daily routine. We have previously reported that CBSRT is associated with improvements in sleep, depression, and anxiety. For this project, we hypothesized that CBSRT was associated with an increased capacity to manage negative mood states, a requisite condition for successfully undertaking emotionally challenging tasks, such as PTSD exposure therapy.
Methods: A total of 31 subjects (24 males; M age = 52.22 years, SD = 11.16 years) with PTSD and MDD participated in a 12-session CBSRT group. Every three weeks throughout treatment and 3-months post-treatment, subjects were administered the Negative Mood Regulation (NMR) scale, which examines the belief in ability to regulate negative mood. We analyzed data with mixed model intent-to-treat analyses.
Results: There was a significant improvement in the NMR from baseline to 3 months follow-up, $\gamma 10 = .81$, SE = .24, $P < .001$, with minimal loss in mood regulation expectancies in the follow-up period. Gender was a significant moderator of mood regulation outcomes. Females had a more variable growth trajectory than males characterized by less stability in mood regulation capacity from post-treatment to 3 month follow-up.
Conclusion: Cognitive Behavioral Social Rhythm Therapy increases the capacity to regulate negative mood. Previous PTSD studies have

shown that improvements in the NMR are associated with a greater success in PTSD exposure therapy, an emotionally intense psychotherapy with an approximate 25% drop-out rate. These data suggest that CB-SRT may have a potential role as an early stage treatment administered prior to exposure therapy for individuals with comorbid PTSD and depression.

Support (If Any): American Sleep Medicine Foundation, Institute for Mental Health Research

0741

SLEEP DISORDERS AND ANTIDEPRESSANT INITIATION: BRANDED ANTIDEPRESSANTS VERSUS GENERIC SSRIs

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Introduction: Sleep disturbance, a core feature of major depressive disorder (MDD), may be differentially impacted by antidepressants and may influence physician selection of antidepressants. This study examined the association between comorbid sleep disorders and selection of a branded antidepressant (duloxetine, venlafaxine XR, or escitalopram) relative to generic selective serotonin reuptake inhibitors (SSRIs) in the usual clinical settings.

Methods: Adult patients (18 to 64 years old) diagnosed with MDD and initiated on duloxetine (n = 7,567), venlafaxine XR (n = 6,106), escitalopram (n = 10,239), or generic SSRIs (n = 20,114) during the 2006 calendar year were identified from a large managed-care claims database. Patients were excluded if they had used the same antidepressant in the 3 months prior to initiation date. Sleep disorders diagnosed during the year 2005 were identified according to the International Classification of Diseases, 9th Edition, Clinical Modification (ICD-9-CM). Chi-square tests and multiple logistic regression analyses were performed to examine the associations between comorbid sleep disorders and branded antidepressant initiation compared to generic SSRIs.

Results: Prior sleep disorders were most prevalent in duloxetine-treated patients followed by venlafaxine XR or escitalopram-treated patients and patients treated with generic SSRIs, including insomnia (5.6%, 5.1%, 4.8%, and 4.4%, $P < .001$), hypersomnia (6.5%, 4.5%, 3.9%, and 3.6%, $P < .001$), and obstructive sleep apnea (OSA) (2.6%, 1.3%, 1.7%, and 1.2%, $P < .001$). After adjustment for demographics and comorbid psychiatric and physical disorders, OSA was significantly associated with duloxetine initiation (OR = 1.6, 95%CI = 1.3-2.0) and escitalopram initiation (OR = 1.3, 95%CI = 1.1-1.7), while hypersomnia was associated with duloxetine initiation (OR = 1.3, 95%CI = 1.2-1.5) compared to generic SSRIs.

Conclusion: Comorbid sleep disorders are associated with antidepressant selection in the treatment of major depression. Duloxetine is more likely to be prescribed for depressed patients with OSA and hypersomnia. Further research is needed to examine the impact of sleep disorders and their treatment on clinical and psychosocial consequences of depression.

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0742

SUBJECTIVE AND OBJECTIVE MEASURES OF SLEEP QUALITY IN ADVANCED CANCER: A POSSIBLE CLINICAL MARKER FOR DEPRESSION SEVERITY

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Introduction: The relationships among depression, poor nocturnal sleep, and daytime sleepiness are well recognized problems. However, although it is estimated that between 5 and 35% of patients with cancer experience these symptoms, research designed to specifically examine associations of depression with both subjective and objective sleep measures is lacking. Thus, the purpose of these analyses was to compare and contrast relationships among depression, subjective measures of nocturnal sleep and daytime sleepiness, and polysomnographic measures of nocturnal sleep.

Methods: The sample included 114 well-characterized patients with advanced solid tumor cancer (mean age 55.2 ± 9.0 years; 49% female). All subjects completed the Beck Depression Inventory-II (BDI-II), Pittsburgh Sleep Questionnaire Index (PSQI), and the Epworth Sleepiness Scale (ESS) Subjects also underwent two nights of home-based ambulatory polysomnography with the average (no significant differences between the nights) total sleep time, sleep efficiency, REM latency, and sleep stages being used as the variables of interest. Data analyses included descriptive and nonparametric correlations.

Results: PSQI (mean score: 6.96) and ESS (mean score: 7.70) scores were significantly and positively correlated with BDI-II (mean score: 13.03) scores at ($P < 0.02$). Total nocturnal sleep time was also positively related to BDI-II scores ($P < 0.05$), but no other relationships were observed between depression and other polysomnographic variables.

Conclusion: Depression was significantly related to subjective sleep quality and daytime sleepiness in this sample of patients with advanced cancer, suggesting that these problems frequently occur together. In addition, higher levels of depression were also associated with increase polysomnographic measures of nocturnal sleep time and might be used clinically as a marker of depression severity. Collectively, these results indicate that patients with depression might benefit from the assessment and treatment of both nocturnal and daytime sleep problems.

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0743

THE DIFFERENTIAL CONTRIBUTIONS OF DEPRESSION AND SLEEP DISTURBANCE TO QUALITY OF LIFE IN OLDER PEOPLE

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Introduction: Improving quality of life (QoL) is central to the management of elderly patients with depression. While sleep disturbances commonly co-exist with depression, they are not specifically targeted in assessment and management. This study sought to evaluate the differential effects of depression and sleep on QoL in a sample of older adults.

Methods: A control group of older participants as well as those with depression were recruited. Participants were selected on the basis of: meeting DSM-IV criteria for lifetime major depression; age ≥ 50 years and a score ≥ 24 on the Mini Mental State Examination (MMSE). Seventy-six patients met criteria. On average patients were 63.3 (sd = 8.7) years of age. Clinicians rated depression severity and sleep disturbance using the Hamilton Depression Rating Scale (HAM-D) and participants completed the World Health Organization Quality of Life subscales (WHOQoL; physical health, environmental, social relationships & psychological health).

Results: As expected, clinician and self-reported depression severity were significantly correlated with poorer QoL on all four WHOQoL subscales. Sleep disturbance correlated with a single QoL domain (physical health), but did so more strongly than depression severity. Multiple regression analyses showed that after controlling for age, depression severity accounted for 3% of variance in physical QoL while sleep disturbance accounted for almost 16% of variance ($t = -2.9$, $P < 0.05$).

Conclusion: Sleep disturbance is an important predictor of physical QoL in depressed elderly regardless of depression severity. Targeted clinical evaluation and treatment of sleep disturbance in depressed elderly warrants consideration to improve QoL.

0744

INSTABILITY OF SLEEP-WAKE PATTERNS IN YOUNG PATIENTS WITH A MOOD DISORDER

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Introduction: Significant comorbidity exists between sleep-wake disturbances and mood disorders. Characterising the sleep-wake patterns of young people diagnosed with a mood disorder (DMD), or at high risk of developing a mood disorder (HRMD), may identify targets for introducing interventions that facilitate the treatment of mood disturbances, at an early stage.
Methods: Twenty-one patients with a DMD (11M, 10F; mean age ± sd = 21 ± 5 years) were compared with 19 HRMD individuals (12M, 7F; mean age ± sd = 19 ± 6 years). All participants were recruited from a psychiatric outpatient service. Participants wore a wrist actigraph (AW64, MiniMitter, OR) and concurrently completed a sleep diary for approximately 14 days. Sleep-wake stability was assessed by examining individual night-to-night variation in sleep duration, bedtime, sleep midpoint and wake-up time across 7 consecutive days. The Hamilton Depression Rating Scale (HAMD), Young Mania Rating Scale, Social and Occupational Functioning Assessment Scale and Horne-Östberg Morningness-Eveningness Questionnaire were also completed.
Results: Participant groups did not significantly differ in age, gender, occupational status, or scores on the clinical assessment scales. Both groups exhibited mild depression (HAMD > 8). There were no significant group differences in mean sleep duration, bedtime, sleep midpoint and wake-up time (P > .05). The DMD group demonstrated a trend for greater individual variability in sleep duration (P = .052) and wake-up time (P = .050).
Conclusion: Although the group means in sleep duration and sleep-wake timing were similar, a trend for greater individual instability of these variables existed in the DMD group relative to the HRMD group. Patients with a DMD may be experiencing sleep-wake instability that is not reflected by measuring group means alone. An emphasis on stabilising sleep-wake patterns may be useful when treating this population as this may reduce the severity of mood disturbances that are experienced.

0745

SLEEP COMPLAINTS AND ANXIETY IN CHILDREN AND ADOLESCENTS WITH UNIPOLAR DEPRESSIVE DISORDER

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Introduction: Insomnia, hypersomnia, sleep continuity problems, and sleep wake reversal are common sleep complaints in children and adolescents with major depressive disorders (MDD). The aim of this study was to explore the subtypes of sleep complaints in children and adolescents with MDD and to compare those subjects with and without comorbidity anxiety.
Methods: 214 pediatric cases (6-17 years) with current DSM-IV criteria MDD. The subjects were evaluated by face-to-face interview with patients and their parents that were performed by a senior child psychiatrist. DSM-IV version Diagnostic Interview for Children and Adolescents (DICA-IV) was applied that included a set of questions about the presence of subjective alterations of sleep, such as initial insomnia, sleep maintenance insomnia, early morning awakening insomnia, and hypersonmia. The assessment of MDD comorbidity with anxiety disorders was based on a set of questions about anxiety disorders in the section of DICA-IV. Data analyses were obtained by descriptive statistics and Chi-square tests.
Results: The subjects were consisted in 97 children (mean = 9.5 ± 1.8 years old) and 117 adolescents (mean = 15 ± 1.3 years old). Sleep complaints was reported by 66% of the total sample during their current MDD episodes, and initial insomnia as the most common subtype. The presence of anxiety disorders was found in 71.5% of the sample. Only 7% of total sample of patients had no sleep complaints and no anxiety disorders. 16 patients (3%) presented during current MDD episode with multiple anxiety disorder comorbidity. There was no gender or age difference in report of sleep complaints.
Conclusion: The most common sleep complaint in our sample was initial insomnia, and it was associated with the presence of anxiety comorbidities. The interaction between depression and anxiety in children and adolescents can be assessed by subjective sleep analyses. Further studies are needed to clarify this interaction.

0746

ASSOCIATION OF DEPRESSION AND SLEEP DEPRIVATION AMONGST A HIGH SCHOOL POPULATION

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Introduction: Recent studies show that US adolescents are subject to both depression and sleep deprivation. About 8 percent of adolescents in America are subject to major depression, while approximately 15 percent of adolescents report sleeping the recommended 8.5 hours or more on school nights. However, little information on the association of depression and sleep deprivation exists among the adolescent population. The purpose of this study was to determine an association between adolescent depression and sleep deprivation.
Methods: Data were collected from a population of 262 high school seniors attending a public high school in Mercer County, NJ. Participants completed a cross-sectional survey containing sociodemographic characteristics, the Epworth Sleepiness Scale (ESS) for Excessive Daytime Sleepiness (EDS) and a validated depression scale. Association of key variables were determined by odds ratios (OR) and 95 percent confidence intervals (CI).
Results: The mean age of participants was 17.7 years old. The mean reported sleep on a school night for participants was 6.1 hours. The mean reported sleep on a weekend night was 8.2 hours. The mean ESS score for the population was 10. 52% (136 students) of participants scored 10 or higher on ESS. 30% (80 students) of participants indicated strong depression symptoms for the depression scale, while 32% (82 students) of participants indicated some symptoms of depression for the depression scale. The odds of strong depression symptoms associated with EDS was high (OR: 3.04, 95CI:1.64 to 5.63). The odds of some depression symptoms associated with EDS was not significant (OR: 1.25, 95CI: 0.69 to 2.25).
Conclusion: Sleep deprivation and depression symptoms were highly prevalent amongst this population. A significant association existed between strong depression symptoms and EDS. Further investigation is required to confirm this association and determine the causality of the findings.

0747

IS SEASONAL AFFECTIVE DISORDER INDEPENDENT OF LATITUDE? A WEB BASED SURVEY

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Introduction: Seasonal affective disorder (SAD) and its milder variant, subsyndromal seasonal affective disorder (SAD-S), consist of depressive disorders that begin in the winter and subside in the following seasons. The putative cause of these disorders in the Nordic countries is the lack of light in winter. Few studies have been done in the southern hemisphere. We sought to characterize SAD in Brazil through the use of the Seasonal Pattern Assessment Questionnaire (SPAQ), a diagnos-

tic tool which scores variations in mood, appetite, body weight, energy, sociability and sleep, as well as in the Seasonal Score Index, ranging from 0 to 24.

Methods: We made available on a website of a sleep medicine clinic a Brazilian translation of the SPAQ. We compared the prevalence of SAD or SAD-S and the Seasonal Score Index (ANOVA followed by Bonferroni's test) among four different bands of latitude, divided by sample quartiles, and among the six Brazilian cities most represented in the sample (Aracaju, Brasília, Belo Horizonte, Porto Alegre, Rio de Janeiro e Sao Paulo). We also correlated the SPAQ scores and the Seasonal Score Index with latitude.

Results: Among 1001 subjects, 28.7% had scores diagnostic of SAD and 25.1% of SAD-S. There was no difference in the prevalence of SAD or SAD-S neither among latitude intervals ($P = 0.15$) nor among the six cities investigated ($P = 0.13$). Similarly, no difference was seen comparing the Seasonal Score Index among latitude intervals ($P = 0.7$) and the six cities ($P = 0.247$). The correlations between latitude and seasonality scores were non significant ($P = 0.3$).

Conclusion: The Brazilian population displays SPAQ scores that are diagnostic of seasonal affective disorder and that are similar in all latitudes. This suggests that affective disorders may have a circannual pattern independent of winter and latitude.

0748

EFFECTS ON SLEEP ARCHITECTURE AND NREM SLEEP INSTABILITY OF ACUTE DOPAMINE-AGONIST TREATMENT IN RESTLESS LEGS SYNDROME

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Introduction: To our knowledge there are no studies on Cyclic Alternating Pattern (CAP) in Restless Legs Syndrome (RLS) and on the therapeutic effect of dopamine agonists on CAP in these patients. For this reason, the aim of the present investigation was to analyze the baseline differences in CAP between normal controls and RLS patients and the eventual changes in sleep architecture and instability induced by the acute administration of pramipexole in RLS patients.
Methods: Thirty-four patients were included: 19 patients received 0.25 mg pramipexole and 15 were given placebo. The control group included 13 normal subjects. Nocturnal polysomnography was carried out in all subjects and a second night was recorded after pramipexole or placebo in patients. Sleep stages, CAP, and leg movement activity were scored following standard criteria.
Results: At baseline, only REM sleep latency was significantly longer in RLS patients than in normal controls; also periodic leg movement during sleep (PLMS) index was significantly higher. On the contrary, many CAP parameters appeared to be significantly different with a general increase in CAP rate in patients. Acute administration of pramipexole induced moderate sleep architecture changes (increased stage shifts/hour, sleep efficiency, and percentage of sleep stage 2, and decreased wakefulness after sleep onset and PLMS index. No treatment effects were observed on CAP.
Conclusion: RLS patients show significant sleep microstructure abnormalities, represented by an excessive sleep instability/discontinuity. Acute pramipexole administration seems to exert no action on these abnormalities and the moderate effects seen on sleep architecture might be interpreted as the beneficial consequence of the removal of pre-sleep RLS symptoms and PLMS.

0749

PRAMIPEXOLE NORMALIZES THE HEART RATE RESPONSE TO PERIODIC LEG MOVEMENTS DURING SLEEP IN RESTLESS LEGS SYNDROME

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Introduction: Restless legs syndrome (RLS) is a common sleep-related movement disorder characterized by a disagreeable sensation in the limbs which worsens at night and in rest condition and is improved by movement. The majority of patients with RLS present periodic leg movements during sleep (PLMS) which are coupled with autonomic activations. Dopamine agonists are the first-line treatment in RLS.
Methods: A prospective, polysomnographic, single-blind, placebo-controlled of a single-night administration study was carried out with the aim to compare the heart rate variability (HRV) between patients with restless legs syndrome (RLS, n = 23) and healthy subjects (n = 10), and to evaluate HRV after treatment with pramipexole (Mirapexin® 0.18, Boehringer Ingelheim) in RLS patients, compared to placebo. Basal spectral analysis of HRV and phasic heart rate (HR) during PLMS were considered.
Results: No differences were found in the basal sympathovagal balance outside of PLMS between RLS and controls and, in the RLS group, before and after treatment. The amplitude of PLMS-related HR changes resulted higher in patients than in controls. Pramipexole suppressed the number of PLMS and normalized the PLMS-related HR response in RLS subjects.
Conclusion: Pramipexole reduced the number of PLMS and the amplitude of the autonomic response to residual PLMS, without effects on the tonic sympathovagal regulation.The repetitive abnormal autonomic response to PLMS might play a role in the increased cardiovascular risk observed in RLS patients. D3 receptors in the sympathetic pre-ganglionic neurons of the spinal intermediolateral columns might be a target of pramipexole. The normalization of the HR response may be relevant in reducing the risk of cardiovascular diseases and associated autonomic dysfunctions in patients with RLS

0750

LONG-TERM TREATMENT WITH TRANSDERMAL ROTIGOTINE IN PATIENTS WITH IDIOPATHIC RESTLESS LEGS SYNDROME (RLS): RESULTS FROM A 12-MONTH OPEN-LABEL EXTENSION TRIAL

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Introduction: A 6-month, double-blind, placebo-controlled trial (SP792 [NCT00135993]) showed that transdermal rotigotine treatment in idiopathic RLS patients was well tolerated and efficacious. We present the results of a subsequent open-label extension study (SP793 [NCT00263068]) for up to an additional 12 months with rotigotine.
Methods: Eligible patients completing the double-blind phase had their rotigotine dose de-escalated, then titrated to the patient's optimal dose (up to a maximum of 3 mg/24h), and maintained between 0.5 and 3 mg/24h for 1 year during surveillance for adverse events (AEs). Efficacy assessments included the IRLS, RLS-6, CGI-1, and CGI-2.
Results: Of 279 patients entering the SP793 extension, 105 (38%) discontinued (51 [18%] because of AEs). The mean daily dose at the start of maintenance was 1.75 mg/24h. During maintenance, 65% of patients did not require dose adjustment, 10% of patients decreased their dose, and 25% of patients increased their dose. At the end of maintenance, the mean IRLS score of all patients was 8.9 (SD: 9.0, -14.2 points from the SP792 baseline). 64% of patients were IRLS responders (IRLS score reduced by 50% or more from SP792 baseline), 63% were IRLS remitters (IRLS score of $\leq$ 10 points), and 35% had no RLS symptoms (IRLS score of 0). Illness severity (assessed by CGI-1) improved to a less severe category (normal, borderline ill, or mildly ill) in 79% of patients, and change in condition (assessed by CGI-2) was categorized as "very much/much improved" in 80% of patients. RLS-6 showed improvement for both nighttime and daytime symptoms. The most common AEs were application site reactions (24.4%), nausea (15.4%), somnolence (11.8%), and headache (11.5%).
Conclusion: In this open-label extension study, the efficacy profile of rotigotine was maintained over the course of the year. In addition, rotigotine was well tolerated.

0751

A RANDOMIZED, CROSSOVER POLYSOMNOGRAPHY STUDY OF GABAPENTIN ENACARBIL IN SUBJECTS WITH MODERATE-TO-SEVERE PRIMARY RESTLESS LEGS SYNDROME AND ASSOCIATED SLEEP DISTURBANCE

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Introduction: Patients with Restless Legs Syndrome (RLS) often present with significant sleep disturbance. Gabapentin enacarbil (GEn), a non-dopaminergic agent that provides sustained, dose-proportional gabapentin exposure, has demonstrated efficacy in the treatment of primary RLS.
Methods: Subjects with moderate-to-severe primary RLS and severe-to-very severe sleep disturbance (International Restless Legs Scale [IRLS] item 4 and average Periodic Limb Movements [PLM] during Sleep Index of ≥ 15 [5 nights' actigraphy, both legs]) were enrolled in this double-blind, placebo-controlled, 2-period crossover study (GlaxoSmithKline study RXP110908; ClinicalTrials.gov: NCT00748098). Subjects received GEn 1200mg for 4 weeks (Days 1-3, 600mg) and placebo for 4 weeks in a randomized sequence. A polysomnography assessment was conducted on the night prior to the baseline visit and following each treatment period. Primary endpoint: mean change from baseline at Week 4/10 LOCF in Wake Time During Sleep (WTDS). Key secondary endpoint: mean change from baseline at Week 4/10 LOCF in PLM associated with arousal per hour (PLMAI). Other selected secondary endpoints included IRLS total score, Stage N3 sleep time, number of awakenings (measured by PSG), and PLM associated with awakenings per hour (PLMAWI). Tolerability assessments included adverse event (AE) reporting.
Results: The intent-to-treat population comprised 131 subjects. GEn 1200mg significantly reduced WTDS (mean change from baseline: adjusted mean treatment difference [AMTD]: −26.0; $P < 0.0001$) and PLMAI (AMTD: −3.1; $P = 0.002$), compared with placebo at Week 4/10 LOCF. GEn 1200mg also significantly improved IRLS total score (mean change from baseline, AMTD: −6.6; $P < 0.0001$) Stage N3 sleep time (AMTD: 12.1 minutes; $P < 0.0001$), number of awakenings (AMTD: -2.5; $P < 0.0001$) and PLMAWI (AMTD: -0.1; $P < 0.001$), compared with placebo at Week 4/10 LOCF. AEs reported most commonly were dizziness (GEn 20%, placebo 2%) and somnolence (GEn 13%, placebo 2%).
Conclusion: GEn 1200mg significantly reduces RLS-associated sleep disturbance, significantly improves RLS symptoms, and is generally well tolerated.
Support (If Any): Study supported by GlaxoSmithKline, Research Triangle Park, NC.

0752

KNOWLEDGE AND AWARENESS LEVEL OF RESTLESS LEGS SYNDROME: A SURVEY OF PHYSICIANS

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Introduction: Restless Legs Syndrome (RLS) is characterized by an unpleasant sensation associated with an urge to move the legs, occurrence at rest, improvement with activity, and with worsening in the evening. The objective of this study is to compare attending physicians (AP) and physicians in-training (PIT) in their awareness and knowledge of the diagnosis and treatment of RLS.
Methods: Electronic surveys were sent to physicians in 6 academic hospitals. The 9-question survey assessed level of training, primary area of practice or specialty, familiarity with RLS, frequency of encounters with RLS patients, patterns of establishing diagnosis, and treatment for RLS. Fisher's exact test was used to compare AP and PIT responses.
Results: 463 surveys were completed (50% response rate): 335 (72%) were APs and 128 (28%) were PITs. Of these, 214 (46%) identified themselves as primary care, 118 (25%) as neurology/psychiatry, and 131(28%) as other specialists. The median respondent estimated that 1% (range 0 to 30%) of his/her patients have RLS. In the combined group, 221(48%) were familiar (response as "familiar" or "very familiar") with RLS. Despite equivalent knowledge of the revised 2003 IRLSSG diagnostic criteria [169 (50%) APs vs. 66 (52%) PITs, $P = 0.87$], APs reported more familiarity with RLS than PITs [180 (54%) vs. 41(32%), $P = 0.0001$]. To establish a diagnosis of RLS, the following procedures were selected: polysomnography [137(41%) APs vs. 44(34%) PITs, $P = 0.20$], EMG/NCS [19 (6%) APs vs. 20 (16%) PITs, $P = 0.0012$], and iron studies [96 (29%) APs vs. 25 (20%) PITs, $P = 0.058$]. Overall, 88 (19%) did not know which test to perform. Treatment options chosen include iron supplementation [131 (28%)], dopamine agonist [123 (27%)], and referral to a specialist [82(82%)].
Conclusion: Many APs and PITs are not familiar with RLS, its diagnosis, and treatments. Additional effort is needed to inform physicians throughout their medical training about this common disorder.

0753

PREVALENCE OF RESTLESS LEGS SYNDROME IN RUNNERS

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Introduction: Restless leg Syndrome (RLS) is a sensorimotor disorder described by Thomas Willis in 1685. It was Ekbom (1944,1945) who recalled the problem elucidating the occurrence and character of the "restless legs" syndrome. RLS is characterized by a distressing urge to move the legs and sometimes also other parts of the body usually accompanied by a marked sense of discomfort or pain in the leg or other affected body part. It begins or worse during periods of rest or inactivity, is partially or totally relieved by movements and is exacerbated or occurs at night and in the evening. RLS affects 5-10% of the general population. Treatment may be closely linked to the dopaminergic system and iron metabolism. Aukerman et al made a randomized controlled trial about exercise and RLS and concluded that the exercise (conditioning program of aerobic and lower-body resistance training 3 days/week) was effective in improving the symptoms.
Methods: We interviewed 61 subjects (47 ♂; 14♀) and was excluded 7 (5♂ and 2♀), 3♂sedentary and hypertensive, 1♂ and 2 ♀ with hypertension and diabetics and 1 refused to participate. The International RLS Study Group (IRLSG) four criteria to diagnosis RLS and questions about physical activity (marathon, half-marathon, running, walking, aerobic, swimming and bike) were during 3 marathons in Brazil (Sao Paulo, Florianopolis, and Porto Alegre). We studied 54 participants: 14 are 50-60 years old; 26 subjects with 61-70 years old and 14 ≥ 71 years old.
Results: We found 7 (12.96%) participants of these population meeting criteria for the diagnosis of RLS based on the four criteria of IRLSG. All symptomatic participants were marathon or half-marathon runners.
Conclusion: The prevalence of RLS in runners is higher than expected for Brazilian general population. Further studies would be necessary to better understand RLS complaints in this specific group.

0754

RESTLESS LEGS SYNDROME IN PATIENTS ON THREE TYPES OF DIALYSIS

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Introduction: It is known that end stage renal patients, especially those who are undergoing dialysis, have significantly higher rates of restless legs

syndrome (RLS) in the general population. However, patients undergoing automated peritoneal dialysis (APD) have not been studied with questionnaires to assess RLS compared to hemodialysis (HD) and continuous ambulatory peritoneal dialysis (CAPD).
Methods: We have selected 166 clinically stable individuals who were on dialysis for at least three months, divided into: patients who underwent HD (n = 89), APD (n = 29) and CAPD (n = 48). We collected socio-demographic, clinical, laboratory parameters, and self-administered questionnaires for the investigation of depression, anxiety, RLS, excessive daytime sleepiness (EDS) and sleep hygiene.
Results: 56.79% (95% CI = 49.2-64.4%) of the individuals contemplated in this survey had RLS and 27.33% EDS. There were no statistically significant differences between patients on HD, CAPD and APD concerning RLS. In univariate analysis, there were differences between gender (female > male P = 0.03), possible depression (P = 0.041) and anxiety (P = 0.023). However, in multivariate analysis, there was no independent risk factor.
Conclusion: Patients with renal insufficiency, undergoing any one of the three dialysis modalities studied, have a high prevalence of RLS and deserves special attention from health professionals.

0755

RESTLESS LEGS SYNDROME IN END-STAGE KIDNEY DISEASE PATIENTS UNDERGOING LONG-TERM HEMODIALYSIS THERAPY: THE ROLE OF PERIPHERAL NEUROPATHY, RESIDUAL RENAL FUNCTION AND POSITIVE FAMILY HISTORY OF RLS

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Introduction: Restless Legs Syndrome (RLS) is common in patients with End Stage Kidney Disease (ESKD) undergoing hemodialysis (HD). A negative effect on long-term ESKD survival has been confirmed in several studies, whereas the factors associated with RLS in these patients are controversial.
Methods: 162 consecutive ESKD patients undergoing long-term HD in two Dialysis Units in Bologna were investigated by means of clinical interview on sleep disturbances and neurological examination to establish the estimated likelihood of distal symmetric polyneuropathy. The Epworth Sleepiness Scale and the Berlin Questionnaire were self-administered to patients. Clinical and laboratory data were collected from patients' records. Patients with and without RLS were compared, thereafter a logistic regression model described the relations between independent predictors and RLS.
Results: Fifty-one patients (32%) currently had RLS (RLS+), 68 (42%) had personal history of RLS, and 23 of them recalled symptom onset before kidney disease. RLS + patients were more frequently women (49% versus 29%, P = 0.012), had positive first-degree relative family history of RLS (22% versus 6%, P = 0.004), evidence of peripheral neuropathy (41% versus 21% with high likelihood; 18% versus 39% with absent likelihood, P = 0.006), and low residual diuresis (8% versus 34% with over 500mL/24h; 65% versus 53% without any residual diuresis, P = 0.001). Insomnia (59% versus 36%, P = 0.007) was associated with RLS, whereas daytime sleepiness, symptoms of sleep apnea, nocturnal legs cramps, pruritus, and sleep-related eating disorder were non-significantly increased in patients with RLS. Low (OR = 8.71; P = 0.002) and absent (OR = 4.96; P = 0.008) residual diuresis, high likelihood of peripheral neuropathy (OR = 4.00; P = 0.008), and positive first-degree-relative family history of RLS (OR = 3.82; P = 0.023) significantly predicted RLS in ESKD patients undergoing HD.
Conclusion: RLS in ESKD undergoing HD shares hallmarks of the idiopathic form (positive family history) together with ESKD associated factors (peripheral neuropathy, residual renal function), and negatively impacts on sleep in these patients.

0756

RESTLESS LEGS SYNDROME IN PREGNANCY: FREQUENCY AND CORRELATES

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Introduction: Restless legs syndrome (RLS) affects approximately 14% of females in the general population. Several studies have shown that RLS is increased during pregnancy but little is known about its true frequency or correlates.
Methods: As part of a larger prospective study on sleep in pregnancy, women were surveyed about their sleep during their third trimester. Validated screening questionnaires included the General Sleep Disturbance Scale (GSDS) and a 4-item Brief Restless Legs Scale. Sleep disturbance was considered present if the mean total score or any subscale score (poor sleep quality and poor daytime functioning) was ≥ 3. Positive responses to the first 3 question items on the brief RLS scale signified RLS. Item 4 provided information on RLS severity.
Results: Thus far, 1387 women pregnant with single fetuses (mean age 29.7 ± 5.7 years and mean gestational age 34.2 ± 3.8 weeks) have participated in this study. Of these, 487 (35%) were found to have RLS. Caucasian women were most likely (37%) and African American women were the least likely (25%) to report RLS. Overall, 70% of women with RLS reported symptoms occurring ≥ 2 nights/week and 33% reported symptoms ≥ 4 nights/week. Compared to women without RLS, women with RLS had a significantly higher frequency of total sleep disturbance (55% vs. 38%), poor sleep quality (79% vs. 67%), and poor daytime functioning (80% vs. 66%; all P-values < 0.001). Using logistic regression and controlling for age, ethnicity, Epworth sleepiness score, BMI, and sleep disordered breathing, RLS independently predicted poor sleep quality (O.R. 1.57, 95%CI 1.2-2.1; P = 0.002) and poor daytime functioning (OR 1.70, 95%CI 1.3-2.3; P = 0.001).
Conclusion: RLS is highly prevalent in pregnancy. While pregnancy is associated with sleep disturbances, the presence of RLS may further impair sleep quality and daytime functioning. These findings suggest potential opportunities to improve women's sleep during pregnancy.
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0757

OBSTRUCTIVE LUNG DISEASE AND ESTROGEN USE ARE ASSOCIATED WITH A HIGHER INCIDENCE OF RESTLESS LEGS SYNDROME

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Introduction: Restless legs syndrome (RLS) is a common condition, but there are few data assessing the incidence of this disorder.

Methods: We obtained data from the Tucson Cohort of the Sleep Heart Health Study, a prospective multicenter study. The study included 534 participants, all aged 40 years and above, who answered questions regarding RLS on the 2002 and 2006 sleep surveys. RLS was defined as presence of all the four International Restless Legs Study Group criteria with at least moderately bothersome symptoms occurring at least 5 days a month.
Results: Mean age of the predominantly Caucasian (90.8%) participants on survey 1 was 59.76 ± 9.73 years, and 52.6% were women. RLS prevalence was 4.1% in 2002 and 7.7% in 2006. The yearly incidence of RLS was 1.7% (6.6% over 4 years). Multivariate analyses demonstrated that estrogen use (OR = 2.5, 95% CI: 1.19-5.19) and self-reported obstructive lung disease (OR = 2.8, 95% CI: 1.36-5.77) were independent risk factors predicting incident RLS. Incident RLS was associated with increased sleepiness (Epworth Sleepiness Scale > 10, 38.2% vs. 22%, P = 0.036) and higher use of sleeping pill in 2006 (23.5% vs. 9.7%, P = 0.019). A regression model revealed higher odds of frequent sleeping pill use in those with insomnia (OR = 8.8, P < 0.001) and in those with RLS (OR = 2.7, P = 0.035), but no association between daytime sleepiness and sleeping pill use.
Conclusion: Use of estrogen and history of obstructive lung disease are associated with a significantly higher incidence of RLS. RLS, in turn, is associated with increased sleeping pill use as well as increased daytime sleepiness.

0758

RLS IN A PALLIATIVE CARE POPULATION: PREVALENCE AND IMPACT

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Introduction: Restless legs syndrome (RLS) is common in the general population (3-10%). The prevalence of RLS in the palliative care population has not been studied, though there is reason to believe that it may be more prevalent due to the frequent presence of anemia, renal failure and medication use that may aggravate RLS. RLS impairs quality of life (QOL), though this has also not been addressed in palliative care patients, where QOL is the goal of treatment. We hypothesized that RLS is common among palliative care patients and negatively impacts QOL.
Methods: A convenience sample of patients attending an outpatient palliative practice at an urban academic center was surveyed for the presence of RLS using the International RLS Study Group standardized diagnostic criteria. Subjects also completed a RLS severity rating and the SF-12. Two sample t-test were used to compare QOL in those with and without RLS.
Results: To date, 21 of 23 patients (91%) approached completed the study. Demographics: average age 53 +/- 15 years, 52% female, 67% Caucasian, 33% African-American, and Palliative Performance Score 70 (on a scale of 0-100). Most patients were seen for chronic pain management (90%). Spinal cord disease (38%) and malignancy (29%) were common. For the cohort, 57% met all 4 criteria for RLS, of which none had been previously diagnosed with RLS. In these patients, RLS severity rating was moderate in 42%, severe in 42% and very severe in 16%. By SF-12, those with RLS had lower mental functioning (40 vs. 47, P = 0.2) and lower physical functioning (27 vs. 28, P = 0.7) compared to those without RLS, though significance was not reached.
Conclusion: RLS is common, yet unrecognized, in patients seen in an outpatient palliative care clinic. QOL may be adversely impacted by the presence of RLS though a larger sample size is needed to determine this. Study enrollment is ongoing.

0759

RESTLESS LEGS SYNDROME: SEVERITY, SERUM FERRITIN AND CHARACTERISTICS FROM A COMMUNITY-BASED STUDY IN BRAZIL

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Introduction: Restless Legs Syndrome (RLS) is a sensorimotor disorder. In a previous study we have conducted a population-based survey using the full standard diagnostic criteria for RLS and report a prevalence of 7.7%. The purpose is to show the severity, serum ferritin and some characteristics of the RLS population.
Methods: This is an epidemiological study which was conducted in Cássia dos Coqueiros(CQ), São Paulo State, Brazil. Population: adults residents in the urban region of CQ, aged 18 years or more, were eligible for inclusion in the study. RLS population: RLS was diagnosed if the respondents answered affirmatively to all questions of the four essential NIH/IRLSSG criteria for diagnosis of RLS. Those who were diagnosed with RLS were invited to participate. Among de 74 patients with RLS, 68 accepted. Protocol: the interview was done by a neurologist with sleep medicine expertise. The variables studied were: the severity of RLS, using the International Restless Legs Syndrome Scale (IRLSS), age of the symptoms onset, family history for RLS and serum ferritin. Statistics: descriptive statistics and Pearson correlation coefficients were used.
Results: Severity: the average value of IRLSS was 17,14 ± 7,81(SD). There were 14 patients (21,9%) with mild RLS, 26(40,6%) with moderate RLS, 23(35,8%) with severe RLS and one patient (1,6%) with very severe RLS. Family history: 34 patients (50%) had a positive family history for first and second-degree relatives. Serum ferritin: 64 patients were evaluated. The average value of serum ferritin was 46,55 ± 17,65(SD). Thirty five patients (54,68%) had serum ferritin below 50. We found a positive correlation between the age of the symptoms onset and the ferritin values for the patients whose symptoms have begun after 18 years-old (r = 0,812; P < 0,0001).
Conclusion: This study reveals the severity and the correlation between serum ferritin and age of the symptom onset among Brazilian RLS patients.
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0760

MEIS1 AS A POTENTIAL MEDIATOR OF THE RLS-IRON PATHOLOGY

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Introduction: Intronic variants in the gene MEIS1 have been associated with Restless Legs Syndrome (RLS). These intronic variants lead to decreased MEIS1 mRNA and protein in RLS brain tissue and lymphoblastic cells. MEIS1 is important for important for development but also in adults mice is expressed in dopaminergic neurons of substantia nigra. Little has been done to understand its role in mature tissues or pathology of RLS. Since brain iron deficiency is considered a primary pathology in RLS, a fundamental question addressed in this study is whether or not there is a relation between MEIS1 and iron regulation that might explain at least in part it relation to RLS
Methods: Two studies cultured THP-1 cells. First, to investigate decreased iron effects on MEIS1 expression cells were cultured for 24 hours with or without 25uM DFO. Second, effects of decreased MEIS1 message and protein expression on iron management were evaluated using siRNA specific to MEIS1 compared to control siRNA.

Results: Study 1: iron chelation with DFO increased by 37% MEIS1 protein on Western blotting. Study 2: 48-hour inhibition of MEIS1 production increased transferrin receptor (TfR) mRNA by 35%, TfR2 mRNA by 146%, SLC40A1 (ferroportin) mRNA by 173% , and decreased hepcidin mRNA by 68%. BTBD9, another gene highly associated with RLS risk, was increased 91% with siRNA inhibition of MEIS1.
Conclusion: MEIS1 protein appears to be, in part, regulated by cellular iron status, while MEIS1 itself may also feedback to regulate some component of cellular iron management. The findings match similar to analyses of human lymphocytes in RLS. These studies strongly support the role for MEIS1 in iron pathology and genetic factors of RLS.

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WHAT ARE THE RELATIONSHIPS BETWEEN SERUM IRON AND FERRITIN ON HEALTH OUTCOMES (SLEEP QUALITY, DAYTIME SLEEPINESS, DEPRESSION, FATIGUE, AND QUALITY OF LIFE) IN PERSONS WITH RESTLESS LEGS SYNDROME (RLS)?

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Introduction: RLS is a sleep disorder caused by dopamine and iron dysfunction resulting in daytime dysfunction and sleepiness, decreased job performance, strained relationships, depression, anxiety, fatigue, and poor quality of life (QoL). Increasing ferritin levels above 50g/mL results in a reduction of sensory and motor symptoms of RLS. However, no studies have reported any relationship of serum iron and ferritin on sleep quality, sleepiness, depression, fatigue, and QoL in persons with RLS. Therefore, the primary aim of this paper presentation is to discuss the relationships between serum iron and ferritin with sleep quality, daytime sleepiness, depression, fatigue, and QoL in persons with Restless Legs Syndrome (RLS).
Methods: Objective data were collected on serum iron and ferritin concentrations in 48 persons with RLS (23-77 years of age). Subjective reports included symptom severity, sleep quality, daytime sleepiness, depression, fatigue, and QoL.
Results: Serum ferritin levels below 50g/mL were seen in 52% of the participants with only one person (4%) treated with iron supplementation. No relationship existed between ferritin with any of the outcome measures. No relationship existed between serum iron with RLS symptom severity. Serum iron levels were directly related to sleep, sleepiness, depression, fatigue, and QoL in persons with RLS. Final multivariate regression models identified age and race as co-variants: 1) being white ($P = 0.047$) and higher iron levels ($P = 0.019$) were independent predictors of higher social functioning; 2) being white ($P = 0.047$) and higher iron levels ($P = 0.004$) were independent predictors of sleepiness; 3) younger age ($P = 0.001$) and lower iron levels ($P = 0.025$) were independent predictors of depression; and 4) younger age ($P = 0.006$) and lower iron levels ($P = 0.005$) were independent predictors of fatigue.
Conclusion: Ferritin levels are used to indicate iron supplementation for motor and sensory symptoms of RLS, however, few health care providers prescribe iron for ferritin levels below 50. While iron levels are not considered a diagnostic indicator for RLS symptoms, iron supplementation may benefit persons with RLS who complain of sleepiness, depression, fatigue, and poor QoL. Iron supplementation should be considered for RLS outcomes as well as for symptom severity based on ferritin levels.
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POLYSOMNOGRAPHIC FINDINGS AND QUALITY OF LIFE IN PRIMARY RLS PATIENTS

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Introduction: Restless leg syndrome (RLS) is known to induce sleep disturbance and secondary consequences such as reduced quality of life, depressive symptoms, and cardiovascular disease. This study investigates the sleep architectures by polysomnography (PSG) and the quality of life in drug naïve patients with symptoms of RLS.
Methods: We enrolled consecutively 69 drug-naïve RLS patients that met the RLS criteria of ICSD-II by face-to-face interviews. All patients completed the overnight polysomnography (PSG), Restless Leg syndrome Quality of Life questionnaire (RLSQoL), International RLS scale (IRLSS), Beck Depression Inventory (BDI), Epworth Sleepiness Score (ESS), Stanford Sleepiness Score (SSS), and Suggested Immobilization Test (SIT). According to RLS severity, patients were divided to 3 groups (10-25: mild, 26-35: moderate, 36-50: severe).
Results: We excluded the 14 comorbid patients with obstructive sleep apnea (OSA) (AHI $\geq$ 10/hr) because of considerable effects on sleep architectures and daytime consequences and the 13 patients with incorrect or incomplete data. Total 42 patients were analyzed (mean age, 54.6 yrs, M:F = 16:26). The mean duration of RLS was 12.7 ± 9.8 years. Mean ESS was 8.1 ± 4.0 and SSS was 2.8 ± 1.1. Mean IRLSS for severity was 22.7 ± 9.4 and mean SIT score was 25.7 ± 22.7. RLSQoL score was 65.8 ± 23.5 and BDI score was 11.3 ± 7.5. All patients complained the sleep onset insomnia due to RLS symptoms, but their mean sleep latency was within normal range (17.7 ± 21.0 min). But, they showed sleep maintenance problem (increased wakefulness after sleep onset, 79.2 ± 44.3min). Also Twenty-seven patients (64.3%) had periodic limb movement during sleep (mean PLMS index,24.1 ± 38.5/hr, movement arousal index,4.1 ± 5.6/hr). The RLSQoL score, SIT score, and BDI score were significantly different between mild, moderate, or severe RLS group. RLSQoL and SIT score were significantly correlated RLS severity ($P < 0.01$). Total sleep time and arousal index were significant correlated with RLS severity.
Conclusion: RLS patients had poor quality of sleep and RLS severity were well correlated with RLSQoL, SIT, and BDI scores.

0763

QUALITY OF LIFE IN PATIENTS WITH RESTLESS LEGS SYNDROME IN KOREA

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Introduction: We studied the quality of life (QOL) of patients with restless legs syndrome (RLS) and compared it to normal controls and patients with hypertension or diabetes in Korea.
Methods: We developed the Korean versions of Johns Hopkins RLS QOL, which involved translating into Korean and then translating back into English to check its accuracy. In total, 250 RLS patients have been included in this study. The scores of RLS patients were compared with the scores of 215 normal controls, 196 hypertension, and 185 diabetes. All subjects completed the questionnaires, including the Korean versions of SF-36, Johns Hopkins RLS QOL, PSQI, and BDI-2. The associations between severity of RLS and the scores from QOL were examined through Pearson correlation.

Results: The subjects with RLS had a lower QOL than normal controls, and even lower than patients with hypertension or diabetes. The more severe the RLS symptoms were, the lower the QOL. Correlational analysis showed a significant negative correlation between the severity of RLS symptom and QOL ($r = -0.702$, $P < 0.001$). However, neither the gender of the RLS subjects nor the age of symptom onset (early- or late-onset), made a difference in the QOL analysis. The factors most related with the QOL in RLS patients were depression and sleep quality.
Conclusion: We found that Koreans with RLS have a considerably diminished QOL, even more so then that seen in Korean subjects with diabetes or hypertension. These findings are comparable with studies of western countries.

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COGNITIVE DYSFUNCTION IN PATIENTS WITH RESTLESS LEGS SYNDROME REVEALED BY EVENT-RELATED POTENTIAL STUDY

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Introduction: Recent study reported that patients with restless legs syndrome (RLS) may have cognitive deficit, particularly prefrontal lobe dysfunction (Pearson et al., 2006). The cognitive dysfunction may be attributed to either secondary to daytime sleepiness and/or attention deficit due to RLS symptoms, or primary to intrinsic brain dysfunction underneath RLS syndrome. Event-related potential (ERP), which offers high temporal resolution, provides information about the precise timing of dynamic neural mechanisms of different cognitive processes. ERP involved in stimulus categorization, probability sequence, attention resource allocation, and memory processing. To identify cognitive dysfunction in patients with RLS, event-related potential (ERP) study was performed.
Methods: Seventeen women (mean age: 53.7years old) with primary RLS and thirteen age-matched female controls participated. ERP was recorded at 10 am using visual oddball paradigm with 80% of nontarget stimuli and 20% of target ones. Stanford sleepiness scale (SSS) and visual analog scale (VAS) for bothersome was checked just after ERP study. Repeated measures analysis of variance was performed for amplitude and latency of each ERP component.
Results: SSS and VAS was not significantly different between groups. RLS patients showed significant longer reaction time than controls (425.3 ± 40.1 ms vs. 382.7 ± 32.6 ms). P2 amplitude showed significant group effect. RLS patients had lower P2 amplitude than controls. P3 amplitude and latency showed significant group effect and group by location interaction. RLS patients showed increased latency and lowered amplitude compared with controls. Post-hoc analysis revealed that these differences were most prominent in frontal region.
Conclusion: Our results support that patients with RLS have cognitive dysfunction, particularly in frontal lobe. The fact that lack of sleepiness and RLS symptom during EEG recording may favor intrinsic brain dysfunction as a underlying mechanism of cognitive dysfunction in RLS.

0765

RESTLESS LEGS SYNDROME (RLS) IS ASSOCIATED WITH AN INCREASED PREVALENCE OF SMALL INTESTINAL BACTERIAL OVERGROWTH: IS RLS MEDIATED BY INFLAMMATORY AND IMMUNOLOGICAL MECHANISMS?

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Introduction: Patients with gastrointestinal (GI) diseases such as celiac disease and Crohn's disease have a high prevalence of Restless legs Syndrome (RLS). Our review of the literature indicates that 30 of the 40 causes of secondary RLS are associated with inflammation. The current study was designed to look at the prevalence of another GI disorder, irritable bowel syndrome (IBS) in RLS. Because a previous meta-analysis indicates that 54% of patients with IBS have small intestinal bacterial overgrowth (SIBO), we also determined the presence of SIBO by a positive lactulose breath test (LBT).
Methods: RLS patients were screened from a population where the presence or absence of GI symptoms was neither encouraged nor discouraged. The presence or absence of GI disease was determined and RLS subjects with IBS or non-specific or no GI complaints were submitted to LBT. Sixty-one RLS patients (43 F, 18M avg age 56.8 yrs) were screened. Two patients were excluded from the calculations of the prevalence of IBS in our RLS population because the presence or absence of IBS was not documented. After the determination of the prevalence of IBS in our RLS patient population, 56 RLS patients underwent LBT testing. Five patients did not have a LBT because of the presence of other GI diseases and they were excluded from further analysis.
Results: The prevalence of IBS in our RLS population was $23/59 = 38.9\%$ as compared to the prevalence of IBS in the general population of 14.1% ($P < .001$). A positive LBT suggestive of SIBO was present in $36/56 = 64.2\%$ of our RLS patients and in $3/28 = 10.7\%$ of a normal population where RLS and GI symptoms were excluded (18F, 10 M avg age 45.3 yrs). Assuming a false positive rate of 10.7%, a full 64.2%-10.7% = 53.5% of positive LBTs can be attributed to their association with RLS in an unselected population. There was an incomplete overlap of IBS and a positive LBT: $14/23 = 60.8\%$ of RLS patients with IBS displayed a positive LBT and $14/36 = 38.9\%$ of RLS patients with a positive LBT displayed IBS.
Conclusion: Evidence of IBS and SIBO are common in RLS but there is not complete overlap. The high prevalence of SIBO in our RLS patients along with the fact that 75% of cases of secondary RLS are associated with inflammation suggests that RLS may be mediated through inflammatory or immunological mechanisms. Since inflammation is also associated with iron deficiency, these results are also in agreement with the iron deficiency hypothesis for RLS.
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0766

HOW DOES RLS PATIENTS REALLY RECOGNIZE THEIR DAYTIME SLEEPINESS?

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Introduction: Restless leg syndrome (RLS) is known to induce insomnia and impaired cognitive function and daily activities. To investigate the objective daytime sleepiness and its relationship with polysomnography (PSG) and other clinical findings in RLS patients, we performed overnight PSG and Multiple Sleep Latency Test (MSLT).
Methods: We enrolled consecutively 109 drug-naïve RLS patients that met the RLS criteria of ICSD-II. But, we excluded the 28 comorbid patients with obstructive sleep apnea (OSA) (AHI $\geq$ 10/hr) or one or more sleep onset REM (SOREM) because of considerable effects on daytime sleepiness (OSA = 9, SOREM = 15, both SOA and SOREM = 4). Total 81 patients were analyzed (mean age = 56.3 ± 12.4yrs, M:F = 26:55). We performed ESS, SSS, and SIT in all patients. International RLS scale was performed in 74, PSG in 58, and MSLT in 32.
Results: The mean duration of RLS symptoms was 11.2 ± 9.7years. Mean ESS was 6.3 ± 4.0 and SSS was 3.9 ± 2.8. Only 11 patients (13.6%) reported moderate to severe daytime sleepiness (ESS $\geq$ 11).

Mean IRLS score for severity was 22.5 ± 8.6 and mean SIT score was 22.3 ± 19.6. Their PSG showed that mean time in bed was 444.5 ± 84.8 min (ranged 214.6-645.5 min), mean total sleep time 339.4 ± 90.4 min (ranged 86.5-490.3 min), mean sleep latency 24.1 ± 49.8 min and WASO (wakefulness after sleep onset) 82.7 ± 52.1 min (2.9- 64.4%). Forty-two (72.4%) out of 58 patients who had overnight PSG had periodic limb movement (PLMS index ≥ 5) during sleep [mean PLMS index = 42.7 ± 39.3/hr, movement arousal index (MAI) = 5.4 ± 6.1/hr]. Sleep latency on PSG and SIT score were significantly correlated not with ESS but RLS severity ($P < 0.05$). Also, arousal index (AI) and MAI were correlated with RLS severity ($P < 0.05$). Sleep latency, AI and SIT score were significantly different between mild RLS (N = 15, IRLS < 15) and moderate to severe RLS group (N = 59, IRLS ≥ 15) ($P < 0.05$), but ESS, SSS, PLMS index, MAI, apnea-hypopnea index (AHI) and WASO were not different between them. In MSLT results, their mean sleep latency was 9.8 ± 5.6/hr and less than or equal to 8 min(4.8 ± 2.0min) in 47 percent of patients(15/32).

Conclusion: Many RLS patients had nonsignificant reductions in ESS and SSS scores inrespective of RLS severity and the degree of daytime sleepiness. But, in fact, they had short sleep latency irrespective of subjective daytime sleepiness.

0767

NOCTURNAL BLOOD PRESSURE DIPPING IN RESTLESS LEGS SYNDROME

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Introduction: Several epidemiological studies showed that restless legs syndrome (RLS) is associated with increased risk for cardiovascular disease. A high prevalence of periodic leg movements during sleep (PLMS) is found in RLS and these movements are associated with significant increase in both systolic and diastolic blood pressure (SBP, DBP). In addition, studies showed decreased sleep efficiency (SE) in RLS patients. The aim of the present study was to evaluate the relationship between polysomnographic (PSG) data and day-to-night changes in arterial blood pressure (BP) in RLS patients.

Methods: We studied 17 RLS patients (10 women, 7 men; age = 44.4 ± 8.1 years) with normal resting BP (SBP = 109.3 ± 9.2 mmHg, DBP = 67.1 ± 5.6 mmHg) and a body mass index < 25 kg/m2. Subjects underwent 42 hours of experimental procedures (night 1, day, night 2) with standard PSG recording. During the day and night 2, brachial BP was measured each half hour for 24 hours using a commercially available ambulatory system to assess nocturnal dipping ((night-day)/day X 100): represented by a negative value). Correlation analyses were performed between RLS severity scale, PLMS index, micro-arousals (MA) index, SE and wake after sleep onset (WASO) on one hand, and nocturnal SBP and DBP dipping on the other hand.

Results: RLS severity scale, PLMS index and MA index did not correlate with any of the BP measures. By contrast, a higher SE was associated with a more important nocturnal BP dipping (SBP: $r = -0.48$, $P = 0.05$; DBP $r = -0.65$, $P = 0.005$. In addition, a higher WASO was associated with a lower BP dipping (SBP: $r = 0.49$, $P = 0.05$; DBP: $r = 0.66$, $P = 0.004$).

Conclusion: These results suggest that poor sleep may be responsible for impairment in nocturnal BP dipping pattern in RLS. These results also suggest that the lack of nocturnal BP dipping observed in hypertensive subjects could be mediated, at least partly, by disrupted sleep.

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0768

RESTLESS LEG SYNDROME AS A PREDICTING FACTOR FOR CPAP EMERGENT PERIODIC LIMB MOVEMENTS

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Introduction: Sleep-disordered breathing is commonly associated with periodic limb movements in sleep (PLMS). Some patients with obstructive sleep apnea (OSA) demonstrate PLMS after initiation of continuous positive airway pressure (CPAP). It has been hypothesized that CPAP-emergent periodic limb movements may be an unmasking effect once OSA is treated. Demonstrating a relationship between CPAP-emergent PLMS and restless leg syndrome (RLS) would support an unmasking hypothesis.

Methods: A retrospective review was performed on the nocturnal polysomnograms performed between 2007 and 2009. Patients with a diagnosis of OSA (Respiratory Disturbance Index [RDI] > 5) and a periodic limb movement index (PLMI) < 5 on the baseline study were reviewed. We selected those patients whose OSA was effectively treated with CPAP in addition to the development of a PLMI > 15. These were compared to patients who did not develop a PLMI > 5 either on the baseline study or on the CPAP titration study. Among the study population, we also documented whether there was an improvement in the PLMS with elimination of the obstructive events or if the PLMS were unchanged despite adequate CPAP therapy.

Results: We reviewed 16 cases and 24 controls that were matched for age (mean 49 SD +/-13.4 years) and BMI (mean 36 +/- 9.9 kg/m2). We found no statistical difference in the AHI (mean 22.3 +/-19 apneas & hypopneas/hour, $P = 0.82$), absolute percentage supine sleep (mean 35.4+/-35% $P = 0.97$) or percentage change in supine sleep between the diagnostic night and CPAP study (mean 9.2 +/-24.4%, $P = 0.83$). The average PLMI in the study group during the CPAP titration was 33 +/-13 PLMs/hour. We found RLS was more frequent in the patients who developed CPAP-emergent PLMS (31%) versus those in the control group (0.04%) with an odds ratio (OR) of 10.5 ($P = 0.03$). When looking at the response of the PLMS to CPAP in the RLS patients, 80% had no significant change in PLMI with CPAP adequate to eliminate OSA.

Conclusion: The presence of RLS appears to be a predicting factor for CPAP emergent PLMS. Although there is a possibility of PLMS being a manifestation of unscorable respiratory events, the persistence of PLMS despite adequate CPAP therapy would at least in this population refute that hypothesis. Hence patients with CPAP emergent PLMS with a pre-existing diagnosis of RLS or PLMS that does not improve with CPAP treatment should be evaluated and potentially be offered treatment with a dopaminergic agent.

0769

THE FREQUENT COMPLICATION OF RESTLESS LEGS SYNDROME IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA-HYPOPNEA SYNDROME

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Introduction: Hypersomnia patients develop a number of disorders. Most patients with restless legs syndrome (RLS), which is one of the disorders of hypersomnia, are aged and have many other sleep-related disorders. The first-line therapy for RLS patients is treatment with a dopamine agonist. The daytime sleepiness resulting from RLS is improved with the therapy, but the symptom in some patients is not always improved with treatment. To differentially diagnose daytime sleepiness in RLS patients after treatment, we determined whether patients with RLS show obstructive sleep apnea-hypopnea syndrome (OSAHS) or periodic limb movement during sleep (PLMS) employing polysomnography (PSG).

Methods: The PSG study involved 143 patients who visited our clinic with the chief complaint of RLS from January 2005 to July 2008. The 143 patients comprised 68 men and 75 women with a mean age of 62.2 ± 14.7. The patients with OSAHS were defined as showing > 5 for the AHI and PLMS patients were defined showing as > 10 for the PLMS index.
Results: In patients with RLS, the complication rate of OSAHS in males and females was 69.1 and 58.7%, respectively. The PLMS complication rate in male and female patients with RLS was 35.3 and 22.7%, respectively.
Conclusion: The complication rates of OSAHS and PLMS in patients with RLS were relatively high. PSG examination should be performed aggressively in RLS patients whose symptoms ameliorate after dopamine agonist therapy.

0770

UNMASKING OF PERIODIC LIMB MOVEMENTS DURING CONTINUOUS POSITIVE AIRWAY PRESSURE APPLICATION

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Introduction: Periodic limb movements (PLM) and obstructive sleep apnea (OSA) are common sleep disorders that frequently overlap. Our study investigated the finding of PLM upon first exposure to continuous positive airway pressure (CPAP), with the hypothesis that appearance of PLM during CPAP application likely represented "unmasking" of a co-existing condition after resolution of respiratory-related sleep fragmentation.
Methods: A total of 78 overnight polysomnographic recordings in 39 subjects with an hourly PLM index ≥ 5 during CPAP application were evaluated. All subjects had an hourly apnea-hypopnea index (AHI) ≥ 5 at baseline.
Results: Our results showed that CPAP significantly improved sleep architecture, despite producing no significant increase in overall PLM index. Eleven subjects showed no significant PLM at baseline, however, and these subjects had a significantly greater change in PLM index between nights as compared to the remainder of the sample (mean difference of 28.1 events/h, $P < 0.007$). There was a significant positive linear correlation between PLM indices and PLM arousal indices for both baseline and CPAP nights ($r = 0.553$, $P < 0.01$; $r = 0.548$, $P < 0.01$, respectively). Sixteen subjects required an optimal CPAP titration level that was higher than the sample average of 8.2 cm H_2O and showed significantly less PLM at baseline ($P = 0.013$). This group was found to have a significantly higher AHI than its counterparts at baseline (mean difference of 39.1 events/h, $P < 0.001$).
Conclusion: Sleep architecture on these subjects was markedly improved upon CPAP application; nonetheless, significant PLM were seen. These findings suggest that PLM, when seen on the CPAP polysomnography, are usually related to a concurrent sleep disorder and "unmasking" of PLM is associated with more severe OSA at baseline.

0771

ANALYSIS OF LIMB MOVEMENTS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA AND PERIODIC LIMB MOVEMENTS OF SLEEP

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Introduction: Periodic limb movements, defined as sets of muscle contractions occurring at intervals of < 90 seconds during the night, may cause sleep disturbance or be associated with other sleep disorders such as apnea. We hypothesize that the characteristics of the limb movements distinguish different disease states and thus imply diverse drivers for these motor events.
Methods: We performed a retrospective analysis of polysomnograms with a periodic limb movement index > 10 and < 20, performed at UNC between January 1, 2009 and December 1, 2010. 20 polysomnograms were then subdivided as demonstrating obstructive sleep apnea with periodic limb movements or periodic limb movements alone. In addition information about diagnoses, meds, age group, Epworth sleepiness score and post- polysomnogram questionnaires was taken from a sleep intake form. Inter-movement interval between the end one of one leg movement and the start of the consecutive leg movement, the maximum amplitude of each leg movement, duration of each leg movement, and side of the leg movements were measured and compared to sleep stage and presence of arousal. Groups were compared using a student t-test ($P < 0.05$).
Results: There was no significant difference in the duration, amplitude, or standard deviation of limb movements in patients with obstructive sleep apnea from patients with periodic limb movements alone. There was a significant difference in the intermovement interval in patients with obstructive sleep apnea versus periodic limb movements alone ($P < 0.05$). The intermovement interval was significantly significant shorter during wake ($P = 0.0002$) and stage 2 sleep ($P = 0.0006$) in patients with obstructive sleep apnea.
Conclusion: Limb movements in patients with obstructive sleep apnea showed significant differences in intermovement interval from patients with periodic limb movements alone. Subgroup analysis showed significantly shorter intermovement intervals during wake and stage 2 sleep. Further work is required to differentiate these movements.

0772

PERIODIC LIMB MOVEMENTS - THE FREQUENCY, SEGMENTS OF SLEEP, AND BODY MOVEMENTS OBSERVED IN A SUBURBAN SLEEP CENTER

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Introduction: Periodic limb movements (PLM's) are commonly recorded during polysomnograms. An observational review was performed of diagnostic polysomnograms ordered for AASM indications to establish the frequency, segment of sleep involved and body movements of PLM's observed in a population studied for sleep problems from a suburban AASM accredited center.
Methods: All initial full-night diagnostic or initial split-night studies performed on patients > 18y/o for any indication between October 2008 and October 2009 were reviewed. All studies were performed and scored following AASM guidelines. Studies were reviewed for the presence of PLM's. The frequency of PLM's was graded based upon the number per hour of recorded sleep - PLM index (none, mild < 14, moderate 15-29 and severe > 30). The segments of the sleep study where PLM's were observed (first, second or last third) were recorded. The body movements for each PLM were visually estimated (0 - none, 1 - one extremity, 2 - two extremities, 3 - three extremities or 4 - a full body movement).
Results: Data was reviewed from 460 studies performed between 10/08 and 10/09. PLM's were observed in 51.7% (238/460). PLM indexes recorded included 63.4% mild, 17.2% moderate and 19.3% severe. As the PLM index increased, PLM's were observed in more sleep segments (one segment - mild 51.8%, moderate 31.4%, severe 4.9% - compared to all segments - mild 20%, moderate 42.9%, severe 58.5%). Movements involving multiple extremities were seen at all levels of PLM indexes (mild 15.4%, moderate 17.9% and severe 29.5%). Multiple extremity movements were seen when PLM's were recorded in one segment (27.1%), two segments (37.8%) and all segments (35.1%) of studies.
Conclusion: Individuals with low PLM indexes or PLM's limited to a portion of a polysomnography can have body movements involving multiple extremities. Body movements during a PLM should be added to routine study scoring.

0773

NIGHT-TO-NIGHT VARIABILITY OF PERIODIC LEG MOVEMENTS (PLMs) IN SUBJECTS DIAGNOSED WITH RESTLESS LEG SYNDROME (RLS): ASSESSING THE IMPACT OF SCORING CRITERIA

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Introduction: Symptom fluctuation has a direct impact on the diagnosis and treatment of RLS and PLMD. Previous studies, using limited numbers of subjects and different methodologies, have reported considerable intra-subject differences in the expression of night-to-night PLM variability. The goal of this study was to examine the impact of the AASM (1993) scoring criteria against the WASM (2006) scoring criteria on the night-to-variability in PLMs in RLS subjects.
Methods: PSG data were collected on 125, medication-free, subjects, from 30 sleep centers, participating in an RLS clinical trial (GSK RRL 103660). All subjects enrolled in the study had an IRLS rating > 20 and reported severe to very severe sleep disturbance due to RLS. Following an adaptation-diagnostic PSG, subjects underwent two additional, consecutive nights of baseline PSG recording if inclusion criteria were met. PLM scoring was performed by experienced polysomnographic technologists trained in both the 1993 and 2006 scoring criteria. Each tracing was scored using both criteria by the same rater, but data were de-identified and scorers were not provided information about their previous ratings when scoring records for the second time. Five different PLM variables were calculated from visually identified events: PLMI, PLMSI, PLMAI, PLMWI and PLMW2I.
Results: Paired t-tests and Bland-Altman statistics showed little, within-method, variability between the two baseline nights for both scoring methods. Only PLMAI (AASM criteria) demonstrated a significant mean difference between PSG1 and PSG2 (mean difference = 2.23, P = .03). Linear regression showed less night-to-night variability using the AASM criteria (PLMI; r2 = .70) versus WASM criteria (PLMI; r2 = .60) and better night-to-night agreement was seen for both methods for PLM variables calculated during sleep compared to wakefulness.
Conclusion: Scoring method impacts night-to-night variability of PLMs with the newer scoring method being associated with greater night-to-night variability in leg movements.

0774

SUBTHALAMIC NUCLEUS ACTIVITY AND PERIODIC LIMB MOVEMENTS DURING SLEEP IN HUMANS

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Introduction: The pathophysiology of periodic limb movements during sleep (PLMS) remains uncertain. Suprasegmental disinhibition of the descending inhibitory pathways or neuronal hyperexcitability of the central pattern generator for gait have been suggested to be involved. The subthalamic nucleus (STN), a key structure of the basal ganglia, has been shown to play a role in motor control and the transmission of PGO-like waves. In this study we examined the activity of the STN during PLMS.
Methods: 9 Parkinson's disease individuals, with deep brain stimulation (DBS) electrodes implanted in the STN, underwent simultaneous deep brain polysomnography to ascertain subthalamic local field potentials (LFPs) and sleep/wake states. The first NREM-REM sleep cycle was submitted to analyses. A limb movement was scored when it lasted more than 0.5 and less than 5.0 s occurring in intervals of more than 4 and less than 90 s between movements. We defined pre-REM as the 3 epochs (90 s) of NREM sleep preceding the first epoch scored as REM sleep. Subthalamic activity in the PGO-like (2-3 Hz) and beta (15-35 Hz) frequency bands was analyzed.
Results: PLMS were not associated with the onset of submental atonia or subthalamic PGO-like waves during pre-REM. PLMS during REM sleep were independent of clusters of subthalamic PGO-like waves and REMs or enhanced subthalamic beta activity. Decreased subthalamic beta activity before, during, or after PLMS was not detected.
Conclusion: The mechanisms involved in the onset of muscular atonia and generation of PGO-like waves during NREM sleep (pre-REM) and in the maintenance of atonia and generation of clusters of PGO-like waves and REMs during REM sleep may not play a role in the generation of PLMS. These preliminary data suggest that PLMS may be primarily driven by enhanced spinal circuitry excitability rather than basal-pontine networks.

0775

PERIODIC LIMB MOVEMENTS DURING SLEEP IN AN ORTHOPEDIC POPULATION AWAITING JOINT SURGERY

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Introduction: The prevalence of periodic limb movement during sleep (PLMS) in the orthopedic population awaiting joint surgery has not been reported. The aim of this study was to determine whether this population may have a higher prevalence of PLMS than the general population, and whether the lateralization of the affected joint correlates with the limb exhibiting the highest PLMS.
Methods: Retrospective analyses were performed of polysomnographic (PSG) data for consecutive orthopedic patients (n = 71) presenting to the Ohio Sleep Medicine Institute for a preoperative sleep apnea evaluation between 1/08 and 12/09. Patients demonstrating a PLMI > 5 were split into subgroups based on the site of planned surgery (knee = 16, hip = 8, shoulder = 3). For those undergoing single knee surgery and demonstrating a PLMI > 5, the PLMI for the affected, or surgical, limb (right = 6, left = 10) was compared to the PLMI of the unaffected limb.
Results: Orthopedic patients had a high prevalence of PLMS with 42.3% demonstrating a PLMI of at least 15/hour of sleep, and, for those demonstrating a PLMI > 5, a mean PLMI of 62.9 ± 6.8. Moreover, there was a trend for the PLMI to be highest in patients awaiting knee surgery (62.3 ± 7.6), less in patients awaiting hip surgery (47.9 ± 12.8), but lowest in those awaiting shoulder surgery (22.1 ± 13.3). Furthermore, there was trend for PLMI to be highest in the affected limb awaiting surgery vs the unaffected limb (PLMI: 33.2 ± 6.5 vs 21.1 ± 5.0, P = 0.08).
Conclusion: The prevalence of PLMS in the orthopedic population (42.1%) is appreciably greater than that reported in the general population (4-11%). Moreover, there is a trend toward correlation between increasing PLMI and the more caudal the site of planned joint surgery (knee > hip > shoulder) and toward lateralization with the affected knee. Although further evaluation is required, these data suggest that sensory afferents from the affected orthopedic site or limb may play a role in triggering PLMS.

0776

PERIODIC LIMB MOVEMENTS IN SLEEP IN PATIENTS WITH MIGRAINES

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Introduction: An association between Restless legs syndrome (RLS) and migraine was reported recently in a case control study. Dysfunction of dopaminergic metabolism in migraine was postulated to cause periodic limb movements in sleep (PLMS. About 90% of patients with RLS also have PLMS. Both migraine and PLMS are known to be associated with ischemic vascular disease. PLMS are also associated with autonomic arousals and rises in blood pressure and heart rate. It is not known whether patients with migraine headache have higher incidence of PLMS and whether it predispose them to vascular disease.
Methods: We collected clinical and polysomnographic data for past three years from one clinician (RB) looking for presence of PLMS in patients with history of migraine. The inclusion criterion was all patients with migraine headache presenting to a Sleep clinic who underwent a polysomnogram (PSG). The following data was collected: demographics, medical illness medications and PSG variablesExclusion criteria included obstructive sleep apnea (OSA) (AHI > 5/hr).
Results: We found 68 migraineurs over a period of three years who had evaluation in the sleep clinic for sleep-related problems such as unexplained sleepiness, snoring or insomnia. Of 61 patients who underwent PSG, 33 (54%) had OSA and were excluded from analysis. Twenty-eight patients (46%) of migraineurs did not have OSA; this group was subject to further analysis. Of 28 patients with migraine without sleep apnea, 20 patients (71%) had PLMS index < 5hour and 8 patients (28%) had PLMS index > 5/hour. Two of these patients also had RLS. Of these 8 patients (M 3 F5 Age: 35-62 yr) with PLMS(Avg:29.4/hr), 4 were taking a selective serotonin reuptake inhibitor or trazadone. None of these 8 patients had any other reason for PLMS such as narcolepsy or REM Sleep behavior disorder. We compared this group with migraineurs without OSA or PLMS (N = 144) and found no statistical association between PLMS and migraine (P NS).
Conclusion: On analysis of preliminary and retrospective data, we found 28% of migraineurs had PLMS when controlled for causative or provocative factors such as OSA and medications. Further prospective studies are needed to determine if the presence of PLMS in migraineurs predispose them to HTN, ischemic heart disease or stroke.

0777

PERIODIC LEG MOVEMENTS AND DAYTIME SLEEPINESS IN CHILDREN

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Introduction: Periodic leg movements during sleep (PLMS) may negatively impact sleep quality, but no studies have supported an effect on daytime sleepiness using objective measurements in children. Our aim was to determine whether children with frequent PLMS based on polysomnographic criteria, and without evidence for sleep-disordered breathing (SDB) or narcolepsy, would demonstrate excessive daytime sleepiness as defined by mean sleep latency on a Multiple Sleep Latency Test (MSLT).
Methods: Our retrospective database analysis included polysomnograms and MSLTs performed from 1987-2003 on children referred for clinical suspicion for sleep disturbances. Analyzed variables included PLMI (PLMS per hour of sleep), AHI (apnea-hypopnea index), and mean sleep latency. Children were classified as having SDB if AHI > 5; frequent PLMS if PLMI > 5; or narcolepsy if ≥ 2 sleep-onset REM periods occurred in the absence of SDB.
Results: Among 153 children, 79 had neither PLMS, SDB, or narcolepsy, and 13 had a combination of more than one sleep problem. Of the remaining 61 children (ages 5-18 years), 16 had PLMS, 25 had SDB, and 20 had narcolepsy. Children with narcolepsy had shorter sleep latencies than those with SDB and PLMS (5.7 ± 4.8 vs. 9.8 ± 5.9 and 11.2 ± 4.2 minutes; P = 0.01 and P = 0.002 respectively). Mean sleep latency did not differ between the SDB and PLMS groups (9.8 ± 5.9 and 11.2 ± 4.2 minutes; P = 0.38). No correlation was found between PLMI and mean sleep latency (r = -.064, P = 0.44).
Conclusion: These results suggest similar objective levels of daytime sleepiness in children with frequent PLMS and those with SDB, whereas narcoleptics have worse sleepiness. Lack of correlation between PLMI and mean sleep latency matches previously reported findings in adults. However, preadolescent norms for mean sleep latency (19 ± 3 minutes) suggest that children referred to our sleep clinic and found to have PLMS alone did also have evidence of excessive sleepiness on MSLTs.

0778

PERIODIC LEGS MOVEMENTS DURING SLEEP IN CHILDREN: FREQUENCY DISTRIBUTIONS ACROSS SLEEP STAGES AND TOTAL SLEEP TIME (TST)

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Introduction: In adults, periodic leg movements during sleep (PLMS) occur primarily in stages N1 and N2. However, sleep stage-specific occurrence of PLMS has not been evaluated in children. We hypothesized that PLMS in children would be greater in N1 and N2, despite the relatively high percentage of N3. Further, to better understand PLMS in children, we examined the distribution of PLMS within intervals of TST to assess circadian variation and differences between subjects with PLMI ≥ 5/h versus < 5/h.
Methods: We examined polysomnograms of children 1.5 - 18 years old with a periodic limb movement index (PLMI) ≥ 2/h. Studies were scored using standard criteria. TST was divided into thirds: T1, T2 and T3. The PLMI was determined in each sleep stage (N1, N2, N3 and REM) and in each third of TST for each subject. Generalized Estimating Equations (GEE) models were used to examine the effects of sleep stage and sleep period on the PLMIs.
Results: 67 subjects met study criteria, with a mean age of 8 ± 4.3 years. Of these, 44% had a PLMI ≥ 5.The total PLM index was significantly greater in N1 and N2 vs N3 (P < 0.0001), and in N1 and N2 vs REM (P < 0.0001). No differences were seen for N3 vs REM sleep. Both the PLMI without arousals and the PLMI with arousals were elevated in N1 and N2 compared to N3 and REM. There were no differences across TST, except for the PLMI ≥ 5 group, which had a significantly higher total PLMI in T2 vs. T3 (P = 0.026).
Conclusion: In this novel study of children, PLMI's were greater in N1 and N2, compared with N3 and REM stages (similar to adults), while PLMI's seldom differed across TST. These findings support a sleep-stage association with PLMs in childhood, without any clear relationship to intervals of TST.
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0779

THE ASSESSMENT OF PHYSICAL MOTOR FUNCTIONS AND AROUSAL LEVEL AFTER AWAKENING FROM AN EARLY MORNING 4:00 TILL AFTERNOON 14:00

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Introduction: The purpose of this study was to assess the physical motor functions and arousal level after awakening from an early morning 4:00 till afternoon14:00.
Methods: Fourteen functionally independent community-dwelling elderly people volunteered to participate in the study. Physical motor functions, such as Timed Up and Go test (TUG), Functional Reach test (FRT), Postural sway (REC AREA), and Critical Frequency of Fusion test (CFF) as arousal level were assessed at baseline, before sleep, and after five hours of sleep. Those assessments were measured before sleep (22:00PM), and after sleep of five hours (4:00AM). After awakening in an early morning, each assessment was also measured two hours later (6:00AM), six hours later (10:00AM), ten hours later (14:00PM), respectively. Stanford Sleepiness Scale (SSS) is also chosen to measures the internal state of subjective sleepiness and it measured seven times in every two hours after awakening 4:00AM. The Repeated measures Analysis of Variance, ANOVA, was used to test for significant differences among the measurement time in each assessment. Dunnett's multiple comparisons test was then applied to compare the different measurement times.
Results: There were significant differences between before sleep and after awakening in TUG ($P \neg = 0.002$), REC AREA ($P = 0.021$), and SSS ($P = 0.001$). The speed of TUG after awaking was slower than before sleep. Postural sway with eye opened was decreased during tests. The value of SSS showed high state of sleepiness.
Conclusion: It is important to understand how the change of environmental factors affects internal factors. In this study, an environmental factor such as after awaking affects the change of internal factors such as the time of TUG, Postural sway, and the sleepiness level in SSS. Therefore, to prevent of falling, we have to evaluate environmental factors and internal factors of fall comprehensively.

0780

PHARMACODYNAMIC (PD) EFFECT OF PREGABLIN MEASURED BY NIGHTTIME ACCELEROMETRY IN PATIENTS WITH MODERATE TO SEVERE RESTLESS LEGS SYNDROME (RLS)

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Introduction: The efficacy of pregablin treatment for RLS has been reported in 2 patient trials. A recent study examined the efficacy of pregabalin in RLS patients and also assessed the PD effect and time course of pregabalin on motor restlessness using accelerometry.
Methods: Accelerometry data from a 6-week dose-ranging study of pregablin treatment for RLS were analyzed. Eighty three participants in 5 dosed groups (50mg, 100mg, 150mg, 300mg, and 450mg) and a placebo group wore a Bodymedia Armband at night during both baseline and the last week of dosing. Armband accelerometry time series data of all nights from all participants were aligned based on sleep onset times and awakening times for more reliable assessment of PD effect during early part and late part of sleep, respectively. The aligned accelerometry data within a given time window were used to compute entropy as a measure of motor restlessness, bypassing Armband built-in algorithms assessing sleep quality. The entropy-based PD time course was generated by stepping the time window through the time series data—an approach similar to Moving Average.
Results: Pregabalin was associated with reduced nighttime motor restlessness measured by entropy at all doses ($P < 0.025$ for 50mg and $P < 0.01$ for all other doses). In contrast, no relative reduction in motor restlessness from baseline was observed for the placebo group. The PD effect of pregablin on motor restlessness varies as a function of both time and dose. Reduction in motor restlessness persisted until about an hour before awakening for doses of 50mg, 100mg, and 300mg and persisted throughout the night for 450mg.
Conclusion: Pregabalin reduced nighttime motor restlessness in RLS patients and this effect persisted throughout most of the night. Time series analysis may provide useful information for dose selection. The entropy measure of motor restlessness seems likely to reflect clinically significant treatment benefits.

0781

COMPARATIVE PLACEBO-CONTROLLED POLYSOMNOGRAPHIC AND PSYCHOMETRIC STUDIES ON THE ACUTE EFFECTS OF PREGABALIN VS. ROPINIROLE IN RESTLESS LEGS SYNDROME

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Introduction: The aim of the ongoing placebo-controlled sleep laboratory study was to compare the acute effects of pregabalin (PGB) and ropinirole (ROP) in restless legs syndrome (RLS).
Methods: In a parallel-group design RLS patients receive 1 mg/kg/body weight PGB or 0.5 mg ROP as compared with placebo. Polysomnographic and psychometric measures are obtained in three sleep laboratory nights (screening/placebo/drug). Preliminary statistics on 26 patients included a Wilcoxon test for differences between drug and placebo and a U-test for inter-group differences.
Results: Sleep efficiency, total sleep time, number of awakenings and wake within total sleep period were found significantly improved after PGB, while they remained unchanged after ROP. Sleep architecture showed oppositional changes after the two drugs: While PGB decreased S1, increased slow-wave sleep and shortened REM latency, ROP increased S2 and decreased slow-wave sleep, with significant inter-drug differences. Periodic leg movements (PLM) showed a significantly greater decrease after ROP (-56%) than after PGB (-36 %). Subjective sleep quality and morning psychomotor performance improved significantly only after PGB.
Conclusion: The dopamine agonist ROP showed acute therapeutic efficacy in regard to PLM measures only, whereas PGB had a less pronounced effect on these measures, but improved objective and subjective sleep and awakening quality as compared with placebo.

0782

CHANGES OF THE SYMPTOMS OF RLS AFTER SIX MONTH PRAMIPEXOLE MONOTHERAPY

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Introduction: Patients with RLS may present with symptoms of insomnia and excessive daytime sleepiness, that can significantly interfere with daytime personal and social activities, cause emotional disturbances. Dopamine receptor agonists are now considered the drugs of choice for the management of RLS. They improved the uncomfortable sensations, urge to move and other symptoms of RLS. Pramipexole has been reported to be effective in the treatment of RLS symptoms in the international literature. Treatment with pramipexole

even in long-term studies was associated with mild augmentation, only, which, however, was easily controllable. In our earlier study we measured the immediate effect of pramipexole treatment on improving sleep and daytime sleepiness. Treatment with pramipexole resulted a statistically significant improvement of the IRLS rating scale, Epworth Sleepiness Scale and Insomnia Severity Index (ISI) difference.

Methods: Therapeutic efficacy was monitored with the International RLS Study Group Rating Scale (IRLS), the Epworth sleepiness scale and the Insomnia Severity Index (ISI) after 6 month' pramipexole therapy. Changes associated with pramipexole treatment were presented using box and whiskers diagrams. Statistical analysis was performed using the one-tailed t-test. Statistical calculations were done and the graphs plotted with version 7.0 of the Statistica f/W software.

Results: Following 6 month' therapy 15 patients were still receiving uninterrupted pramipexole monotherapy. Two patients discontinued pramipexole owing to the lack of efficacy (n = 2), one because of side effects (n = 1), and because of both (n = 1). The dose range of pramipexole was between 0.88 and 0,54 mg/day. As reflected by IRLS rating scale and Epworth sleepiness scale treatment with pramipexole accomplished a substantial improvement. Analyzing baseline vs. post-treatment mean values with Student's one-tailed t-test revealed a statistically significant difference. Treatment with pramipexole was associated with an improvement of the Insomnia Severity Index (ISI).

Conclusion: Treatment with pramipexole in 6 month long study was associated with improving sleep and daytime sleepiness as indicated by the IRLS rating scale, Epworth Sleepiness Scale and Insomnia Severity Index (ISI).

0783

PHARMACOKINETICS OF DOPAMINE AGONISTS IN RLS PATIENTS WITH END-STAGE RENAL DISEASE IN JAPANESE POPULATION

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Introduction: Restless legs syndrome (RLS) is known common comorbid condition in end-stage renal disease (ESRD). Recently, the main treatment against RLS has been dopamine agonists. In ESRD, pharmacokinetics of dopamine agonist has not been well understood and no clear guidelines or safety has been established.

Methods: First, retrospective chart review was performed in all patients with ESRD on hemodialysis(HD) (either in Toyohashi Mates Clinic or other facility from 2002 to 2009 who was diagnosed as RLS and followed up in our facility. RLS was diagnosed based on diagnostic criteria of International RLS study group.89 patients (44 men and 45 women) with ESRD and RLS were identified. Out of these patients, 60 patients required medication for treatment. In these patients on medication, effectiveness of dopamine and dopamine agonist was investigated. Second, cross sectional investigation for pharmacokinetics of pramipexole was performed in July 2009. 12 patients (5 men and 7 women, mean age of 70.6 ± 7.6) who had been treated with pramipexole and agreed to participate were involved. Blood concentration of pramipexole was surveyed both on the day with and without HD.

Results: Pramipexole was effective in 30(69.8%) of 43 patients, talipexole was effective in 16(45.7%) of 35 patients and pergolide in 1(7.7%) of 13 patients and Carbidopa/levodopa in 5(31.3%) of 16 patients. Trough blood concentration of pramipexole was 1.82 ± 0.65ng/ml, 2.08 ± 0.62ng/ml, 5.40ng/ml with 0.125mg, 0.25mg and 0.375mg respectively. These blood concentrations are 3-5 times higher than the value in patients with normal renal function after one time administration. Those are also 8-12 times higher in maintenance administration. Comparing blood concentration on the days with and without HD, there was no statistical significant difference in the values of 6 hours after administration of pramipexole. Only mild statistical significant decrease was found in 5 hours after administration. Thus, elimination of pramipexole with HD was found to be very limited.

Conclusion: Pramipexole is effective against RLS in ESRD patients as well. Because of very limited elimination with HD, it is crucial to limit its use to small dose in this population.

Support (If Any): This research received financial grant support from Japan foundation for Neuroscience and Mental Health.

0784

SUBJECTIVE POST-SLEEP DIARY (SPSD) FINDINGS FROM A POLYSOMNOGRAPHY STUDY OF GABAPENTIN ENACARBIL IN SUBJECTS WITH PRIMARY RESTLESS LEGS SYNDROME AND ASSOCIATED SLEEP DISTURBANCE

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Introduction: Many patients with Restless Legs Syndrome (RLS) report sleep disturbance as their primary complaint. The Subjective Post-Sleep Diary (SPSD) was developed to assess subject-reported sleep in RLS.

Methods: In a double-blind, crossover study (GlaxoSmithKline protocol RXP110908; ClinicalTrials.gov: NCT00748098), adults with moderate-to-severe primary RLS and severe-to-very severe sleep disturbance (International Restless Legs Scale item 4 and average Periodic Limb Movements during Sleep Index of ≥ 15 [5 nights' actigraphy, both legs]) received gabapentin enacarbil (GEn) 1200mg and placebo once daily for 4 weeks, each in a randomized sequence. Primary endpoint: mean change from baseline at Week 4/10 LOCF in Wake Time During Sleep (WTDS). Key secondary endpoint: mean change from baseline at Week 4/10 LOCF in Periodic Limb Movements associated with Arousal per hour (PLMAI). Both endpoints were measured by polysomnography. The SPSD was completed for 7 days prior to baseline and daily during each treatment period. Secondary endpoints from the SPSD included 'sleep quality' and 'rested upon awakening' (11-point scale: 0-10, poor-excellent), both prospectively pre-selected, and number of awakenings due to RLS symptoms.

Results: GEn 1200mg significantly reduced WTDS (adjusted mean treatment difference [AMTD]: −26.0; 95%CI: −35.64,−16.36; $P < 0.0001$) and PLMAI (AMTD: −3.1; 95%CI: −5.04,−1.10; $P = 0.002$) compared with placebo at Week 4/10 LOCF. GEn provided significantly greater improvements compared with placebo at Week 4/10 LOCF on SPSD subjective measures of sleep quality (mean [standard deviation] changes from baseline: 2.0 [1.68] and 0.9 [1.45]; AMTD: 1.1; 95%CI: 0.75,1.44; $P < 0.0001$) and feeling rested upon awakening (1.7 [1.72] and 0.8 [1.39]; AMTD: 0.9; 95%CI: 0.51,1.20; $P < 0.0001$), and a greater proportion of GEn-treated subjects reported no nighttime awakenings (76%) compared with placebo (54%) at Week 4/10 LOCF.

Conclusion: Significant improvements in the objective sleep endpoint WTDS and on PLMAI are supported by significant improvements in subjective sleep (quality and feeling rested upon awakening) in adults with primary RLS and associated sleep disturbance.

Support (If Any): Study supported by GlaxoSmithKline, Research Triangle Park, NC.

0785

AN OPEN-LABEL, 52-WEEK EXTENSION STUDY ASSESSING TOLERABILITY AND EFFICACY OF GABAPENTIN ENACARBIL IN SUBJECTS WITH PRIMARY RESTLESS LEGS SYNDROME

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Introduction: Gabapentin enacarbil (GEn) is a transported prodrug of gabapentin that provides sustained, dose-proportional gabapentin exposure and reduces symptoms of primary Restless Legs Syndrome (RLS).
Methods: XenoPort, Inc. protocol XP055 (NCT00333359) was a 52-week, multicenter, open-label extension study in subjects with primary RLS who had completed one of four parent studies (XP052/XP053/XP081/XP083). GEn 1200mg was administered once-daily at 5pm; dose adjustments to 600mg or 1800mg were permitted. Tolerability assessments included XP055 treatment-emergent adverse events (AEs), laboratory values, vital signs, ECGs and the Epworth Sleepiness Scale (ESS; score > 10 represents excessive daytime sleepiness). Efficacy evaluations included International Restless Legs Scale (IRLS) total score and investigator-rated Clinical Global Impression-Improvement (CGI-I) scale.
Results: The safety population comprised 573 subjects; 386 (66.4%) randomized subjects completed the study. The modal dose was 1200mg for 316 (55.1%) subjects, 1800mg for 158 (27.6%) subjects, and 600mg for 98 (17.1%) subjects. Treatment-emergent AEs were reported by 80.1% of subjects (the most common were somnolence [19.7%] and dizziness [11.5%]) and led to discontinuation in 10.3% of subjects; most AEs were mild or moderate in intensity. Twenty (3.5%) subjects reported serious treatment-emergent AEs; one subject died (fall, 25 days after stopping GEn, judged not treatment-related). No serious AE occurred in more than one subject. No clinically relevant changes in vital signs, laboratory results, or electrocardiograms were observed. Overall, mean (SD) ESS score was 6.7(4.29) at Week 0 (GEn-naïve subjects, 7.3[4.29]; non-naïve subjects, 6.3[4.27]) and 5.7(4.03) at Week 52 (GEn-naïve subjects, 5.4[3.74]; non-naïve subjects, 5.8[4.16]). The mean (SD) change from baseline in IRLS total score was -15.2(8.85) and 84.8% of subjects were rated as CGI-I responders at Week 52 LOCF.
Conclusion: GEn was generally well tolerated and improved RLS symptoms for up to 52 weeks in subjects with primary RLS. ESS scores suggest no mean increase in daytime sleepiness in subjects receiving GEn.
Support (If Any): XenoPort, Inc., Santa Clara, CA, and GlaxoSmithKline, Research Triangle Park, NC.

0786

POPULATION PHARMACOKINETIC-PHARMACODYNAMIC RELATIONSHIP OF GABAPENTIN AFTER ADMINISTRATION OF GABAPENTIN ENACARBIL IN SUBJECTS WITH RESTLESS LEGS SYNDROME

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Introduction: Gabapentin enacarbil (GEn), a transported prodrug of gabapentin, provides sustained, dose-proportional gabapentin exposure and has demonstrated efficacy in reducing symptoms of Restless Legs Syndrome (RLS).
Methods: A population pharmacokinetic model was developed with data from five Phase-II/III clinical studies (subjects with RLS; n = 899) and seven Phase-I studies (n = 95); GEn doses 300mg (healthy subjects only) to 2400mg were administered for ≤ 24 weeks. Pharmacodynamic data from the Phase-II/III studies (n = 763; change from baseline in International Restless Legs Scale [IRLS] total score, average daily total sleep time [TST], and average daily wake time after sleep onset [WASO]; response on the investigator-rated Clinical Global Impression-Improvement [CGI-I] scale) were modeled with GEn dose and gabapentin area under the concentration-time curve (AUC) by E_{max} and logistic-regression models. Tolerability measures modeled included incidence, severity, and onset of adverse events (AEs) of somnolence/sedation and dizziness.
Results: Mean change in IRLS total score was similar for GEn 600mg-2400mg. A dose/exposure response relationship was observed for CGI-I, with higher GEn doses/AUCs showing greater predicted probability of response. For GEn 600mg and 1200mg, predicted changes were approximately 47.1 and 49.9 minutes for TST and approximately -17.4 and -18.5 minutes for WASO. The majority of somnolence/sedation and dizziness AEs occurred in the first 2 weeks of treatment, resulting in an apparent higher incidence with GEn 600mg (dose for first titration step); for later-onset AEs (after Week 2), the incidence was similar for GEn 600mg and 1200mg doses/gabapentin AUCs. The predicted incidence was similar for mild versus moderate/severe AEs at all GEn doses/gabapentin AUCs and for placebo.
Conclusion: Increasing gabapentin exposure after GEn administration resulted in a corresponding increase in CGI-I response, but not in IRLS total score. The pharmacokinetic/pharmacodynamic model for safety indicated no appreciable differences in the predicted incidence or severity of somnolence/sedation or dizziness between GEn 600mg and 1200mg.

0787

EFFECTS OF GABAPENTIN ENACARBIL ON QUALITY OF LIFE, MOOD, AND FUNCTION IN SUBJECTS WITH RESTLESS LEGS SYNDROME

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Introduction: Quality of life (QoL), mood, and function are often impaired in subjects with Restless Legs Syndrome (RLS). Gabapentin enacarbil (GEn) significantly reduces RLS symptoms.
Methods: Subjects with moderate-to-severe primary RLS were randomized 1:1:1 to GEn 1200mg (n = 113), 600mg (n = 115), or placebo (n = 97) at 5pm daily with food in a 12-week, multicenter, double-blind, placebo-controlled study (NCT00365352). Co-primary endpoints: change from baseline in International Restless Legs Scale (IRLS) total score and proportion of responders on the Clinical Global Impression-Improvement (CGI-I) scale for GEn 1200mg compared with placebo at Week 12 LOCF. Secondary assessments included Johns Hopkins RLS QoL questionnaire, Mood Assessment Question (MAQ), Profile of Mood States (POMS), and Post-Sleep Questionnaire (PSQ) item 2 (ability to function in past week). Tolerability assessments included treatment-emergent adverse events (AEs).
Results: GEn 1200mg significantly improved mean IRLS total scores (AMTD:−3.5;95%CI:−5.6,−1.3;P = 0.0015) and significantly more subjects were CGI-I responders (AOR:4.3;95%CI:2.34,7.86;P < 0.0001) compared with placebo at Week 12 LOCF; GEn 600mg results were similar. GEn 1200mg significantly improved mean change from baseline in RLS QoL overall life-impact score (AMTD:6.1, P = 0.0009), PSQ ability to function (P = 0.0152, distribution of responses), overall mood (MAQ:P = 0.0168, distribution of responses), and mean change from baseline in the POMS vigor-activity subscale (AMTD:1.7, P = 0.0018) but not in POMS total mood disturbance score (AMTD:-3.5; P = 0.0893) or other subscales, compared with placebo at Week 12

LOCF. GEn 600mg significantly improved RLS QoL overall life-impact score (AMTD:5.5; P = 0.0025) and PSQ ability to function (P = 0.0366, distribution of responses), but not MAQ overall mood, POMS total mood disturbance score, or POMS subscales compared with placebo at Week 12 LOCF. Treatment-emergent AEs reported most commonly (GEn 1200mg, 600mg, placebo) were dizziness (24%, 10%, 5%) and somnolence (18%, 22%, 2%).
Conclusion: GEn 1200mg and 600mg significantly improve RLS symptoms, QoL and function, but not mood compared with placebo, and are generally well tolerated.
Support (If Any): XenoPort, Inc., Santa Clara, CA. and GlaxoSmithKline, Research Triangle Park, NC.

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GABAPENTIN ENACARBIL MAINTAINS IMPROVEMENTS IN SLEEP DURING LONG-TERM TREATMENT IN SUBJECTS WITH MODERATE-TO-SEVERE PRIMARY RESTLESS LEGS SYNDROME

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Introduction: Restless Legs Syndrome (RLS) may negatively impact patients' sleep. Gabapentin enacarbil (GEn) provides sustained, dose-proportional exposure to gabapentin and significantly improves RLS symptoms.
Methods: XenoPort, Inc. study XP060 (ClinicalTrials.gov NCT00311363) comprised a 24-week, single-blind (SB) phase during which subjects with moderate-to-severe primary RLS received GEn 1200mg, with responders randomized 1:1 to GEn 1200mg (n = 96) or placebo (n = 97) for a 12-week, double-blind (DB) phase. Primary endpoint: the proportion of subjects relapsing during the DB-phase. Secondary endpoints included Medical Outcomes Study (MOS) Sleep Scale and Post-Sleep Questionnaire (PSQ). Tolerability evaluations included treatment-emergent adverse events (AEs) and Epworth Sleepiness Scale (ESS; score of > 10 indicates excessive daytime sleepiness).
Results: Significantly fewer GEn-treated subjects relapsed during the DB-phase compared with placebo (9.4% versus 22.7%; odds ratio: 0.4; P = 0.0158). Improvements were seen on all MOS Sleep Scale domains and PSQ items during the SB-phase. During the DB-phase at Week 36 LOCF, GEn-treated subjects reported significantly smaller mean changes from randomization in MOS Sleep Scale sleep disturbance (P = 0.0067) and adequacy (P = 0.0205) domains compared with placebo, but not in sleep quantity (P = 0.7160) or daytime somnolence (P = 0.1833). GEn-treated subjects reported fewer nights with RLS symptoms (P = 0.0490), fewer nighttime awakenings (P = 0.0422), and fewer hours awake/night due to RLS symptoms (P = 0.0234) on the PSQ, but overall sleep quality (P = 0.1500) and ability to function (P = 0.5384) were not significant compared with placebo at Week 36 LOCF. GEn-treated subjects had a mean (SD) reduction in ESS score from randomization to Week 36 (5.3 [4.33] to 5.2 [4.16]; -0.2 [3.56]) compared with placebo-treated subjects who had an increase (5.2 [4.02] to 5.8 [4.77]; 0.7 [2.82]). AEs reported most commonly during the SB-phase were somnolence (30%) and dizziness (22%), and during the DB-phase, nasopharyngitis (placebo, 5%; GEn, 3%) and viral gastroenteritis (placebo, 5%; GEn, 1%).
Conclusion: GEn 1200mg once-daily maintains improvement in RLS symptoms and sleep for up to 36 weeks compared with placebo.
Support (If Any): Study supported by XenoPort, Inc., Santa Clara, CA, and GlaxoSmithKline, Research Triangle Park, NC.

0789

AN EVALUATION OF RESTLESS LEGS SYNDROME SYMPTOM AUGMENTATION IN SUBJECTS TREATED WITH GABAPENTIN ENACARBIL FOR 12 WEEKS: SECONDARY INTEGRATED ANALYSES FROM TWO STUDIES

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Introduction: Augmentation, the worsening and/or earlier onset of Restless Legs Syndrome (RLS) symptoms while on treatment, usually associated with long-term dopaminergic therapy, can begin as early as 12 weeks after treatment initiation. This secondary analysis retrospectively examined short-term treatment with gabapentin enacarbil (GEn) 1200mg and potential RLS symptom augmentation.
Methods: Data from two 12-week, double-blind, randomized, multicenter, placebo-controlled studies of GEn in moderate-to-severe primary RLS (NCT00298623 and NCT00365352) were integrated for the 1200mg and placebo groups *post hoc*. Secondary analyses evaluated drug exposure, International Restless Legs Scale (IRLS) total score, the investigator-rated Clinical Global Impression-Improvement (CGI-I) scale, and 24-hour RLS symptom diary. The earlier onset or worsening (duration) of RLS symptoms, possible signs of augmentation, were assessed using diary data: change from baseline in time-to-onset (since 8am) and duration of RLS symptoms.
Results: The integrated safety population comprised 428 subjects (GEn 1200mg = 224; placebo = 204). Mean duration of exposure was similar for GEn 1200mg (78.1 days) and placebo (76.1 days). GEn 1200mg significantly improved mean IRLS total score from baseline to Week 12 LOCF compared with placebo (adjusted mean treatment difference [AMTD]:−3.8;95%CI:−5.36,−2.32; P < 0.0001) and more GEn-treated subjects were CGI-I responders (adjusted odds ratio:4.7;95%CI:3.07,7.15; P < 0.0001). A greater proportion of GEn 1200mg-treated subjects (45%) reported no RLS symptoms at Week 12/end-of-treatment (ET) compared with placebo-treated subjects (20%). For subjects with RLS symptoms at baseline and Week 12/ET, the distribution of change from baseline in time-to-onset of RLS symptoms was similar for GEn 1200mg and placebo at Week 12/ET. GEn 1200mg significantly reduced the mean duration of evening (6pm-10pm) RLS symptoms from baseline to Week 12/ET (−51.7 minutes) compared with placebo (−36.7 minutes) (AMTD:−21.9;95%CI:−37.84,−5.96; P = 0.0072).
Conclusion: GEn 1200mg significantly improved RLS symptoms compared with placebo. In this short-term analysis, there was no indication of RLS symptom augmentation with up to 12 weeks of treatment. Longer-term data are needed.
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0790

GABAPENTIN ENACARBIL RELIEVES THE PAIN ASSOCIATED WITH RESTLESS LEGS SYNDROME

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Introduction: Many patients with Restless Legs Syndrome (RLS) report pain. Gabapentin enacarbil (GEn) significantly reduces RLS symptoms.
Methods: In this 12-week, double-blind, placebo-controlled study (NCT00365352), subjects with moderate-to-severe primary RLS were randomized 1:1:1 to GEn 1200mg (n = 113), 600mg (n = 115) or placebo (n = 97), 5pm daily with food. Co-primary endpoints: change from baseline in International Restless Legs Scale (IRLS) total score and proportion of responders on the Clinical Global Impression-Improvement (CGI-I) scale for GEn 1200mg compared with placebo at Week 12 LOCF. Subjects recorded "pain associated with RLS" in the previous 24 hours (11-point scale: 0 = no pain, 10 = most intense pain imaginable) each morning for 7 days prior to baseline and Week 12; average daily pain scores were calculated for each period. Two subgroups were analyzed, subjects with average daily pain scores > 0 (baseline or Week 12 LOCF) and ≥ 4 (baseline). Tolerability assessments included treatment-emergent adverse events (AEs).
Results: GEn 1200mg significantly improved mean IRLS total score (AMTD: −3.5; 95% CI: −5.6, −1.3; P = 0.0015) and significantly more subjects were CGI-I responders (AOR: 4.3; 95% CI: .34, 7.86; P < 0.0001), compared with placebo at Week 12 LOCF; GEn 600mg results were similar. Average daily pain scores > 0 or ≥ 4 were reported by 91% and 57% of subjects. GEn 1200mg and 600mg significantly reduced mean pain scores for subjects with baseline or Week 12 LOCF scores > 0 (AMTD: −0.9; 95% CI: −1.5, −0.4; P = 0.0015; AMTD: −0.9; 95% CI: −1.4, −0.3; P = 0.0029) or baseline scores ≥ 4 (AMTD: −1.1; 95% CI: −1.9, −0.3, P = 0.0054; AMTD: −1.1; 95% CI: −1.9, −0.3; P = 0.0084), compared with placebo. Overall, significantly more GEn 1200mg- than placebo-treated subjects reported reductions in pain scores from baseline to Week 12 LOCF of ≥ 30% (69.1%, 51.6%; P = 0.0117) and ≥ 50% (60.0%, 44.1%; P = 0.0253); GEn 600mg results were similar for ≥ 30% (67.6%; P = 0.0235) but not ≥ 50% (55.9%; P = 0.0997) reductions. Treatment-emergent AEs reported most commonly were dizziness (GEn 1200mg = 24%, 600mg = 10%, placebo = 5%) and somnolence (18%, 22%, 2%).
Conclusion: GEn 1200mg and 600mg significantly reduce RLS symptoms and pain associated with RLS compared with placebo in subjects with moderate-to-severe primary RLS and are generally well tolerated.
Support (If Any): XenoPort, Inc., Santa Clara, CA, and GlaxoSmithKline, Research Triangle Park, NC.

0791

GABAPENTIN ENACARBIL IMPROVES RESTLESS LEGS SYNDROME SYMPTOMS AND SUBJECTIVE MEASURES OF SLEEP IN SUBJECTS WITH PRIMARY RESTLESS LEGS SYNDROME WITH AND WITHOUT SEVERE SLEEP DISTURBANCE: SECONDARY ANALYSES FROM TWO STUDIES

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Introduction: Gabapentin enacarbil (GEn) significantly improves the symptoms of primary Restless Legs Syndrome (RLS).
Methods: Data from two 12-week, multicenter, double-blind, randomized, placebo-controlled studies (NCT00298623 and NCT00365352) of subjects with moderate-to-severe primary RLS were retrospectively integrated for secondary analyses (GEn 1200mg and placebo groups). Subjects were divided into two subgroups based on International Restless Legs Scale (IRLS) item 4 response at baseline: severe/very severe or moderate-to-no sleep disturbance. Efficacy assessments included IRLS total score and investigator-rated Clinical Global Impression-Improvement (CGI-I) scale (co-primary endpoints), Medical Outcomes Study (MOS) Sleep Scale, and investigator-developed Post-Sleep Questionnaire (PSQ).
Results: The integrated, modified intent-to-treat population comprised 427 subjects (GEn 1200mg = 223; placebo = 204). At baseline, 43.8% and 56.2% of subjects reported severe/very severe and moderate-to-no sleep disturbance, respectively. GEn 1200mg significantly improved mean IRLS total score from baseline to Week-12 LOCF compared with placebo in each subgroup (severe/very severe, adjusted mean treatment difference [AMTD]:−3.9; P = 0.0024; moderate-to-no, AMTD:−3.3; P = 0.0012) and significantly more GEn-treated subjects were CGI-I responders (severe/very severe, adjusted odds ratio [AOR]:3.7; P < 0.0001; moderate-to-no, AOR:5.4; P < 0.0001). GEn significantly improved all MOS Sleep Scale domain scores (sleep disturbance, quantity, adequacy, and daytime somnolence) from baseline to Week-12 LOCF compared with placebo in both subgroups (all P < 0.05); improvements were seen on all domains at Week-4 LOCF (the earliest assessment; all P < 0.05). GEn-treated subjects with severe/very severe sleep disturbance reported higher overall sleep quality, fewer nighttime awakenings, and fewer hours awake/night due to RLS symptoms at Week-12 LOCF compared with placebo (PSQ items 1, 4, and 5, all P < 0.001, distribution of responses); similar results were seen at Week-4 LOCF (the earliest assessment; all P < 0.0001, distribution of responses).
Conclusion: GEn 1200mg significantly improved RLS symptoms and subjective sleep outcomes in adults with moderate-to-severe primary RLS, with and without severe/very severe sleep disturbance compared with placebo. Sleep significantly improved as early as Week 4 of treatment.
Support (If Any): XenoPort, Inc., Santa Clara, CA, and GlaxoSmithKline, Research Triangle Park, NC.

0793

PREVALENCE AND PREDICTORS OF EXCESSIVE DAYTIME SLEEPINESS IN A COMMUNITY SAMPLE OF YOUNG CHILDREN: THE ASSOCIATION WITH METABOLIC AND MEDICAL FACTORS, ANXIETY/ DEPRESSION AND OBJECTIVE SLEEP

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Introduction: Few studies have researched the prevalence and risk factors of EDS (excessive daytime sleepiness) in school aged children, and the results are inconsistent. In this study, we investigated the prevalence and association of EDS with a wide range of risk factors (e.g., medical complaints, obesity, anxiety/depression, and objective sleep including SDB) in a large general population sample of children.
Methods: A population based study of 700 school aged children (6-12 years) from The Penn State Child Cohort underwent a 9-hour polysomnogram , a physical examination and parent completed health, sleep and psychological questionnaires. Using a standardized EDS questionnaire developed by Chervin et al., children were divided into two groups: those with and without parent reported EDS.
Results: The prevalence of subjective EDS was approximately 11%. Significant univariate relationships were found between children with EDS and BMI percentile, waist circumference, heartburn, asthma, chronic sinusitis, and parent reported depression/anxiety. The strongest independent predictor of EDS was waist circumference. All polysomnographic sleep variables including apnea/hypopnea index, physical activity level, caffeine consumption and allergies were nonsignificant.
Conclusion: Contrary to popular belief, the best predictor of EDS was waist circumference (obesity) and not objective sleep measures. Treatment of EDS in young children may need to include weight loss.
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0794

THE COMORBID CONDITIONS OF EXCESSIVE SLEEPINESS IN THE AMERICAN POPULATION

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Introduction: Excessive sleepiness is a serious sleep disturbance that might have several important consequences on the safety of individuals being sleepy while they should be alert.
Methods: This is a cross-sectional telephone study using a representative sample consisting of 8,937 non-institutionalized individuals aged 18 or over living in Texas, New York and California. They represented a total of 62.8 million inhabitants. The participation rate was 85.6% in California, 81.3% in New York and 83.2% in Texas. Participants were interviewed on sleeping habits, health, sleep and mental disorders using Sleep-EVAL.
Results: As many as 19.5% of the sample reported having moderate excessive sleepiness and 11.0% reported severe sleepiness. Moderate sleepiness was comparable between men and women but severe sleepiness was higher in women (8.6% vs. 13.0%). Falling asleep or being drowsy in situations requiring high concentration (meetings, during a conversation, etc) was reported by 17.7% of the sample and sleepiness in situations requiring low attention (reading, watching tv) was reported by 18.2% of the sample. Factors associated with sleepiness in situations requiring high concentration were night work (OR:1.9); sleeping 6 hours or less per main sleep episode (OR:2.5); OSAS (OR:3.0); insomnia diagnosis (OR:2.6); major depressive disorder (OR: 1.9); anxiety disorder (OR:1.5) and presence of an organic disease (OR: 1.5). Factors associated with sleepiness in situations requiring low attention were the same with the addition of age (subjects between 18 and 54 were at higher risk) being a woman (OR:1.3), daily use of alcohol (OR: 1.5) and being obese (OR:1.3).
Conclusion: Excessive sleepiness is highly prevalent in the American population. It was strongly associated with insufficient sleep and various sleep disorders as well as night work, mental and organic diseases.
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0795

AUTONOMIC ACTIVATION DURING PERIODIC LEG MOVEMENTS IN SLEEP IN NARCOLEPSY-CATAPLEXY

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Introduction: Recent studies highlighted the roles for hypocretins in controlling central pathways involved in the regulation of cardiovascular functions. As hypocretins stimulate sympathetic activity, studying interactions between sleep and the cardiovascular system is of interest in narcolepsy-cataplexy. We propose to test the hypothesis of autonomic nervous system dysfunctions in narcolepsy-cataplexy in assessing the physiological activations associated with PLMS that represents a model for the study of arousal responses.
Methods: Forteen narcoleptic patients free of drugs (6 men, 8 women, mean age: 52.5 ± 11.9 years) were compared to fourteen control subjects matched for age and gender. Sleep stages, PLMS, microarousals, and RR intervals converted into beats per minute on segments lasting 25 heartbeats (comprising 10 RR intervals before the movement and 15 RR intervals after the movement) were analysed.
Results: The mean number of PLMS per patient was 214.2 ± 102.3 and 283.1 ± 116.6 per control. The mean PLMS and PLMS-MA indexes were 30.8 ± 13.3 and 3.5 ± 2.1 for patients, and 43.6 ± 16.6 and 4.8 ± 4.9 for controls. Even non significant, mean RR at baseline for PLMS without MA and/or PLMS with MA was higher in patients (67.0 ± 12.0 and 65.5 ± 9.5) than in controls (59.9 ± 5.7 and 59.6 ± 7.0). Moreover, narcoleptic patients showed a tachycardia of lower amplitude, and a delayed and lower amplitude of bradycardia associated with PLMS without MA, compared to healthy normal subjects ($P < 0.001$). Similar significant HR modifications were observed for PLMS with MA between patients and controls ($P < 0.05$)
Conclusion: Our study pinpointed the significant reduction in the amplitude of HR changes in both tachycardia and bradycardia in narcolepsy-cataplexy. These findings favour the physiological relevance of hypocretin actions in autonomic function that may be of clinically significant with increasing risk of cardiovascular diseases.

0796

EVALUATING THE CLINICAL DEFINITION OF CATAPLEXY IN NARCOLEPSY BY HLA-DQB1*0602 STATUS

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Introduction: How best to define cataplexy is unknown, especially in epidemiologic studies. The HLA-DQB1*0602 allele is common in patients with narcolepsy, present in 90-100% of those with definite cataplexy, and likely etiologically relevant. We sought to compare the sensitivity and specificity of five definitions of cataplexy for detecting HLA-DQB1*0602 in an epidemiologic, population-based study of narcolepsy.
Methods: Patients with physician-diagnosed narcolepsy were recruited in King County, Washington using multiple overlapping techniques.

The diagnosis was consistent with the ICSD-R. Five alternative definitions of cataplexy were compared: C1) self-report; C2) medical chart review; C3) weakness when telling or hearing a joke OR when laughing; C4) weakness when telling or hearing a joke; and C5) weakness when telling or hearing a joke AND when angry. We used McNemar's test to compare sensitivity and specificity for HLA DQB1*0602 status among these definitions.
Results: 181 narcolepsy patients provided complete data with mean age 46.3 years old (SD = 16.2), 64% women, and 50% positive for HLA-DQB1*0602. Overall, definition C1 showed 66% with cataplexy; C2, 59%; C3, 55%; C4, 46%; and C5, 29%. Sensitivity fell and specificity rose from definition C1 to C5. For sensitivity of detecting HLA-DQB1*0602 positivity, C1 was the highest at 76%, and C5, the lowest at 42% ($P < 0.001$). For specificity of detecting HLA-DQB1*0602 negativity, C5 was the highest at 83%, and C1 the lowest at 43% ($P < 0.001$). C4 had the highest positive predictive value at 73% as well as the highest negative predictive value at 69%.
Conclusion: In discerning HLA-DQB1*0602 status in this epidemiologic study, defining cataplexy as the presence of weakness when telling or hearing a joke and with anger (C5) is the most specific, while self-reported cataplexy (C1) is the most sensitive.
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0797

SLEEPINESS AND FATIGUE IN HABITUAL MIDRANGE AND LONG SLEEPERS

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Introduction: Much of the literature on the association linking sleepiness and sleep duration is based on studies of the "U-shaped" relationship between sleep length and morbidity/mortality. These investigations as well as recent studies of excessive daytime sleepiness and hypersomnia suggest that such "healthy midrange" findings are also applicable to daytime sleepiness and fatigue. The assumption that the U-shaped relationship applies to such daytime aspects is premature, however. There are several important demographic and circadian confounds as well as sleep, measurement, and illness related factors which affect this relationship. In the present investigation we evaluate the connection between long sleep, on the one hand, and daytime sleepiness and fatigue, on the other, in three samples where long and midrange sleepers who do not experience the confound of insomnia are compared.
Methods: Participants comprised three samples which excluded those with difficulty initiating or maintaining sleep: 54 older adults (mean age = 71), 33 college students (mean age = 20), and 30 adults with diagnosed apnea (mean age = 63)who had not yet begun treatment. Participants were divided into habitual long (= > 8 hr nocturnal sleep time) and midrange sleepers (7 - 7.9 hr). All completed questionnaires assessing sleep and related daytime variables. They indicated the number of hours they habitually sleep each night and completed the Stanford Sleepiness Scale and the Empirical Sleepiness and Fatigue Scales.
Results: All three samples showed similar results: habitual long and midrange sleepers did not differ on any measures of daytime sleepiness or fatigue. Total nocturnal sleep time and Stanford Sleepiness Scale scores were not correlated significantly in any of the samples.
Conclusion: Once insomnia is ruled out as a confound, habitual long sleep does not appear to be a pathological condition. Rather, it seems to be an expression of variability in human sleep.

0798

TRAUMATIC BRAIN INJURY INDUCED HYPERSOMNIA FOLLOWING REPETITIVE BLAST INJURIES IN IRAQ

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Introduction: Traumatic Brain Injury (TBI) has been shown to cause several sleep disorders, but its mechanism is poorly understood. Although rarely reported, single event blunt head trauma has been shown to cause narcolepsy and hypersomnia. The effects of repetitive head traumas on sleep are unknown. No cases of posttraumatic narcolepsy/hypersomnia following this repetitive injury pattern have been previously reported.
Methods: We present five cases of U.S. Service members who developed hypersomnia after sustaining TBIs following multiple Improvised Explosive Devices (IED) blast injuries while serving in Iraq. All patients underwent a thorough evaluation, including neuroimaging, overnight polysomnography, and Multiple Sleep Latency Test (MSLT) to evaluate excessive daytime sleepiness.
Results: Five patients with hypersomnia following repetitive blast injuries and TBIs were identified (80% were men, mean age was 27.0 ± 3.4 years old). Mean sleep latency on MSLT was 6.8 ± 4.8 minutes. Sleep onset REMs were present in all patients, four of which had ≥ 2. Mean time from TBI to diagnoses was 21.6 ± 5.9 months.
Conclusion: We present 5 cases of PTN/PTH following TBIs resulting from multiple blast injuries. While uncommon, PTN has been reported after single blunt trauma. This injury pattern represents a novel etiology for secondary sleep disorders that may be overlooked.

0799

RELATIONSHIP BETWEEN KLEINE-LEVIN SYNDROME AND UPPER RESPIRATORY INFECTION IN TAIWAN

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Introduction: The etiology of Kleine-Levin syndrome (KLS), characterized by recurrent episodes of hypersomnia remained unknown despite the hypothesis to be an auto-immune disorder. A new episode of hypersomnia is often preceded by an acute flu-like fever, or upper airway infection 3 to 5 days before symptom onset. Considering the above information we investigated the relationship between occurrence of mild respiratory infection and occurrence and the seasonality of episodes of hypersomnia.
Methods: 30 patients (26 males and 4 females, mean onset age 13.23 years, ranged 9 to 17) diagnosed with KLS based upon ICSD-II criteria and with long term follow-up both during symptomatic and asymptomatic episodes were investigated. We compare the timing of the hypersomnic episodes with the calendar reports of URI events obtained from the national health service on age matched Taiwanese general population subjects for the years 2006 and 2007. Bivariate correlations were performed with SPSS version-13.
Results: The bivariate correlation between occurrence of KLS episodes and URI in the general population is significant ($P = 0.042$). When following the national health information records, we subdivide the infection in "acute upper respiratory infections" , "acute bronchitis and bronchiolitis" and "chronic pharyngitis and nasopharyngitis", and compare the results with onset of hypersomnia, the results are again significant at respectively $P = 0.043$, $P = 0.037$ and $P = 0.010$. Our analyses also show that there is a strong positive correlation between higher URI reports in a given season and higher report of symptomatic hypersomnia .
Conclusion: URIs and KLS symptomatic episodes are significantly correlated, and there is a strong seasonal distribution for both. This re-

enforce the concept that KLS may be an auto-immune syndrome: the agent behind the URI or the consequences of the URI (such as fever that may modify temporarily the permeability of the blood-brain-barrier), may explain the periodic recurrence of the symptoms.

0800

PREVALENCE AND CORRELATES OF SLOW WAVE SLEEP IN PATIENTS UNDERGOING MULTIPLE SLEEP LATENCY TESTING (MSLT) FOR HYPERSOMNIA

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Introduction: Sleepiness is a problem reported by 10-25% of the population. The MSLT is an objective measure of daytime sleepiness. Slow wave sleep is equivalent to "delta activity" and is seen in EEG with signal in the frequency of approximately 0.5Hz to 4.4Hz as measured with adaptive segmentation with Morpheus TM. This study examines prevalence and correlates of slow wave sleep in adults undergoing multiple sleep latency tests for evaluation of hypersomnolence.
Methods: A retrospective review was undertaken of 162 consecutive patients presenting to SleepMed of SC for MSLT in 2008-2009 with a complaint of daytime sleepiness. Of those 101 who had 360 minutes of sleep prior to the MSLT by PSG or sleep diary were included. All underwent pre and post treatment assessment using the ESS, age, gender, BMI, and number of SWS & REM periods. Means, standard deviations are assessed.
Results: A review of 101 subjects were studied with 31 males (31%) and 70 females (69%); age 28(16); BMI 29(7). For the group mean ESS scores were 13(5) and by gender there were 23/31 males (74%) and 55/70 females (78%) scoring 10-24 on the ESS. TST was 400(36) with a range 360-480 minutes. Mean sleep latency for all naps was 7.1(5) minutes with a range of 0.3 to 20 minutes. For the group 43/101 (43%) had at least one REM period occurring during the MSLT with 22/101 (21%) with 2 or more REM periods. SWS was seen 19/101 (19%) with 10/101 (10%) having 2 or more SWS episodes and the highest frequency of SWS episodes occurring in naps 3-4. Of the 19 with SWS 10/19 (53%) did not have REM during the MSLT; median age was 39 years; and mean ESS score was 14; 9 males (47%) 10 females (53%). In the no SWS group there were 22 males (27%) and 60 females (73%); median age was 35; mean ESS score was 13. Mean TST in SWS group was 410 minutes(41)while in no SWS group was 403 minutes(30).
Conclusion: Our study shows that SWS is seen in subjects undergoing MSLT for evaluation of hypersomnia. SWS may be a process that can be used as an additional homeostatic marker measuring sleep need. However, SWS did not seem to correlate with age, ESS score, TST or REM sleep. SWS did tend to occur in naps later during the day.

0801

GENDER DIFFERENCES IN DAYTIME SOMNOLENCE AMONG SPANISH-SPEAKING MEXICAN AMERICANS

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Introduction: Prior studies have indicated that the Epworth Sleepiness Scale (ESS) is more likely to identify men with daytime somnolence than women. These studies have primarily included English-speakers of Western European descent. This study compared Spanish-speaking Mexican American men and women.
Methods: Spanish-speaking Mexican American men (n = 89) and women (n = 114) provided sleep health data using the newly validated Spanish Sleep Heart Health Study (SHHS) Sleep Habits Questionnaire (SHQ), which included the ESS. Subject characteristics, ESS scores, and SHHS daytime sleepiness, feeling unrested and insufficient sleep items were compared by gender using analysis of variance (mean ± SD) and frequency statistics (PASW v17) with significance set at $P < 0.05$.
Results: The mean ESS score for men was significantly higher than for women (7.9 ± 5 versus 6.4 ± 5, $P < 0.05$). Men were also more likely to report an abnormal ESS score (> 10) compared to women (31% versus 19%, respectively). Men were more likely to report a 'moderate' to 'high' chance of dozing in 6 of the 8 ESS situations. Men and women did not significantly differ, however, for the SHQ items that assessed daytime sleepiness, insufficient sleep, or feeling unrested. There were no differences in ESS scores for groups by age, education or body mass index.
Conclusion: Results from this study replicate prior research indicating that men score higher on the ESS than woman. Notably, these findings suggest a cross-language validation of the phenomenon. Further, they may indicate the greater sensitivity of multi-item measures of daytime somnolence than single item measures. Future research should explore whether the ESS contains a multi-cultural gender bias, or if it is sensitive to differences in sleep patterns of men and women.
Support (If Any): This work was supported through NIH NICHD Grant #1R03 HD051678A2 'Spanish Translation and Validation of a Sleep Measure' (PI: CM Baldwin).

0802

PREVALENCE OF MICROSLEEP IN COMMERCIAL MOTOR VEHICLE OPERATORS DURING THE MAINTENANCE OF WAKEFULNESS TEST

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Introduction: The Maintenance of Wakefulness Test(MWT) is a validated objective measure of an individual's ability to stay awake. Pathological sleepiness is associated with an increased risk of motor vehicle crashes. This fact has significant public safety implications, especially as it relates to commercial motor vehicle operators who log hundreds of hours behind the wheel each year. Excessive sleepiness may be secondary to sleep apnea which has been reported to be more prevalent in commercial drivers compared to the general population. One clinical application of the MWT is to evaluate individuals with treated or undertreated sleep apnea applying for a commercial driving license as part of their comprehensive medical evaluation. Previous studies have demonstrated worsened driving simulator performance in persons with an abnormal MWT result. Microsleep is defined as sleep occurring for three seconds or longer but less than 15 seconds of each 30 second epoch. To date, there have been no studies evaluating the prevalence of microsleep in the commercial motor vehicle operator cohort of patients.
Methods: 1.Patient Selection: All patients referred for MWT evaluation as part of a medical evaluation for commercial driving licensure between 1/1/07 and 12/15/09 were included. 2.Maintenance of Wakefulness Test was performed and interpreted in accordance with the American Academy of Sleep Medicine Practice Parameter guidelines. 3.Microsleep is defined as a period of at least three but less than 15 seconds with a 4-7 Hz rhythm replacing an alpha rhythm or appearing on a background of desynchronized EEG, without eye-blinking artifact.
Results: Of the ten study patients studied to date,30% failed the MWT,40% passed and did not demonstrate any periods of microsleep and 30% passed but had at least one period of microsleep. The later subgroup accounted for 43% of the study population who had a normal MWT result.
Conclusion: Currently, the result of a MWT does not account for the presence or absence of microsleep. Operating a motor vehicle requires a

high level of vigilance. At a speed of 65 mph, a vehicle would travel 285 feet during a 3 second microsleep, more than twenty times the distance required to completely change lanes on an average highway. Even with a reportedly normal MWT result, a microsleep of 14 seconds would allow a vehicle to travel greater than one quarter of a mile unattended. Microsleep may pose a significant public safety issue for both commercial drivers and those with whom they share the road.

0803

NORMAL 24 HOUR GHRELIN LEVELS IN HUMAN NARCOLEPSY AND IN RESPONSE TO SODIUM OXYBATE

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Introduction: Obesity is recognized as an associated symptom of narcolepsy. Recently, the narcolepsy therapeutic sodium oxybate (SXB) has been reported to decrease body weight. Both the origin of the obesity in narcolepsy, and the mechanism of SXB on weight loss are unknown however. Ghrelin is a key mediator of food intake and consequently body weight. Here, we studied ghrelin secretion and its response to SXB in hypocretin-deficient narcolepsy.
Methods: Ghrelin levels were measured in 8 male, medication-free, hypocretin-deficient, narcolepsy with cataplexy patients and 8 healthy controls, matched for age, sex, and body mass index (BMI). Blood samples were collected over 24 hrs at 60-min intervals, during two study occasions: baseline, and during the last night of 5 consecutive nights of single-blinded treatment with SXB (2x3.0 g/night). Three standardized meals were served, one at 0830, 1300, and 1800h (1500-1800 kcal/d) and subjects remained sedentary except for bathroom visits. Repeated measures ANOVA and unpaired t-tests were used to assess group differences.
Results: At baseline, mean 24 h ghrelin levels were similar in both groups (936 ± 50 vs. 949 ± 62 pg/mL, P = 0.873). After SXB treatment, ghrelin levels did not change in either group (920 ± 50 vs. 886 ± 53 pg/mL, P = 0.642). Comparisons at any single time point did not reveal significant differences either. Finally, food-induced suppression of ghrelin release was similar across all conditions.
Conclusion: We found no evidence for altered ghrelin levels in hypocretin-deficient narcolepsy. Although SXB may influence body weight in narcolepsy, the underlying mechanism is unlikely to involve changes in ghrelin secretion.
Support (If Any): This study was supported by an unrestricted grant from UCB Europe.

0804

NMDA RECEPTOR ANTIBODY POSITIVE CASES WITH HYPOCRETIN DEFICIENT NARCOLEPSY AND SEVERE PSYCHOSIS

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Introduction: There are several reports that symptoms of psychosis and narcolepsy occur in the same individual. Psychosis in patients with narcolepsy can occur in three ways; (i) as the psychotic form of narcolepsy with hypnagogic and hypnopompic hallucinations; (ii) as a result of psycho stimulant use in a patient with narcolepsy; and (iii) as the concurrent psychosis of schizophrenia in a patient with narcolepsy. Deficiency of hypocretin/orexin neurons is responsible for causing narcolepsy, so we need to reconsider comorbid cases with symptoms of psychosis. On the other hand, it has been recognized that anti-NMDA receptor(NMDAR) antibody is a one reason of symptomatic psychosis. Anti- NMDAR antibody is produced against tumor and migrated to brain, and then present psychiatric symptoms. This paraneoplastic brain syndrome usually develops in young women with ovarian teratoma, but some cases are in elder men. In this study, we measured anti-NMDAR antibody in narcoleptic patients with psychiatric symptoms.
Methods: We measured anti-NMDAR antibody of 4 hypocretin deficient narcoleptic patients with psychiatric symptoms. Testing for NMDAR antibodies was performed in Kanazawa Medical University as following the method of Dr. Dalmau.
Results: Two cases (37 years woman, 61 years man) were found to be NMDAR antibody positive and other remaining two cases have been testing now. These four cases have serious psychotic symptoms rather than the REM sleep related symptoms or side effects of psycho-stimulants. All patient stopped using psycho-stimulant and took antipsychotics. One case has been received modified electric convulsion therapy. The cases have possibilities to be improved by tumor resection. Now we are scanning whether comorbid tumors at ovarian and mediastinum are.
Conclusion: The anti-NMDAR antibodies were positive in the hypocretin deficient narcoleptic patients with severe psychiatric symptoms. Further studies are needed for the anti-NMDAR antibodies in the patients with narcolepsy.

0805

ABNORMALLY LOW SERUM ACYLCARNITINE IN NARCOLEPSY PATIENTS

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Introduction: Genome-wide association study identified a novel narcolepsy related SNP rs5770917, which affects expression level of adjacent CPT1B gene. CPT1B conjugates carnitine to long-chain fatty acyl coenzyme A and allows the transport of long-chain fatty acid into mitochondrial matrix for subsequent β-oxidation. We hypothesize the dysregulation of fatty acid β-oxidation in narcolepsy.
Methods: We measured CPT1B gene expression in white blood cell by quantitative RT-PCR and serum carnitine fractions (total, free, and acylcarnitine) by enzymatic cycling method. Blood samples from 38 patients with narcolepsy and 56 healthy control subjects were used for CPT1B gene expression analysis, and the same 38 patients and 30 control subjects selected from the above 56 controls were used for carnitine fraction measurement.
Results: Stepwise multi-regression analysis showed that the risk allele (C) of SNP rs5770917 was associated with decreased CPT1B expression ($P = 1.0 \times 10^{-9}$), and the level of CPT1B expression was higher in narcolepsy patients than in control subjects (P = 0.005). Although the distribution of serum acylcarnitine level did not show significant difference, acylcarnitine levels in 21% (eight of 38) narcolepsy patients were abnormally low below the established normal range, while those of 30 control subjects were all within normal range, regardless of the SNP rs5570917 genotype. Stepwise multi-regression analysis using the dichotomous variable of acylcarnitine (normal or abnormal) as an objective variable revealed that the diagnosis of narcolepsy was associated with abnormally-low acylcarnitine level while other variables such as CPT1B expression level and BMI were not.
Conclusion: Our results indicate the involvement of multiple factors in the regulation of serum acylcarnitine levels. Abnormally-low levels of acylcarnitine observed in narcolepsy suggest the dysfunction in the fatty acid β-oxidation pathway in narcolepsy.

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0806

COGNITIVE FUNCTIONS IN PATIENTS WITH NARCOLEPSY

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Introduction: This study evaluated the attentional, memory, and executive functions of patients with narcolepsy.

Methods: The sample consisted of 23 patients at Chonnam National University Hospital Sleep Disorders Clinic or at other Korean hospitals from 2005 to 2008 who had been diagnosed with narcolepsy according to the criteria contained in the International Classification of Sleep Disorders (ICSD-2): 23 healthy persons were used as controls. All participants received the Korean-Wechsler Adult Intelligence Scale and the following tests of neuropsychological functioning: The d2 test (attention), Rey Complex Figure Test (nonverbal memory), the Korean-California Learning Test (K-CVLT, verbal memory), and the Wisconsin Card Sorting Test (executive functioning). We investigated the frequency of excessive daytime sleepiness, cataplexy, sleep paralysis, and hypnagogic hallucinations with structured clinical interviews conducted by the neuropsychiatrist. Excessive daytime sleepiness was evaluated by the Epworth sleepiness scale.

Results: We found the following prevalence rates for the characteristic symptoms of narcolepsy: excessive daytime sleepiness (19 subjects. 82.6%), cataplexy (19 subjects. 82.6%), hypnagogic hallucinations (5 subjects. 21.7%), and sleep paralysis (12 subjects. 52.2%). Nocturnal polysomnographic findings showed that the percentages of stage 2 sleep and REM latencies were significantly lower in narcolepsy patients than in controls and that the percentage of stage 1 sleep was significantly higher in patients that in controls. Compared with those in the control group, narcolepsy patients obtained lower scores on total, TN-E, concentration performance, and fluctuation-rate sections of the d2 test, which measures attention, and on the B list of K-CVLT, which measures verbal memory.

Conclusion: Narcolepsy patients showed attention and verbal memory deficits compared to the control group. However, the patients did not manifest deficits in other cognitive functions.

0807

EVALUATION OF CSF HISTAMINE IN THE PATIENTS WITH NARCOLEPSY OR VARIOUS DISEASES

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Introduction: It has been recently reported that histamine decreases in the primary CNS hypersomnia, such as narcolepsy and idiopathic hypersomnia (Nishino2009, Kanbayashi2009). However, the histamine levels in other diseases are still unknown. We have estimated the histamine in CSF of many diseases.

Methods: The histamine was measured by using HPLC. The measurements were duplicated and the mean values were used. The disease groups were neurological control (n = 75), non-medicated narcolepsy (n = 25), medicated narcolepsy (n = 27), non-medicated idiopathic hypersomnia (IHS, n = 22), medicated IHS (n = 5), other hypersomnia (n = 23), acute disseminated encephalomyelitis (ADEM, n = 8), multiple Sclerosis (MS, n = 8), recurrent hypersomnia (RH, n = 5), obstructive sleep apnea syndrome (OSAS) (n = 25), meningitis (n = 31) and encephalitis (n = 18). For statistical analysis, a nonparametric Kruskal-Wallis test and Mann-Whitney test was used. Statistical significance was set at $P < 0.05$.

Results: We found significant reductions in CSF histamine levels in non-medicated narcolepsy and medicated narcolepsy (median: 97 pg/ml, 126 pg/ml, respectively), non-medicated IHS (92 pg/ml), other hypersomnia (189 pg/ml) and MS (106 pg/ml, with hypothalamic lesion) compared to neurological controls (310 pg/ml). The levels in medicated IHS (191 pg/ml), RH (202 pg/ml) and OSAS (317 pg/ml) did not statistically differ from those in the neurological controls (310 pg/ml). The levels of ADEM (748 pg/ml), meningitis (886 pg/ml) and encephalitis (401 pg/ml) were higher than those of controls.

Conclusion: The reductions of histamine were observed in narcolepsy, non-medicated IHS, other hypersomnia and MS with hypothalamic lesion, while those in OSAS (non central nervous system hypersomnia) and other neurological diseases were not observed. The levels of ADEM, meningitis and encephalitis were higher than controls. This may be due to inflammations. There is a possibility for histamine amount to be an indicator of hypersomnia symptoms. Especially, it is thought to become an indicator for central hypersomnia.

0808

METABOLIC AND ENDOCRINE ALTERATIONS IN CHILDREN WITH NARCOLEPSY WITH CATAPLEXY

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Introduction: Narcolepsy with Cataplexy (NC) is a central hypersomnia, due to a specific hypothalamic cell loss, known to show a major peak of disease onset around adolescence (15 y.o.). Nevertheless, cases with a childhood/pre-puberal onset have been reported. Our aim is to present a large NC childhood population, whose major points of interest are the possible concomitant onset of precocious puberty and of weight increase (until definite obesity).

Methods: Thirty-one consecutive children affected by NC, including clear-cut cataplexy, CSF hypocretin-1 deficiency (< 110pg/ml), and HLA DQB1*0602 haplotype, have been enrolled. All patients underwent weight and height measurement; and, when pre-puberal or close to puberty, they underwent lutenising hormone-releasing hormone test, wrist X-ray and pelvic echography. Additional diagnoses of overweight/obesity and/or precocious puberty have been performed. Retrospective data on possible precocious puberty have been collected in post-puberal patients.

Results: NC patients (14 females, mean age 12 ± 3 y.o.), with a disease onset at 9 ± 3 y.o., presented overweight and/or definite obesity (i.e. BMI > 95 percentile) in 12/31 (38.71%; overweight prevalence in the general Italian childhood population is 24%). Moreover, they presented a precocious puberty (which has a rare prevalence in the general population) in 5/31 (12.90%, 3 females), and an isolated advanced bone age at X-ray (i.e. > 2 years) in 2/31 (6.45%).

Conclusion: This study reports on specific metabolic and endocrine alterations of childhood NC in a large sample. The presence of overweight/obesity and precocious puberty stresses the importance to assess these possible additional diagnoses for the consequents growth stop and frequent permanence of severe obesity in adulthood. Moreover, our data suggest that both overweight and precocious puberty could represent an additive clinical sign of a wider hypothalamic dysfunction in NC.

0809

PUPILLARY CONSTRICTION VELOCITY AND LATENCY TO PREDICT EXCESSIVE DAYTIME SLEEPINESS

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Introduction: Excessive daytime sleepiness (EDS) is common in adults. A need exists for an easier and faster objective clinical measures of EDS. The autonomic nervous system controls pupil size and prior pupillometry studies have demonstrated associations with sleepiness. We used a novel portable device to assess pupillometry and prospectively evaluated a sleep clinic cohort.
Methods: Following IRB approval Pupillometry (The ForsiteTM, NeurOptics, Irvine, CA), was performed on 113 sleep clinic patients. Constriction and dilation velocity and latencies, minimum and maximum aperture were obtained along with Epworth Sleepiness Score (ESS), 10 point Visual Analog Scale (VAS), BMI, gender, age and AHI. Three sets of measures were obtained and analyzed with ANOVA, t-test, Linear Regression and Pearson correlation coefficients (SAS, Cary, NC).
Results: Both constriction velocity and constriction latency correlated with VAS ($n = 88$, $r = 0.28$, $P = 0.007$ and $r = 0.31$, $P = 0.004$). Only constriction velocity correlated with AHI ($n = 78$, $r = -0.27$, $P = 0.016$). Multivariate linear regression which include VAS and age predicted constriction velocity ($r = 0.36$, $P = 0.002$) and latency ($r = 0.38$, $P = 0.001$). Using Pearson correlation, AHI and VAS combined were associated with constriction velocity (-0.273 (0.016), and 0.284 (0.007), respectively). Using a maximum constriction velocity threshold value (age adjusted) of 2.8, VAS ≥ 6 was predicted with a sensitivity of 83% and specificity of 84%.
Conclusion: Pupillary constriction velocity and latency predict self reported VAS state of sleepiness. While both are affected by age only constriction velocity is affected by apnea severity. These data suggest that a portable pupillometer may provide a method to identify individuals with abnormal sleepiness.

0810

AUTONOMIC CORRELATES OF EXCESSIVE DAYTIME SLEEPINESS BASED ON HEART RATE VARIABILITY ANALYSIS

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Introduction: Excessive daytime sleepiness (EDS) increases the risk of accidents, leads to decreased cognitive ability and quality of life. We aimed to identify correlates and possible physiological causes of EDS among patients with suspected sleep apnea.
Methods: 147 consecutive sleep studies were collected from patients referred for suspected sleep apnea. Age was 50 ± 16, BMI 29.8 ± 6.8, AHI 23.0 ± 25.4, 103 male. All patients underwent PSG and MSLT, scored according to standard criteria. Fluctuations in cardiovascular autonomic control based on heart rate variability analysis were determined using the HC1000P System. Patients with MSLT score < 10 minutes were defined as sleepy. Patients were categorized by PSG results into healthy, or having mild, moderate or severe sleep apnea according to AHI using common limits: 0-5, 5-15 and 15-30, and greater than 30, respectively. Two tailed t-test was used to identify significant differences between groups.
Results: Sleepy patients had significantly longer Total Sleep Time and higher Sleep Efficiency than the non-sleepy group ($P < 0.05$). They also attained sleep faster ($P < 0.01$). Sleepy patients had shorter REM latency, more REM time and more REM periods ($P < 0.05$). Among patients with severe sleep apnea (AHI > 30), hypersomnolence was associated ($P < 0.05$) with long total apnea time, total apnea/hypopnea time, higher number of arousals due to apnea and higher apnea index. Regardless of AHI, sleepy patients exhibited higher VLF power and autonomic balance. In patients with AHI < 15, sleepy patients had higher LF power ($P < 0.05$).
Conclusion: Sleepy patients during the day were found to sleep more at night, fall asleep faster and spend more time in REM than non-sleepy individuals. Increased VLF power, LF power and autonomic balance in the sleepy group indicate increased sympathetic activity, suggesting that the hypersomnolence might be causing the exhaustion of their stress capabilities needed to overcome sleepiness.

0811

EARLY ONSET NARCOLEPSY: CLINICAL, POLYSOMNOGRAPHIC FEATURES AND COEXISTING SLEEP DISORDERS

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Introduction: Narcolepsy is frequently under-diagnosed in children which could lead to long term negative consequences. There is limited information on clinical manifestation of narcolepsy in children.
Methods: We conducted a retrospective review of medical records of patients diagnosed with narcolepsy at our center between January 2000 and August 2009. All children have completed clinical evaluation including at least one polysomnographic study (PSG) and Multiple Sleep Latency Test (MSLT). Children with secondary narcolepsy were excluded.
Results: A total of 35 narcoleptic children met the criteria for the study. Most children were male (M: F ratio = 1.5:1), and the average age at diagnosis was 13.3 ± 3.4 years. About half of children with narcolepsy were obese (average BMI 27.8 ± 8.4 kg/m2). The duration from onset of symptoms to diagnosis varied from 3 months to 14 years (3.8 ± 3.2 years). All children presented with excessive daytime sleepiness, 11% of which resulted in car accident at the time of initial presentation. REM-related accessory symptoms including cataplexy, hypnagogic hallucination and sleep paralysis were reported in 43%, 36% and 22% respectively. Other common sleep presentations in children with narcolepsy included snoring (77%), sleep maintenance problem (66%) and parasomnia (66%). Some children reported daytime consequences such as behavior problems (26%), decreased school performance (26%) and depression (11%). Analysis of sleep study and MSLT revealed that all patients have short sleep latency (2.9 ± 1.8 minutes) and multiple sleep onset REM periods (4 ± 1), although six patients were diagnosed after repeated MSLT. Coexisting sleep disorders including sleep disordered breathing and periodic limb movement disorder were noted in 40% and 11%.
Conclusion: Narcolepsy should be considered in children presenting with hypersomnia. Snoring and obesity are commonly seen and contribute to high prevalence of co-existing sleep disordered breathing. Other accessory symptoms such as cataplexy, hypnagogic hallucination or sleep paralysis may not be present at the early stage. The study emphasizes the importance of obtaining detailed clinical information, however, sleep study and MSLT are essential to establish the definite diagnosis.
Support (If Any): This study is supported by the Cincinnati's Children Hospital Research Fund.

0812

THE CORRELATION OF DREAM RECALL AND CLINICAL VARIABLES IN NARCOLEPTICS

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Introduction: Narcolepsy is a sleep disorder characterized by abnormal rapid eye movement (REM) sleep. The relations between the REM sleep, dream and clinical manifestations of narcolepsy have been reported by many scientists. This study was designed to investigate the relation between clinical features and frequency of DQB1*0602 in narcoleptics with dream recall to compare with those without dream recall during sleep onset REM period in multiple sleep latency test (MSLT).
Methods: From March 2004 to August 2009, we selected 126 patients who visited at Sleep Disorders Clinic of St. Vincent's Hospital, Catholic University of Korea and suffered excessive daytime sleepiness. All subjects examined by nocturnal polysomnography and multiple sleep latency test. Subjects were divided into 66 dream recall group and 60 non-dream recall group and compared to clinical symptoms, sleep pattern and frequency of HLA-DQB1*0602.
Results: Among the two groups which were classified by the dream recall during multiple sleep latency test, no significant differences were found regarding the demographic features. But in clinical symptoms, daytime drowsiness was more severe and cataplexy was more in the dream recall group than non-dream recall group. In polysomnography tests, sleep latency and REM sleep latency of the group which recall dreams proved to be shorter than that of the group which did not recall. In MSLT, mean sleep latency of the group which recall dreams proved to be shorter than that of the group which did not recall. Not any significant difference in the relation with dream recall and frequency of HLA-DQB1*0602 was identified.
Conclusion: In this study, we found that the dream recall was related to daytime drowsiness and cataplexy which are symptoms of narcolepsy. It is desired that more comprehensive and in-depth studies on the pathogenesis of narcolepsy and other sleep disorders by studying the relationship between other symptoms of narcolepsy and dream recall.

0813

ALERTING AND PERFORMANCE EFFECTS OF THE HISTAMINE INVERSE AGONIST MK-0249 IN OBSTRUCTIVE SLEEP APNEA PATIENTS ON CPAP WITH EXCESSIVE DAYTIME SLEEPINESS: A RANDOMIZED, CONTROLLED, ADAPTIVE CROSSOVER STUDY

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Introduction: Histaminergic neurons are important regulators of the sleep-wake cycle. Pre-clinical data suggest the potential of H3 inverse agonists to treat excessive daytime sleepiness (EDS). MK-0249, a selective histamine-3 receptor inverse agonist (H3R-IA), was evaluated in patients with obstructive sleep apnea (OSA) and EDS while using CPAP therapy with refractory EDS.
Methods: Patients (N = 125) were randomized in a 3-period crossover to 2 weeks each of daily MK-0249 (5, 8, 10, or 12 mg, assigned adaptively), modafinil 200mg, and placebo. At baseline and after each treatment period, 6 Maintenance of Wakefulness Tests (MWT) and Psychomotor Vigilance Tests (PVT) were conducted at 2h intervals, beginning 1h post-dose (~ 09:00h). The digit symbol substitution test (DSST) was also assessed. The protocol-specified primary outcome was the effect of MK-0249 (compared to placebo) on the MWT.
Results: Patients received each treatment: MK-0249 (N = 119), PBO (N = 117) and modafinil (111). MWT mean change-from-baseline (CFB) at week-2 for MK-0249 (top two most frequently allocated doses pooled) was 1.88 minutes (P-value vs. placebo = 0.324), modafinil 5.55 minutes (P-value vs. placebo > 0.001). For PVT total sum of errors, MK-0249 (top two doses) mean CFB result at week-2 was -0.68 (P-value vs. placebo = 0.002), modafinil -0.33 (P-value vs. placebo = 0.089). For DSST total number of items correct, MK-0249 (top two doses) CFB result at week-2 was 3.88 (P-value vs. placebo = 0.003) and modafinil 2.60 (P-value vs. placebo = 0.508). Adverse experience reports and discontinuations due to AEs were greater for MK-0249 vs. PBO and modafinil, notably insomnia.
Conclusion: MK-0249 did not significantly affect MWT. However, the pattern of improvement on secondary subjective performance endpoints suggest that MK-0249 was associated with changes in cognitive functioning not captured by the MWT.
Support (If Any): Merck Research Laboratories

0814

PREDICTORS OF SLEEP-RELATED FUNCTIONING IN YOUNG ADULTS WITH NARCOLEPSY

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Introduction: Merritt and colleagues reported significant differences in health-related quality of life and sleep-related functioning between young adults with narcolepsy and healthy adults of the same age. Little is known, however, about specific factors contributing to functioning in young adults with narcolepsy. The purpose of this analysis was to examine the relationships between perceived sleep-related functioning and daytime sleepiness, anxiety, depression, and nighttime sleep disturbances in young adults with narcolepsy.
Methods: This was a secondary analysis from a survey of young adults with narcolepsy conducted by Merritt and colleagues(2003). The sample included 28 men and 96 women with narcolepsy (mean ± SD): Age = 27 ± 5 and daytime sleepiness score (Epworth Sleepiness Scale[ESS]) = 2 ± 0.6. Sleep-related functioning was measured using the Functional Outcomes of Sleep Scale (FOSQ). Other measures included: Hospital Anxiety and Depression Scale (HADS) and Pittsburgh Sleep Quality Index (PSQI) sleep disturbances scale. Path analysis was used to examine relationships among variables.
Results: Daytime sleepiness, anxiety, depression and nighttime sleep disturbances accounted for 55% of the variance in sleep-related functioning. Results of the path analysis included: 1. greater levels of daytime sleepiness, depression and nighttime sleep disturbances directly and statistically significantly predicted lower sleep-related functioning. 2. depression was correlated with anxiety and indirectly predicted sleep-related functioning through nighttime sleep disturbances.
Conclusion: These findings suggest that in young adults with narcolepsy, depression and nighttime sleep disturbances have a greater influence on perceived sleep-related functioning than previously recognized.
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0815

CLINICAL EXPERIENCE WITH SLEEP FRAGMENTATION IN NARCOLEPSY REQUIRING TREATMENT

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Introduction: Narcolepsy is characterized by excessive daytime sleepiness, hypnagogic hallucinations, cataplexy, and nocturnal sleep disruption. This study examines the clinical history of subjects with

narcolepsy to determine the frequency of disturbed nocturnal sleep and subsequent pattern of medication usage.
Methods: This is a retrospective review of charts of subjects followed at one sleep clinic with a clinical diagnosis of narcolepsy. Data was collected with pre and post treatment assessment using the Epworth Sleepiness Scale (ESS) to assess daytime sleepiness and the SleepMed Insomnia Index (SMI) to measure nocturnal sleep disruption. Other data collected included age, gender, and usage of sedating medications.
Results: 248 subjects included 79 males (32%) and 169 females (68%). The mean age for the group was 42 (15) (range 10-83 years). 42/248 (17%) reported cataplexy. 77/248 (31%) were taking sodium oxybate at the last office visit. 221/248 (89%) were taking wakefulness enhancing medications. ESS scores at pre and post therapy were 16 (5) and 12 (5) P = 3.02 E-12. SMI scores pre and post therapy were 19 (9) and 14 (9) P = 5.09 E-07. 81/248 subjects (33%) were taking sedative medications at follow-up with 26 males/81 (32%) and 55 females/81 (68%). 68/81 (84%) were taking wakefulness enhancing medications. SMI scores pre and post therapy for those taking sedative medications were 22 (9) and 18 (10) P = 0.04. 66/81 (81%) were on non-benzodiazepines; 12/81 (15%) on benzodiazepines; 3/81 (4%) on an atypical agent.
Conclusion: Sleep fragmentation in narcolepsy frequently requires specific clinical therapeutic intervention. Excessive sleepiness and insomnia complaints respond to sedative medications as measured by SMI and ESS scores. Subjects requiring sedating medications had higher baseline SMI scores reflecting more sleep disruption. The SMI can be useful to assist the clinician to quantify sleep disruption and assess the efficacy of therapy.

0816

THE EFFECT OF SODIUM OXYBATE ON THE MOTOR ACTIVITY IN SLEEP IN PATIENTS WITH NARCOLEPSY

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Introduction: Narcolepsy is associated with parasomnias. Sodium oxybate (SO) is a common treatment for narcolepsy. Side effects of SO include sleepwalking. The aim of the study was to investigate the influence of SO on motor activity RBD in patients with narcolepsy.
Methods: Muscle activity was scored from m. mentalis in polysomnographies of 30 narcoleptic patients and represents preliminary data of about 300 pts. Muscle activity was compared between baseline and medication with SO (4.5g: 15pts., 6g: 11 pts., 9g: 4 pts.). Muscle activity was defined as short (< 0.5 s) and long (> 0.5s) lasting activity. It was evaluated with a recently published automatic program (Mayer et al., Clin Neurophysiology 2008). Group differences could not be calculated due to the small patient numbers.
Results: SO increases mean muscle tone nonsignificantly in wake and all sleep stages. Frequency of long muscle activity is nonsignificantly decreased in REM sleep and wake and highly increased in N3. Frequency of short muscle activity is nonsignificantly decreased in N1 & 2 and increased in all other sleep stages.
Conclusion: It is known that long muscle activity in the group patients with RBD is significantly higher than in controls, and seems to be responsible for acting out dreams. Our preliminary data could be an indicator that the effect of SO on motor activity is stage dependant. A reduction of long muscle activity in REM sleep could explain the observation that SO may suppress RBD, the increase in N3 may explain the occurrence of sleepwalking. We hypothesize that the effects may be dose dependant, which has to be confirmed in the evaluation of the large group.
Support (If Any): UCB

0817

DAY-NIGHT DISTRIBUTION OF SEIZURES IN AMBULATORY CONDITIONS

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Introduction: Sleep and circadian rhythms may affect the times when individual seizures occur in patients with epilepsy. Studies performed in hospital conditions suggest that patients with temporal lobe epilepsy (TLE) may have proportionally more seizures in the mid-afternoon compared to other times. We report the distribution of seizures over time in patients tested in ambulatory conditions.
Methods: We analyzed records from 815 consecutive patients who had ambulatory EEG monitoring for 24-72 hours using DigitraceTM EEG recording system. The participants maintained a log of symptoms and signaled the time when symptoms occurred by pushing an event button. Additionally, automatic seizure and spike detection was performed on each record using Persyst detection software.
Results: Out of 815 total patients, a total of 60 electrographic seizures were recorded from 11 unique individuals during their ambulatory recording. The largest numbers of seizures occurred in the intervals between 3:00-7:00 and 15:00-23:00 with 68% of all seizures occurring in these intervals. When divided by locations, frontal seizures occurred preferentially within 3:00 -7:00 a.m. (36%) and temporal seizures - between 15:00 - 23:00 (55%).
Conclusion: In ambulatory conditions, electrographic seizures follow day/night patterns similar to those observed in hospital conditions. Frontal seizures occur preferentially in the hours after midnight and temporal lobe seizures occur in the late afternoon-early evening hours.

0818

MWT, BUT NOT IMPAIRED OLFACTION, DIFFERENTIATES PARKINSON'S DISEASE (PD) FROM IDIOPATHIC REM BEHAVIOR DISORDER (RBD)

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Introduction: Non-motor dysfunction in Parkinsonism includes both impaired olfaction and disturbances of the sleep/wake cycle. We hypothesized that PD and idiopathic RBD would show similar impairments on measures of both domains.
Methods: PD (N = 26) (X age = 64.3 [9.5]) and RBD (n = 5) (X age = 67.2 [10.2]) pts underwent a 48-hour protocol consisting of 2 PSG nts followed by 2 days of 4-nap MWTs. Duration of MWTs was held constant at 40 mins; we scored sleep latency (SLAT) and sleep efficiency (SE) of each nap and obtained means across naps.
Results: Groups did not differ on UPSIT (olfaction) with both substantially impaired (PD = 21.9; RBD = 22.8). Epworth's were similar (11.5 vs 11.6). UPDRS Motor subscale confirmed greater impairment in PD (11.6 vs 2.6, t = 3.64, P = .001). Mean MWT SLAT (12.9 mins vs. 28.6 mins, t = 2.42, P = .02) and MWT SE (37.8% vs 15.7%, t = 1.83, P = .08) confirmed greater deficits in alertness in the PD group. Pergolide dose equivalents were unrelated to MWT measures in the PD group (all P values > .50). Levo-dopa use was common (18/26) but dosing showed positive relationship to MWT SLAT (rho = .56, P = .003) and a negative relationship to MWT SE (rho = -.37, P = .06), indicating that higher dosages were related to greater alertness, i.e., MWT differences in SLAT between PD and RBD were further accentuated by the elimination of those cases. No other medications contributed to differences in MWT. Results were similar using median MWTs.
Conclusion: Following the Braak model of early brainstem predilection for Parkinsonism, a broad range of functional neuroanatomic features would be expected to deteriorate synchronously. These data suggest that loss of olfactory function and alerting are disassociated early in disease course.

Support (If Any): R01 NS-050595; KL2 RR-025009 (ACTSI); Consolidated Anti-Aging Consortium

0819

NUMBER OF ANTIEPILEPTIC DRUGS PREDICT THE PRESENCE AND THE SEVERITY OF OBSTRUCTIVE SLEEP APNEA IN EPILEPSY

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Introduction: Recent studies suggest the prevalence of obstructive sleep apnea (OSA) is higher in epilepsy than the general population. OSA may increase the risk of seizures; its treatment reduced seizures in small series. Traditional OSA risk factors (BMI, age, male gender) predicted the presence of OSA in prior studies involving epilepsy patients. The role of antiepileptic drugs (AEDs) remains unclear. We sought to evaluate the relationship between AEDs and OSA severity in a larger population.
Methods: This is a cross-sectional, IRB-approved study. Adult epilepsy patients without prior sleep disorder diagnoses underwent sleep evaluation to investigate the prevalence of OSA. The association between apnea-hypopnea index (AHI) and type of AED therapy (mono- or poly)/ number of AEDs was analyzed using linear regression controlling for age, gender, BMI, mean monthly seizure frequency, and epilepsy syndrome (focal vs. generalized).
Results: 132 treated subjects (mean age 38.7 yr + 13.2; BMI 28.9 + 7.3; male gender 44%) were included. Subjects took a mean of 1.6 (1-4) AEDs including 46% mono- and 54% poly-therapy. 55 (42%) subjects had OSA (AHI > 5). Higher number of AEDs and poly-therapy were associated with a higher AHI ($P < 0.001$, $P = 0.02$, respectively). Age and BMI were also significant predictors for AHI. Subjects with OSA were taking more AEDs (1.7+0.7 vs. 1.6+0.7; $P = 0.001$), more likely to be on poly-therapy (56% vs. 52%; $P = 0.02$), were older (44.8+1 vs. 34.4+12; $P < 0.001$) and had a higher BMI (31.5+7.3 vs. 27+6.7; $P = 0.003$) than non-OSA subjects. There was no significant difference in gender, monthly seizure frequency or epilepsy syndromes between OSA and non-OSA groups.
Conclusion: Our findings provide evidence for significant effects of AED therapy on OSA severity apart from traditional risk factors. In addition, the prevalence of OSA in epilepsy exceeded that of general population. Further studies are needed to understand the mechanisms underlying these findings.

0820

MODAFINIL AMELIORATES EXCESSIVE DAYTIME SLEEPINESS AFTER TRAUMATIC BRAIN INJURY

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Introduction: Excessive daytime sleepiness (EDS) and fatigue are common complaints following traumatic brain injury (TBI), and they significantly impair quality of life and daytime functioning including professional performances and social activities. However, there is no specific treatment for affected patients. With this pilot study, we aimed at studying the effect of daily modafinil on posttraumatic EDS and fatigue.
Methods: We conducted a prospective, double-blind, randomized, placebo-controlled pilot study in 20 TBI patients with fatigue or EDS or both. Following baseline examinations (questionnaires including the Epworth sleepiness scale to assess EDS, and the fatigue severity scale to assess fatigue, actigraphy, polysomnography, maintenance of wakefulness test, and psychomotor vigilance test), ten patients received

100-200mg modafinil every morning, and ten patients were treated with placebo. Following a 6-week treatment period, all examinations were repeated.
Results: Baseline EDS and fatigue did not differ in both groups. EDS improved significantly in TBI patients treated with modafinil, compared to the placebo group. The decrease in ESS scores was higher in the modafinil group (-2.3 ± 2.3 compared to 0.7 ± 1.8, P = 0.005). Similarly, the ability to stay awake on the maintenance of wakefulness test improved only in the modafinil group: compared to baseline, there was a significant increase of the mean sleep latency on maintenance of wakefulness test in the treatment group (8.4 ± 9.6 minutes) compared with the placebo group (0.4 ± 6.2 minutes, P = 0.04). Modafinil, however, had no impact on posttraumatic fatigue. Clinically relevant side effects were not observed.
Conclusion: This study indicates that modafinil is effective and well tolerated in the treatment of posttraumatic excessive daytime sleepiness but not of fatigue.
Support (If Any): This investigator-initiated trial was supported by Schweizerischer Versicherungsverband (SVV), Zurich, Switzerland, and Cephalon GmbH, Martinsried, Germany. References

0821

USE OF SLEEP MEDICATIONS PRIOR TO PRESENTATION TO SLEEP CLINIC IN PATIENTS WITH EPILEPSY AND INSOMNIA: A RETROSPECTIVE STUDY

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Introduction: Insomnia in patients with epilepsy has been well described. However, there have been no studies documenting the self-directed sleep medication usage of patients with epilepsy and insomnia. The purpose of this study is to explore the tendency of patients with epilepsy and insomnia to try either over-the-counter sleep medications or prescribed sleep medications before presenting to a Sleep physician.
Methods: We performed a retrospective chart review of patients with epilepsy and insomnia. The inclusion criteria included patients with epilepsy and insomnia who presented to the New York Sleep Institute over a one-year period.
Results: There were 50 patients with epilepsy and insomnia included in the study. Patients' ages ranged from 16 to 91 years. 13 patients had excessive daytime sleepiness as determined by a score greater than 10 on the Epworth Sleepiness Scale (ESS). One patient was not on an anti-epileptic drug (AED). 21 patients were on one AED. 20 patients were on two AEDs. Eight patients were on three or more AEDs. 29 patients (58%) did not take medications for sleep prior to presenting to Sleep clinic. 21 patients (42%) took medications for sleep. 13 patients took zolpidem; three patients took diphenhydramine; two patients took melatonin. Three patients took more than one medication. The average ESS score for patients who took medications for insomnia was 4.9/24 (range, 1/24 to 14/24). The average ESS score for patients who did not take medications was 8.75/24 (range, 0/24 to 24/24). Two of 13 patients with excessive daytime sleepiness (15.4%) took medications for insomnia. 19 of 37 patients without excessive daytime sleepiness (51.4%) took medications. 10 of 21 patients on one AED (47.6%) took medications for insomnia. Nine of 20 patients on two AEDs (45%) took medications for insomnia. Two of eight patients on three or more AEDs (25%) took medications for insomnia.
Conclusion: Many patients with epilepsy and insomnia take sleep medications prior to presenting to a Sleep physician. Patients on one or two AEDs were more likely to take medications for insomnia than patients on three or more AEDs, which suggests that patients on multiple AEDs may be hesitant to take additional medications. Interestingly, patients without excessive daytime sleepiness were more likely to take medications for insomnia than patients with excessive daytime sleepiness.

0822

LATERALIZED ABNORMALITIES OF EEG STRUCTURE AT LIGHT SLEEP STAGES CORRESPONDED TO FOCAL ICTOGENESIS IN PATIENTS WITH INTRACTABLE PARTIAL SEIZURES

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Introduction: Clinically, there are significant interrelation between the sleep and the epileptic seizure. A lack of sleep or poor quality of sleep can increase frequency of seizures. Seizures usually occur at light sleep stages in the patients with epilepsy. We studied the brain waves in sleep stage II from patients with chronic partial seizures. We planed to identify variant abnormalities of sleep-spindle, K-complex and vertex sharp wave, which corresponded to the focal epileptogenicity.
Methods: We reviewed the over-night EEG recordings from the patients with chronic epilepsy. Patients with symptomatic epilepsies (head trauma, CNS infection, cortical malformation, mesial temporal lobe atrophy or hippocampal sclerosis), primary generalized epilepsies, existing neonatal/infantile epilepsies or hereditary neurological disorders were excluded. Twenty-one patients with intractable partial seizures, normal EEG background (rhythmic alpha activity over the posterior region of head at eye-closure) and non-lesional MRI were studied. We tried to recognize whether there are abnormal sleep spindles or K-complexes in the Non-REM II stage.
Results: Short and irregular sleep spindles, abnormal K-complexes and poor organized vertex sharp waves occurring on the same side of ictogenesis were found in all of the patients. In the nine patients with frontal lobe epilepsy, two had pure abnormal sleep spindles, four had mixture of abnormal K-complexes and sleep spindles, and the other three had abnormal vertex sharp waves. In the four patients with temporal lobe epilepsy, one had abnormal sleep spindle and three had abnormal vertex sharp waves. In the eight patients with multiple ictogeneses, five had abnormal sleep spindles and three had abnormal vertex sharp waves.
Conclusion: Abnormal sleep EEG structures were found in the patients with intractable partial epilepsies. The abnormal bursts of brain activity were lessen organization and ipsilateral to the epileptogenetic region/s. The results implied altered interactions between cells in the thalamus and the epileptogenic cortices.

0823

IS THERE GENDER DIFFERENCES IN SLEEP-RELATED PROBLEMS OF SUBJECTS HAVING EPILEPSY?

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Introduction: Sleep disorders are common among the epilepsy patients. Little research, however, has been performed to evaluate gender differences in the sleep problems related to epilepsy. Here we report on the distribution of insomnia and excessive daytime sleepiness (EDS) in the male and female epilepsy patients living in Tbilisi, a capital city of Georgia.
Methods: 116 epilepsy outpatients (72 females, 44 males), consisting of 30 subjects (16 females, 14 males) with newly diagnosed epilepsy and 86 patients (56 females, 30 males) treated with antiepileptic drugs (AEDs), filled out self-administrated questionnaire which contained 15- items concerning sleep-wake habits, insomnia symptoms and daytime sleepiness with multiple answer-choices. An association for categorical variables was examined by Pearson Chi-square Test. Data analysis was performed by SPSS statistical software, version 13.0.
Results: Among the untreated epilepsy patients, who had not received AEDs before, 33.3% of males and 13.3% of females had three

symptoms of insomnia and only one man had all symptoms characteristic for clinical insomnia. The prevalence of insomnia in the patients, who have undergone antiepileptic therapy, was as follows: 19.5% of the females and 21.1% of the males had three symptoms of insomnia; 14.6% of women and 15.8% of men were found as the patients having clinical insomnia. The overall prevalence of EDS was higher in males (27.3%; 12 out of 44) than females (11.1%; 8 out of 72); chi-square (df-1, n = 116) = 5.00, P = 0.025. Eight (26.7%) out of 30 males and eight (14.3%) out of 56 females treated with AEDs were categorized as the patients having EDS (difference was not significant). Among the untreated epilepsy patients, EDS was noted in 28.6% of men.

Conclusion: Although there has been observed some gender differences in the prevalence of insomnia and EDS among the epilepsy patients, it is required to conduct a large scale study to address this issue.

0824

OBSTRUCTIVE SLEEP APNEAS AND EPILEPSY

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Introduction: Reported prevalence of obstructive sleep apnea in epilepsy is much higher than in general population. Moreover, epileptic seizures might be aggravated by obstructive sleep apnea (OSA). We observed the reduction of seizure frequency after continuous positive airway pressure (CPAP) therapy in patients with OSA and epilepsy.

Methods: We included nine patients (all male, 39 ± 11.4 years old) with epilepsy who were referred to the sleep clinic for the evaluation of habitual snoring or observed apneas. OSA was diagnosed when obstructive apnea-hypopnea index (AHI) was at least 5 on nocturnal polysomnography. CPAP or upper airway surgical therapy was done. Change in seizure frequency and severity was observed after intervention.

Results: Presence of OSA was documented in all patients (AHI 28.9 ± 22.4)). Six patients were seizure free and three suffered from medically intractable epilepsy at presentation. OSA severity was not different between two groups (AHI, 28.9 ± 25.6 vs 29.0 ± 19.1, P > 0.05). Upper airway surgery was performed in five and CPAP therapy was done in four including three with intractable seizures. After three successful months of CPAP therapy, two of them had reduced seizure frequency less than 50% of baseline. The other one with secondarily generalized tonic-clonic seizures experienced only simple partial seizures without generalization.

Conclusion: Treating OSA in patients with refractory epilepsy may reduce seizure frequency and severity.

0825

INITIAL ANALYSIS OF SLEEP OUTCOME TOOLS IN CHILDREN WITH EPILEPSY AT CINCINNATI CHILDREN'S HOSPITAL MEDICAL CENTER (CCHMC)

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Introduction: Our initial report of sleep outcome tools as part of the quality improvement (QI) initiatives at CCHMC have shown that several tools such as Michigan PSQ, quality of life (QL), etc, are useful instrument to tract long term outcome data in children with obstructive sleep apnea. In this study, we intend to evaluate if these tools can be used as a screening tool for sleep disordered breathing in selective population such as children with epilepsy.

Methods: We conducted a retrospective review of sleep outcome tools in children with epilepsy who were referred to sleep clinics from March 2008 to July 2009. As part of the QI initiatives, all children and their parents were asked to complete sleep questionnaire in our sleep clinics prior to physician's visit. Only children with epilepsy who completed questionnaire during the visit and had adequate sleep study were included in the analysis.

Results: 43 children met the criteria for entry into analysis. The average age was 9.3 ± 5.6 years. The average BMI was 22.5 ± 9.3 kg/m2. 90.7 % (39/43) of children had positive Michigan PSQ score (total score > 0.33) for sleep apnea, but only 44.2 % (19/43) had documented obstructive sleep apnea (OI > 1) from sleep study. The sensitivity of Michigan PSG was 0.73 (OI > 1), 0.71 (OI > 3), 0.73 (OI > 5), but the specificity was 0.2, 0.21 and 0.23 respectively.

Conclusion: Our initial QI data demonstrates that most children with epilepsy who were referred to sleep clinics have positive score from the Michigan PSQ. The Michigan PSQ is sensitive but not specific in this population. We continue to assess if the Michigan PSQ can be a useful follow up tool for sleep outcome. We are currently reevaluating other sleep outcome tools in this population.

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0826

DAYTIME NAPPING IN PATIENTS WITH PARKINSON'S DISEASE

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Introduction: Patients with Parkinson's disease (PD) typically experience sleep disturbance which may partly contribute to increased levels of daytime sleepiness. The aim of this study was to determine the frequency of daytime napping in patients with PD and to determine whether this was related to nocturnal sleep patterns.

Methods: N = 14 (7M, mean age = 63.23, SD = 6.04) participants, diagnosed with PD, were recruited from an outpatient clinic. Participants wore wrist actigraphs (AW Spectrum, OR) and completed sleep diaries for 14 days. Nocturnal rest periods and daytime nap periods were scored using Actiware software. In addition nap intervals were then manually scored by one scorer incorporating the following criteria: between 9am- 9pm, no activity, self-reported naps from the diary. Logistic regression was employed to determine the likelihood of napping based on sleep quality and sleep duration.

Results: Mean nocturnal rest duration for all participants was 445.57 minutes ± 90.93. N = 13 of 14 participants napped. Sleep debt was calculated by the difference between the total sleep time over 14 days and the nocturnal sleep time. Using logistic regression analysis, sleep debt was found to significantly predict the occurrence of a daytime nap (Wald = 8.003, P < 0.01), however wake time during the rest interval had no predictive effect (P > 0.05).

Conclusion: From the present study, nocturnal sleep duration rather than sleep quality had greater predictive value for determining the likelihood of daytime napping in PD patients. Further studies are underway to increase the sample size and examine other measures of daytime functions, e.g. neurocognitive performance.

Support (If Any): NHMRC Program Grant

0827

OBSTRUCTIVE SLEEP APNEA IN VASCULAR DEMENTIA

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Introduction: Although obstructive sleep apnea (OSA) is suspected of the association with vascular dementia (VaD), there is no evidence supporting the contentions. The goal of this study is to identify clinical, cognitive function or subjective sleep quality that independently

associated with polysomnography (PSG) parameters in patients of VaD with or without OSA.
Methods: Twelve patients (female = 6, male = 6) with mild-to-severe VaD filled out the Athens insomnia scale (AIS), Pittsburgh sleep quality index (PSQI), Epworth Sleepiness Scale (ESS) prior to do the PSG. Their cognitive function evaluations include Mini-Mental Status Examination (MMSE), Clinical Dementia Rating (CDR) and (Cognitive Abilities Screening Instrument) CASI.
Results: The patients of VaD with OSA are 8 (66.67%), with upper airway resistance syndrome is 1 (8.33%), with Central Sleep Apnea is 1 (8.33%) and with Insomnia Due to Medical Condition are 2(16.67%). The mean PSQI is 12.3 ± 6; the mean AIS is 9.5 ± 5.35 and the ESS is 9.67 ± 4.48. The average sleep apnea severity is mild: 5 (62.5%), moderate: 2 (25%), severe: 1(12.5%) in OSA group. The relationship between Apnea-Hyponea Index (AHI) and three cognitive function tests shows obvious significances. However, the CDR reveals positive relationship with AHI in rapid eye movement (REM) stage ($P < 0.05$). At the same time, MMSE shows negative association with non-rapid eye movement (NREM) arousal index ($P < 0.05$).
Conclusion: The patients with VaD have a high rate of poor sleep quality. The cognitive function might have association with some parameters of PSG.

0828

THE ROLE OF POLYSOMNOGRAPHY ASSESSMENT AS SLEEP DISORDER MEASURE IN ALZHEIMER'S DISEASE

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Introduction: There is an association between Alzheimer disease (AD) and sleep related breathing disordered. Significant sleep disturbance is an extremely common complaint in AD, affecting as much as half of clinic-based or community AD cases. Polysomnography(PSG) is the effective tool in assessment sleep related breathing disorder. However, The major causes of sleep disruption in dementia is multi-factorial. This study evaluates the effects of PSG on sleep related breathing disordered in patients with AD.
Methods: Retrograde analysis in patients with dementia classified into disease groups on the basis of established clinical criteria. Eleven patients with mild-to-moderate Alzheimer disease and subjective daytime sleepiness, frequently waked up during midnight, snoring were arranged PSG assessment. In addition, they filled out the Athens insomnia scale(AIS), Pittsburgh sleep quality index(PSQI), Epworth Sleepiness Scale(ESS) prior to do the PSG. The linear relationship of cognitive and sleep data were analyzed using Spearman's rho.
Results: The mean age was 69.73 ± 7.99. The average sleep apnea severity was mild: 4 (36.36%), moderate: 2 (18.18%), severe: 5 (45.45%). The mean body mass index (BMI) was 24.69 ± 4.3. The mean AIS was 9 ± 5.42 with maximum was 23 and minimum was 4; the ESS was 8.82 ± 6.38 and the mean PSQI was 12.64 ± 4.86. The relationship between snore index (SI) and MMSE did show obvious significances ($P < 0.05$). The Denaturation_index were associated with snoring severity ($P = 0.028$) and Total arousal index was associated to oxygen saturation ($P < .0001$). Besides, The neck circumferences (NC) showed positive relationship to Apnea-Hyponea Index (AHI) ($P = 0.0109$).
Conclusion: The NC has positive relationship to Apnea-Hyponea Index and snoring. The SI has significantly relationship to MMSE. However, We will prospectively collect more data for more research in which AD patients are at greatest risk for obstructive sleep apnea, or even whether significant obstructive sleep apnea make AD symptoms.

0829

SLEEP DISTURBANCES IN THE PATIENTS WITH PARKINSON'S DISEASE

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Introduction: Sleep disturbances are commonly seen in the patients with Parkinson's disease (PD) with a prevalence of 74-98%. We investigated the sleep disturbances and the influential factors among Chinese patients with PD.
Methods: Fifty PD patients were evaluated by a battery of standard questionnaires of Parkinson Disease Sleep Scale (PDSS), Epworth Sleepiness Scale (ESS), Unified Parkinson's Disease Rating Scale (UPDRS)II-III, Hoehn-Yahr (H&Y) stage, Mini Mental State Examination (MMSE) and Hamilton Depression Rating Scale (HAMD).
Results: The mean total PDSS score was 102.9 ± 20.3. When subitem score equal or less than 5 was considered as abnormal, the calculation of PDSS revealed that forty-two patients (84%) had sleep disturbances, twenty-three (46%) had difficulties in the initiation of sleep, twenty-four (48%) had fragmented sleep and eighteen (36%) had early awakening. PDSS calculation also showed that nocturia (44%), nocturnal pain and cramps (30%), tremor (22%), nightmares (18%) were the main influential factors of insomnia. Nine patients (18%) had restless legs syndrome and seven (14%) had hallucination. The mean ESS score was 7.2 ± 3.5 and fourteen patients (28%) had total score over 10. Multivariate analysis showed that PDSS scores were positively associated with the score of MMSE and negatively correlated with the disease duration and dopamine treatment dosage and the score of UPDRS, H&Y stage and HAMD, but did not related to the age and gender. Total ESS score was correlated with the UPDRS scores and Hoehn-Yahr stage and dopamine treatment dosage.
Conclusion: In accordance with the published data, Chinese patients with PD also have a high prevalent rate in sleep disturbances. The insomnia appears to be the most commonly seen symptom. Nocturia, nocturnal cramps, tremor, nightmare and daytime somnolence are the important factors to influence sleep quality. Sleep disturbances associates with illness length and severity, emotional problem and dopamine treatment dosage.
Support (If Any): Chinese National Natural Science Foundation 30870891/C090302

0830

TOLERABILITY OF POLYSOMNOGRAPHY IN ADULTS WITH DOWN SYNDROME

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Introduction: Adult patients with Down Syndrome are at increased risk for developing Alzheimer's disease due to the third copy of chromosome 21. Identifying factors affecting their cognitive function is essential. Down Syndrome is associated with a high risk for sleep apnea as documented in the pediatric population. Obstructive sleep apnea can contribute to cognitive symptoms such as irritability, depression and other behavioral changes. Our objective is to determine the tolerability of an overnight PSG in adults with Down syndrome
Methods: Systematic retrospective chart review of all patients seen in the Alzheimer and Memory Center's Down syndrome Dementia Clinic from January 2008-June 2009.
Results: 36 patients were seen in the DS Dementia Clinic. 25 patients were referred for PSG. 16/25 successfully completed the PSG with 4 studies pending. 15/16 (94%) were diagnosed with OSA. 5 did not tolerate the PSG. 3 of the 5 subsequently tolerated the overnight pulse oximetry.
Conclusion: Excluding the pending PSG's, 76% (16/21) of the adult patients with Down syndrome tolerated the PSG. The primary reason for intolerance is related to behavioral issues.

0831

UPDRS MOTOR EVALUATION AND LIGHT SLEEP IN PARKINSON'S DISEASE

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Introduction: It is well-known that sleep disorders and daytime sleepiness are common among individuals with Parkinson's disease (PD). Changes in sleep architecture related to disease progression or medications can also have an effect on sleep quality. Motor impairment is a significant part of deterioration in PD functionality. As part of an on-going clinical study on PD and sleep, we examined whether motor impairment was related to sleep.

Methods: Forty patients (Men: 24; mean age: 67.2 years, SD: 9.78, range: 48-89 years) with mild to moderate PD were evaluated. PD functionality was assessed with the Unified Parkinson's Disease Rating Scale (UPDRS) that is composed of three subscales: (1) mentation, behavior; and mood (MBM) (2) activities of daily living (ADL); and (3) motor examination. The UPDRS motor examination assesses motor symptoms such as rigidity, bradykinesia, and tremor. Greater score on the UPDRS motor evaluation reflects greater motor impairment. Percent of total sleep time spent in N1, N2, N3, and REM sleep was assessed during an overnight polysomnography. Pearson correlation analysis was used to examine the relationship between UPDRS motor score and sleep stage as a percentage of total sleep time.

Results: There was a significant positive correlation ($r = 0.314$, $P = 0.048$) between UPDRS motor score and %N2 sleep and a significant negative correlation ($r = -0.326$, $P = 0.040$) between UPDRS-motor score and %N3 sleep. No significant relationships were found for %N1 or %R sleep.

Conclusion: Although preliminary, the results suggest that greater motor impairment in PD is significantly correlated with lighter sleep, i.e., more N2 and less N3 sleep. In other words, PD subjects with greater motor impairment spend more time in light sleep. In the future, studies might focus on aspects of sleep that may influence the impact of sleep benefit on morning motor symptoms. Further data collection will allow for continuing assessment and control of confounding variables.

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0832

SLEEP AND HEALTH IN MOTHERS AND FATHERS OF VENTILATOR-ASSISTED CHILDREN

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Introduction: Parents of children with chronic illnesses have been reported to have more sleep disruptions, including more night wakings and poorer quality sleep than parents of healthy children. Although caregiving responsibilities may differ between mothers and fathers, few studies have examined whether sleep disruptions and health outcomes differ between these caregivers. The aim of this study is to compare sleep quantity, sleep disturbances, subjective sleep quality and health in mothers and fathers of ventilator-assisted children (VAC).

Methods: Participants included 32 VAC caregivers, with 16 mothers (M age = 43.9 ± 5.7) and 16 fathers (M age = 46.1 ± 7.9). Sleep quality and disturbances were assessed using the Pittsburgh Sleep Quality Index (PSQI); sleep quantity was calculated from the 24-Hour Sleep Patterns Interview (SPI) collected over an average of 2 weeks. Health was assessed using the SF-36. Group differences on subjective sleep quality, quantity, disturbances, and parent health were assessed using independent samples t-tests.

Results: Almost all caregivers (regardless of sex) reported significant sleep disturbances, with 93.8% of the full sample scoring > 5 on the PSQI and 40.6% getting less than 6 hours of sleep. However, there were no significant differences between mothers and fathers on subjective sleep quality, sleep quantity, or disturbances. A trend existed for mothers, who endorsed a better general health perception (M = 69.50) than fathers (M = 52.31), $t(22.39) = 1.824$, ($P = .08$). There was a medium negative, one-tailed correlation between sleep quality and general health perception among mothers ($r = -.468$, $P < .05$), suggesting that mothers with poorer sleep quality have poorer health. No relationship was found between sleep quality and health in fathers.

Conclusion: Regardless of parent role, caregivers of VAC reported clinically significant sleep disturbances and poor sleep quality. Of equal significance, mothers' sleep was associated with poorer health. In light of the caregiving required by chronically ill children, these findings highlight the need for additional research, interventions, and support for all parental caregivers. It is especially important to examine parental sleep patterns, daytime functioning, health and well-being over time.

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0833

SLEEP AND FATIGUE QUALITY IN PEDIATRIC MULTIPLE SCLEROSIS PATIENTS

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Introduction: An estimated 2-5% of MS patients experience their first symptoms before the age of 18 years. The prevalence of sleep problems and its impact on fatigue in pediatric-onset MS is unknown. The objective of this study was to determine if pediatric MS patients have more sleep and fatigue disturbances compared to an age-matched control group.

Methods: Pediatric MS patients (N = 26, ages 13-18) were recruited from the UAB Center for Pediatric Onset Demyelinating Disease (CPODD) clinic. Healthy control subjects (N = 20, ages 13-18 years) were recruited from siblings of MS patients and outpatient clinics at Children's Hospital. Sleep disorders were evaluated using the Modified Epworth Sleepiness Scale (mESS), where a score ≥ 10 indicates excessive daytime sleepiness. Sleep quality was measured using the Adolescent Sleep Wake Scale (ASWS) looking at five behavioral dimensions. Sleep hygiene was determined using the Adolescent Sleep Hygiene Scale (ASHS) along six conceptual dimensions. The ASWS and ASHS were assessed on a 6-point scale with higher scores indicating better sleep quality and hygiene, respectively. Fatigue was characterized using the Pediatric Quality of Life (PedsQL) with general, rest/sleep, and cognitive fatigue domains scored from 0 to 4, with higher scores indicating more severe symptoms.

Results: The MS and control adolescents had similar total mESS scores (7.38 vs. 9.00, $P > 0.05$). On PedsQL, MS patients had higher scores for total overall fatigue (1.58 vs. 1.34, $P < 0.05$), the general fatigue subscale (1.44 vs. 1.15, $P < 0.05$), and the cognitive fatigue subscale (1.53 vs. 1.26, $P < 0.05$). Rest/sleep fatigue scores were similar among the two groups (1.78 vs. 1.60, $P > 0.05$). The MS patients had higher scores on the "going to bed" behavioral dimension (3.84 vs. 3.24, $P < 0.05$) on the ASWS, and the physiologic conceptual dimension (4.67 vs. 4.13, $P = 0.050$) on the ASHS, while all other dimensions were similar between the two groups.

Conclusion: Pediatric MS patients had better sleep quality and hygiene compared to age-matched controls. However, they reported similar levels of excessive daytime sleep and were similar to the control groups in the rest/sleep domain of PedsQL. Moreover, despite better sleep habits, pediatric MS patients reported more total, general, and cognitive fatigue, suggesting factors other than sleep disorders contribute to this important symptom in pediatric MS.

0834

ARE HALLUCINATIONS IN PRIMARY NARCOLEPSY DIFFERENT FROM PARKINSON'S DISEASE ?

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Introduction: Because narcolepsy and Parkinson's disease (PD) are two neurological diseases associating hallucinations, and disturbances of dream and REM sleep, we compared the hallucinations in both diseases.
Methods: We face-to-face interviewed 200 consecutive patients, including 100 patients with primary narcolepsy with/out cataplexy and 100 patients with PD about the frequency, type (minor, formed, uni- or multimodal, elaborate), and content (visual, auditory, tactile, motor, human, animals) of hallucinations, as well as their risk factors, insight, time association with sleep, wake, and sleep paralysis, and the strategy to avoid them.
Results: Hallucinations were more frequent in narcolepsy (45%) than in PD (26%). Compared to PD, they were as frequently visual, but more frequently auditory and motor, complex and holistic (associating several sensorial modes) in narcolepsy, and more often associated with sleep onset/offset. They also occurred while wide wake in 40% narcoleptics and 54% patients with PD. Narcoleptics (unlike patients with PD) had reduced immediate insight during the hallucinations, but psychosis was exceptional (2%), transient, and built on hallucinations in both groups. Sleep paralysis and REM sleep behavior disorder (RBD) were risk factors for hallucinations in narcolepsy. When the PD and narcolepsy groups were merged, only the presence of RBD and excessive daytime sleepiness (but not the nature of the disease, age, and gender) made the patients more vulnerable to develop hallucinations.
Conclusion: The more frequent and dreamlike aspect of hallucinations in narcolepsy (compared to PD) could transiently impairs the insight. The association of hallucinations with sleepiness and RBD suggests that they stem from a common mechanism (a phasic manifestation of REM sleep) in PD and narcolepsy, the visual hallucinations in PD being a "forme frustre" of the complex hallucinations of narcoleptics. The fact that orexin deficiency is partial in PD, while it is complete in narcolepsy, may explain these differences.
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0835

EFFECTS OF PARKINSON'S DISEASE ON EEG COUPLING DURING SLEEP

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Introduction: If two oscillatory processes are weakly coupled, they can become phase synchronized. Phase synchronization (PS) has been studied in cardio-respiratory data, gait dynamics, and brain wave data focusing on epilepsy, Alzheimer's disease, and Parkinson's disease (PD). The degree of PS was suggested to distinguish physiologically different states or pathologies. Most studies focused on the coupling of similar frequencies while the coupling structure between different frequency components is hardly studied and understood. Here we investigate the effects of PD on both types of coupling during sleep employing standard PS analysis and a novel cross-modulation (CM) analysis technique.
Methods: We analyze 40 full-night polysomnographic recordings (duration 7.9 ± 0.5h) from 10 patients with Parkinson's disease (PD, age 62.4 ± 4.4 years) and 10 age-matched healthy controls (age 61.3 ± 6.1 years). EEG data from three locations (C3-M2, C4-M1, and O1-M2) are band-pass filtered separating six components (δ1, δ2, θ, α, σ, and β band) as well as different sleep stages. One amplitude and one frequency signal is obtained from each lead and each band. Inter-signal coupling is quantified by standard PS analysis (corresponding bands only) and CM analysis (all band combinations). Results from PD patients and healthy controls are compared and indexes indicating significant differences between both groups are identified.
Results: We find that PS between the left and right hemisphere of the brain is characteristically reduced for all six bands in PD patients compared with healthy controls, while there is no significant reduction for data taken from the same hemisphere. This suggests a relation with problems in coordinated motion of left and right limbs often observed in PD patients. The advanced cross-modulation analysis yields an even more significant decrease of component coupling in PD patients not limited to data from different brain hemispheres.
Conclusion: Effects of PD on the brain can be identified and quantified studying sleep EEG data without monitoring gait or tremor. Compared with PS, CM analysis identifies stronger differences between PD patients and healthy controls. It might thus pave the way to an improved PD diagnostics and rating.
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0836

ULTRADIAN, HOMEOSTATIC AND MICROSTRUCTURAL MODULATION OF ICTAL EVENTS IN NOCTURNAL FRONTAL LOBE EPILEPSY

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Introduction: Nocturnal Frontal Lobe Epilepsy (NFLE) is characterized by motor events which occur almost exclusively in NREM, particularly in stage 2 (S2). It is known that sleep is disturbed by ictal and interictal phenomena which in turn promote sleep instability. Whether these epileptic events are distributed randomly along the night or are ordered in specific patterns remains to be explored.
Methods: A group of 37 patients with NFLE (20 males; 31 ± 10yrs). Inclusion required patients to show at least one video-recorded paroxysmal event during polysomnography (PSG). Quantification of nocturnal events evaluated their distribution in sleep stages, sleep cycles, and Cyclic Alternating Pattern (CAP).
Results: A total of 139 motor events supported by video-PSG evidence were counted. 136 events occurred in NREM and 3 in REM. No event emerged from stage 1, 38 events from S2 and 98 from slow wave sleep (SWS). 60 events (48 from SWS) occurred in the sleep cycle 1, 43 (28 from SWS) occurred in sleep cycle 2, 23 (14 from SWS) in sleep cycle 3, 8 (5 from SWS) in sleep cycle 4 and 3 (all in SWS) during sleep cycle 5. 90.4% of total events occurred during CAP sequences and all but one in phase A.
Conclusion: This study confirms the powerful modulation exerted by the ultradian process on ictal events. However, SWS seems to be the real trigger of motor events in NFLE. In effect, motor attacks appear to be strongly influenced by the homeostatic pressure of SWS which expo-

nentially declines across the night. Motor phenomena are also affected by unstable sleep with a dominant activating role played by phase A. The permissive action played by SWS and by phase A can be explained by the common neural pathways (frontal cerebral regions) shared by physiological sleep mechanisms and NFLE.

0837

PARKINSON PATIENTS CARE ABOUT IMPROVING THEIR SLEEP DIFFICULTIES: DO WE CARE?

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Introduction: Parkinson's disease (PD), the second most prevalent neurodegenerative disorder, is caused by progressive dopaminergic depletion in the brain. Historically viewed as a motor disorder, PD is now recognized as a complex, multi-system disorder associated with several "non-motor" symptoms (i.e., cognitive, emotional, and sleep difficulties). Previously our center showed that sleep disturbances affect about 75% of Parkinson patients. The purpose of this study was to determine how much importance this patient subset places on improving their sleep relative to other major symptoms of PD.

Methods: The Patient-Centered Outcome Questionnaire-Modified (PCOQ-M), a 40-item questionnaire rated on a 100 point scale, was administered to a convenience sample of 159 idiopathic Parkinson patients seen through the UF Movement Disorders Center. The subset of patients with sleep difficulties (N = 92) used in this study was determined by responses > 10 to the PCOQ-M item, "What is your usual level of difficulty with sleep?" The PCOQ-M also asked how important ten symptoms were to improve (e.g., "How important is it for you to see improvement in your sleep"). This section included 4 motor (tremor, stiffness in limbs, slowness in movement, walking) and 6 "non-motor" (pain, fatigue, emotional distress, interference with daily activities, thinking, and sleep) symptoms that severed as the independent variables. Ratings served as the dependent variables in a one-way repeated measures ANOVA.

Results: Analysis revealed that these Parkinson patients rated some symptoms as significantly more important to improve than others [Wilks' $\Lambda = .70$, $F(9,75) = 3.50$, $P < .01$, $\eta^2 = .30$]. Followup planned contrasts revealed that sleep improvements, M = 71.46 (3.22), were rated as more important than improvements in motor, M = 63.58 (3.30); $t = 3.36$, $df = 84$, $P < .01$, and other "non-motor" symptoms, M = 59.28 (3.26); $t = 4.35$, $df = 84$, $P < .001$.

Conclusion: Significantly, Parkinson patients with sleep difficulties reported that sleep improvements were more important than improving motor and other "non-motor" symptoms. This finding suggests a need for the development of patient-centered treatment approaches for PD that better incorporates sleep management into these patients' standard care.

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0838

POLYSOMNOGRAPHIC FEATURES PECULIAR TO NOCTURNAL FRONTAL LOBE EPILEPSY: DIFFERENTIAL DIAGNOSIS WITH OTHER SLEEP DISORDERS

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Introduction: Nocturnal Frontal Lobe Epilepsy (NFLE) is characterized by EEG abnormalities and motor events that impair sleep quality. While knowledge is growing on the phenomenology of motor behaviour, limited attention has been dedicated to the dynamic organization of sleep in NFLE. This study aims at assessing the structure of sleep in untreated patients with NFLE compared to normal controls.

Methods: Among a group of 80 patients with NFLE, 37 (20 males; 31 ± 10 yrs) with at least one video-recorded paroxysmal event were included in the study. Both conventional and cyclic alternating pattern (CAP) polysomnographic (PSG) variables were measured. A t-test was used for statistical analysis.

Results: Compared to controls, NFLE patients spent more time awake although sleep efficiency and total sleep time were not significantly different. In NFLE recordings slow wave sleep (SWS) was significantly longer, while stage 2 and REM were significantly shorter. NFLE was also characterized by a significant delay of REM latency, some SWS close to final awakening and abrupt shifts from deep sleep to wakefulness. CAP time and CAP rate were significantly enhanced in NFLE patients, who also presented more CAP cycles and longer CAP sequences. All phase A subtypes were increased in NFLE recordings, but the percentages of A1, A2 and A3 subtypes did not differ compared to controls.

Conclusion: The long REM latency, the increased amount of SWS, and the occurrence of rapid upward shifts from SWS to wakefulness, are unusual PSG findings in medication-free subjects. As for NFLE, other sleep disorders, are associated with high amounts of CAP rate but they are associated with a reduction of SWS and selective increases of subtypes A phases. In conclusion, simply looking at a conventional sleep histogram, we can immediately suspect a diagnosis of NFLE. A more accurate investigation of the sleep variables can shed further light on this nocturnal disorder.

0839

SUBTYPES OF SLEEP PROBLEMS IN PATIENTS WITH ALZHEIMER'S DISEASE

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Introduction: Sleep problems in patients with Alzheimer's disease are among the most troublesome aspects of the disease for caregivers. Little is known about the patterns of sleep problems in Alzheimer's disease. Knowledge of patterns of sleep problems may inform the development of treatments for sleep problems for patients with Alzheimer's disease.

Methods: Caregivers of patients with Alzheimer's disease rated patient behaviors during evaluation at a memory disorders clinic on five sleep-related behaviors: behavior worsening in the evening, difficulty falling asleep, frequent nighttime awakenings, early morning awakenings, and excessive daytime sleepiness. Ratings defined subgroups with patterns of sleep problems using latent class analysis (LCA). The probability of class membership related to patient and caregiver depression.

Results: Data from 407 patients with Alzheimer's disease were available. Evaluation of model fit (chi-square goodness of fit and Bayesian information criterion statistics) suggested that three classes represented patterns of sleep disturbance in the data. Three patterns were found: (1) little or no sleep disturbance (n = 183, or 45% of patients); (2) moderate levels of sleep disturbance with greater probability of evening worsening of behavior (n = 138, or 34%); and (3) severe sleep disturbance with a high probability of frequent nighttime awakenings (n = 85, or 21%). Probability of being in the type with frequent nighttime awakenings was related to caregiver depression, while probability of membership in the type with worsening in the evening was related to patient depression.

Conclusion: Distinct patterns of sleep disturbance can be identified in patients with Alzheimer's disease. Worse behavior in the evening and frequent nighttime awakenings are especially relevant. These patterns can be related to patient and caregiver depression. Results may be helpful in developing treatments for sleep disturbance in Alzheimer's disease.

Support (If Any): Florida Department of Elder Affairs

0840

THE EFFECT OF AGE ON NEUROCOGNITIVE ABILITY IN PEOPLE WITH NEURODEGENERATIVE DISORDERS

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Introduction: Neurocognitive ability changes with age, with neurocognitive performance such as reaction time and attention decreasing typically with increasing age. Changes in neurocognitive function are also common in neurodegenerative disorders. The aim of this study was to examine Psychomotor Vigilance Task (PVT) performance in patients with neurodegenerative disorders.
Methods: N = 17 participants with mood disorders (10m, 7f, aged 49-90y) completed an overnight in-laboratory assessment protocol which included three PVT trials, each lasting 10 minutes. The first trial was 6 hours before habitual bedtime, the second was 3 hours before habitual bedtime and the final one was given when sleep deprived for 1.5hrs. The participants remained in the laboratory with light levels < 50lux. The outcome variables analysed were lapses, meanRT, fastest10%RT and 1/RT slowest10%. Repeated-measures analysis of variance was performed to investigate the effect of the PVT performance while controlling for age. Trend analysis was employed to investigate the changes in performance at different time points of circadian phase. Two age groups were used: 49-65y (n = 8; 5m, 3f) and 66-90y (n = 9; 5m, 4f).
Results: There was a significant effect of age on the number of lapses ($F = 4.00$, $P < 0.05$), with the older participants having a greater average number of lapses across the 3 testing sessions. In addition, there was a significant age effect on the fastest 10% of RT, in favour of the younger group ($F = 5.24$, $P < 0.05$). Median RT decreased over time in both participant groups.
Conclusion: In the present study, we bound an average age related decline in neurocognitive performance, suggesting psychomotor slowing. In addition, acute sleep deprivation (1.5hrs) in these participant groups had further effects on PVT performance. This finding suggests that older participants with neurodegenerative disorders may be more vulnerable to the negative effects of even mild sleep loss.
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0841

STABILITY OF SLEEP PROBLEMS IN PATIENTS WITH ALZHEIMER'S DISEASE

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Introduction: Sleep problems in patients with Alzheimer's disease are among the most troublesome aspects of the disease for caregivers but little is known about their stability over time. Additional information would be useful to clinicians in deciding how to intervene with these patients.
Methods: Caregivers of patients with Alzheimer's disease rated patient behaviors during evaluation at a memory disorders clinic. Ratings include five sleep-related behaviors: behavior worsening in the evening, difficulty falling asleep, frequent nighttime awakenings, early morning awakenings, and excessive daytime sleepiness. Patients were evaluated at approximately six-month intervals on three occasions. Latent transition analysis (LTA) was used to evaluate the pattern and stability of patient sleep problems at each clinic visit.
Results: Data from 407 patients with Alzheimer's disease were available for analysis. Sleep problems varied substantially over time. At the first evaluation visit, three subtypes could be identified, including groups with little sleep disturbance, with moderate sleep disturbance and evening worsening of behavior, and with severe sleep disturbance and frequent nighttime awakening. Patients in the first group had about a 30-40% probability of remaining in this group at the subsequent two visits, with moderate probabilities of transitioning to the moderate or severe patterns. Those with moderate or severe sleep disturbance by contrast showed probabilities of transitioning to other patterns of sleep disturbance that ranged from 20 to 40%.
Conclusion: Results of this study suggest that sleep disturbance in patients with Alzheimer's disease, at least as reported by caregivers, has a substantial likelihood of changing over time. Clinicians may consider this issue in choosing to intervene with these patients.
Support (If Any): Florida Department of Elder Affairs

0842

THE EFFECTS OF CARBAMAZEPINE VS. EVETIRACETAM ON SLEEP IN CHILDREN WITH PARTIAL EPILEPSY

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Introduction: Sleep complaints are common among children with epilepsy, and this study examines the differences in sleep effects of levetiracetam, a newer anticonvulsant, compared to carbamazepine, an older anticonvulsant. Practice patterns over the last five years have seen a shift to initial monotherapy with Levetiracetam replacing carbamazepine in clinical use for partial seizures in children.
Methods: 11 patients with epilepsy on monotherapy of levetiracetam were gender and age matched to patients with epilepsy on monotherapy of carbamazepine, patients newly diagnosed with epilepsy not yet on medication, and normal patients without any neurologic deficits. The 111-question Pediatric Sleep Questionnaire was used to assess sleep habits and patterns, and each patient received scores for excessive daytime sleepiness, insomnia, narcolepsy, parasomnias, restlessness, and sleep apnea. These areas were summed for a total score of sleep disturbance.
Results: Nonparametric analysis showed that mean rank of the total score of sleep disturbance for the patients on levetiracetam monotherapy (22.86),was significantly lower than the total scores of patients on carbamazepine monotherapy (31.73). Also, the total scores of the patients on levetiracetam monotherapy, carbamazepine monotherapy, and patients newly diagnosed with seizures (24.00) were each significantly higher than normal control patients (11.41). Kruskal-Wallis one-way analysis of variance $P = 0.003$.
Conclusion: This study suggests that monotherapy with levetiracetam has fewer and less severe sleep effects than monotherapy with carbamazepine. Further study is necessary to determine the scope of these effects with a larger subject sample.

0843

ORTHOSTASIS ACROSS PARKINSONIAN SYNDROMES ASSOCIATED WITH LOWER MWT-DEFINED ALERTNESS

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Introduction: Autonomic dysfunction, such as orthostasis, is highly characteristic of many Parkinsonian syndromes, however, it is unclear to what extent such a phenomenon may overlap with impaired daytime alertness.
Methods: Pts were idiopathic PD (n = 26), Lewy Body Dementia (n = 7), Idiopathic RBD (n = 5) and Multisystem Atrophy (MSA) (n = 3). We conducted 583 measurements of orthostasis (X = 14.2 assessments per case) over a 48-hour sleep lab protocol of 2 PSG nts followed by 2 days of 4-nap MWT. MWT duration was held constant at 40 minutes; we scored sleep efficiency (SE) on each nap. BP measurements were made after each MWT and on 7 other occasions (e.g., postprandially). We defined orthostasis as a systolic BP (SBP) or diastolic (DBP) drop of > 19 or > 9 mm Hg, respectively, at 3 minutes after standing.
Results: MSA patients showed predictably larger drops in SBP (46.1 vs 3.8, $t = 7.53$, $P = < .0001$) and DBP (25.7 vs - 1.7, $t = 5.78$, $P = < .0001$) than all other groups and were excluded from further analyses. Among

remaining pts, orthostasis was observed on 27/256 MWT occasions. SEs were significantly higher (49.5% vs 33.2%, t = 2.54, P = .01) on these MWTs than after non-orthostatic MWTs. Drops in SBP were significantly greater for measurements occurring after meals (n = 284) than for those after MWTs (n = 256) (6.6 vs. 0.6 mg Hg, t = 5.04, P = < .0001).
Conclusion: These data indicate that impairments in MWT-defined alertness were related to conventionally defined orthostasis, seen most dramatically after meals but also present after 40 mins of controlled bedrest. We interpret these results to suggest an association between level of MWT-defined arousal and autonomic dysfunction in Parkinsonism.
Support (If Any): R01 NS-050595; KL2 RR-025009 (ACTSI); Consolidated Anti-Aging Consortium

0844

HOUR-TO-HOUR FLUCTUATIONS IN DIGIT SPAN (DS) PERFORMANCE IN PARKINSON'S DISEASE (PD): RELATION TO MWT-DEFINED ALERTNESS

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Introduction: Fluctuation in mental status is characteristic of Parkinsonism and often noted by family members. Motor impairments of the condition preclude conventional measurements (e.g., PVT). We examined variability in performance in relation to alertness using a verbally administered task involving both attention and memory.
Methods: 26 non-demented (X MMSE = 28.8) PD patients underwent a 48-hour sleep lab protocol of 2 PSG nts followed by 2 days of 4-nap MWT. Duration of MWTs was held constant at 40 minutes; we scored both sleep latency (SLAT) and sleep efficiency (SE) of each nap and obtained means across naps. Prior to each MWT, each patient underwent conventional, verbally presented DS with ascending increments of randomly presented digits, first Forwards (DS-F) and then Backwards (DS-B). Scores were maximum number of digits recalled.
Results: Mean DS-F and DS-B completed were 7.2 and 5.2 digits, respectively. Mean performances were unrelated to MMSE, SLAT or SE. We also examined fluctuation in performance (calculated as highest minus lowest within each patient). Over 48 hours, DS-F varied 1 - 5 digits (X = 2.1) and DS-B varied 1 - 4 digits (X = 2.7). DS-F fluctuation was unrelated to either MWT measure. Greater DS-B fluctuation was associated with shorter SLAT (rho = -.64, P = .0005) and higher SE (rho = .67, P = .0002). Caregiver-based Mayo Fluctuations Scale related to DS-B fluctuation (r = -.43, P = .04) but not DS-F fluctuation, nor MWT.
Conclusion: Digit Span Backwards represents a complex task of both attention and memory, particularly difficult for PD patients. Although absolute performances were unrelated to alertness, variability in performances was. These data provide validation for caregiver recognized fluctuation in mental status over the 24-hour day in PD and suggest that lack of alertness on the MWT may be a valid indicator of such effects.
Support (If Any): R01 NS-050595; KL2 RR-025009 (ACTSI); Consolidated Anti-Aging Consortium

0845

SLEEP EFFICIENCY OF PATIENTS WITH PARKINSON'S DISEASE PREDICTS THEIR PARTNERS' DAYTIME SLEEPINESS

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Introduction: Parkinson's disease (PD) patients commonly experience sleep disturbances and have considerably low sleep efficiency (SE). Sleep disturbances and daytime sleepiness are also common in partners of PD patients. Studies using subjective measures of sleep report associations between PD patients' sleep disturbances and partners' poor sleep, with partners' depression being the strongest predictor of their own poor sleep. To our knowledge, no studies have evaluated relationships between partners' daytime sleepiness, partners' depression, and objective measures of patients' sleep. It was hypothesized that low SE in PD patients would be associated with daytime sleepiness in their partners, after controlling for partners' depression.
Methods: As a part of a larger study, 22 PD patients (Men = 18; Mean Age = 69yrs, SD = 7.84, Range = 53-83yrs) and their partners (Mean Age = 66yrs, SD = 9.92, Range = 41-81yrs) were evaluated. Patients' SE was calculated from overnight polysomnography. Partners' daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS). Partners' depression was assessed with the Beck Depression Inventory (BDI). Pearson correlations were used to examine relationships between patients' SE and partners' ESS and BDI. Linear regression analysis was used to evaluate a model predicting partner's ESS scores using patients' SE and partners' BDI scores.
Results: Bivariate associations revealed a significant positive correlation between partners' ESS scores and their own BDI (r = 0.50; P = 0.016), and a significant negative correlation between partners' ESS and patients' SE (r = -0.65; P = 0.001). In the multiple regression model, patients' SE significantly predicted partners' ESS scores (β = -.552, t = -3.23, P = .004), while partners' BDI was not a significant predictor of their own ESS scores (β = .302, t = 1.766, P = .093). The model explained a significant proportion of variance in partners' ESS score [R2 = 0.502, F(2, 21) = 9.57, P = 0.001].
Conclusion: Although preliminary, results suggest that SE of PD patients is a significant and strong predictor of partners' daytime sleepiness after controlling for partners' mood. In other words, partners of PD patients with worse SE reported significantly more daytime sleepiness independent of their own depression.
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0846

THE RELATIONSHIP BETWEEN SEDATIVE HYPNOTICS USE AND FUNCTIONAL RECOVERY IN OLDER PATIENTS UNDERGOING INPATIENT POST-ACUTE REHABILITATION

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Introduction: Sedative hypnotics are commonly prescribed for patients with insomnia, including those undergoing inpatient post-acute rehabilitation (PAR). When used by older adults, these medications have been associated with daytime drowsiness. In prior research, we found that increased daytime sleeping during PAR is associated with worse immediate and long-term physical functional recovery. The purpose of this study was to determine whether use of sedative hypnotics is associated with functional recovery among older people undergoing PAR.
Methods: We examined data for older patients (aged > or = 65 years, N = 245) admitted for inpatient PAR at two sites (one community and one Veterans Administration). Using multiple linear regression, we modelled the relationship between number of sedating medications and functional recovery (using the motor component of the Functional Independence Measure). Our model adjusted for demographics (gender, age, race), rehabilitation factors (type of rehabilitation, facility

type, minutes of therapy received), comorbidity (Geriatric Depression Scale, Geriatric Pain Measure, Mini-Mental Status Exam, medical illness composite score, length of acute hospitalization), sleep measures (actigraphically estimated daytime and nighttime sleep [in minutes] and Pittsburgh Sleep Quality Index [PSQI]), use of continuous airway pressure, and daytime light exposure (by actigraphy). We also included interaction terms between number of sedating medications and daytime sleep and PSQI.

Results: We found no significant relationship between number of sedating medications (mean = 1.14, SD = 0.81) and functional recovery (P = .532), even after accounting for differential effects of sleep medications on patients with varying levels of daytime sleepiness (interaction term P = .231) and baseline sleep quality, as measured by the PSQI (interaction term P = .178).

Conclusion: Sedative hypnotics have been associated with adverse effects such as daytime drowsiness, but we found no evidence that use of these medications is associated with either improved or impaired functional recovery in older patients undergoing post-acute rehabilitation.

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0847

SLEEP MANIFESTATIONS OF VOLTAGE-GATED POTASSIUM CHANNEL AUTOIMMUNITY

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Introduction: Voltage-gated potassium channel (VGKC) autoimmunity is increasingly recognized in association with a spectrum of neurologic and sleep disorders. The objective of this study was to identify sleep manifestations of this condition.

Methods: We searched the medical record system of Mayo Clinic, Rochester, MN, for all patients with VGKC autoimmunity who were evaluated in the Center for Sleep Medicine. Included patients had a neurologic disorder recognized within the spectrum of VGKC autoimmunity and were seropositive for VGKC autoantibodies.

Results: 14 patients were identified. All subjects experienced onset of sleep complaints coinciding with development of neurologic symptoms. 5 subjects had clinical, radiographic, and neurophysiologic features of limbic encephalitis, 3 were characteristic of Morvan syndrome, and 6 were not clearly classifiable as either disorder. Moderate to severe insomnia was present equally in each of these patient populations, and occurred overall in 9 cases (64%). Polysomnography at initial presentation was available for 11 patients and revealed a median sleep efficiency of 55%, including 3 cases with complete absence of sleep. Dream enactment behavior was reported by 9 patients (64%), but more commonly with limbic encephalitis (80%). Polysomnography was available in 7 of these cases and demonstrated REM sleep without muscle atonia in 3 patients; interpretation was limited in 3 others by absent/minimal recorded REM sleep. Sleep disorders improved dramatically with immunotherapy in 8 of 10 cases. The mean VGKC autoantibody value at initial presentation was 1.51 nmol/L (range 0.09 to 4.86 nmol/L). Neoplasms were discovered during follow-up in 5 cases (36%) [thymoma (2), prostate adenocarcinoma (1), colon adenocarcinoma (1), and melanoma (1)].

Conclusion: Insomnia and REM sleep behavior disorder are important considerations in patients with VGKC autoimmunity and occur in association with a spectrum of neurologic presentations. Sleep disorders affiliated with VGKC autoimmunity generally respond favorably to immunotherapy.

0848

THE EFFECT OF MINDFULNESS MEDITATION ON SLEEP FOR DIABETIC PERIPHERAL NEUROPATHY

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Introduction: Diabetic peripheral neuropathy (DPN) affects between 26-47% of diabetic adults. Although not all DPN sufferers develop complications, many experience painful symptoms that are especially bothersome at night. This pilot RCT explored the effect of mindfulness meditation on quality of life, pain and sleep.

Methods: A convenience sample of 22 participants was recruited from several locations in New Jersey and Pennsylvania. Participants were randomly assigned to either the experimental or control group. The treatment group received instruction in mindfulness meditation and was instructed to listen to a guided compact disc 5 days/week over a 4-week period. The control group received nutritional information and was asked to maintain a food diary for 4 weeks. Both groups were followed by telephone weekly. Data was collected at baseline and again in 4 weeks using a demographics' form, Neuropathic Pain Scale (NPS), Neurology-Specific Quality of Life tool (NeuroQoL), and the Pittsburg Sleep Quality Index (PSQI).

Results: Twenty participants (10 in each group) completed the study. No significant differences were noted between the groups on any measure. However, reasonable differences between the means were found on two constructs: painful symptoms and symptom-related QoL. The intervention group performed better than the controls in both instances. Further, a moderately strong positive relationship was found between symptom severity and sleep quality (n = 16, Pearson r = .53, P = .043). Higher scores for pain on the NeuroQoL correlated with higher scores on the PSQI.

Conclusion: Although mindfulness meditation was not beneficial in improving quality of life, sleep, or pain, the findings suggest that neuropathic pain negatively impacts sleep. Research examining symptoms over an extended period would give insight into the variability of symptoms and effectiveness of mindfulness meditation on sleep in this population. Further, a larger sample may show significance on the two constructs that had differences.

0849

EVALUATION OF SLEEP QUALITY IN OIF/OEF VETERANS WITH A HISTORY OF BLAST EXPOSURE

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Introduction: Mild traumatic brain injury (mTBI) secondary to blast exposure is an increasingly common problem for veterans returning from the conflicts in Iraq and Afghanistan (OIF and OEF veterans). Sleep disturbances and neuropsychological complaints are common in mTBI patients. While certain features of mTBI such as memory impairment, poor concentration and irritability are difficult to treat directly; sleep problems are potentially quite treatable. However, a significant barrier to treatment is the lack of knowledge regarding the interaction between neuropsychological function and sleep quality in this population.

Methods: As part of an ongoing study involving 52 OIF/OEF veterans comparing neuropsychological function in blast and non-blast exposed veterans, the PSQI was administered to determine whether blast exposed OIF/OEF veterans had decreased sleep quality compared to non-blast exposed veterans. Further analysis was conducted to determine whether decreased sleep quality as measured by the PSQI was correlated with other measures of neuropsychological dysfunction.

Results: Among the 52 cases completing the PSQI there was a significant difference between the mean PSQI scores which were as follows:

blast exposed 12.9 (95% CI (11.3-14.5)) compared with non-blast exposed 7 (95% CI (2.2-11.8)) at a P = 0.01. In addition, blast exposed veterans also reported higher rates of problems with executive function (P = 0.01).
Conclusion: While both blast exposed and non-blast exposed OIF/OEF veterans had elevated PSQI scores indicating decreased sleep quality, blast exposed veterans had significantly higher PSQI scores compared to non-blast exposed veterans and this was associated with poorer performance on executive function testing.

0850

CSF MELANIN-CONCENTRATING HORMONE CONCENTRARION IN NARCOLEPSY AND VARIOUS NEUROLOGICAL DISORDERS

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Introduction: Peptidergic neurons containing melanin-concentrating hormone (MCH) and hypocretins (or orexins) are intermingled in the posterior hypothalamic area. Both types of neurons implicate in the integrated regulation of energy homeostasis and body weight. Hypocretin neurons also involve in sleep-wake regulation and their deficiency relate to the pathophysiology of narcolepsy. Luppi et al (2003) indicates that MCH is a powerful hypnogenic factor. They further suggest that MCH-containing neurons play a crucial role in REM sleep homeostasis. Thus, it is also important to study whether neurological disorders have abnormal CSF MCH levels. We therefore measured MCH in the CSF of various neurological disorders and narcolepsy to identify altered MCH levels.
Methods: CSF was collected from patients with (1) inflammatory neuropathy (n = 13), such as Guillian-Barre syndrome (GBS), Fischer syndrome, Bickerstaff's brainstem encephalitis (BBE), (2) multiple sclerosis (MS, n = 8), (3) encephalopathy (n = 7), (4) Parkinson's disease (PD, n = 7), (5) other autoimmune disease (basedow disease, CNS lupus, Neuro-Behcet, sarcoidosis, n = 4), (6) hereditary disease (Mytonic dystrophy, Niemann-Pick type C, n = 4), (7) hypocretin deficient narcolepsy (n = 4), (8) spinocerebellar degeneration (SCD, n = 3), (9) Alzheimer's disease (AD, n = 2), (10) cerebrovascular disorders (CVD, n = 2), (11) progressive supranuclear palsy (n = 2), and (12) anorexia nervosa (n = 1). Patients or families gave informed consent for the lumbar puncture. CSF MCH was measured in crude CSF samples (0.2ml duplicate) using a commercially available radioimmunoassay (RIA) kit (Phoenix Pharmaceuticals). Intra-assay variability was 4.9 % and the detection limit was 25 pg/ml.
Results: The range of MCH levels were 25 - 225 pg/ml and the mean value was 95 pg/ml. MCH mean levels were GBS, Fischer, BBE (110 pg/ml), MS (90 pg/ml), encephalopathy (75 pg/ml), PD (80 pg/ml), other autoimmune diseases (125 pg/ml), hereditary disease (100 pg/ml), narcolepsy (90 pg/ml), SCD (85 pg/ml), AD (50 pg/ml), CVD (130 pg/ml) and progressive supranuclear palsy (60 pg/ml) and AN (85 pg/ml).
Conclusion: The CSF MCH can be measured by using RIA kit. There were no diseases of high or low MCH levels in this preprimary study. The MCH levels of the patients with hypocretin deficient narcolepsy were close to the mean level. Further studies are needed for larger samples.

0851

THE INFLUENCE OF NEUROGENIC BLADDER IN THE SLEEP QUALITY OF PARA-ATHLETES WITH MEDULLARY INJURY

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Introduction: People with medullary injury (MI) may have neurogenic bladder (NB), that is the term given to the malfunction of the urinary bladder due to neurological disorders. This situation may come necessary to use a tube to emptying the bladder, increasing the chance of repetition urinary infections impacting the quality of life and morbimortality. Another important aspect related to the neurogenic bladder is the interference in sleep quality to what has been given little attention in this context. Objectives: Investigate a interference of BN in the quality of sleep, in Wheelchair Basketball (WCB) para-athletes (PA) with MI.
Methods: Cross sectional study during stages of the Brazilian WCB Championship in 2007 and 2009. Were investigated thirty seven PA with MI, males, from several regions of Brazil with a mean age of 30.1 years and average of body mass index of 23. The PA were evaluated in relation to the characteristics of the MI and NB, questionnaire was applied for sleep disorders (SD) and subjective quality of wakefulness.
Results: As to the socio-demographic data, 35% have completed high school, 19% have upper education and 46% are married. As to the characteristics of the MI, all occurred more than 2 years, 60% were taking complete paraplegic, 46% occurred due to firearms, 90% of the PA had BN, 68% make use of probe and 22% presented urinary tract infection in evaluating. The sleep average of this study is seven and a half hours per day. 70% reported SD mainly snoring (30%), and 27% reported sleep fragmentation as a NB with consequence reduction on the subjective quality of wakefulness and daily performance.
Conclusion: This is the first study evaluating the impact of the NB in sleep of PA with MI, disclosing sleep fragmentation in 27% of them, because their nocturnal awakenings due their NB problems.

0852

INCREASED PREVALENCE OF CERVICAL RADICULOPATHY IN SLEEP DISORDERS

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Introduction: We have observed that patients with sleep disorders have an increased prevalence of cervical radiculopathy (CR). Thus, we examined the records of 1076 consecutive patients seen in our sleep center for the presence of cervical radiculopathy.
Methods: 1076 consecutive patients from a neurology practice were suspected of having a sleep disorder requiring polysomnography (PSG) in an accredited sleep disorders center. Patients were divided into the following categories: Obstructive Sleep Apnea (OSA), Upper Airway Resistance Syndrome (UARS), and Other Sleep Disorders (OSD). The presence of CR was diagnosed clinically and electromyographically.
Results: Of the studied patients, 56.6% had CR. Of those patients, 70.4% had OSA, 7.6% had UARS, and 22% had OSD. Of the patients with OSA, 55.4% had CR; with UARS, 69.7% had CR; with OSD, 56.8% had CR. Patients with OSA and CR tended to be older (43.8+- 14.2 vs 38.1+-13.0 years) and had a higher BMI(32.0+-8.3 vs 27.0+-8.9) than those with UARS. Otherwise, no marked differences among the groups with and without CR were noted. Total REM and total NREM times among the groups were unaffected by the presence of CR.
Conclusion: The prevalence of CR in patients with sleep disorders is surprisingly high. A possible reason for this is sample bias from an idiosyncratic patient population (neurology clinic). Against this is the fairly typical prevalence of obstructive sleep disordered breathing (OSDB, 78.1%) found in this population of patients. OSDB and other sleep disorders may affect the structures of the cervical spine through abnormal musculoskeletal pressures in side or prone sleeping during vulnerable periods of sleep, such as during REM atonia. On the other hand, the pro-inflammatory effects of sleep disorders may make the cervical spine more vulnerable to injury both inside and outside the sleep period. The answers to these questions must await further study.

0853

ASSOCIATION OF RESTLESS LEGS SYNDROME/ PERIODIC LIMB MOVEMENT DISORDER AND LUMBAR RADICULOPATHY

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Introduction: We have observed that patients with Restless Legs Syndrome (RLS) or Periodic Limb Movement Disorder (PLMD) have an increased prevalence of lumbar radiculopathy (LR). Thus, we examined the records of 1076 consecutive patients seen in our sleep center for the presence of lumbar radiculopathy.
Methods: 1076 consecutive patients from a neurology practice were suspected of having a sleep disorder requiring polysomnography (PSG). PSG's were carried out in an AASM accredited sleep disorders center. Patients were divided into the following diagnostic categories: RLS, PLMD, Both RLS and PLMD and Other Sleep Disorders (OSD). The presence or absence of clinically and electromyographically diagnosed LR in each of these groups was noted.
Results: Of the studied population, 22.6% had lumbar radiculopathy. Of these patients, 21% had RLS, 3% had PLMD, 7% had both RLS and PLMD, and 69% had OSD. Of the patients with RLS, 28.7% had LR; with PLMD, 36.8 % had LR; with both PLMD and RLS, 29.3% had LR; with OSD, 20.5% had LR. Patients with LR tended to be awake more during their study than those without LR. Otherwise, no marked differences among the groups with and without LR were noted.
Conclusion: The overall prevalence of lumbar radiculopathy found in RLS/PLMD patients is surprisingly high in this study. In addition, the role of LR in RLS is probably underestimated because many patients with RLS alone are not studied with PSG. Whether this represents selection bias in this series, or whether lumbar radiculopathy truly represents a causative factor in many patients with RLS/PLMD, due to nerve root irritation or other factors, is unknown, but the results are exciting, and may have therapeutic implications for the treatment of RLS/PLMD patients.

0854

SLEEP DISORDERS IN MYOTONIC DYSTROPHY TYPE II

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Introduction: Myotonic dystrophy type II (DMII) is an autosomal-dominant, progressive, clinically heterogeneous multisystem disorder involving proximal weakness, prominent myalgias and fatigue, and variable early cataracts, endocrine abnormalities and cardiac arrhythmias. In contrast to myotonic dystrophy type I, little is yet known about sleep disturbances in DMII. We aimed to describe sleep disturbances in DMII.
Methods: Retrospective chart review of all cases of genetically-confirmed DMII seen in the Mayo Center for Sleep Medicine.
Results: Eight patients were evaluated. Complaints of excessive daytime sleepiness (EDS) were present in 5 (63%), and 4 (50%) had fatigue. Mean Epworth Sleepiness Scale (ESS) score was 7.37, and ESS was > = 11 in only 2 of 7 (29%) patients (13, 14). Insomnia was present in 5 of 6 patients (83%). Restless legs syndrome (RLS) was present in 4 of 6 (80%). The 2 remaining patients reported nonspecific nocturnal leg discomfort. Polysomnography (PSG) was performed in 5 patients. Obstructive sleep apnea (OSA) was found in 3 (Apnea-Hypopnea Index = 1, 2, 5, 11, 13), with a mean overall AHI of 6.3. The arousal index was elevated at a mean of 27.06. This remained high at a mean of 30.38 in the 4 patients who underwent positive airway pressure (PAP) titration.
Conclusion: The clinical spectrum of DMII includes a wide range of sleep disorders. In addition to sleep-disordered breathing, RLS and insomnia are frequent, and should be specifically inquired about. An underlying propensity for increased arousals may contribute to the prominent fatigue and EDS. Further, prospective studies are needed to better characterize sleep disorders in DMII.

0855

THE EFFECTS OF TRIPTANS ON RESPIRATORY DYNAMICS AND SLEEP ARCHITECTURE IN PATIENTS WHO SUFFER FROM MIGRAINE HEADACHES

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Introduction: Patients with sleep disorders have a propensity to suffer from migraine headaches. It is unclear if triptans have any effect on respiratory dynamics and sleep architecture as a way of improving treatment outcome in migraine headaches.
Methods: Variables were compared between two groups that suffer from migraine headaches.(Group A: patients using a triptan medication ≥ 1/day during the week proceeding PSG; Group B: No triptan treatment during the preceding week (controls)).
Results: 93 patients were included. When comparing PSG findings between group A and group B, we noted no significant differences in sleep efficiency($P = 0.15$), sleep latency ($P = 0.23$), or time spent with oxygen saturation less than 90% ($P = 0.124$). We noted significant difference in sleep time spent with End-Tidal Co2 (ETCO2) higher than 45mmhg between Group A and Group B (min) 35.56/36.8 vs. 13.84/17.34 ($P = 0.028$).
Conclusion: There were no significant PSG changes in the migraine patient population that utilized triptans. There was however a significant finding of increased end-tidal CO2. A larger prospective study would be needed to determine if this plays a role in the vascular theory of migraine headaches.

0856

EVIDENCE OF SLEEP DYSREGULATION FOLLOWING TRAUMATIC BRAIN INJURY

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Introduction: Individuals who have sustained a Traumatic Brain Injury (TBI) often complain of disrupted sleep. Little research has investigated the neurophysiological underpinnings of these sleep difficulties. We predicted that sleep architecture, phasic events, EEG power, and ERPs would depict a breakdown in sleep regulation in those with a TBI.
Methods: We compared 20 individuals with TBI (Mean age = 29.7, 10 men) to 20 age-matched controls (Mean age = 29.4, 9 men). Apnea and PLMs were excluded on a prior adaptation night. Sleep was recorded with a 20-channel montage on three consecutive nights. Phasic events were visually counted. EEG power was analyzed in the delta (1-4 Hz) and gamma (35-45 Hz, 65-75 Hz) bands. ERPs were measured to pitch oddball stimuli on Night3. Paired-samples t-tests compared matched groups.
Results: TBIs had poorer sleep architecture: on Night1, they had longer SOL; on Night2, they had less Stage2, less TST, lower sleep efficiency, and more movement. TBIs also had fewer K-complexes (both nights). Injury severity was negatively correlated with spindle density in Stages 2 and 3 on Night1. Further, TBIs had less delta power in NREM (Night1: all NREM stages; Night2: early Stage2, Stage4), and more gamma power in late Stage2 on Night2. ERPs showed processing that was faster for TBIs (reduced latencies for: N1 to standard stimuli in pre-sleep wake, Stage2, and SWS; N350 to standard and target stimuli in early Stage2). Amplitude differences at frontal regions showed hyper-attentiveness for TBIs (larger target P300 in pre-sleep wake; smaller P450 to standard stimuli in Stage2; smaller N350 to target stimuli in late Stage2; larger N1 to standard and target stimuli in SWS).
Conclusion: Results support hypotheses of dysregulation in sleep homeostatic mechanisms for TBIs, including measures of sleep efficiency

and information processing. Follow-up analyses will investigate influence of injury severity and type of sleep difficulty.
Support (If Any): Ontario Neurotrauma Foundation (ONF)

0857

ASSOCIATIONS BETWEEN VERBAL MEMORY AND POST-LEARNING SLEEP IN OLDER ADULTS WITH NEUROPSYCHIATRIC DISORDERS; PRELIMINARY RESULTS

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Introduction: Sleep difficulties are thought to be prodromal to cognitive alterations emerging in neuropsychiatric disorders throughout aging. In healthy adults, efficient learning has been shown to induce increases in REM sleep and slow wave sleep during the subsequent sleep episode, and those changes are thought to reflect memory consolidation processes. Hence, sleep disruption associated with neuropsychiatric disorders may contribute to memory deterioration. This study aimed to assess associations between verbal memory and the architecture of subsequent sleep in older adults with neuropsychiatric disorders.
Methods: Five older males (54-82y.o., mean67.9(SD12.4)) with mild cognitive impairment, mood or anxiety disorders underwent an adaptation night before completing the study. Two hours before their habitual bedtime, they performed the Rey Auditory-Verbal Leaning Task (RAVLT: five repetition trials of a 15-item word list, free recall following an interference list and free recall following a 30min delay). After this learning session, PSG was recorded and analyzed through visual scoring. Pearson correlations were applied on RAVLT scores and polysomnographic variables. To correct for multiple comparisons, statistical significance was set at a probability level of $P < 0.01$.
Results: During the post-learning sleep episode, REM sleep (min) there was a significant positive correlation between REM sleep (min) and the RAVLT's number of items recalled on the last learning trial ($P = 0.003$) and the total number of items recall across the five trials ($P = 0.01$). Moreover, stage 3 sleep (min) was positively correlated with the total number of items recalled across the five trials ($P = 0.01$).
Conclusion: These preliminary results suggest that poorer memory performance in older adults with neuropsychiatric disorders may be associated with lower levels of REM sleep and slow wave sleep during post-learning sleep episodes. Therefore, possible disruptions of sleep mediated memory consolidation processes may be associated with the progression of memory decline in older neuropsychiatric populations.

0858

SELF-REPORTED SLEEP SYMPTOMS PREDICT THE DEVELOPMENT OF THE METABOLIC SYNDROME IN COMMUNITY ADULTS

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Introduction: Sleep complaints are highly prevalent and are associated with cardiovascular morbidity and mortality. Several cross-sectional studies have previously reported associations between sleep disturbances, including short sleep duration, poor sleep quality, and snoring with prevalent metabolic syndrome. This is the first study to report prospectively, the degree to which commonly reported insomnia and sleep-disordered breathing symptoms predict the development of the metabolic syndrome in an initially metabolic syndrome -free cohort.

Methods: Participants were drawn from the community-based Heart Strategies Concentrating on Risk Evaluation study. The sample was comprised of 860 participants (37% African American; 67% female) who were free of the metabolic syndrome at baseline, had completed a baseline sleep questionnaire, and had metabolic syndrome evaluated 3 years after baseline. Apnea-hypopnea index (AHI) was measured cross-sectionally using a portable monitor in a subset of 296 participants. Logistic regression models examined the risk of developing the metabolic syndrome and its components according to individual sleep symptoms and insomnia syndrome.

Results: After adjusting for demographic and lifestyle risk factors, self-reported difficulty falling asleep was a significant predictor of the development of metabolic syndrome, but was not a predictor of its individual components. Loud snoring was a significant predictor of both metabolic syndrome and specific components (central adiposity, hypertriglyceridemia, and low high-density lipoprotein cholesterol). Loud snoring was associated with approximately 3-fold increased risk of developing metabolic syndrome, even after adjusting for difficulty falling asleep and AHI. The effect of difficulty falling asleep was reduced to borderline statistical significance, after adjusting for AHI and loud snoring. Insomnia syndrome was unrelated to metabolic syndrome incidence.

Conclusion: Difficulty falling asleep and loud snoring significantly predict the development of metabolic syndrome in community adults. Evaluating sleep symptoms is a cost-effective and easily-disseminated method to identify individuals at risk for developing the metabolic syndrome.

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0859

SHORT SLEEP DURATION IS INDEPENDENTLY ASSOCIATED WITH OBESITY IN WITH TYPE 2 DIABETES

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Introduction: Population studies have indicated that altered sleep duration is associated with obesity. This association has not been studied in type 2 diabetes (T2D) patients. We aimed to assess this association in T2D patients.

Methods: A cross-sectional study of adult T2D patients recruited randomly from the outpatient department of a large UK tertiary centre. Patients with known sleep-related disorders were excluded. Data were collected during one-to-one interviews. Sleep duration assessment: 7-day sleep diary (bedtimes, wake-times, and number and duration of naps). Adiposity assessment: body mass index (BMI), waist (WC) and neck (NC) circumferences and fat mass. Obstructive sleep apnoea(OSA) risk was assessed using the Berlin questionnaire. Other data collected: drug history, smoking, alcohol consumption and blood pressure (BP). Data presented as median(IQR) or percentages.

Results: Eighty-eight patients returned questionnaires (60% response rate): Age 57y(49-65), 57% men, 49% Caucasians, diabetes duration 12y(6-19), BP 129(118-138)/79(72-74)mmHg, BMI 32.8(28.6-36.5) kg/m2, WC 111(101-121)cm, NC 41(38-43)cm, fat mass 37(30-44)%, HbA1c 8(7-9)%, Diabetes therapy: insulin 51%, exenatide 11.3%, oral diabetes agents 85%. Sleep data: Average sleep duration 7.9(7.2-8.9) hours/night, 78% had daytime naps (4 (1-7)naps/week, duration 113(31-330)minutes/week), 79% were at 'high-risk' for OSA. 17%, 62% and 21% had short(< 7), normal(7-9) and long(> 9 hours/night) sleep duration, respectively. A stepwise reduction in BMI and WC was detected between short, normal and long sleepers (BMI: 37.8(32.4-43.1) vs. 32.8(30.7-36.5) vs. 29.8(25.8-35.8)kg/m2, P = 0.03; WC: 119(109-134) vs. 112(103-122) vs. 109(94-118)cm, P = 0.1) Sleep duration correlated negatively with BMI(r = -0.3, P = 0.009) and WC(r = -0.3, P = 0.01) but not with NC or fat mass. Multivariate linear regression, demonstrated that sleep duration remained independently associated with BMI(Beta = -0.333, P = 0.03) but not WC(Beta = -0.233, P = 0.07) after adjusting for age, gender, ethnicity, HbA1c, BP, diabetes treatment, alcohol, smoking, napping, OSA risk and Epworth sleepiness score.

Conclusion: Short sleep duration is independently associated with obesity in T2D patients. Further studies examining the role of short sleep duration in the development of adiposity in T2D are needed.

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0860

PREVALENCE OF INADEQUATE SLEEP IN OVERWEIGHT ADULTS INTERESTED IN WEIGHT LOSS

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Introduction: Inadequate sleep has become increasingly common in modern society. Short sleep has been associated with obesity and weight gain in cross sectional and prospective epidemiological studies. Experimental sleep curtailment has been shown to alter glucose metabolism and satiety and appetite-stimulating hormones in a manner consistent with weight gain. The nature of sleep loss linked to obesity, however, is not well understood. During the recruitment phase for a trial of weight

loss, extensive sleep data were collected from potential participants. The objective of the current analysis is to characterize the sleep characteristics of these individuals.
Methods: A total of 661 (79% women, mean age 50 years) individuals responded to recruitment for a weight loss study, of whom, 291 presented for a clinic screening. Of these, 287 were verified to have eligible BMI (28-40 kg/m2) and were asked to complete the Pittsburgh Sleep Quality Index (PSQI), Global Sleep Assessment Questionnaire, Psychiatric Diagnostic Screening Questionnaire, SF-36, and 1-week sleep log. These assessments were completed by 246 participants (BMI 32.7+/-3.4 kg/m2; mean age 51 years; 80% female).
Results: Insomnia, defined as 1) use of any medication for sleep, 2) sleep onset latency and/or 3) wake after sleep onset > 30 min for 4 or more nights was found in 28.9% of our sample. Short sleep without insomnia, defined as having total sleep < 6.5 hrs per night for 4 or more nights a week, and absence of any insomnia indicators, was found in 18.3% of our sample. The remaining 52.8% did not have either insomnia or short sleep. A limitation of these data is that this was not a random sample of the population, but rather, a population recruited for a weight loss study.
Conclusion: These data demonstrate that a substantial proportion of individuals interested in weight loss have inadequate sleep characteristics that may be a clinical target and adjuvant therapy for obesity treatment.
Support (If Any): NIH.

0861

ELECTROCARDIOGRAM-BASED SLEEP SPECTROGRAM MEASURES OF SLEEP STABILITY AND GLUCOSE DISPOSAL IN SLEEP DISORDERED BREATHING

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Introduction: Sleep-disordered breathing (SDB) is independently associated with insulin resistance, glucose intolerance, and type 2 diabetes mellitus. Experimental sleep fragmentation has been shown to impair insulin sensitivity. Conventional EEG-based sleep quality measures have been inconsistently associated with indices of glucose metabolism. This analysis explored associations between glucose metabolism and an EEG-independent measure of sleep quality, the sleep spectrogram, which maps coupled oscillations of heart rate variability and ECG-derived respiration.
Methods: Non-diabetic subjects with and without SDB (n = 118) underwent the frequently sampled intravenous glucose tolerance test (FSIVGTT) and a full-montage polysomnography. The sleep spectrogram was generated from the ECG.
Results: Standard polysomnographic stages (N1, N2, N3, and REM) were not associated with measures derived from the FSIVGTT including insulin sensitivity, acute insulin response to glucose, or the disposition index. In contrast, spectrographic high frequency coupling (a marker of stable sleep) was positively correlated, and very low frequency coupling (a marker of wake/REM/transitions) was negatively correlated with the disposition index after adjusting for age, gender, apnea hypopnea index and body mass index. Glucose effectiveness and the glucose effectiveness at zero insulin derived from the IVGTT data also correlated with very low frequency proportion and duration.
Conclusion: ECG-derived sleep spectrogram measures of sleep stability are associated with alterations in glucose-insulin homeostasis across the spectrum of SDB. This alternate mode of estimating sleep fragmentation could improve understanding of sleep and sleep-breathing effects on glucose metabolism.
Support (If Any): This work was conducted with support from The Periodic Breathing Foundation; UL1 RR 025005 National Center for Research Resources (NCRR); NIH Roadmap for Medical Research and NIHLBI grants HL083640, HL07578 and AG025553; and a KL2 Medical Research Investigator Training (MeRIT) grant awarded via Harvard Catalyst / The Harvard Clinical and Translational Science Center (NIH grant #1KL2RR025757-01 and financial contributions from Harvard University and its affiliated academic health care centers).

0862

NOCTURNAL HYPOXEMIA IS ASSOCIATED WITH GLUCOSE INTOLERANCE IN CHILDREN WITH CYSTIC FIBROSIS

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Introduction: Patients with cystic fibrosis (CF) can have poor sleep quality and hypoxemia during sleep. In adults, sleep disorders have been associated with abnormal glucose tolerance and inflammation. Patients with CF are at great risk for glucose abnormalities, and these are associated with worsening pulmonary function and nutritional status. We hypothesized that recurrent episodes of hypoxemia during sleep and sleep disruption would be associated with inflammation and glucose intolerance in patients with CF.
Methods: Subjects with CF underwent overnight polysomnography and 14 days of actigraphy. A 3-hour oral glucose tolerance test was performed; blood glucose area under the curve (AUC) and indices for insulin resistance including the Homeostasis Model Assessment (HOMA-IR) and Matsuda-DeFronzo Insulin Sensitivity Index (ISI) were determined. Serum inflammatory markers IL-1β, IL-6, IL-8, IL-10, TNF-α, CRP, sVCAM-1, sICAM-1 and sE-selectin were measured. Impaired glucose tolerance (IGT) was defined as 2-hour blood glucose 140 - 200 mg/dL. CFRD was defined as 2-hr blood glucose ≥ 200 mg/dL.
Results: Twenty-five subjects with CF (aged [mean + SD] 14 ± 4 years, BMI-Z 0.1 ± 0.9) were studied. FEV1 predicted was 92 ± 14%. 28% of subjects had IGT and 4% had CFRD. The mean nocturnal SpO_2 correlated negatively with glucose AUC at 120 minutes ($r = -0.49$, $P = 0.015$). Partial correlations and regression models including age, BMI-Z, SpO_2 and FEV1 indicated that SpO_2 accounted for the majority of the predictive power for glucose AUC ($R^2 = 0.24$, $P = 0.001$).There was no association between SpO_2 and HOMA-IR or ISI. There were no meaningful relationships between sleep quality, inflammation and glucose tolerance.
Conclusion: Even mild nocturnal hypoxemia is associated with glucose intolerance in children with CF, unrelated to insulin resistance. We speculate that hypoxemia may have a detrimental effect on glucose utilization and pancreatic beta cells function.
Support (If Any): Junior Investigator Pilot Grant Program from UL1 RR024134

0863

SLEEP, KIDNEY FUNCTION AND GLUCOSE METABOLISM AMONG PERSONS WITH CHRONIC KIDNEY DISEASE: THE CHRONIC RENAL INSUFFICIENCY COHORT STUDY

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Introduction: Impaired sleep is associated with altered hormonal profiles, including cortisol, aldosterone and renin, which could wors-

en metabolism and promote loss of kidney function in persons with chronic kidney disease (CKD). We examined cross-sectional relationships among measures of sleep, kidney function and glucose metabolism in persons with mild to moderate CKD.

Methods: In an ancillary study of 339 participants from the Chronic Renal Insufficiency Cohort (CRIC) Study, a prospective observational study of nearly 4,000 subjects with CKD, we estimated sleep duration and fragmentation using wrist actigraphy over 5 consecutive days. Participants also answered questions about snoring frequency. Outcome measures included estimated glomerular filtration rate (eGFR) derived from the MDRD equation (higher levels indicate better kidney function), fasting glucose levels, and insulin resistance estimated from the homeostatic model assessment (HOMA).

Results: The mean age (SD) was 59 (11) years, 53% were female, 47% were non-Hispanic white, 46% were non-Hispanic black, 47% had diabetes and 46% reported frequent snoring. Mean (SD) sleep duration was 6.2 (1.4) hours and mean sleep fragmentation was 23.5 (10.3)%. Means (SD) of outcome measures were: 37.4 (14.9) ml/min/1.73m2 for eGFR, 112.9 (47.0) mg/dl for glucose, 6.5 (9.2) for HOMA. Regression models adjusting for age, race, sex and diabetes indicated that both sleep duration (beta = 1.25 ml/min/1.73m2 per hour of sleep, P = 0.03) and fragmentation (beta = -2.71 ml/min/1.73m2 per 10% of fragmentation, P = 0.001) were associated with eGFR. Greater sleep fragmentation was also significantly associated with higher fasting glucose (beta = 5.2 mg/dl per 10% of fragmentation, P = 0.026), and a trend for greater insulin resistance (beta = 0.9 per 10% of fragmentation, P = 0.066). Snoring was not associated with any of the outcomes.

Conclusion: Short and poor quality sleep were associated cross-sectionally with worse kidney function and disturbances in glucose metabolism among patients with CKD. The role of impaired sleep in the progression of CKD deserves further study.

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0864

CLINICAL SLEEP VARIABLES IN PATIENTS WITH PAINFUL DIABETIC PERIPHERAL NEUROPATHY

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Introduction: Diabetes Mellitus is a complex disease with many complications, including painful diabetic peripheral neuropathy (DPN). Patients with painful DPN often report that pain has a severe impact on their sleep and complaints such as insomnia and excessive daytime sleepiness are thought to be common in this patient group. Neuropathic pain, apnoeas and/or periodic limb movements (PLM) may all affect the quality of sleep. The aim was to investigate the prevalence of above factors and how they may interfere with sleep quality.

Methods: 83 type 1 and 2 diabetic patients (57 male, 26 female, mean age 65 ± 9 yrs, mean BMI 32kg/m2) with painful DPN entered the study. Clinical sleep was assessed using full polysomnography. Subjective pain was measured using the Brief Pain Inventory (BPI) and daytime sleepiness was assessed by the Karolinska Sleepiness Scale (KSS).

Results: Patients with painful DPN (mean pain severity of 3 ± 2) had a sleep efficiency of 78% ± 10.0 %. Clinically, sleep was characterised by an apnoea/hypopnoea index (AHI) of 4 ± 5, with less than 1 (± 1) respiratory arousal/hour. Over 30% of patients had mild sleep apnoea (AHI > 5). Patients had a mean of PLM index of 18 ± 20 and 40% of patients had an index > 15. Only 2 ± 2 PLM/hour were associated with arousals. Patients reported an average daytime sleepiness score (KSS) of 5 (± 2).

Conclusion: The results suggest that the sleep of patients with painful DPN is poor. The PLM index was clinically significant in 40% of the patients and over 30% of patients had mild sleep apnoea. The incidence of both apnoeas and PLMs is higher than reported in the normal population. There was no association however between clinical sleep variables and arousals. It is therefore likely that diabetes and/or neuropathic pain is contributing to the poor sleep seen in these patients.

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0865

HOW DO SLEEP BEHAVIORS AND VALUES RELATE TO PERCEIVED SLEEP QUALITY AND HEALTH OUTCOMES

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Introduction: Even though public awareness of sleep has increased recently, the association between value on sleep and sleep behaviors is uncertain. To date, there is a paucity of direct measures of sleep related behaviors which may be of critical importance in relation to numerous negative health outcomes. The current study demonstrates the relationship between sleep behaviors and perceived sleep quality and health outcomes.

Methods: This analysis includes 34 completed participants (Mean age = 38.6, 35% male, 71% college degree). Sleep-related behaviors (SB) significantly predicted sleep quality estimates on the PSQI ($F = 51.8$, $P < .001$) and accounted for 62% of the variance. Using a split-median to divide the sample into good and bad sleep behaviors groups (GsB and BsB, respectively), the BsB group has a history of significantly more adverse health consequences such as chronic pain, depression, and anxiety (all $P < .05$) as well as increased stress scores ($P < .05$). Interestingly, sleep values related to an individual's most relevant health consequences did not differ between the two sleep behavior groups.

Results: Sleep behavior highly predicts perceived sleep quality; however sleep behavior is not related to the value placed on sleep relative to personally salient health outcomes. These results illustrate the need for public education regarding sleep-promoting behaviors as those individuals who highly value sleep are not engaging in healthy sleep practices.

Conclusion: Sleep behavior highly predicts perceived sleep quality; however sleep behavior is not related to the value placed on sleep relative to personally salient health outcomes. These results illustrate the need for public education regarding sleep-promoting behaviors as those individuals who highly value sleep are not engaging in healthy sleep practices.

0866

SCREENING FOR SLEEP DISORDERS IN PRIMARY CARE: PRESENCE OF MEDICAL CONDITIONS ASSOCIATED WITH SLEEP APNEA

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Introduction: It is well established that sleep apnea is associated with a constellation of medical conditions including cardiovascular disease (CD), hypertension (HT), diabetes (DI), hyperlipidemia (HL), and overweight/obesity (OB). The goal of this prospective study was describe the presence of these medical conditions in primary care patients with no known history of sleep disorders, and to screen them for sleep apnea.

Methods: 53 volunteer patients were recruited from two primary care settings, with a mean age of 54.3 years (sd = 12.1). During their appointment, their doctor indicated the presence of any of the targeted medical conditions (CD, HT, DI, HL, OB). All patients completed an overnight polysomnogram to screen for sleep apnea.
Results: The frequencies of patients in each medical condition (MC) category were as follows: No MC (n = 17), 1 or 2 MCs (n = 22), and 3 or more MCs (n = 14), and are presented in a Venn diagram. Those with one or more medical conditions (n = 36) tended to have a higher mean Respiratory Distress Index (RDI = 32.6, sd = 29.7) than those with no medical conditions (n = 16, RDI = 18.1, sd = 13.6). Organising the subjects according to medical conditions (MC Yes/No) and RDI (using 19.9 as the cutoff between low and high) also shows an interesting trend, where 41.5% of participants fell in the Yes MC/High RDI category, and only 17% fell into the No MC/Mild RDI category.
Conclusion: Screening for sleep apnea in primary care may be improved by attention to medical conditions in addition to patient symptom reports. The study is important as it uses a prospective approach, starting with patients in primary care without a known history of sleep disorder, and following them through a laboratory screening.
Support (If Any): Canadian Institutes of Health Research

0867

FACTORS ASSOCIATED WITH A POSITIVE STOP-BANG SCREEN IN THE PREOPERATIVE CLINIC POPULATION

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Introduction: Many preoperative clinics use the STOP-Bang Questionnaire as a screening tool for obstructive sleep apnea considering data that suggests obstructive sleep apnea predisposes to increased postoperative complications. Factors associated with obstructive sleep apnea include but are not limited to age, gender, BMI > 35 kg/m2, hypertension, hyperlipidemia, and diabetes. Factors associated with positive STOP-Bang screening need clarification.
Methods: We analyzed STOP-Bang scores collected on 996 patients in the Virginia Commonwealth University (VCU) preoperative clinic over a 6 week period. A score greater than or equal to three defined a positive STOP-Bang screening. In addition to the STOP-Bang score, we collected data regarding age, gender, race, BMI and other co-morbidities including those most commonly associated with obstructive sleep apnea.
Results: We found that 43.3% of preoperative patients scored positive on the STOP-Bang Questionnaire. Increasing body mass index demonstrated a direct, linear correlation of 0.982 with increasing STOP-Bang, ultimately contributing to STOP-Bang positive patients averaging 38.9 kg/m2. A positive STOP-Bang screen yielded an average age of 57.6 years compared with 48.9 years seen in those with a negative screen. Among co-morbid conditions, renal disease exhibited the highest STOP-Bang positivity with 67.9%, followed by diabetes (66.9%) and hypertension (65.3%). Sixty-seven percent of preoperative patients presenting for gastric bypass surgeries scored positive on STOP-Bang.
Conclusion: STOP-Bang positivity demonstrates associations similar to co-morbid conditions identified in obstructive sleep apnea. Specifically, these include increased body mass index, average age and the presence of renal disease, diabetes and hypertension. Based on the above findings, one could speculate that patients scoring positive on STOP-Bang, regardless of a sleep apnea diagnosis, exhibit similar increased risks of associated postoperative complications.

0868

INFLUENCE OF COUNTRY OF ORIGIN ON THE ASSESSMENT OF DAYTIME SLEEPINESS: ANALYSIS OF THE CAATCH DATA

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Introduction: This study assessed the influence of country of origin on subjective daytime sleepiness among hypertensive blacks, participating in the Counseling African-Americans to Control Hypertension (CAATCH) Trial.
Methods: Data from the present study emanated from the CAATCH study, a multi-level intervention to improve blood pressure control among hypertensive blacks. Specific details on study design and methodology are published elsewhere (Circulation 2009;2:249-256). The present analysis focuses on baseline data, which includes sociodemographic, medical history, and daytime sleepiness assessed with the Epworth sleepiness scale (ESS); a cut-off score of ≥ 10 was used to classify EDS. Participants were diagnosed with hypertension and were receiving antihypertensive medications. All provided informed consent under the supervision of the IRB at New York University Medical Center. Data were coded and analyzed by an experienced statistician using SPSS 15.0.
Results: A total of 1059 participants provided baseline data for the analysis; 73% were US-born blacks (UBB), 27% were foreign-born blacks (FBB). There were no significant group differences in term of age (UBB = 56 ± 13; FBB = 58 ± 13), gender (UBB female = 71%, FBB females = 73%). However, FBB participants were more likely to be employed (45% vs. 29%; $\chi 2 = 20$, $P < 0.0001$), but less likely to have received more than a high school education (FBB = 23% vs. 31%; $\chi 2 = 24$, $P < 0.0001$), less likely to report alcohol consumption (18% vs. 39%; 2 = 39, $P < 0.0001$), and less likely to report a smoking history (24% vs. 63%; $\chi 2 = 114$, $P < 0.0001$). Logistic regression analyses showed that UBB participants were twice as likely as their FBB counterparts to exhibit EDS (OR = 1.85, 95% CI:1.5-2.73, $P < 0.01$); effects of age, sex, education, history of smoking and/or education were adjusted in the model.
Conclusion: Results of the study demonstrate the importance of considering country of origin in the analysis of the epidemiologic sleep data. Future studies should assess whether UBB are at greater risk for sleep problems (e.g., sleep apnea) associated with daytime sleepiness.
Support (If Any): This work was supported by funds from NIH/NHLBI (RO1HL78566 and R01MD004113).

0869

WHAT CAN EYE IMAGING TECHNIQUES REVEAL ABOUT UNDIAGNOSED SLEEP DISTURBANCES?

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Introduction: There have been several case series and prevalence studies which have documented a relationship between various eye disorders, such as glaucoma, floppy eyelid syndrome, and optic neuropathy with obstructive sleep apnea (OSA). However, there has been

a paucity of data documenting this relationship utilizing optical coherence tomography (OCT). The current study attempts to characterize the prevalence of OSA in patients with abnormal variants of OCT findings.
Methods: This retrospective case series evaluated 96 consecutive patients referred for diagnostic sleep evaluation following ophthalmological evaluation. All patients had received OCT as part of their ophthalmological evaluation. Patients were between the ages of 18-79 and were not previously diagnosed with a sleep disorder. Abnormal OCT findings were defined as least one of the retinal thickness dimensions in each eye (superior, inferior, nasal, temporal) beyond the normal distribution percentiles.
Results: A total of 66 patients had full OCT reports and polysomnography data available for analysis (41 abnormal OCT, 25 normal OCT). 71% of patients with abnormal OCT vs. 40% with normal OCT tested positive for sleep apnea (AHI > 5/hr; $\chi 2 = 6.068$, $P = 0.014$). Comparison of groups indicated a higher arousal index associated with the abnormal OCT group (30.2 vs. 25.9/hr) and less Stage 3% (10.1% vs. 15.1%), although not a statistically significant difference.
Conclusion: OCT is a powerful tool that allows for high resolution imaging of the optic nerve. As demonstrated in the present study, and considering the strong relationship between eye disease and poor sleep, the use of OCT may give new insight to the impact and pathophysiology associated with the consequences of poor sleep.

0870

BODY MASS INDEX AND PERCEIVED INSUFFICIENT SLEEP

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Introduction: Over the past 50 years, average sleep duration for adults in the United States has declined while prevalence of obesity and associated outcomes has increased.
Methods: We analyzed data from the 2008 Behavioral Risk Factor Surveillance System (BRFSS) survey to determine if body mass index (BMI) was associated with perceived insufficient sleep in an US adult population (N = 384,020) in all states/territories. The distribution of BMI categories included 36.8% not overweight or obese (BMI < 25), 36.4% overweight (BMI ≥ 25 and < 30), 17.2% obese class I (BMI ≥ 30 and < 35), 6.2% obese class II (BMI ≥ 35 and < 40), and 3.5% obese class III (BMI ≥ 40). Respondents were asked, "During the past 30 days, for about how many days have you felt you did not get enough rest or sleep?" Multivariate linear regression and logistic regression analyses with sex, age, race/ethnicity, and education as covariates were conducted using SUDAAN to account for the complex study design.
Results: Adjusted mean days of insufficient sleep ranged from 7.9 (7.8-8.0) days for respondents who were not overweight or obese to 11.4 (11.0-11.7) days for individuals in the most obese category (BMI ≥ 40). Days of insufficient sleep followed a linear trend across the five BMI categories. The likelihood of reporting 30 days of insufficient sleep in the past 30 days was higher for respondents in the highest BMI category (BMI ≥ 40) than for respondents who were neither overweight nor obese (BMI < 25) [16.7% vs. 9.8%; adjusted odds ratio = 1.87 (1.70-2.06)].
Conclusion: Among adults in the United States, BMI strongly correlated with days of insufficient sleep or rest. Adequacy of sleep should be considered in weight reduction messaging.
Support (If Any): AGW: This project was made possible through a cooperative agreement between the Association for Prevention Teaching and Research (APTR) and the Centers for Disease Control and Prevention (CDC), award number 3U50CD300860.

0871

GASTROESOPHAGEAL REFLUX DISEASE SYMPTOMS RESPOND TO AN ORAL APPLIANCE USED FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: Evidence indicates Continuous Positive Airway Pressure (CPAP) (Green et al. 2003 and Tawk et al. 2006), and uvulopalatopharyngoplasty (UPPP) (Wang et al. 2009) reduce gastro-esophageal reflux disease (GERD) symptoms and/or objectively documented reflux in patients with obstructive sleep apnea syndrome (OSAS). We hypothesized that an oral appliance (OA) also would reduce reflux symptoms.
Methods: We prospectively studied patients electing to use an OA for OSAS. Polysomnography (PSG) established the presence and severity of OSAS (mean AHI = 23+-19) in adult patients (18-79 yr.). OSAS patients electing OA therapy (N = 56) visited 1 of 2 dentists skilled in OA use. No discussion regarding the utility of the OA in GERD occurred. Patients completed a validated GERD symptom questionnaire (Shaw, 2001) at the initial visit and after satisfactory use of OA (GERD defined score > = 15.5). Bruxism patients visiting these same dentists, utilizing bruxism appliances and serving as the control group, continue enrollment. Patient characteristics were male 32, female 24; age 54 ± 9 years; BMI 31 ± 5.4; AHI 23 ± 19; and low SaO2 85 ± 5.6.
Results: Overall, GERD scores decreased to 2.9+-5.4 from 5.9+-7.3 ($P = 0.001$) with 14% meeting score criterion for GERD. Women had higher pre GERD scores (8.0+-8.4 versus 4.3+-6.0, $P = 0.014$). Symptoms decreased similarly in men and women with OA use (P = NS). No significant correlation occurred between pre or post GERD scores with baseline age, AHI, low O2 saturation, BMI, Arousal/hr, or REM sleep. A sensitivity/specificity analysis indicated that the reduction in GERD symptoms was best when the OA was used for more than 20 days/month and more than 6 hours/night.
Conclusion: These findings suggest that like CPAP and UPPP, use of an OA improves GERD symptoms. Research is needed to ascertain if OA and CPAP may mediate improvement though reduced sleep apnea, increased reflux barrier pressure, decreased arousals, or other mechanisms.

0872

ARBACLOFEN PLACARBIL IMPROVES SLEEP QUALITY IN PATIENTS WITH PROTON PUMP INHIBITOR (PPI)-RESPONSIVE GASTROESOPHAGEAL REFLUX DISEASE (GERD)

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Introduction: An aim of this study was to determine the effects of arbaclofen placarbil (AP), a novel reflux inhibitor, on sleep-related symptoms in patients with GERD.
Methods: In this double-blind, placebo-controlled study, randomization to AP monotherapy was stratified based on prior PPI use (naïve or partial responder). Following a 2-week washout period, patients were randomized to 20, 40, or 60 mg qd, 30 mg bid, or placebo for 4 weeks. Patients used an electronic diary to record GERD symptoms, nighttime awakenings due to GERD, and visual analog scale (VAS) sleep measures from a modified Pittsburgh Sleep Diary. The Epworth Sleepiness Scale (ESS) was used to assess daytime sleepiness. Week 4 data are presented.
Results: Compared with placebo, AP had no significant effect on heartburn episodes/week in PPI-naïve patients or overall population (n = 156). The percentages of PPI-responsive patients with complete re-

lief of heartburn and regurgitation were greater with AP than placebo. In PPI-responsive patients, AP significantly improved sleep quality at 40 and 60 mg qd, and 30 mg bid (least squares [LS] mean difference vs. placebo in VAS scores: 9.4, 7.8, and 8.2, respectively ($P < 0.05$)). AP also significantly improved mood on final awakening at 30 mg bid (LS mean difference vs. placebo in VAS scores: 8.4 ($P < 0.05$)) and numerically improved awakenings/week from heartburn or regurgitation at all doses compared with placebo. In PPI-naïve patients, AP had no effect on sleep quality, mood on final awakening, or awakenings due to GERD, and significantly increased daytime sleepiness at 30 mg bid (LS mean difference vs. placebo in ESS scores: 4.5 ($P < 0.05$)).
Conclusion: AP improved GERD symptoms and sleep quality in PPI-responsive patients. We believe the lack of effect in PPI-naïve patients may be due to the limited accuracy of diagnosing GERD based only on symptoms in this heterogeneous group of patients.
Support (If Any): XenoPort, Inc., Santa Clara, CA.

0873

ENDOGENOUS MELATONIN PROFILES IN PATIENTS WITH INFLAMMATORY BOWEL DISEASE

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Introduction: Inflammatory bowel disease (IBD) is comprised of two common gastrointestinal disorders: Crohn's Disease and Ulcerative Colitis. While it is recognized that IBD is associated with poor sleep, it is unclear why. We measured complete salivary melatonin profiles in patients with IBD to determine if they had (1) any circadian misalignment that could contribute to their poor sleep and (2) abnormally low levels of salivary melatonin that could contribute to their chronic inflammation. To our knowledge this is the first report of complete melatonin profiles in IBD patients.
Methods: To date, we have recruited four patients (22-39 years old) with inactive IBD. Patients wore a wrist actigraph and followed their self-reported habitual sleep schedule for 8-9 days at home. They then participated in a dim light phase assessment in the laboratory, giving saliva samples every 30 minutes for 23 hours. Each patient was age and sex matched to two healthy controls ($n = 8$).
Results: Consistent with previous reports, patients had significantly lower sleep efficiency (mean 78%) than the matched controls (mean 87%, $P < 0.02$). Three patients had visually identifiable circadian rhythms in their melatonin secretion despite their use of immunomodulators. Both the timing and amount of melatonin in the circulation was within the range seen in healthy controls.
Conclusion: These results suggest that (1) the poor sleep in patients with IBD is not due to circadian misalignment, (2) the chronic gut inflammation characteristic of this disease is not due to abnormally low levels of circulating melatonin, (3) several commonly prescribed immunomodulators do not eliminate the circadian rhythm in melatonin, and (4) IBD patients may not need melatonin supplementation.
Support (If Any): The study was supported in part by a generous special gift to the research program of the Division of Digestive Diseases and Nutrition by Mr. and Mrs. Larry and Barbara Field.

0874

SELF-REPORTED SLEEP: HOW DO PATIENTS WITH OAB COMPARE TO INSOMNIACS AND NORMAL SUBJECTS?

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Introduction: Sleep in overactive bladder syndrome (OAB) is frequently disturbed by nocturia, defined as awakenings with micturition followed by sleep. However, a systematic sleep diary is not routinely used in OAB patients. Our objective was to compare sleep diary data in OAB patients, with insomniacs and healthy controls.
Methods: 7-day sleep and 3-day bladder diaries were completed by 10 subjects with detrusor overactivity, 10 primary insomniacs and 5 controls. Documentation of awakenings and duration of sleep was provided on the 7-day sleep diary. Timing and volume of all voids as well as a 1-5 rating of the perceived urgency and recording of urge incontinent episodes were documented on a 3-day bladder diary. Subjects with overlapping pathologies were excluded. One-way ANOVAs and the Kruskal-Wallis test were used for analysis.
Results: Age and BMI did not statistically differ across the 3 groups ($P < 0.23$; $P < 0.50$; respectively). Mean number of nocturia was significantly different (OAB: 2.9 ± 1.8; insomniacs: 0.4 ± 0.4; controls: 0.3 ± 0.4; $P < 0.0003$), but no difference was seen between insomniacs and controls ($P < 0.70$). Similarly, the mean number of awakenings was significantly different across the three groups (OAB: 2.9 ± 1.4; insomniacs: 2.9 ± 0.9; controls: 1.3 ± 1.0; $P < 0.039$), and this was in particular true for controls versus insomniacs and OAB ($P < 0.011$). In contrast to insomniacs and even controls, all awakenings for the OAB were accounted for by nocturia. The mean wake time after sleep onset (WASO) was significantly different across the three groups (insomniacs: 103 ± 55 min.; OAB: 39 ± 29; controls: 14 ± 10, $P < 0.0004$), confirming the sleep disrupting effects of nocturia for the OAB group. Likewise, sleep onset latency (SOL) was statistically different (insomniacs: 40 ± 24 min.; OAB: 18 ± 11; controls: 13 ± 9, $P < 0.006$) as was total sleep time (TST) (insomniacs: 295 ± 71 min.; OAB: 423 ± 68; controls: 444 ± 25; $P < 0.0001$). Finally, the perception of feeling refreshed upon awakening was also significantly different across the three groups (insomniacs: 2.4 ± 0.6; OAB: 3.3 ± 0.8; controls: 4.5 ± 0.4; $P < 0.0001$).
Conclusion: Sleep in OAB is disrupted by an increase in awakenings comparable to insomnia. Contrastingly, there is no increase in WASO because most awakenings in OAB occur due to nocturia and remain relatively short. Sleep onset latency, total sleep time and perception of being refreshed upon awakening were all better in OAB than in insomnia but worst than for controls.
Support (If Any): This study was undertaken with a research grant from Astellas Pharma US Inc. and GlaxoSmithKline.

0875

MONITORED NIGHTTIME BLADDER FUNCTION: COMPARISONS BETWEEN PATIENTS WITH INSOMNIA AND THOSE WITH OVERACTIVE BLADDER SYNDROME

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Introduction: Small voided volumes, frequency and urge incontinence characterize overactive bladder syndrome (OAB). These symptoms disrupt sleep resulting in nocturia. Nighttime voided volumes in insomniacs are not known. Our objective was to compare nighttime bladder function in insomnia, OAB and healthy controls.
Methods: 7-day sleep and 3-day bladder diaries were completed by 10 subjects with detrusor overactivity, 10 primary insomniacs and 5 controls. Documentation of awakenings and duration of sleep was provided on the 7-day sleep diary. Timing and volume of all voids as well as a 1-5 rating of the perceived urgency and recording of urge incontinent episodes were documented on a 3-day bladder diary. Subjects with overlapping pathologies were excluded. One-way ANOVAs and the Kruskal-Wallis test were used for analysis.
Results: Across subject groups, age and BMI were not statistically different ($P < 0.23$, $P < 0.50$; respectively). There was no statistical difference in 24-h urine output or in nighttime rate of urine production. The total number of voids per 24 hours was statistically different (OAB: 11.5 ± 4; insomniacs: 6.4 ± 1.6; controls: 6.1 ± 2.3, $P < 0.0015$) as was nocturia (OAB: 2.9 ± 1.8; insomniacs: 0.4 ± 0.4; controls: 0.3 ± 0.4; $P < 0.0003$). Similarly, the overall degree of urgency was statistically different across the three groups (OAB: 2.6 ± 1.4; insomniacs: 1.5 ± 0.6; controls: 1.6 ± 0.6, $P < 0.037$), while a direct comparison between insomniacs and controls was not statistically different ($P < 0.87$). The OAB group was characterized by more frequent voids in spite of comparable 24-h urine output. The mean daytime voided volume was statistically different (OAB: 171 ± 86.77 ml.; insomniacs 245.9 ± 106.7; controls 298.1 +/67.3, $P < 0.048$). Sleep and the effects on bladder function revealed a mean voided volume increase during nighttime voids for all groups (OAB: 52 ± 136 ml.; insomniacs: 49 ± 84; controls: 298 ± 67; $P < 0.029$). This nighttime increase in voided volume correlated significantly with sleep period time for insomniacs and controls(insomniacs: 398 ± 51 min.; controls: 459 ± 19; $P < 0.036$).
Conclusion: OAB patients and insomniacs failed to increase their nighttime voided volume compared with normal subjects. For insomniacs because this is not reflective of urinary pathology it may reflect greater consciousness at night due to greater wake time or diminished sleep quality. Contrastingly, for OAB patients this is secondary to persistently small bladder capacity throughout the night.
Support (If Any): This study was undertaken with a research grant from Astellas Pharma US Inc. and GlaxoSmithKline.

0876

NOCTURNAL DETRUSOR OVERACTIVITY IN OVERACTIVE BLADDER SYNDROME: A NOCTURNAL CYSTOMETROGRAPHIC AND POLYSOMNOGRAPHIC STUDY

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Introduction: Nocturia, a frequent symptom of overactive bladder syndrome(OAB), is the most common cause of sleep disturbance in older adults. It is also associated with an increased risk of falls, hip fractures, nursing home admission, major depression and mortality. Yet, the ability to effectively treat nocturia remains limited and the pathophysiology of nocturia in OAB patients has hardly been evaluated. This investigation was intended to establish methods for studying the physiology of nocturia in OAB patients and to improve our understanding of this phenomenon
Methods: We recorded simultaneous, time-aligned, bladder pressure (nocturnal cystometrographic) and polysomnographic (PSG) data during a single night in the sleep laboratory in: 9 OAB patients with nocturia; 2) 10 insomnia patients ($N = 10$); and 5 healthy controls.
Results: Nocturnal detrusor overactivity events (nDO) occurred significantly more frequently in OAB patients than insomnia patients or controls ($P = 0.02$). 67% of OAB patients had at least one nDO in the 10 minutes prior to a nocturia episode, while this never occurred in insomnia or control subjects ($P = 0.002$). OAB patients were also awake (by PSG) for a shorter period of time prior to nocturia events ($P < 0.001$), and had a greater percentage of awakenings due to nocturia than the other groups. Nocturnal polyuria (NP), another possible cause of nocturia in OAB patients was not associated with nDO.
Conclusion: It is possible to safely and accurately monitor sleep and bladder pressure physiology during sleep. nDOs appears to occur in association with nocturia in the majority of OAB patients and do not generally occur during sleep in non-OAB subjects, are not due to sleep disturbance and are not linked to NP. It is hoped that this study will provide a foundation for research on the pathophysiology and treatment of nocturia in OAB.
Support (If Any): Astellas

0877

ASSOCIATION ANALYSIS OF eNOS G894T GENE POLYMORPHISM AND ERECTILE DYSFUNCTION COMPLAINTS IN A POPULATION-BASED SURVEY

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Introduction: Erectile dysfunction (ED) is a common disorder leading to a serious, negative impact on the quality of the patient□s life. The gene encoding endothelial NOS (eNOS) is an interesting candidate gene for understanding the physiopathology of ED, since it is involved in the catalytic production of nitric oxide (NO), the neurotransmitter that plays a critical role in penile tumescence and erection. The objective was to evaluate a potential association between the G894T polymorphism in the eNOS gene and ED complaints in a population-based sample in São Paulo, Brazil.
Methods: A total of 449 men were enrolled in the study and answered an eight-item questionnaire to ascertain sexual performance/erectile dysfunction and satisfaction. The eNOS G894T polymorphism was genotyped using a standard polymerase chain reaction method.
Results: Univariate analysis demonstrated that ED was associated with diabetes, hypertension, sleep apnea severity, increasing age and body mass index, as well as testosterone levels ($P < 0.05$). Forward

multiple regression models indicated that age was the only independent factor associated with ED in this population (OR = 1.09; 95%IC: 1.06-1.11; P < 0.0001). Genotypic and allelic analyses provided no evidence for an association between this polymorphism and the risk for ED complaints in this sample. Population stratification did not affect the association test results.
Conclusion: This is the first study to examine the effect of polymorphisms in the eNOS gene and the risk for ED utilizing a case-control approach in the Brazilian population. Our results do not support a major role for eNOS gene polymorphisms in ED in this population.
Support (If Any): Associação Fundo de Incentivo à Psicofarmacologia (AFIP) and FAPESP (CEPID no. 98/14303-3 to ST). MLA, LRB and ST are recipients of the CNPq fellowships.

0878

SLEEP DISTURBANCES AND FUNCTIONING IN PATIENTS WITH CHRONIC LOW BACK PAIN AND NEUROPATHIC PAIN

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Introduction: Although the link between chronic pain and poor sleep seems obvious, this area still requires further investigation. Chronic low back pain (CLBP) and neuropathic pain (NP) are two such non-malignant pain populations that need further study. The current study attempted to compare subjective estimates of sleep, stress, and functioning between these two pain groups.
Methods: Patients with a history of CLBP, NP, or healthy controls (HC) participated in the current study. Pain patients had an average rating of > 4 on the Brief Pain Inventory, a pain complaint > 3 months, and complained of sleep disturbance. Patients previously diagnosed with a sleep disorder, other major co-morbid medical condition, other pain condition, or who work shift work were excluded. Participants completed the Pittsburgh Sleep Quality Index (PSQI), Perceived Stress Scale (PSS), Fatigue Severity Scale (FSS), SF36, and daily ratings of fatigue, stress and pain.
Results: A total of 33 CLBP, 16 NP, and 25 HC participated. Groups were age and gender matched. Both pain groups (CLBP, NP respectively) reported significantly less habitual TST than HC (5.7 vs. 4.8 vs. 6.6, P < 05), higher PSQI scores (11.6 vs. 12.7 vs. 3.7, P < .001), more stress (17.7 vs. 18.7 vs. 9.5, P < .001), and significantly worse quality of life scores on all dimensions, including general health (58.5 vs. 51.8 vs. 85.0, P < .001). Typically, there were no significant differences in scores between the pain groups. Morning, afternoon, and evening fatigue complaints in the pain groups are significantly related to role limitations (P < .05) with evening fatigue rating related to estimation of sleep quality (P < .05).
Conclusion: This comparison of two prominent chronic pain groups to a control group further validates the impact pain conditions have on sleep related complaints. The data also suggest that the relationship between both pain and poor sleep consequently can result in daytime functioning deficits, stress, and poor quality of life.
Support (If Any): Equipment support for this study provided by Philips, Respironics, Inc.

0879

ACTIGRAPHY AND DIARY SLEEP CHARACTERISTICS IN PATIENTS WITH CHRONIC LOW BACK AND NEUROPATHIC PAIN

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Introduction: Poor sleep complaints are common in 50-90% of those with chronic pain. Two common pain groups are chronic low back pain (CLBP) and neuropathic pain (NP). The current study attempts assess sleep disturbances in patients with CLBP and NP utilizing actigraphy/sleep diary over a seven day period.
Methods: Patients with a history of CLBP, NP, or healthy controls (HC) wore actigraphy and maintained a sleep diary for at least seven days. In addition, daily "real-time" ratings of fatigue and pain were assessed three times daily (rated 0-10). Pain patients had an average rating of > 4 on the Brief Pain Inventory and a pain complaint > 3 months. Patients with a previous diagnosis of a sleep disorder, other major co-morbid medical condition, other pain condition, or who work shift work were excluded.
Results: A total of 17 CLBP, 6 NP, and 15 HC participants completed study measures. All three groups were age and gender matched. According to diary data, both pain groups report significantly more sleep disruption per night than HC (P = .001), with the CLBP group reporting a longer sleep latency (32.7 vs. 16.2 min, P < .01) than HC. CLBP patients had a significantly longer time in bed (455.8 vs. 382.1 min, P < .01) and total sleep time (388.6 vs. 328.9, P < .05) than the NP group according to actigraphy data. The CLBP also had an increased WASO time compared to NP, and HC (67.2 vs. 53.2 vs. 48.3 min respectively, P = .058). Using linear regression, WASO time significantly predicted the daily ratings of pain in the morning (F = 5.020, P < .05).
Conclusion: Although the actigraphy data is not robust, in part due to low sample size, there does appear to be differences in sleeping habits and sleep continuity in the pain groups, especially the CLBP. Rating of pain throughout the day is also predictive by actigraphy WASO.
Support (If Any): Equipment grant provided by Philips Respironics, Inc.

0880

THE RELATIONSHIP BETWEEN POST-SLEEP COGNITIONS AND PAIN IN A COLLEGE SAMPLE

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Introduction: Moldofsky and colleagues (1976) proposed that sleep disruption, pain and depression are a part of a self-perpetuating cycle. However, Moldofsky did not address anxiety or cognitions surrounding sleep and pain. Anxiety and cognitions significantly influence perception of sleep and pain beyond the physical sensations reported. We tested an expansion of this model to include anxiety and cognitions (post-sleep).
Methods: An undergraduate student sample (N = 98) were recruited and attended one assessment session. Each participant completed the Pre-Sleep Arousal Scale, Post-Sleep Cognitions Questionnaire, State-Trait Anxiety Scale, Center for Epidemiologic Studies-Depression Scale, and McGill Pain Questionnaire and had his/her pain threshold tested by the cold pressor task.
Results: Post-sleep cognitions significantly contributed to pain threshold, as measured by the CPT (b = .24, t(96) = 2.37, P = .02) When depression was added to the model, CES-D scores showed a trend in contributing to the amount of variance in pain threshold, as measured by the CPT (b = .18, t(96) = 1.70, P = .09). Pain threshold did not account for the variance in subjective pain reporting, as measured by McGill Pain Questionnaire (b = -.12, t(90) = -1.10, P = .27).
Conclusion: Our results suggested that depression and anxiety contribute to the relationship between sleep and pain. However, anxiety accounts for variance in pain when pain is self-reported on the McGill pain questionnaire; whereas, post-sleep cognitions and depression accounted for variance when reporting pain behaviors (how long it took the person to initially feel pain).

0881

CHRONIC FATIGUE SYNDROME OR FIBROMYALGIA IN SUCCESSIVE ADMISSIONS TO A SLEEP LAB

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Introduction: Disturbed sleep is a common complaint in patients with medically unexplained illnesses - fibromyalgia (FM) and chronic fatigue syndrome (CFS). However, the presence of FM and CFS symptoms in patients with sleep disorders has not been thoroughly investigated. The goal of this study is to assess the rates of comorbid unexplained illnesses in the presence of primary sleep disorders.

Methods: Participants were 173 sleep clinic patients with sleep-related symptoms that underwent diagnostic polysomnography and were diagnosed with a primary sleep disorder, and 39 healthy controls. Sample size limited the results to three "primary sleep diagnosis groups" (obstructive sleep apnea (OSA), insomnia, and narcolepsy/hypersomnia). Symptoms suggesting FM and CFS were assessed by a questionnaire; and presence of tenderness by Tender Point Exam. Daytime sleepiness and mood were assessed with Epworth Sleepiness Scale and Beck Depression Inventory, respectively.

Results: All three groups with sleep diagnoses had appreciable rates of unexplained illnesses - 14.5% for OSA, 46.4% for insomnia, and 38.1% for narcolepsy/hypersomnia. These rates were particularly high in patients with insomnia and narcolepsy/hypersomnia. Specifically, OSA patients had lower rates of FM only or FM with CFS than insomnia patients, and lower rates of FM only than narcolepsy/hypersomnia patients. No differences in rates of unexplained illnesses were found between insomnia and narcolepsy/hypersomnia. Furthermore, coexistence of any of the sleep disorders with unexplained illnesses was associated with depressed mood. Daytime sleepiness increased significantly in the presence of medically unexplained symptoms in OSA but not in insomnia or narcolepsy/hypersomnia patients.

Conclusion: These results suggest that patients with OSA, insomnia and narcolepsy/hypersomnia have high rates of CFS and/or FM. Thus, CFS or FM patients with complaints suggestive of a primary sleep disorder should undergo a comprehensive sleep evaluation including polysomnography, when indicated, before the diagnosis of one of these otherwise unexplained illnesses is made.

0882

FIBROMYALGIA PATIENTS HAVE IMPAIRED SLEEP AND DAYTIME FUNCTIONING AT BASELINE: DATA FROM AN INTERNATIONAL PHASE 3 TRIAL OF SODIUM OXYBATE

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Introduction: Fibromyalgia patients experience disrupted and non-refreshing sleep that often leads to impairment in daytime functioning. To better describe the nature and severity of these symptoms prior to treatment, data on subjective measures of sleep quality and daytime functioning were collected during the baseline period of a 14-week, double-blind, placebo-controlled, international trial of sodium oxybate in the treatment of fibromyalgia.

Methods: A total of 573 fibromyalgia patients from eight countries were randomized to one of three treatments: SXB4.5g, SXB6g, or PBO. At baseline, subjects were administered the Jenkins Sleep Scale (JSS; a validated, 4-item, self-report questionnaire for sleep disturbance, range 0-20), Fatigue Visual Analog Scale (VAS; range 0-100), Fibromyalgia Impact Questionnaire (FIQ) and Pain VAS (range 0-100). In addition, subjects completed a questionnaire to describe their sleep history.

Results: The mean age (SD) was 46.6 years (10.7), mean body mass index (SD) was 27.6 (4.6), 90% were female, and 91% were Caucasian. The mean (SD) JSS scores at baseline for the PBO, SXB4.5g, and SXB6g groups were 15.6 (4.4), 15.0 (4.6), and 14.9 (4.7), respectively. The mean (SD) Pain VAS scores at baseline were 72.6 (12.9), 70.5 (13.0), and 72.2 (14.0); Fatigue VAS scores were 73.5 (15.0), 71.1 (15.4), and 71.5 (17.2); and FIQ scores were 63.7 (14.1), 62.3 (15.2), and 62.1 (15.1), respectively. Using a sleep-history questionnaire, combined data indicated 78.6% of patients described themselves as not normal sleepers, and 87.9% described their usual sleep as fair or poor. Data from multiple measures indicated that study subjects reported poor sleep quality and high level of impairment in sleep and functioning.

Conclusion: These results demonstrate that the fibromyalgia patients in this study manifested high levels of pain, impaired sleep quality, and daytime functioning. Improving sleep disturbance in fibromyalgia patients represents an important goal of therapy.

Support (If Any): Study funded by Jazz Pharmaceuticals, Inc.

0883

FIBROMYALGIA PAIN, FATIGUE, AND SLEEP IMPROVE WITH SODIUM OXYBATE TREATMENT: A 14-WEEK RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED INTERNATIONAL TRIAL

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Introduction: Fibromyalgia is a chronic disease characterized by widespread pain, chronic fatigue, impaired function, sleep disturbance, and psychophysiological distress. This is the first international and second Phase 3 study examining the treatment effects of sodium oxybate (SXB) in fibromyalgia.

Methods: Fibromyalgia patients (n = 573) who met the American College of Rheumatology criteria were randomized equally to sodium oxybate 4.5g/night (SXB4.5g), 6g/night (SXB6g), or placebo (PBO). The primary outcome measure was the percentage of subjects reporting a ≥ 30% reduction from baseline to Week14 on the Pain Visual Analog Scale (PVAS). Other measures included Fatigue VAS, Jenkins Sleep Scale (JSS; a validated, 4-item questionnaire for sleep disturbance), and patient global impression of change (PGIC). Analysis: LOCF. Safety was assessed by treatment-emergent adverse events, vital signs, laboratory tests, and ECG.

Results: SXB4.5g and SXB6g resulted in significantly more patients reporting ≥ 30% improvement in PVAS compared with PBO (42.0% and 51.4%, respectively, vs 26.8%, $P \leq 0.002$). Compared with PBO, treatment with SXB4.5g and SXB6g resulted in significantly greater reductions in mean JSS scores (-4.9 and -5.9, respectively, vs -2.9, both $P < 0.001$) and significantly greater reductions in mean Fatigue VAS scores (-22.96 and -26.22, respectively, vs -13.65, both $P < 0.001$). In addition, a significantly greater percentage of subjects treated with SXB4.5g and SXB6g perceived meaningful improvement in symptoms, evidenced by PGIC scores of "much better" or "very much better" compared with PBO (32.1% and 39.7%, respectively, vs 16.0%, both $P < 0.001$). Adverse events occurring with SXB treatment with incidence ≥ 5% and twice the incidence of PBO were: nausea, dizziness, vomiting, insomnia, anxiety, somnolence, fatigue, muscle spasms, and peripheral edema.

Conclusion: This first international Phase 3 study provides further evidence that SXB is efficacious and well-tolerated in fibromyalgia patients. In addition to its substantial effect on pain, SXB produced significant improvements in fatigue, sleep, and patient global status.

Support (If Any): Study funded by Jazz Pharmaceuticals, Inc.

0884

FUNCTIONAL DISABILITY MEDIATES THE ASSOCIATION BETWEEN DISEASE ACTIVITY AND SLEEP QUALITY IN RHEUMATOID ARTHRITIS

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Introduction: Rheumatoid arthritis (RA) is a chronic systemic inflammatory disorder with periods of exacerbation and remission of symptoms. Increases in disease activity or arthritic flares are associated with increases in joint pain and stiffness and functional disability. Sleep disturbances are significantly worse during arthritic flares. This study examined whether functional disability mediates the relationship between disease activity and sleep quality.
Methods: This study included baseline data from 324 individuals with RA (mean age = 59.48 ± 11.02 years, range: 21-84; 80% female). The sample had RA for 14.88 ± 10.89 years. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). Self-reports of disease activity was measured by the Rapid Assessment of Disease Activity in Rheumatology (RADAR) which assesses pain and tenderness in 20 joints (0 = "no pain," 3 = "severe pain" for a total score that ranges from 0 to 60). The Functional Status Index (FSI) assesses three dimensions of functional ability, including assistance, difficulty, and associated pain with activities of daily living (scale ranges 0-4).
Results: Patients were experiencing on average mild levels of disease activity (mean = 16.12 ± 10.81, range 0-51) and moderate difficulty and pain associated with daily activities (mean = 1.71 ± 0.59, mean = 1.73 ± 0.57, respectively). About 60% of the sample had poor sleep quality (global PSQI score ≥ 6), with almost one-third (n = 103) reporting having pain that disturbed their sleep three or more times per week. Mediational analyses using the Sobel test indicated that the relationship between disease activity and sleep quality was mediated by the FSI subscale scores on difficulty and pain associated with daily activities ($z = 3.78$, $P < .001$; $z = 6.53$, $P < .001$, respectively).
Conclusion: These findings suggest that improvements in functional ability through disease management may significantly improve sleep quality in patients with RA.
Support (If Any): This project was supported by Grants NR04554 (J.D-J.), P30-NR00392 (J.D-J.), and HL082610 (F.S.L) from the National Institutes of Health, Bethesda, Maryland.

0885

SLEEP DISTURBANCES AND DAYTIME SLEEPINESS, AND ITS ASSOCIATION WITH HLA-DR, HLA-DQ ALLELES IN SYSTEMIC LUPUS ERYTHEMATOSUS (SLE)

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Introduction: The aim of this study is to describe and examine the sleep pattern in SLE patients according to system/organ involved, and to assess the level of sleepiness in SLE as its association to the presence of HLA haplotypes.
Methods: Forty-nine SLE women attending the outpatient Lupus Clinic at the Immunology and Rheumatology Department from the INCMNSZ with a mean age of 38.8 ± 11.4 years were studied polysomnographically and compared to twenty five healthy controls. Validated instruments were used to measure disease activity, fatigue, and depression symptoms. SLE patients were classified according the more recent specific organ/systems SLE activity. HLA typing was performed in the SLE group. Allele and genotype frequencies were obtained by direct counting. Carrier frequencies were compared to a control group of healthy Mexican subjects.
Results: Lupus patients compared with healthy women, have less sleep efficiency, greater number of awakenings, and higher percent of awake stage. Renal involvement SLE patients have exacerbated these alterations. More than sixty percent of the Lupus patients have excessive daytime sleep (MSLT 4.7 ± 2.1 min). The carrier frequency of HLA-DR2 (1501) and HLA-DQ*0602 was not associated with the level of sleepiness in SLE.
Conclusion: Poor sleep at night is very common in SLE independent of their system/organ involvement, but those with renal involvement have an exacerbated pattern of sleep alteration. Daytime sleepiness is high prevalent in SLE, but is not related to the presence of narcolepsy. These data show that the treatment of sleep disturbance in SLE patients it most be taken in account as a part of the integral management of these patients, and that it will be necessary to contemplate comorbid condition as depression, daytime hypersomnia, and specific sleep disturbance as apnea syndrome and PLM disorder.
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0886

PREVALANCE OF SLEEP PROBLEMS IN SMITH-LEMLI-OPITZ SYNDROME

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Introduction: Smith-Lemli-Opitz Syndrome (SLOS) is an autosomal recessive genetic disorder, characterized by multiple congenital malformations, dysmorphic facial features, and mental retardation. It is caused by a genetically inherited deficiency of the enzyme 7-dehydrocholesterol delta 7 reductase (7-DHC reductase), the catalyst involved in the final step of cholesterol biosynthesis, with increased serum levels of 7-DHC, and a generalized cholesterol deficiency. This study assesses the prevalence of sleep problems in patients with SLOS, all on replacement oral cholesterol.
Methods: The study group comprised 15 subjects with SLOS, ten girls, aged 1.5-31 years, (median 9.2 years ± 6.7); two subjects were older than 18 years. Parents completed 4 questionnaires (Intake Demographic Form; Pediatric Sleep Questionnaire; Pediatric Daytime Sleepiness Scale; Specific SLOS Questionnaire).
Results: The SLOS subjects had symptoms of sleep disordered breathing (53.3% snoring; 66.7% mouth breathing), problems with sleep onset [difficulty falling asleep (53.3%) with more than 46% of them taking > 30 minutes to fall asleep], sleep maintenance [wake up at night screaming (60%), waking up more than twice (46.7%), and having trouble falling back to sleep (66.7%), waking up early in the morning (60%), and restless sleep (40%)]. One third of subjects used medications to aid with sleep. The subjects with SLOS needed parents in the room to fall asleep (53.3%), watch TV or music to fall asleep (40%), and described bed sharing (33.3%), indicating sleep-anxiety & sleep-associations. Symptoms of excessive daytime sleepiness were frequently reported [unrefreshed in the morning (46.7%), sleepiness during the day (46.7%), and day time naps (53.3%)]. Parents frequently observed their children with SLOS to have difficulty organizing tasks (66.7%), and have easy distractibility (86.7%).

Conclusion: Sleep problems such as sleep-disordered breathing, sleep-related anxiety and sleep associations, disturbed sleep patterns at night, and excessive daytime sleepiness are frequent in subjects with SLOS.

0887

PRESENCE OF SLEEP DISORDERS SYMPTOMS IN PRIMARY CARE PATIENTS WITH AND WITHOUT ASSOCIATED MEDICAL CONDITIONS

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Introduction: The goal of the present study was to assess the presence and severity of self-reported sleep disorder symptoms in primary care patients with no prior identified history of sleep disorder. In addition, we examined these symptoms in the context of the following commonly associated medical conditions: cardiovascular disease (CD), hypertension (HT), hyperlipidemia (HL), diabetes (DI), and overweight/obesity (OB).
Methods: The participants were 167 adult patients (91 females, 76 males) aged 32 to 84 (M = 54.6, sd = 13.1), recruited from two primary care settings. While waiting to see their doctor, they completed the SSC, an 18-item screening instrument including signs and symptoms of sleep disorders reduced to three factors: Sleep Disorder, Daytime Distress, and Insomnia. During their appointment, the doctor indicated which, if any, of the medical conditions characterized the patient's recent medical history.
Results: The mean SSC subscale scores of participants having no medical condition (n = 77) and each of the medical conditions were compared: CD, n = 13; HT, n = 36; DI, n = 30; HL, n = 48; OB, n = 55. Significant differences were found between the No medical conditions group and each of the DI, HL, and OB groups on the SSC Sleep Disorder subscale. Many patients had more than one medical condition. Those with three or more medical conditions had more severe Sleep Disorder scores than those with none, or with one or two medical conditions. No significant differences were found for the Daytime Distress or Insomnia subscale scores.
Conclusion: Primary care patients with hyperlipidemia, diabetes, or obesity, or with three or more medical (cardio/metabolic) conditions report more severe sleep disorder symptoms (other than Insomnia) than those without these conditions. Increased attention to these risk profiles in primary care would improve screening and treatment of sleep disorders.
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0888

NOCTURNAL GASTROESOPHAGEAL REFLUX DISEASE AND INSOMNIA: A LOOK AT SLEEP STAGE AND BODY POSITION

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Introduction: Various studies have sought to characterize the occurrence of gastroesophageal reflux (GER) during the sleep interval. This study specifically examined features of nocturnal acid reflux among patients with chronic sleep maintenance insomnia in an effort to further elucidate the interplay between sleep and gastroesophageal reflux disease.
Methods: Thirty-one patients suffering from chronic sleep maintenance insomnia (duration > 6 months) with a BMI < 30, no history of snoring, no history of acid reflux, and no ongoing reflux therapy were evaluated with concomitant standard overnight polysomnogram (PSG) and 24 hour dual-chamber wired pH study. Of these patient's, ten individuals had objective evidence of insomnia (sleep efficiency < 83%) and at least one episode of reflux (pH < 4 for 15 seconds) in the recumbent position. Using the PSG data, each episode of reflux was evaluated to determine the patient's sleep stage and body position.
Results: Among ten patients with objective evidence of insomnia, 61 separate episodes of reflux were documented. These episodes were examined to determine PSG stage (Wake 75.4%, Stage I/II 16.2%, Stage III 4.9%, and REM 3.3%) as well as recumbent body position (Left 26.25%, Right 36.3%, Supine 37.5%). A significantly greater number of reflux events occurred during wakefulness as compared to sleep ($P < 0.05$), with analysis of variance between the 4 PSG stages reaching statistical significance as well ($P = 0.001$). In contrast, there was not a significant difference in the distribution of reflux events among the various recumbent positions.
Conclusion: These preliminary results suggest that the incidence of nocturnal acid reflux varies significantly between wakefulness, light sleep, slow wave sleep and rapid eye movement sleep. This finding provides further support for the distinct physiology of the gastrointestinal tract in wakefulness and the various stages of sleep. Furthermore, it provides a possible etiology for sleep disruption in patient's suffering from chronic sleep maintenance insomnia.

0889

SLEEP MICROSTRUCTURE IN PATIENTS WITH GASTROESOPHAGEAL REFLUX AND OSAS

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Introduction: Recent observations underline the importance of nocturnal gastroesofageal reflux (GER) and its possible correlations with obstructive sleep apnea sindrome (OSAS). However, polysomnographic (PSG) data on the interactions between the two diseases and their effects on sleep structure are scarce. Aim of this work is to evaluate cyclic alternating pattern (CAP) and the characteristics of GER episodes in patients with and without OSAS and correlations between different kinds of events.
Methods: Seventeen consecutive patients with a clinical history suitable for OSAS and GER syndrome were enrolled in the study. All patients underwent nocturnal PSG recording and a simultaneous esophageal pH monitoring. After PSG evaluation, patients were divided in OSAS (6 male subjects, mean age: 53,3 ± 11,7 yrs.) and 11 non-OSAS (6 males and 5 female, mean age: 52,6 ± 9,3 yrs.). Beside conventional PSG and pHmetric variables and their correlations, CAP parameters were measured and temporal correlations between apneas, refluxes and microstructural modifications were examined.
Results: Non-OSAS patients presented reflux episodes during wakefulness, while OSAS patients mostly during sleep with a significant association with CAP. Recorded refluxes were longer if associated to non CAP sleep as compared to CAP and in OSAS patients as compared to non OSAS patients. Reflux events provoked an increase of CAP rate during episodes. Ninety-three percent of the reflux episodes were temporally related to respiratory events in OSAS patients
Conclusion: Our data suggest that CAP could play a major role in sleep modifications due to gastroesophageal reflux, but also in the modulation of GER itself. The utility of different approaches to evaluate sleep in this kind of pathology is underlined.

0890

EXCESS PREVALENCE OF RLS IN LIVER TRANSPLANT RECIPIENTS - A TERTIARY CARE CENTER EXPERIENCE

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Introduction: We previously reported higher prevalence of RLS in chronic liver disease. Minai et al have previously reported increased prevalence of RLS in lung transplant recipients. Here we analyzed the prevalence of RLS in liver transplant recipients and characteristics of patients with and without RLS.
Methods: Randomly selected 41 liver transplant recipients followed in transplant clinic were invited to complete survey for clinical features of RLS. Participants considered positive were reconfirmed via telephone. Chart review was completed on all subjects. Fisher's exact test or Pearson's chi-square and Mann-Whitney test where relevant was used when comparing groups for categorical measures including medications. Comparison of creatinine, hemoglobin, calcium, magnesium and medications lists was done between the two groups. Multivariate analysis using ANOVA on Rank and Dunnet test was performed.
Results: 16 of 41 subjects (39%: 95% confidence 26-57%) reported core symptoms of RLS in survey. Comparison between those with RLS and those without revealed no significant differences ($P > 0.05$) in the mean values for hemoglobin, calcium, and creatinine (> 1.5mg/dl, 37.5% vs. 33.3%). Subjects reporting diabetes were similarly high in both groups (50% vs 41%). Neuropathy was rarely reported in both groups (25% vs 12.5%). Use of medications known to exacerbate RLS was low in both groups however, calcium channel blockers use ($P < 0.05$) were more common in those without RLS symptoms.
Conclusion: Liver transplant recipients may have a higher prevalence of RLS than the general population. Larger multicenter studies are needed to confirm increased prevalence seen in our institution. The cause for increased prevalence of RLS in transplant patients does not appear to be due to excess coexistent comorbid disease associated with RLS and warrants further investigation.

0891

EVALUATION OF SLEEP PARAMETERS IN CHRONIC RENAL FAILURE PATIENTS ON HEMODIALYSIS

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Introduction: Sleep disorders occur in up to 80% of patients who is in hemodialysis treatment (HD), worsening their already compromised quality of life. Patient come to the HD Health Service three times per week and does not have their sleep routinely assessed.
Methods: We apply Sleep Diary and Pittsburgh Sleep Quality Index (PSQI) in 40 patients (24 women) aged 40 to 60 years, during a period of 30 days. They were instructed to report their nocturnal sleep and the naps. The difficulties with the filling out the sleep diary had been few and any problems were oriented during the HD sessions.
Results: The patients had presented total sleep time = 6.2 ± 1.3hours; nap number = 0.4 ± 0.5 naps/day; number of wake up after sleep onset (WASO) = 0.9 ± 1.0 awake/night. The quality of sleep according to PSQI was: good (20%) and bad (80%).
Conclusion: The results of this study had evidenced impairment in the amount of sleep of patients on HD. The total sleep time was below the expected for the age range. WASO had occurred 2 times more than the expected, exceeding 5% of the total sleep time. Most of the patients did not present satisfactory sleep quality.

0892

SLEEP IN DIABETES

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Introduction: Research suggests that diabetes affects sleep quality and quantity. Research also suggests that body mass index (BMI) has similar effects on sleep and is correlated with diabetes. Research has investigated the effects of diabetes and BMI on sleep but it is unknown if the variation in BMI among diabetics can explain those differences in sleep. The present study replicated sleep effects in diabetics and explored the role of BMI.
Methods: Participants were recruited using random-digit dialing and were between the ages of 20 and 98. The full sample numbered 772. The self-identified diabetic group numbered 58 (27 males, 31 females). The non diabetic group numbered 714 (354 males, 360 females). Volunteers completed 14 days of sleep diaries and other daytime functioning questionnaires. Sleep variables were: sleep onset latency (SOL), number of nighttime awakenings (NWAK), wake time after sleep onset (WASO), total sleep time (TST), sleep efficiency (SE), sleep quality rating (SQR), and total nap time during the day (NAP).
Results: Patients with diabetes had significantly worse sleep than non-diabetic individuals, according to a multivariate T-test, Wilks' lambda = .958, $F = 4.7$, $P < .001$. Univariate follow-up tests showed that these differences were significant in five of the seven sleep variables tested (SOL, NWAK, WASO, SE, and NAP). Hierarchical regression of each of these five sleep variables on diabetes status showed that diabetic individuals continue to have poor sleep on all of these measures even when controlled for BMI.
Conclusion: Future research should consider routine insomnia treatment for diabetic individuals and should explore other mechanisms of sleep disturbance besides BMI.
Support (If Any): Research supported by National Institute on Aging grants AG12136 and AG14738.

0893

THE PREVALENCE OF INSOMNIA IN 543 ENDOCRINOLOGY OUTPATIENTS WITH DIABETES AND ITS RELATIONSHIP TO GLYCEMIC CONTROL

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Introduction: Diabetes Mellitus (DM) affects 6.2% of the U.S. population. Although poor sleep quality and short sleep duration have been associated with higher HbA1c levels/poorer glucose control, the relationship of DM and insomnia has not been evaluated using validated insomnia instruments.
Methods: 591 consecutive DM patients seen in a university medical center endocrinology clinic completed the Insomnia Severity Index (ISI). Chart reviews on a subsample of 132 patients were undertaken to gather demographic and glycemic control data (as assessed by HbA1c levels). Beyond descriptive statistics, t-tests were used to analyze differences in insomnia severity between various patient groups and Pearson's correlation was calculated between ISI score and HbA1c levels. We also performed contingency analyses by dichotomizing HbA1c at 8.0 (an accepted cutoff for poor glycemic control) and the ISI at 10 (a cutoff for clinically relevant insomnia often used in clinical trials).

Results: 543 patients had useable ISI data and 122 had a full complement of chart review data. The parent sample had a mean age of 51.8 (15.1); was 58% female; and 87% White, 9% Black and 4% Asian, Latino or unknown. The mean ISI was 7.0 (6.9) with mild, moderate, and severe insomnia present in 21.0%, 14.4% and 4.2% of patients, respectively. Insomnia severity was not associated with age and did not differ by gender, but was significantly higher in Blacks than Whites ($t = 2.42$, $df(203)$;$p = .02$) and significantly higher in Type 2 (more prevalent in Blacks) than Type 1 DM ($t = 2.35$, $df(203)$; $P = .02$). In the chart review subsample, HbA1c levels were positively correlated with the ISI ($r = .255$; $P < .01$). Elevated ISI score was associated with having poor glycemic control (Fishers exact test $P = .03$; unadjusted OR 2.3[95% CI: 1.1-4.8]).
Conclusion: The rate of insomnia in this clinical DM sample exceeds that of the general population. In addition, insomnia severity is associated with higher HbA1c levels and poor glucose control. This study is limited in not accounting for covariates such as BMI, other co-morbidities and medications, which will be undertaken with further chart review. In addition, this is a cross-sectional study with no possible causal inferences. Nonetheless, work in other disorders where insomnia is co-morbid suggests it might be treatable when present in DM patients. This raises the testable hypothesis that improving sleep in DM patients may improve glycemic control and thereby reduce the risk of diabetes-related complications.
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0894

EFFECTS OF MELATONIN ON SLEEP IN HIV+ INDIVIDUALS

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Introduction: Disturbed sleep patterns have been reported in over 70% of the persons infected with HIV and the third reason for seeking health care. Insomnia includes difficulty in going to sleep and disturbed sleep or frequent waking, all of which lead to fatigue, excessive debilitating daytime sleepiness and a significantly diminished quality of life. The circadian pacemaker and sleep homeostasis play pivotal roles in the functions of everyday living. Sleep has been shown to increase immune function, however the mechanisms are unclear. Melatonin and cortisol play a crucial role in circadian thermoregulatory adjustments of body temperature. Changes in the thermoregulatory set-point in those infected with HIV may influence the circadian patterns of both temperature and hormones. Therefore, the purpose of the study was to determine the effects of exogenous melatonin on the overall sleep quality and improvement of quality of life.
Methods: Specific aims of the study were divided into both primary and secondary. The primary aims were to determine the effect of exogenous melatonin administration on: 1) sleep quality (efficiency and latency) and 2) the overall quality of life. The secondary aims were to determine the effect of exogenous melatonin administration on: 1) the relationships among circadian patterns of core body temperatures, melatonin and cortisol, 2) the subjective assessment of sleep, 3) immune status indicators (CD4/VL) and, 4)and correlation of actigraphy with sleep parameters. The study used a prospective, randomized, double blind, placebo controlled clinical trial. Each subject was assigned to either a placebo control or one of two treatments groups, each using a different concentration of melatonin (1mg or 5mg). A computerized actigraphy watch was used to collect the sleep parameters. Sleep diaries allowed subjects to record subjective sleep quality, timing of meals and exercise. Serum melatonin, cortisol, and temperature was collected every two hours for 72 hours.
Results: This pilot study provided significant information on feasibility and outcomes. Those receiving either dose of melatonin showed improvement in overall sleep quality and subjective sleep. Changes in total sleep and sleep latency were significantly improved.
Conclusion: Melatonin can be an effective, over-the-counter supplement to improve sleep in HIV+ infected individuals. A larger study underway will provide greater support for the use of melatonin.
Support (If Any): AD Williams Foundation

0895

HIGH CARDIOVASCULAR DISEASE (CVD) RISK PROFILE IN YOUNG-MIDDLE AGE IS ASSOCIATED WITH POOR SLEEP QUALITY IN OLDER AGE - PRELIMINARY RESULTS FROM THE CHICAGO HEALTHY AGING STUDY (CHAS)

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Introduction: Previous studies have demonstrated that sleep quality is associated with major CVD risk factors (RFs) including obesity, hypertension, and diabetes. Insufficient data exist regarding the relationship of CVD RFs earlier in life with overall sleep quality later in life.
Methods: We examined whether having a high CVD risk profile at baseline (1967-73) (i.e., 2 or more high levels of blood pressure, serum total cholesterol, smoking, obesity and/or diabetes) is associated with sleep quality at follow-up examination (2007-09). Data on sleep duration (SD), efficiency (SE), latency (SL), wake after sleep onset (WASO), and morning wake (MW), were collected for 5-7 consecutive days using wrist actigraphy/sleep diary. The sample consisted of 603 CHAS participants (26% women, 9% blacks) ages 25-43. Participants (mean age 71 at follow-up) were categorized into 3 groups based on baseline CVD RF as 0 RF High, 1 only RF high, and 2+RFs high.
Results: With adjustment for age, sex, race, education and minor ECG abnormalities at baseline, SE, MW, and WASO were significantly different for participants in the high CVD risk profile groups. Participants with 2+RF high had lower SE, more WASO and longer MW compared to those with 1 only RF high and 0 RF high (P-values: 0.056 and 0.043). For example, comparing persons with 0 or only 1 RF high, SE for those with 2+ RF high was lower by 3% ($P < 0.05$). MW time was about 10 minutes longer ($P < 0.01$). No significant association between baseline CVD RF profile and SD or SL at follow-up.
Conclusion: These data suggest CVD risk factors in young-middle age predict sleep disturbance, specifically, difficulty maintaining sleep in older age. The presence of more than 2 CVD risk factors in young adulthood and middle-age may be an important correlate of sleep health in older age.
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0896

PROSPECTVE EVALUATION OF SLEEP DISORDERS IN PRESERVED EJECTION FRACTION HEART FAILURE PATIENTS

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Introduction: Approximately one-half of patients with heart failure (HF) and reduced ejection fraction (SHF) are known to have sleep apnea. Less is known about the incidence and prevalence of sleep apnea in patient preserved ejection fraction heart failure (PEF-HF). The aim of this study was to prospectively characterize differences in sleep disorders between PEF-HF and SHF patients.

Methods: New patients seen in Heart Failure clinic between May and August 2009 were identified. Subjects were screened by Epworth Sleepiness Score (ESS), and those scoring > = 10 were referred for diagnostic polysomnography (PSG); otherwise a nocturnal pulse oximetry was ordered. PEF-HF was defined by presence of clinical HF with left ventricular ejection fraction > = 45%; SHF was LVEF < 45%. Differences between PEF-HF and SHF subjects were analyzed using Student's t-tests or Fisher's exact tests.
Results: Of 49 new HF patients, 16 subjects had interpretable nocturnal pulse oximetry (nPx) and/or PSG data. PEF-HF subjects (n = 7) were more obese (body-mass index 41.2+/- 8.5 vs. 29.6+/-5.1, P = 0.01) compared to SHF (n = 9); age and gender were not different. nPx showed both groups were similar with respect to minimum O2 saturation (79% +/- 13.2 vs. 77.1% +/-9.9, P = 0.76), average O2 saturation, and total recording time with saturation < 90%. Of the 15 subjects who underwent PSG, no differences were noted in all PSG variables, including sleep architecture data, apnea-hypopnea index (25.6+/-38.4 vs. 46.1+/-33.1, P = 0.30), and periodic limb movements.
Conclusion: Despite higher BMI in patients with PEF-HF, nocturnal indices of sleep staging, O2 saturation, apnea hypopnea index, and periodic limb movements were similar between groups of HF patients. While differences in sleep disorders may not be observed in the present study between patients with PEF-HF and SHF, nocturnal hypoxemia and sleep disordered breathing are common in this population, and should be evaluated.

0897

RACIAL DIFFERENCES IN SLEEP QUALITY IN ADULTS WITH HEART FAILURE

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Introduction: Few investigators have studied racial differences in sleep quality. The purpose of this study was to test the hypothesis that racial differences in sleep quality exist that can be explained by financial strain, body mass index (BMI), illness severity, depression, and treatment differences.
Methods: A convenience sample of N = 270 (African-Americans [35%] and White [65%]) adults with chronic, symptomatic heart failure (HF) was enrolled from outpatient settings. Those with major depression were excluded. Sleep quality was measured with the Pittsburgh Sleep Quality Index (PSQI). The importance of race as a determinant of sleep quality was examined using binary regression analysis with a PSQI cut-point of 5. Hypothesized determinants of sleep quality were race, household income, BMI, HF severity (New York Heart Association [NYHA] functional class), depressive symptoms (PHQ-9), and HF treatment quality.
Results: The typical subject was male (64%), age 62 ± 12.5 years, functionally compromised (58% NYHA class III), with systolic HF (64%) and few comorbid conditions (53%); 58% were classified on the PSQI as having poor sleep. The model of 6 variables explained 34% of the variance in sleep quality, although only race (P = .01) and depressive symptoms (P < .0001) were significant individual correlates of sleep quality. African-American subjects were 2.4 times as likely to report poor sleep quality as the White subjects. Only 7% had depressive symptoms but these subjects were 1.5 times as likely to report poor sleep as non-depressed subjects. African-Americans were not significantly more likely than Whites to have depressive symptoms (8.3% vs. 6.3%).
Conclusion: Race is an important contributor to sleep quality, although the reason why remains unclear. Interventions that decrease even mild depressive symptoms may improve sleep quality in both African-American and White adults with HF.
Support (If Any): National Heart, Lung & Blood Institute (1HL084394-01A1)

0898

DAYTIME SLEEPINESS IS ASSOCIATED WITH POOR MEDICATION ADHERENCE IN ADULTS WITH HEART FAILURE

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Introduction: Adults with heart failure (HF) take numerous medications important in controlling the neuroendocrine response associated with HF. Sleep disordered breathing and other causes of excessive daytime sleepiness (EDS) are common in this population. This study tested the hypothesis that medication adherence is poorer in adults with HF and EDS compared to adults with HF but without EDS.
Methods: A convenience sample of 270 adults with chronic stage C HF was enrolled from outpatient settings. Those with major depression, dementia, terminal illness, a recent history of heavy drug or alcohol abuse, and night shift workers were excluded. Trained research assistants administered structured interviews assessing adherence with medication taking, timing, and drug holidays over the past month. A positive answer on any question classified the subject as nonadherent. EDS was measured using measures of trait (Epworth Sleepiness Scale), state (Stanford Sleepiness Scale), and behavioral (Psychomotor Vigilance Task [PVT] lapses) sleepiness. Chi square analysis was used to examine group differences in medication adherence after classifying subjects into two groups—those with and without EDS.
Results: Among the 270 enrolled individuals, 62% were white, 64% male, mean age was 62 ± 12.5 years, 58% were functionally compromised (NYHA class III), 66% had systolic HF and 56% had comorbid conditions. Those who were sleepy were significantly more likely than non-sleepy subjects to miss their HF medications (41% vs. 30%, P = .03), skip consecutive medication doses (10% vs. 3%, P = .02), and take their medications more than 2 hours late (56% vs. 38%, P = .007) over the past month.
Conclusion: Daytime sleepiness contributes to poor medication adherence in adults with HF. Interventions designed to improve EDS may improve medication adherence.
Support (If Any): National Heart Lung, and Blood Institute of NIH (RO1 HL084394-01A1)

0899

HEART RATE VARIABILITY ANALYSIS DURING SLEEP IN HEART FAILURE PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Congestive heart failure is currently a major public health problem worldwide. The study of the autonomic nervous system behavior by analyzing the heart rate variability (HRV) in patients with congestive heart failure (CHF) can be used as an indirect estimate of changes in the autonomic cardiovascular system, since it is possible to know the status of autonomic activity in the cardiovascular system, studying the HRV. Patients with CHF usually have reduced values of HRV when compared to healthy subjects. The analysis of the autonomic nervous system (ANS) activity proved important information related to prognosis, the pathogenesis and strategy for treatment of cardiovascular disorders. This study aimed to evaluate the behavior of

the autonomic nervous system in patients with CHF functional class II and III (NYHA) with obstructive sleep apnea (OSA) during sleep.
Methods: It was included 13 subjects of both sexes, (08 men), adults, with CHF due to dilated cardiomyopathy, ischemic or idiopathic. The subjects performed the baseline nocturnal polysomnography, and they were divided into two groups according to the apnea/hippopnea index (AHI < 30 and AHI > 30).
Results: It was observed that all subjects presented an imbalance of the ANS with a prevalence of the low frequency component in the HRV analysis, regarding to the sympathetic nervous system activity increased, showing a direct relationship with the AHI. We also observed greater imbalance in the group of subjects with AHI > 30.
Conclusion: We concluded that the use of the HRV analysis was effective in identifying the ANS activity in patients with CHF functional class II and III with OSA during sleep.
Support (If Any): We would like to thank FAPESP - Fundaçao de Auxilio a Pesquisa do Estado de Sao Paulo and CNPq - Conselho Nacional de Desenvolvimento Cientifico e Tecnologico.

0900

CENTRAL BUT NOT OBSTRUCTIVE SLEEP APNEA HAS STRONGER IMPACT ON THE ACCELERATED CARDIAC SYMPATHETIC NERVE ACTIVITY IN PATIENTS WITH HEART FAILURE

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Introduction: Systemic sympathetic nerve enhancement in heart failure (HF) is well known and the extent is considered as a surrogate marker of the prognosis of the patients. Both central and obstructive sleep apnea is commonly observed in patients with heart failure. It is also known that both types of sleep apnea cause acceleration of systemic sympathetic nerve activity. Studies utilizing cardiac 123I-metaiodobenzylguanidine (MIBG) scintigraphy showed cardiac sympathetic nerve acceleration in HF patients with or without sleep breathing disorder (SBD). However, it is not known whether central sleep apnea (CSA) and obstructive sleep apnea (OSA) differently affect cardiac sympathetic nerve activity in HF.
Methods: Thirty patients with and without HF with significant SBD (Apnea hypopnea index (AHI) over 15/hr) were included in the study.
Results: Mean AHI was 55.1 ± 30.9/hr, and was not different in the presence of HF (56.3 ± 39.1/hr, n = 12). Patients underwent cardiac MIBG scintigraphy for determining cardiac sympathetic nerve activity. Heart/mediastinum ratio (H/M) was lower (1.91 ± 0.34, $P < 0.01$) and cardiac washout rate (WOR) was higher (43.4 ± 15.4, $P < 0.05$) in patients with HF compared to non-HF subjects. Furthermore, a significant negative correlation was noted between H/M and AHI in patients with CSA ($P = 0.007$, n = 7) but not in OSA ($P = 0.62$, n = 5). There is also a strong trend that WOR positively correlates with AHI in patients with CSA ($P = 0.22$) but not in OSA ($P = 0.74$).
Conclusion: These results suggest that severity of SBD is associated with accelerated cardiac sympathetic nerve activity in CSA, but not in OSA in HF. In conclusion, CSA and OSA differently contribute to the pathophysiology in developing HF, though the causality between CSA and enhanced cardiac sympathetic nerve activity is to be determined.

0901

EFFECT OF OSAS ON THE LV DIASTOLIC FUNCTION - A STUDY USING ABPM

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Introduction: Obstructive sleep apnea (OSAS) derives sympathetic enhancement, reptin resistance, insulin resistance, enhancement of rennin - angiotensin - aldosterone cascade, oxidative stress, and inflammation. Consequently OSAS is associated to the development of hypertension (HT) especially the non-dipping HT. The correlation of OSAS and LV systolic or diastolic function is still controversial.
Methods: Fifty-six consecutive patients (29 males) with OSAS (AHI > 20) were included who underwent polysomnography, ambulatory blood pressure monitoring (ABPM), and ultrasound cardiography (UCG). Controls were 38 patients (12 males) without HT who underwent ABPM and UCG. ABPM was recorded by oscillometric method. BP dip (daytime average BP - night average BP) and HR dip (daytime average HR - night average HR) was recorded. LV hypertrophy (LVH) and LV diastolic property was evaluated by UCG. Mitral inflow (early component) divided by mitral annular velocity (E/E') was evaluated by doppler imaging.
Results: In OSAS group, average AHI was 40.1 ± 15.6/h, and average BP was 134 ± 13 / 80 ± 10mmHg (In control group, 128 ± 16 / 75 ± 8mmHg). BP dip and LV hypertrophy was not correlated irrespective of the existence of OSAS, and BP dip and E/E' was not also correlated irrespective of the existence of OSAS. HR dip and E/E' was correlated in OSAS group ($P < 0.05$), however the correlation was not documented in the control group. The severity of OSAS (AHI) and HR dip was not correlated in OSAS group.
Conclusion: BP dip was correlated to neither LVH nor LV diastolic property irrespective of the existence of OSAS, however, HR dip was correlated to LV diastolic dysfunction in OSAS patients but not in control group. Depressed parasympathetic activity, rather than enhanced sympathetic activity could be more closely related to the progression of myocardial dysfunction.

0902

UTILITY OF OVERNIGHT POLYSOMNOGRAPHY IN DETECTING CARDIAC ARRHYTHMIAS

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Introduction: Obstructive sleep apnea (OSA) is associated with sympathetic overactivity due to the repetitive cycles of hypoxia and arousals. This may increase the risk of arrhythmias in patients. Routine electrocardiograms (ECGs) performed on these patients while they are awake may not show evidence of arrhythmias. A polysomnogram (PSG) can be an additional tool to detect cardiac arrhythmias in high-risk patients.
Methods: All baseline polysomnograms and split night studies done at Vanderbilt over 3 months in patients over the age of 17 were reviewed and included for analysis if prior ECG was available. PSG-ECG was considered abnormal if it detected any sinus, atrial, or ventricular arrhythmias.
Results: One hundred sixty-five patients were identified. 51 (31%) had an abnormal PSG-ECG. 43/51 patients(84%) had new arrhythmias identified on PSG-ECGs that were not present on prior ECGs ($P = 0.0002$; McNemar's test). Abnormalities on PSG-ECG were more likely in those with a prior history of arrhythmia (74%) compared to those without prior history of arrhythmia (22%; $P < 0.0001$, Chi-square test). Abnormalities included: premature atrial complexes (n = 6), premature ventricular complexes (n = 32), bigeminy (n = 6), trigeminy (n = 2), quadrigeminy (n = 1), atrial fibrillation (n = 5), sinus ventricular tachycardia (n = 1), sinus tachycardia (n = 3), sinus bradycardia (n = 2), sinus pauses (n = 1), and other (n = 2).
Conclusion: Overnight polysomnography is more sensitive in detecting arrhythmias than routine ECGs done during awake hours. This is probably due to a combination of a longer duration of monitoring, sleep-related and circadian influences on the heart, and the frequent presence of OSA in patients referred for polysomnography. Arrhythmias detected in such a manner may aid in diagnosis and impact patient management e.g., (initiation of anticoagulation in those with atrial fibrillation).

0903

INVESTIGATION OF SLEEP IN CORONARY ARTERY DISEASE VERSUS IMPLANTABLE CARDIOVERTER DEFIBRILLATOR PATIENTS: COMPARISON OF SUBJECTIVE AND ACTIGRAPHIC MEASURES

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Introduction: Cardiac patients frequently have insomnia symptoms that may pose risk for future cardiac events. Poor sleep relates to hypertension, hyperarousal, anxiety and depression associated with short total sleep time and poor sleep quality. Women with short (< 6 hours) and long (> 9 hours) total sleep times are significantly more likely to experience myocardial infarction at 10-year follow-up compared to women who sleep 7-8 hours per night (Ayas,2003). We hypothesized that implantable cardioverter defibrillator (ICD) patients will have poorer sleep than coronary artery disease (CAD) patients related to hypervigilance for device functioning and worry over shock discharge.

Methods: We investigated sleep efficiency and sleep latency in a sample of 60 patients (n = 30 CAD and n = 30 ICD) without obstructive sleep apnea at the University of Florida & Shands Hospital. For 14 days, participants completed a daily sleep diary. Additionally, half of the total sample also used actigraphy to objectively measure their sleep. Additional measures of somatic hypervigilance and psychosocial distress were administered.

Results: Using actigraphy, mean sleep efficiency was poorer (69.76%) in CAD patients compared to ICD patients (82.80%). This difference was highly significant, $F(1,27) = 16.840$, $P < .001$. CAD patients also had shorter mean total sleep times per sleep diaries (336.19 minutes;5.60 hours) compared to ICD patients (430.65 minutes;7.18 hours), $F(1,27) = 15.908$, $P < .001$. Ejection fraction% (EF%) and physical activity significantly predicted 56% of the variance in sleep efficiency scores, $F(2,26) = 8.322$, $P = .005$.

Conclusion: The finding that ICD patients slept more efficiently than CAD patients is surprising given that CAD patients had higher EF%s and no concerns about ICD shocks. This difference cannot be accounted for by differences in somatic hypervigilance, depression, anxiety, or physical activity levels. Results suggest that CAD patients may have more sleep problems and warrant increased research attention to determine the contributions of a biopsychosocial model of sleep for these patients.

0904

INSOMNIA IN ADOLESCENCE AS A RISK FACTOR FOR HYPERTENSION AND HYPERCHOLESTEROLEMIA IN YOUNG ADULTHOOD

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Introduction: There is growing evidence that insomnia could play a role in the etiology of both hypertension and hypercholesterolemia. Insomnia is a stressful condition associated with elevated sympathetic nervous system activity and increased activation of the HPA axis. Stress promotes salt appetite, suppresses renal salt excretion, and increases blood lipids. Insomnia often reduces sleep duration. Experimental sleep restriction has been shown to increase blood pressure and cholesterol. Short sleep duration raises average 24-hour blood pressure, which through structural adaptations could entrain the cardiovascular system to operate at an elevated equilibrium. No previous studies have explored the longitudinal relationships between insomnia, hypertension, and hypercholesterolemia in adolescents.

Methods: Multivariate logistic regression analyses of ADD Health data (n = 14,270) to explore whether insomnia in adolescence (grades 7 to 12 in 1994-95) is associated with hypertension and hypercholesterolemia in young adulthood (ages 18 to 26 in 2001-02).

Results: Trouble falling or staying asleep every day, versus never or just a few times, was associated with 78% (OR = 1.78, 95% CI 1.12-2.83) increased odds of hypertension and 77% (OR = 1.77, 95% CI 1.04-3.00) increased odds of hypercholesterolemia after controlling for age, sex, race, BMI, physical activity, alcohol, smoking, and emotional distress. Trouble falling or staying asleep almost every day was associated with increased yet not statistically significant odds of hypertension (OR = 1.28, 95% CI 0.96-1.72) and hypercholesterolemia (OR = 1.39, 95% CI 0.98-1.97) after controlling for covariates.

Conclusion: We found insomnia in adolescence to be associated with increased odds of suffering from hypertension and hypercholesterolemia in young adulthood. If insomnia functions to raise blood pressure and cholesterol levels, then behavioral interventions that improve sleep quality could serve as treatments and as primary preventative measures for hypertension and high cholesterol.

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0905

SHORT SLEEP DURATION AND RISK OF HYPERTENSION IN WOMEN: EXPLORATION OF MEDIATION BY OBESITY, DIABETES, AND HIGH CHOLESTEROL

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Introduction: Short sleep duration has been found to be associated with hypertension incidence. Blood pressure dips by 10-20% during sleep, so short sleep durations raise average 24-hour blood pressure, which over time could lead to hypertension through structural adaptations that entrain the cardiovascular system to operate at an elevated pressure equilibrium. Experimental sleep restriction has been shown to decrease leptin, increase ghrelin, raise appetite, compromise insulin sensitivity, and raise cholesterol. Short sleep duration is associated with obesity, diabetes, and high cholesterol, potent risk factors for hypertension. Obesity, diabetes, and high cholesterol may therefore act as mediators in the relationship between short sleep duration and hypertension incidence.

Methods: Longitudinal (1986 to 2006) multivariate Cox regression analyses of women in the Nurses' Health Study (n = 61,538) to explore whether sleep duration is associated with hypertension incidence in women and whether obesity, diabetes, and high cholesterol act as mediators of this relationship. Hypertension incidence (n = 30,260) was determined by self-report of physician diagnosed hypertension on biennial questionnaires.

Results: In comparison to sleeping 7 hours, sleeping ≤ 5 hours (HR = 1.10, 95% CI 1.04-1.17) and 6 hours (HR = 1.06, 95% CI 1.03-1.10) were associated with small but significant increased risks for hypertension incidence after controlling for age, race/ethnicity, physical activity, salt, alcohol, and smoking. Consistent with obesity acting as a mediator of the relationship, the inclusion of obesity in the multivariate model appreciably attenuated the results for ≤ 5 hours (HR = 1.06, 95% CI 1.00-1.13) and 6 hours (HR = 1.04, 95% CI 1.01-1.08). The inclusion of diabetes and high cholesterol in the multivariate models did not appreciably attenuate the results.

Conclusion: Our results are consistent with obesity acting as a mediator in the relationship between sleep duration and hypertension incidence.

Support (If Any): Financial support for this study was provided by National Institutes of Health grants HL091443 from the National Heart, Lung, and Blood Institute and CA87979 from the National Cancer Institute.

0906

EXCESSIVE DAYTIME SLEEPINESS AND ADHERENCE TO ANTIHYPERTENSIVE MEDICATIONS: ANALYSIS OF THE CAATCH DATA

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Introduction: It is estimated that 20% of adults in the US population experience excessive daytime sleepiness (EDS). This study ascertained the associations between excessive daytime sleepiness and adherence to hypertensive medication among inner-city blacks.
Methods: One thousand and fifty nine hypertensive blacks (average age: 57 ± 12 years) participated in the Counseling African-Americans to Control Hypertension (CAATCH) trial. Details of the study design and methodology have been published previously (Circulation 2009;2:249-256). Data analyzed in this study included baseline sociodemographic, medical history, EDS, and medication adherence (MA). Sleepiness was measured with the Epworth Sleepiness Scale, using a cut-off score of ≥ 10 to define EDS. MA was measured with an abbreviated Morisky scale, with a score > 0 indicating non-adherence. All participants provided informed consent under the supervision of the IRB at New York University Medical Center. Data analysis was performed using SPSS 15.0.
Results: Of the sample, 71% were female, 72% received at least a high school education, 51% reported a history of smoking and 33% a history of alcohol consumption. The mean systolic and diastolic blood pressure was 144 ± 29 and 86 ± 19, respectively. The mean total cholesterol, triglyceride and glucose levels were 194 ± 32, 122 ± 71, 113 ± 48, respectively. Overall, 27% of the participants exhibited EDS, while 44% were classified as adherent to prescribed antihypertensive medications. Multivariate logistic regression analysis was used to assess association between EDS and MA, adjusting for effects of age, sex, education, and smoking and drinking history. Results indicated that participants who exhibited excessive daytime sleepiness were nearly twice as likely to be non-adherent (OR = 1.85, 95% CI = 1.31-2.59, P < 0.0001).
Conclusion: Analysis of the CAATCH data showed a high prevalence of EDS among hypertensive blacks. EDS is a significant predictor of the likelihood of adhering to prescribed medications for hypertension.
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0907

PREVALENCE AND INCIDENCE OF INSOMNIA COMORBID WITH CANCER OVER AN 18-MONTH PERIOD

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WITHDRAWN

0908

OBJECTIVE TOTAL SLEEP DURATION PRE-CHEMOTHERAPY PREDICTS DEPRESSION AND SUBJECTIVE SLEEP QUALITY IN BREAST CANCER PATIENTS

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Introduction: Inadequate total sleep time is associated with hypertension, diabetes, higher mortality, and even with increased risk of breast cancer. Using actigraphy-based total sleep time, this study examined the association between objective sleep duration pre-chemotherapy and depression and subjective sleep quality before and at the end of cycle four of chemotherapy.
Methods: Data reported in this study were from 142 women (age = 50.1+9.7 years, range = 31~79) from two studies with similar research protocols. All women were with newly diagnosed stages I-III breast cancer and were scheduled to receive > 4 cycles of chemotherapy. Data were collected before (baseline) and at the end of cycle four (cycle-4) of chemotherapy. Objective total sleep duration (OTSD) was assessed with actigraphy (Actillume and Actiwatch-L), including total sleep time and total nap time (nap = at least 10 minutes inactivity during daytime). Depressive symptoms were assessed with the Center of Epidemiological Studies-Depression (CES-D); subjective sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI). Women were divided into three groups based on their baseline OTSD: short sleepers (OTSD < 7 hours, n = 52), moderate sleepers (7 < OTSD < 9, n = 59; reference group), and long sleepers (OTSD > 9 hours, n = 31). Using binary logistic regression, odds ratios (ORs) for more severe depression (total CES-D score > 16) and worse subjective sleep quality (total PSQI score > 8) were computed at baseline and cycle-4, respectively. Body mass index, cancer stage and baseline total PSQI score were significantly different among the three groups and were adjusted in the models accordingly.
Results: Compared to moderate sleepers, short sleepers reported more severe depression (OR = 4.6, 95%CI = 1.4~15.5), and long sleepers reported worse sleep quality (OR = 6.2, 95%CI = 2.1~18.3) at baseline. At cycle-4, short sleepers reported more severe depression (OR = 4.3, 95%CI = 1.2~15.7).
Conclusion: Women with short total sleep time pre-chemotherapy experienced more severe depression both before and at the end of cycle-4 chemotherapy, while women with longer sleep time pre-chemotherapy reported worse sleep quality before treatment.
Support (If Any): Supported by NCI CA112035, NIH M01 RR00827, and the Department of Veterans Affairs Center of Excellence for Stress and Mental Health (CESAMH).

0909

EFFECTS OF EXERCISE ON SLEEP IN WOMEN UNDERGOING CHEMOTHERAPY FOR THE TREATMENT OF BREAST CANCER

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Introduction: Patients undergoing chemotherapy complain of poor sleep. Previous studies have prescribed regular exercise for these patients as exercise has been shown to improve sleep in cancer survivors.

As part of a larger study, we examined the effect of self reported exercise on sleep in breast cancer patients during chemotherapy.
Methods: 40 women (mean age = 50.93 years; SD = 9.3; range 31-76) with breast cancer were tested pre-treatment and at the end of four cycles of chemotherapy. At both time points, sleep was objectively recorded using actigraphy (Actiwatch-L, Mini Mitter, and Actillume, Ambulatory Monitoring, Inc.). Total sleep time (TST) and number of naps per day (NAPS) were calculated. Exercise data were collected using the leisure-time exercise (LTE) questionnaire. Post-chemotherapy sleep and exercise data were examined to determine if those patients who were able to maintain a regular exercise program during treatment derived any sleep benefits. Linear regression and Pearson correlations (r) were performed using R and SPSS statistical software to examine the relationship between time spent exercising, TST and NAPS.
Results: Weekly exercise ranged from 0-9.83 hours (mean = 1.84 hours; SD = 2). NAPS ranged from 0-13.5 (mean = 3.16; SD = 2.75) with naptime during the day ranging from 0 to 5.43 hours (mean = 1.15 hours; SD = 1.12) .TST ranged from 3.52-10.10 hours (mean = 7.26; SD = 1.29). In linear regression analysis, each additional hour of exercise per week was associated with approximately 0.22 hours less TST (SE = 0.10; P = 0.027; r = -0.35). Increased exercise also suggested approximately 0.35 fewer NAPS (SE = 0.22; P = 0.11; r = -0.26) and a 0.13 hour decrease in the number of hours spent napping per day (SE = 0.09, r = -0.24; P = 0.15), but were not significant in this small sample.
Conclusion: Our preliminary results suggest regular exercise leads to less sleep at night and fewer daytime naps among breast cancer patients receiving chemotherapy. As additional data are collected, these questions will be further examined in a larger sample.
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0910

CBTI FOR INSOMNIA AFTER BREAST CANCER TREATMENT: INDIVIDUAL IMPROVEMENT IN SLEEP OUTCOMES

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Introduction: Previous studies have demonstrated a variety of positive sleep outcomes of CBTI, but few studies have identified individual change/growth in sleep outcomes over the course of the intervention. The aim of the present study was to examine weekly sleep latency (SL), sleep efficiency (SE), wake after sleep onset (WASO), total sleep time (TST), number of awakenings, and subjective sleep ratings over the duration of the multi-component CBTI intervention.
Methods: Twenty women with persistent insomnia after breast cancer treatment (average age = 53.5) participated in a 6-week individual intervention of sleep restriction, stimulus control, sleep hygiene and cognitive therapy. Participants completed a daily sleep diary during the 6-week intervention, for 2 weeks post intervention, and two weeks at 3-months and 6 months.
Results: Hierarchical linear models (HLM) afford an approach for studying predictors of individual change (slope). Results of interim HLM analysis indicated that over the duration of the weekly interventions, there was a reduction in sleep latency (t Ratio = 3.221, P = .002), increase in TST (t Ratio = 2.218, P = .029), greater SE (t Ratio = 1.970, P = .05), and a positive subjective rating of feeling "refreshed" upon awakening (t Ratio = 2.523, P = .014). However, two other indicators of sleep improvement (number of awakenings, and overall quality of sleep ratings) did not reach significance.
Conclusion: These preliminary results suggest that over the course of a six week CBTI treatment, individual participants improve in several sleep outcomes. SL and subjective rating of feeling "refreshed" were the most significant. Implications include support for the cumulative effect of CBTI over six weekly treatments. Future studies of individual change in sleep outcomes over the CBTI intervention in a larger sample may help determine the optimal number of sessions needed in this population.
Support (If Any): NINR 1K23NR010587

0911

PREDICTORS OF ADHERENCE TO CBTI FOR CHRONIC INSOMNIA IN WOMEN AFTER BREAST CANCER TREATMENT

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Introduction: Previous studies have demonstrated adherence to CBTI is associated with positive sleep outcomes, but few studies have identified adherence as a continuous rather than as a dichotomous variable. The aim of this study is to examine the role of age, education, insomnia severity, anxiety and depression in predicting a variety of adherence measures related to behavioral recommendations. Indices of adherence included: prescribed bedtime hour (TIB), prescribed arising time from bed (TOB), and adherence to the total time spent in bed (TST). Questionnaires included the HADS and ISI.
Methods: Twenty women with insomnia after breast cancer treatment (average age = 53.5) received CBTI for 6 weeks. Participants completed a daily sleep diary during intervention, 2 weeks post intervention, and at 3-months and 6 months. Adherence was derived from the diaries, including total days non-adherent, average minutes of nonadherence, and proportion of adherent days/week to prescribed TIB, TOB, and TST.
Results: Overall, adherence with recommended TIB, TOB, TST was 83%, 47%, and 64% of the nights/week, respectively. Hierarchical linear model (HLM) analysis indicated that older women were more likely to go to bed earlier than recommended (t Ratio = 2.221, P = .04) and those with higher levels of anxiety had a longer TST (t Ratio = 2.074, P = .05). Other demographic variables (e.g., education, marital status), depression level, insomnia severity did not predict adherence to prescribed TIB, TOB, or TST.
Conclusion: These preliminary results suggest that the majority of women with breast cancer receiving CBTI go to bed at the recommended time or later; adhere to TST restriction, yet less than half adhere to the prescribed TOB. Only age and anxiety predicted adherence to recommended sleep times and TST. If these results are supported in larger samples, studies aimed at identifying and increasing adherence are warranted.
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0912

SLEEP AID USE DURING AND FOLLOWING BREAST CANCER ADJUVANT CHEMOTHERAPY

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Introduction: Insomnia symptoms are three times higher in patients with cancer than in the general population. Unresolved insomnia symptoms persist in > 50% of breast cancer survivors; yet, sleep aid use is unknown. This study's purpose was to 1) determine frequency and percent of participants taking one or two sleep aid(s) ; 2) identify frequency and percent of sleep aid use by category (prescription sedative/hypnotics, prescription anti-depressants, prescription analgesics, prescription anti-emetics, Over-the-counter (OTC) analgesics, OTC cold/flu/sinus, OTC sleep , alcohol, and herbal supplements); and 3) compare sleep aid use by category in participants in the experimental and control groups within a randomized-controlled clinical trial (RCT).
Methods: Longitudinal, descriptive, secondary RCT data analysis of women (n = 219) receiving out-patient chemotherapy treatment (CTX), with follow-up at 30, 60, 90 days after the last CTX and 1 year after CTX1. Participants recorded daily sleep aid use on a

Sleep Diary. Analyses included frequencies, percentages, and RM-ANOVA.
Results: Approximately 15-20% of participants took at least one sleep aid on at least one night before, during, and following adjuvant CTX. Prescription sedative/hypnotics (46%) and OTC analgesics (24%) were used most frequently and decreased significantly over time: prescription sedative/hypnotics [F(7(211) = 4.257, P = 0.00]; OTC analgesics [F(7(211) = 2.383, P = 0.023]. Use of a 2nd sleep aid was low (7.6% of all sleep aids used). OTC sleep medications were the most common 2nd sleep aid.
Conclusion: We found lower sleep aid use compared to women in the general population (29%), in cancer patients (28-37%), and in breast cancer survivors with insomnia (40%). The risks and benefits of sleep aid use in breast cancer patients must be considered when acute sleep disturbances occur. Health care providers need to screen for sleep-wake disturbances, sleep aid use, and prescribe intervention therapies to treat acute, and prevent chronic, insomnia in breast cancer patients.
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0913

SLEEP DISORDERS IN LUNG CANCER PATIENTS

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Introduction: Lung cancer patients frequently report fatigue, sleep disturbance and insomnia. Although concomitant respiratory dysfunction may be present, unrefreshed sleep may suggest an underlying sleep disorder.
Methods: All patients with primary lung cancer who underwent polysomnogram from 9/1/2006 to 12/1/2009 were identified. Clinical history and polysomnographic data were reviewed retrospectively. All patients were seen by a sleep specialist and pulmonologist.
Results: The lung cancer patients consisted of 22 men and 21 women, with a mean age of 66.2 years (range 50.2-83.3) and mean BMI 27.3 (range 20-45). On average, they were studied 2.4 years (range 0.1-12.1) after their cancer diagnosis. Most patients were referred for fatigue and daytime hypersomnia (24), but others were referred for insomnia and interrupted sleep (3), nocturnal desaturation and/or dyspnea (7), sleep apnea symptoms (7), and pulmonary hypertension (2). Epworth Sleepiness Scale was available in 28 patients with a mean of 13 (range 2-23). There were 37 non-small cell lung cancers (1 bronchoalveolar, 1 large cell, 4 neuroendocrine, 16 adenocarcinoma, 5 squamous, 9 poorly differentiated), 1 thymoma, 1 mesothelioma, 1 pulmonary artery sarcoma and 3 small cell (2 limited, 1 extensive). Most patients had no evidence of disease (27), but 16 were receiving active treatment (8 chemotherapy, 8 radiation). Three patients had pleural effusion with indwelling pleural catheters. Pulmonary function tests revealed 26 with obstruction (12 severe, 5 moderate, 9 mild), 4 with restriction (1 mild, 1 moderate, 2 severe), and 8 were normal. Twenty patients used bronchodilators, 2 patients used supplemental oxygen and 12 patients used both. Performance status using ECOG ranged from 0 to 3 (9 with 0, 17 with 1, 11 with 2, 6 with 3). Thirty-one baseline studies, 7 split-night studies and 5 titration studies were performed. In the diagnostic studies, 31 patients had significant sleep apnea (12 mild, 5 moderate, 14 severe), 3 had periodic limb movement disorder, 2 had sleep-related hypoventilation and 1 had upper airway resistance syndrome.
Conclusion: Sleep disturbances may complicate the care of lung cancer patients. Even though respiratory disorders may exist, these patients may still have underlying sleep disorders. A high clinical suspicion should prompt further evaluation and treatment.

0914

SLEEP IN LUNG CANCER: COMPARING SUBJECTIVE AND OBJECTIVE MEASURES

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Introduction: Sleep disturbances in patients with lung cancer are under-recognized and under-treated. Previous research has focused on self-reported measures, but now objective measures are adding to our understanding of sleep problems. The purpose of this paper is to describe and evaluate relationships between subjective and objective measures of sleep.
Methods: Participants were referred from the Philadelphia and Buffalo VA Medical Centers and asked to participate following one cycle of platinum-based chemotherapy. Participants completed the Pittsburgh Sleep Quality Index (PSQI) and wore the motionlogger actigraph (Ambulatory Monitoring, Inc.) on their nondominant wrist for 3-7 days. Descriptive and inferential statistics were used.
Results: Among 50 participants, mean age was 64.2 years (sd = 9.9, Range = 47-84), with 98% male, and 50% African American. The majority of patients were diagnosed with Non Small Cell Lung Cancer (73.6%). Mean PSQI results revealed: sleep latency 36 (sd = 32), sleep duration 5.9 (sd = 1.8) hours, and sleep efficiency 77% (sd = 19). Mean motionlogger actigraphy results revealed sleep latency 76 (sd = 83), sleep duration 5.2 (sd = 2.1), and sleep efficiency 67% (sd = 16). Mean global sleep quality was 9.0 (sd = 4.0) with 77% of the sample scoring above the clinically significant cutoff score of five. Only two significant correlations were identified between subjective and objective measures: PSQI and actigraph sleep duration (r = 0.397; P = 0.005) and PSQI global and actigraph WASO (r = 0.380; P = 0.027). Paired t-tests revealed significant differences between PSQI and actigraphy data for sleep duration (P = 0.001), sleep latency (P = 0.005) and sleep efficiency (P = 0.001).
Conclusion: Results demonstrated significant differences between subjective and objective measures of sleep in patients with lung cancer. Patients overestimate sleep duration and sleep efficiency and underestimate sleep latency. The disconnect between subjective and objective measures may be related to gradual changes in sleep quality. This results in adaptation and now typical poor sleep is not recognized as disturbed. Findings are preliminary and warrant confirmation through prospective large-scale studies.
Support (If Any): T32HL007713 Postdoctoral Fellowship (Dean) Veterans Affairs Competitive Pilot Project Fund, VISN 4 (Gooneratne) University at Buffalo School of Nursing, Garman Fund (Dean)

0915

CHEMOTHERAPY INDUCED PERIPHERAL NEUROPATHY AND SUBJECTIVE SLEEP QUALITY IN NON-SMALL CELL LUNG CANCER

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Introduction: Both chemotherapy-induced peripheral neuropathy (CIPN) and sleep disturbances are common problems in non-small cell lung cancer (NSCLC) patients, and independently contribute to morbidity in NSCLC. Previous studies have demonstrated that neuropathy and sleep disturbances are associated with other conditions; however, this

association has not been investigated in lung cancer populations. This study describes the pattern of CIPN and subjective sleep quality in persons with NSCLC.

Methods: Recruitment is ongoing, and will be completed in early 2010. For this study, 30 participants with NSCLC will complete the Pittsburg Sleep Quality Index (PSQI), and the Total Neuropathy Score, clinical version (TNSc). Medical history and treatment history are collected from medical records. Descriptive statistics are used to characterize the sample and describe study findings.

Results: We report findings for the first 7 participants (5 female, mean age 61.86 ± 5.93, n = 7). Mean TNSc score was 7.00 ± 2.58, with greater TNSc scores indicating worse neuropathy. Participants reported varying degrees of sensory, motor, and autonomic neuropathy, with sensory neuropathy being the most severe. Mean PSQI global score was 8.28 ± 6.39 (range 1 to 18) indicating moderate to severe sleep disturbance. Using a median split, participants were classified as having high or low neuropathy scores. Participants in the high neuropathy group (n = 4) tended to have higher PSQI global scores (mean 10.5 ± 7.93) compared with those in the low neuropathy group (mean 5.33 ± 2.3).

Conclusion: Preliminary results indicate participants with higher neuropathy scores may experience poorer sleep quality. As we continue to enroll participants, we will be able to more fully explore associations between chemotherapy induced neuropathy and sleep quality.

Support (If Any): NCI R21 CA125213

0916

SMOKING CESSATION IS ASSOCIATED WITH TRANSIENT AGGRAVATION OF INSOMNIA COMORBID WITH CANCER

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WITHDRAWN

0917

EFFECTS OF SOCIODEMOGRAPHIC AND SOCIOECONOMIC FACTORS ON SLEEP COMPLAINTS DEPEND ON AN INDIVIDUAL'S RACE/ETHNICITY

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Introduction: Lower socioeconomic status is associated with sleep complaints. However, the role of race/ethnicity in this relationship is unclear.
Methods: Sample consisted of n = 159,856 adults (age18-99+) participants from the Behavioral Risk Factor Surveillance System. Sleep complaints (SC) were measured with, "Over the last 2 weeks, how many days have you had trouble falling asleep or staying asleep or sleeping too much?" Data analysis utilized logistic regression and Rao-Schott chi-square. The present analyses explored race/ethnicity-by-socioeconomic interactions. Race/ethnicity categories included Black/African-American, Hispanic/Latino, Asian/Other, Multiracial and White (reference). Socioeconomic factors included income (reference = $75,000+), education (reference = college), marital status (reference = married), and employment (reference = employed). Models were evaluated separately by sex, and adjusted for age.
Results: For women, only education was significant; Asian/Other women demonstrated increased SC in all categories relative to college graduates. Multiracial women who received some college reported less SC than college graduates. Hispanic/Latina women reported less SC if they did not finish high-school. Significant interactions for marital status, employment and income were found for men. For marital status, Black/African Americans had less SC if they were in an unmarried couple, Hispanics/Latinos reported more SC when divorced or widowed, Asians/Others reported more SC when widowed, separated or never married, and Multiracial men experienced more SC when separated. For employment, Black/African American men were less likely to report SC if they were a homemaker or retired, and more likely if they were out of work < 1 year. For income, Hispanic/Latino men reported less SC if they earned between $10,000-$25,000 or $35,000-$50,000. Multiracial men reported more SC if they reported $10,000-$15,000 and Asian/Other men were more likely to report SC if they earned $50,000-$75,000.
Conclusion: These complex interactions demonstrate that not only is sleep related to socioeconomic status, but these relationships depend on ethnicity.
Support (If Any): This study was supported by T32HL007713 and the Center for Sleep and Respiratory Neurobiology at the University of Pennsylvania. Data were collected and provided by the CDC.

0918

OBESITY AND AFRICAN AMERICAN RACE ARE INDEPENDENT PREDICTORS OF REDUCED SLOW WAVE SLEEP: A CROSS-SECTIONAL ANALYSIS OF A LARGE CLINICAL POPULATION

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Introduction: Limited data from small population-based studies have reported reduced slow wave sleep in African Americans. The aim of this study was to quantify the impact of race and obesity on slow wave sleep duration.
Methods: A cross-sectional study of 1019 consecutive adults who had an overnight PSG for suspicion of OSA. R & K criterion was used for staging sleep. A multiple linear regression model was used to evaluate the association between age, gender, race, obesity, and AHI on slow wave sleep (SWS) duration.
Results: For the entire sample of 1019 patients the mean ± SD was 49 ± 15 years for age and 36 ± 9 kg/m2 for BMI. Full night polysomnogram was performed in 72% of the patients. Median (IQR) was 11 (0, 38.5) minutes for SWS and 26 (12,56) for AHI. Severe OSA (AHI ≥ 30) was present in 46% of patients. Our sample was 58% female and 57% African American. Several covariates were significantly associated with SWS, including age (beta = -6.0 minutes/decade, $P < 0.001$), gender (beta = -7.5 minutes for men, $P < 0.001$), and baseline AHI (a 10% increase in AHI reduced SWS by 0.5 minutes, $P < 0.001$). After adjusting for these covariates, African American race (beta = -8.8 minutes, $P < 0.001$) and obesity as measured by BMI (beta = -2.1 minutes per 10 kg/m2, $P = 0.023$) were independently associated with reduced SWS. Based on standardized coefficients, the strongest association was seen for age followed by AHI, race, gender and BMI. Adjusting for socioeconomic indicators, such as education or insurance status, did not change these results.
Conclusion: In this large and diverse clinic-based population, race and obesity were independently associated with slow wave sleep duration. Further studies are needed to establish whether reduced slow wave sleep increases morbidity risk in African Americans and the obese.

0919

SLEEP CHARACTERISTICS OF SELF-REPORTED LONG SLEEPERS

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Introduction: Self-reported long habitual sleep durations consistently predict increased mortality. However, it is unclear whether self-reported long sleepers truly sleep more or whether this represents a surrogate marker for co-morbidity or an underlying sleep disorder. Thus, we sought to compare objectively measured sleep parameters between self-reported long and normal duration sleepers.
Methods: Older community-dwelling men participating in the prospective Osteoporotic Fractures in Men Study (MrOS) were recruited for a comprehensive sleep assessment between December 2003 and March 2005. Subjects completed questionnaires including a question about usual nocturnal sleep duration, wore a wrist actigraph for a minimum of 3 nights and underwent in-home unattended polysomnography.
Results: Of the 3134 participants (mean age 76.4 ± 5.6 yrs and 89.9% Caucasian), 1888 (60.2%) reported sleeping 7-8 hours (normal sleepers) and 174 (5.6%) reported sleeping 9 hours or more (long sleepers). Self-reported long sleepers were older on average (78.9 vs. 76.4 yrs) and had a greater prevalence of diabetes (19.5% vs. 11.7%) and antidepressant use (14.4% vs. 7.5%) compared to normal sleepers. Based on actigraphy, long sleepers spent on average 63.0 min more per night in bed ($P < 0.001$), slept 42.8 min longer ($P < 0.001$), and spent 6.8 min more per day napping ($P = 0.01$). Based on polysomnography, the apnea hypopnea index, periodic limb movement index, arousal index, and sleep stage distribution did not differ. After adjusting for differences in demographics, co-morbidities, and medication usage, self-reported long sleepers continued to spend more time in bed and sleep more based on objective measures of sleep. Each additional 30 minutes in bed or asleep as measured by actigraphy increased the odds of being a self-reported long-sleeper 1.73-fold and 1.33-fold respectively ($P < 0.001$ for both).
Conclusion: On objective assessment, self-reported long sleepers spend more time in bed and more time asleep than normal sleepers. This is not explained by differences in co-morbidity or sleep disorders.
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0920

CIRCADIAN PHASE PREFERENCE, SLEEP PATTERNS AND PERCEIVED HEALTH IN ADOLESCENTS

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Introduction: Both circadian phase preference and inadequate sleep have been associated with clinical and functional outcomes. The impact of circadian phase preference on sleep patterns in adolescents in relation to perceived health and health outcomes is less well explored. The present study examines associations among circadian phase preference, total sleep time, and perceived health in a sample of adolescents.
Methods: 145 participants recruited from a large sample of students recently admitted to college (ages 17 - 21, mean age of 18 years; 68 males) completed an online questionnaire to assess sleep, mood, and other behaviors. Circadian phase preference was measured using the Horne-Östberg Morningness-Eveningness Questionnaire (MEQ); participants were categorized into three groups based on the original scoring criteria: morning types (n = 21), neutral types (n = 84), and evening types (n = 40). Perceived health was taken from a single item ("How would you characterize your general health?") on a scale of 1 to 5 (1 = "excellent," 5 = "poor"). Sleep patterns on school nights and non-school nights over the past two weeks were assessed using items from an adolescent sleep habits survey.
Results: As a continuous variable, higher MEQ score (associated with morningness) was related to better perceived health ($R^2 = .034$, $P < .05$); however, when self-reported school night total sleep time was entered into the regression equation, MEQ score was no longer a significant predictor of perceived health ($\Delta R^2 = .005$, $P > .1$). Analyses of MEQ as a categorical variable revealed that evening types reported a later bedtime on school nights (mean = 12:36am, SD = 1.07hrs) than morning (mean = 11:34pm, SD = 0.96hrs) and neutral types (mean = 11:44pm, SD = 0.86hrs), but wake times did not differ among MEQ groups (mean = 6:44am, SD = 0.69hrs). Evening-types reported less total sleep time on school nights (mean = 6.79hrs, SD = 1.69) than morning (mean = 8.03hrs, SD = 1.17) and neutral types (mean = 7.69hrs, SD = 1.34).
Conclusion: Adolescents who self-identify as evening types sleep less than morning types or neutral types on school nights due to later bedtimes and similar wake times. Evening types perceive their health as worse than their morning type counterparts; this diparity is accounted for by the difference in total sleep time on school nights between the groups.
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0921

VARIABILITY IN SELF-REPORTED SLEEP AMONG YOUNG, MIDDLE-AGED, AND OLDER ADULTS

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Introduction: Objective and subjective measures of sleep have documented high night-to-night variability in people with insomnia and in specific age groups. The goals of this study were to examine night-to-night variability and between-subjects variability in self-reported total sleep time (TST) across three age groups of normal sleepers.
Methods: Random-digit dialing was used to recruit a stratified sample from Shelby County, Tennessee. Participants completed self-report measures of health, mood, daytime functioning, and two-weeks of sleep diaries. This study analyzed sleep diary data from 596 normal sleepers (defined as absence of sleep disorder). Participants were classified by age as young (20-35 years), middle-aged (36-64 years) or older (65-96 years) adults. Night-to-night variability in TST was represented by within-subject standard deviation across the two weeks of sleep diaries. Between-subject variability was represented by the difference between each subject's mean TST and the group mean TST. One-way analyses of variance were conducted to examine night-to-night variability and between subjects variability across the age groups; young (n = 148), middle-aged (n = 268), and older (n = 180) adults.
Results: Results of the first analysis revealed a significant difference between the groups, $F(2,593) = 31.65$, $P < .001$. Tukey's post hoc analysis revealed that young adults (M = 82.38, SD = 38.92) had significantly greater within-subjects variability in TST than middle-aged or older adults. Middle-aged adults (M = 69.83, SD = 30.66) had significantly less variability in TST than young adults, but more than older adults, and older adults (M = 54.20, SD = 28.21) had significantly less variability than both younger age groups. In the analysis of between groups variability, Levene's test of equal variances revealed no significant differences among age groups, $F(2,593) = 1.63$, $P = .20$.
Conclusion: Within-subject variability in sleep diary measures of TST was the greatest for young adults, followed by middle-aged, and then older adults. These results warrant further investigation into the potential influence of age on variability in sleep pattern.
Support (If Any): Research supported by National Institute on Aging grants AG12136 and AG14738.

0922

SLEEP IN EARLY GESTATION: A PRELIMINARY LOOK

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Introduction: Pregnant women complain of disturbed sleep. Yet, few studies have quantified sleep in pregnant women particularly during early gestation. Describing and exploring early gestational sleep and how it relates to pregnancy complications is pertinent given the link between disturbed sleep and adverse health outcomes, and especially since the pathophysiology often begins in early gestation.
Methods: We present preliminary sleep data on 45 women enrolled in an observational study evaluating the relationship between sleep and risk of adverse pregnancy outcomes. Beginning around 10 wks gestation, each woman completed a sleep diary and wore an actiwatch between 10 - 12 weeks, 14 -16 weeks, and 18 - 20 weeks gestation. On the 15th day of each data collection period, women completed several questionnaires.
Results: Women (N = 45) were ~29 yrs old, 70% were Caucasian and 73% were married. Over 70% were at least college graduates with > 50% making at least $50K/yr. This was the first pregnancy for 60% of the participants. Sleep quality characterized by the Pittsburgh Sleep Quality Index (PSQI) varied in early gestation with 25% of participants indicating poor sleep (score > 6 at each time point). Approximately 10% met diagnostic criteria for insomnia based on the Insomnia Symptom Questionnaire (ISQ). According to both sleep diary and actigraphy, sleep remained fairly consistent across 10-20 weeks gestation. On average, women reported a sleep onset latency (SOL) = 16 - 20 minutes, wake after sleep onset (WASO) = 20 - 25 minutes and total sleep time (TST) = 483 -487 minutes. However, the top quartile had an average SOL > 25 min and WASO > 30 minutes suggesting some women had difficulty initiating and maintaining sleep. On average, sleep efficiency was good (91 - 92.5%), however one quarter had SE < 90%. Actigraphy data indicates slightly poorer sleep with a women spending 22 - 25% of the night awake, TST = 337 - 361 minutes and a sleep efficiency = 68-72%. About 25% of women spent

> 35% of the night awake, with sleep efficiency among the bottom quartile ~ 60%.
Conclusion: This preliminary look at various sleep domains during early and mid-pregnancy suggest that while sleep remains consistent between 10-20 weeks gestation, there is a subset of women who have disturbed sleep and may be at increased risk of developing adverse pregnancy outcomes.
Support (If Any): R00 NR010813

0923

SLEEP QUALITY AND SLEEP PATTERNS OF ON-DUTY PROFESSIONAL FIREFIGHTERS

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Introduction: Sleep deprivation is a significant safety hazard among shift workers due to decrease performance and mental acuity; this is particularly true among professional firefighters. The aim of this pilot study was to describe the sleep quality and the sleep-wake patterns in on-duty firefighters.
Methods: Pittsburg Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS) were administered to professional firefighters on night duty (16hr shift); firefighters continuously wore a motionlogger actigraph (Ambulatory Monitoring, Inc.) on their nondominant wrist for 3 days, during which all activities including fire and medical calls were monitored. Six parameters were observed and normal thresholds identified: sleep quality (PSQI < 6), work-time alertness (ESS < 11), sleep duration (> 6 hrs), sleep efficiency (> 84%), and wake after sleep onset (WASO < 31 min). Those who failed to meet > 4 parameters were considered sleep deprived.
Results: All firefighters (n = 16) had 72hr analyzable recordings. Demographics included: age 44+6 yrs, 81% males, 75% white, 25% with cardiac history, 31% obese (BMI > 29), 25% with wide waist circumference (> 100cm) and 25% with smoking history. The mean total scores for PSQI and ESS were 7.1+3.3 (0 better-21 worse) and 8.1+4.3 (0 better-24 worse), respectively. Actigraphy parameters showed: sleep duration 380+112 min, sleep latency 46+42 min, WASO 93+62 min (P = 0.04 vs normal population), and sleep efficiency 88+11. Significant differences (P < 0.05) were observed between firefighters who were sleep deprived (n = 6, 38%) and those who were not (n = 10, 62%) regarding age > 40 yrs, male gender, white ethnicity, cardiac history, wide waist circumference, and smoking history.
Conclusion: Though firefighters' sleep efficiency and quality seems to be adequate, their sleep is mildly disturbed by multiple etiologies that predispose them to sleep deprivation. This preliminary work shows that a strategy of continuous field monitoring of firefighters could provide new insight into the association between firefighter's specific professional lifestyle and sleep disorders.

0924

EFFECTS OF SLEEP ON GROSS MOTOR, FINE MOTOR AND SERIAL ORDER MEMORY

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Introduction: Past research has indicated that sleep enhances memory on fine motor and recall and recognition tasks more than an equivalent amount of time spent awake. We sought to extend these findings to gross motor and serial order learning tasks.
Methods: Participants (n = 70) learned a finger-tapping task (fine motor skill), an arm coordination task (gross motor skill) and a card task (serial order learning). They were tested on 3 occasions: immediately after learning, and 12 and 24-hours afterwards. The timing of initial training was randomly assigned so that half were allocated to a Sleep-wake Group trained in the evening prior to sleep (SW) and the remainder to a Wake-sleep Group trained in the morning (WS). All participants slept for one night during the 24 hour testing period and this was verified by actigraphy. Data were analysed by 3 x 2 (test phase x group [SW,WS] ANOVA to determine the main effect of sleep and wake on tasks.
Results: Over the 24-hour period, a night of sleep facilitated consolidation of gross motor memory more than a day awake in both SW and WS groups (P < 0.01). Similarly, although memory for serial order decreased in the initial 12-hour period in both groups, during the second 12-hour period, sleep facilitated task consolidation (WS group), however wakefulness did not (SW group) (P < 0.01). Fine motor memory was enhanced by sleep in both SW and WS groups but by wake only for the WS group (P < 0.01).
Conclusion: Previous findings for enhanced fine motor task learning with sleep were replicated. New findings include evidence that sleep enhances gross motor task learning and facilitates task consolidation in a serial order task.
Support (If Any): PYL is supported by NHMRC Career Development Award 511929

0925

THE EVALUATION OF PHYSICAL AND COGNITIVE FUNCTIONS, AROUSAL LEVELS AND MOODS IN HEALTHY UNIVERSITY STUDENTS AFTER ZALEPLON ADMINISTRATION

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Introduction: It is well known that physical activity or athletic ability cannot be exhibited to its full extent when the subject has a sleep disturbance or insufficient sleep the prior night. In the past, attempts to use hypnotics for athletes to overcome sleep disturbances the night before sports events were often unsuccessful due to carryover effects of the drug on the following day. Therefore, in the present study, we evaluated effects of Zaleplon (10 mg) on sleep at night and psychomotor function, physical activity and subjective evaluation on the next day, in healthy university students.
Methods: The subjects enrolled in the study included 12 healthy male university students. According to a cross-over double-blind design, the subjects had both placebo and drug sessions. The hypnotic or placebo was taken at 0:00a.m., and the subjects were instructed to get up at 7:00a.m. The subjects had the same breakfast (8:00a.m.) and lunch (12:00p.m.). To investigate the remaining effect of the medication on the next day, psychomotor and physical performance tests were carried out at 9:00a.m., 13:00p.m. and 17:00p.m. respectively. The performances tests included a combined test for finger dexterity (CTFD), simple discriminatory reaction test (SDR), critical flicker fusion test (CFF), Digit Symbol Substitution Test (DSST), finger tapping, standing trunk flexion, right grip strength, right quadriceps femoris muscle strength, repeated side jumps, Japanese Translation of Profile of Mood States (POMS), Stanford Sleepiness Scale, alertness with VAS, well-being with VAS and fatigue with VAS.
Results: The results of the CFF test were significantly better in the zaleplon group than in the placebo group. In the results of CFTD, there was an interaction between time and medication. Also, the results were significantly low at 9:00a.m. in the zaleplon group. No significant difference was found in other physical and cognitive functions and subjective evaluations.
Conclusion: Several reports suggest that CFF is a tool to measure arousal levels and hypnotics cause CFF score to decrease. But in the current study, hypnotics improved the CFF test performance as Ue-

mura et al. (2007) reported. Although there were no significant differences in the subjective evaluations, the subjects' good sleep and hyperarousal state caused by the withdrawal from the hypnotic may be the reasons for this result. The CFTD score was worse in the zaleplon group at 9:00a.m., so there is a possibility that zaleplon impairs finger dexterity.

0926

PERSONALIZATION OF FALLING-ASLEEP AND WAKE-UP ENHANCEMENT PROGRAMS: PILOT STUDY

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Introduction: The technological innovation allows adjusting the behavior of falling-asleep and wake-up enhancement programs to the profile of the Sleeper. Objective: assess the subjective efficiency on sleep and alertness of a simulator offering customized programs for falling-asleep and wake-up enhancement.
Methods: Two profiles are defined [Executive (E), Junior (J)]. Customized programs are created for each profile. 27 healthy adults (no chronic pathology, no serious visual disorder, no psychotropic treatment or treatment likely to influence body temperature, no serious sleep or alertness disorders, no intercurrent disease) (13 Executives, 14 Juniors). Longitudinal study: 1 reference week without simulator (Ref), 1 week using standard programs of the simulator (St), 1 week using profile-specific (E or J) customized programs (Pr). A sleep agenda is filled daily, assessing wake-up mind-clarity and alertness (visual analogic scale). Vis-Morgen (freshness at wake-up) and Spiegel questionnaires are filled once per week.
Results: The E program improves nocturnal parameters : sleep efficiency (Pr : 93.6 ± 6.5% vs Ref : 92.3 ± 6.3%, $P < 0.05$ et Pr vs St : 92.3 ± 6.3%, $P < 0.05$) and sleep latency (Pr : 13.2 ± 15.2min vs Ref : 18.9 ± 14.3min, $P < 0.05$) as well as diurnal parameters : mind-clarity (66.9 ± 10.7% vs 54.2 ± 14.1%, $P < 0.01$), wake-up alertness (Pr : 59.6 ± 11.4% vs Ref : 45.3 ± 10.5%, $P < 0.01$) and morning energy (52.5% ± 14.8% vs 40.1 ± 14.4%, $P < 0.01$). The J program improves total sleep quality: Spiegel questionnaire (Pr : 21.9 ± 2.6 vs Ref : 20.4 ± 2.3, $P < 0.05$) et wake-up parameters : mind-clarity (62.0 ± 13.8% vs 44.5 ± 16.4%, $P < 0.001$), morning energy (50.9 ± 19.9% vs 32.3 ± 12.2%, $P = 0.01$), freshness at wake-up (Pr : 56.1 ± 13.5 vs 42.7 ± 11.3, $P < 0.01$), wake-up time (Pr : 9.0min ± 12.5 versus 18.9min ± 20.2, $P < 0.01$).
Conclusion: Customized programs seem more efficient than standard programs and improve the subjective quality of sleep and wake-up

0927

THE ROLE OF BODY TEMPERATURE RHYTHMS IN RISK TAKING

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Introduction: Core body temperature (CBT) is often used as an alias for sleep-wake circadian rhythms, and high core body temperature is associated with wakefulness and optimal cognitive functioning. In a society that values 24-hour operations, it is critical that we determine the conditions that are more or less likely to facilitate or inhibit risk-taking behavior.
Methods: 134 participants (mean age 19, SD = 1.14; 60% female) completed the Balloon Analog Risk Task (BART), a computerized measure of risk-taking behavior, at two time points: four and sixteen hours after their average self-reported weekday rise time. To index CBT, tympanic temperature was taken at both sessions, and a difference score was created by subtracting temperature at the bedtime session from temperature at the morning session. Participants were categorized into one of four groups based on a quartile split of this difference score: large positive difference, small positive difference, small negative difference, and large negative difference.
Results: Mixed RMANOVAs revealed an interaction between the time of day at which participants completed the BART and temperature difference group ($F(3,125) = 2.31$, $P = .08$). When the analysis was run using only the large negative and large positive difference groups, this interaction was significant ($F(1,61) = 7.99$, $P < .01$). Participants in the large negative difference group exhibited significantly more risk-taking behavior during the morning session than during the bedtime session ($t(32) = 2.55$, $P < .05$). Participants in the large positive difference group exhibited more risk-taking behavior during the bedtime session than during the morning session, however this difference was not significant ($t(29) = 1.47$, $P = .15$).
Conclusion: Previous research suggests that participants' body temperature should be higher during the morning session than during the bedtime session. Individuals whose body temperature showed this pattern may be physiologically akin to "morning types", while those whose body temperature showed the opposite pattern (i.e., higher at bedtime than at peak time) might represent physiological "evening-types". These results suggest that individuals with a physiological propensity for eveningness are more apt to engage in risky behavior during the day than at night whereas individuals with a physiological propensity for morningness may act more riskily at night.
Support (If Any): This research was supported in part by grants to the author from the American Psychological Association and the University of Arizona Social and Behavioral Sciences Research Institute.

0928

THE RECIPROCAL INTERACTIONS BETWEEN PHASIC EVENTS DURING NREM SLEEP

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Introduction: Several phasic events characterize NREM sleep (spindles, slow oscillations, arousals, etc.) which are usually evaluated and reported separately; however, it is evident that there are time correlations between them. The rules for scoring cyclic alternating pattern (CAP) provide a structural framework to most of these events but exclude spindles. However, several studies have shown that sigma activity and spindles in particular have a stabilizing effect on sleep with an inhibitory action on arousals. For this reason, the purpose of this study was to evaluate the reciprocal interaction between CAP and spindle/sigma band EEG activity.
Methods: 27 children aged 7-16 years (13 males and 14 females) underwent standard polysomnography. CAP analysis was carried following the criteria by Terzano et al. (2001), spindles were visually detected and counted; spindle density was calculated during stage N2 as well as the power of the EEG sigma band (C3-A2 or C4-A1).
Results: A significant negative correlation was found between spindle density and CAP rate (-0.52), CAP subtype A1 index (-0.46) and A2 index (-0.60). The same CAP parameters showed a negative correlation also with the power of the EEG sigma band during N2.
Conclusion: This study confirms the original hypothesis that during sleep stage N2 a negative correlation exists between CAP (and consequently unstable sleep) and spindle activity or EEG sigma band. Thus, the sleep stabilizing effects of spindles are negatively correlated with sleep instability which characterizes CAP and these two apparently different phenomena appear to be in coordinated interaction between them.

0929

AROUSALS IN REM SLEEP WITHOUT EMG CHANGES

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Introduction: The standard practice for visual scoring of arousals from REM sleep requires changes in EEG frequency, accompanied by changes in EMG. The rationale for these requirements was to improve inter-rater reliability, and to not falsely identify normal REM EEG as an arousal. Our objective in this study was 1) to determine the rate at which EEG arousals without EMG changes ("non-EMG arousals") actually occur in REM in healthy subjects; and 2) to determine if we can induce these events during REM by disrupting sleep with external noise.
Methods: Thirteen healthy young adult sleepers were admitted to the sleep lab for three consecutive nights of 8.5 hr sleep periods: an undisturbed baseline night (control) and two noise exposure nights. Noises were fourteen sounds commonly encountered in the hospital (e.g., IV alarm; door; helicopter). Sounds were presented in random order through a speaker array with rising 5 decibel step exposures from 40 to 70dB(A). EEG arousals were quantified in REM sleep by standard EEG criteria excluding the accompanying EMG change criterion.
Results: In the control night, non-EMG arousals took place in REM sleep at 9.3 events per hour. On the nights that sounds were presented, non-EMG arousals took place in REM sleep at 96.6 events per hour, yielding a mean difference of 87, $t(12) = 4.05$, $P < 0.002$ (paired t-test).
Conclusion: These results demonstrate that EEG disruptions of sleep during REM, without accompanying EMG changes, can be readily induced by environmental noise. Based on this data, we suggest that EEG arousals from REM sleep, like those in other stages, can demonstrate brain-based disruptions of sleep—irrespective of whether there is EMG change.

0930

ATYPICAL HEART RATE INCREASE AFTER SLEEP ONSET

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Introduction: The decrease in heart rate after sleep onset is a clinically recognized physical behavior. We observed an atypical increase in HR after sleep onset in several patients referred for a polysomnogram (PSG) for suspected sleep apnea. We suppose this behavior is due to an abnormal autonomic cardiovascular control at least during sleep in these subjects. We aimed to estimate the autonomic function during sleep using time frequency decomposition of heart rate variability (HRV) as a measure of autonomic cardiovascular control.
Methods: PSG data from 8 patients that exhibited increasing HR were compared to a control group of 16 studies that exhibit the characteristic decline in HR. HRV analysis was performed using the HC1000P software. Control studies were matched for age, sex, BMI and Apnea/Hypopnea Index (AHI). Average age was 50.0 ± 9.2; BMI was 27.0 ± 5.0; AHI was 7.0 ± 7.3 HRV analysis was performed as follows: ECG signals were analyzed by the HC1000P software based on time-dependant spectral analysis of the RR interval. Thus we calculated three arrays: very low frequency (VLF), low frequency (LF), and high frequency (HF), and the Autonomic Balance Index (ABI) across the night during different sleep states. Differences between groups was examined by T-Test, $P < 0.1$(*) and $P < 0.05$(**) were considered significant.
Results: HR was significantly higher for the test group than for controls for all sleep stages (**). VLF was lower for the study group for all sleep states but was did not reach statistical significance. LF was significantly higher for the study group during wakefulness (**). HF was higher for the study group for all stages, reaching statistical significance for the entire night (*), light sleep (*) and during wakefulness (**). ABI was lower for the test group during light sleep (*).
Conclusion: Subjects with an atypical increase in HR after sleep onset showed a significantly higher HR during all sleep/wake stages and a significantly higher LF during wakefulness, expressing higher sympathetic activity. Thus this atypical behavior of the HR after sleep (non-dipping HR) may represent a marker of increased cardiovascular risk in these patients.

0931

INFLUENCE OF CLONIDINE ON BREATHING DURING STABLE NREM SLEEP IN HEALTHY INDIVIDUALS

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Introduction: Clinical studies suggest that clonidine may cause respiratory depression in humans. We investigated the acute effects of clonidine on ventilation, respiratory cycle timing and upper airway mechanics in healthy humans during sleep.
Methods: Under normoxic conditions, we studied 3 healthy subjects. Subjects were studied over 2 nights receiving either placebo or 0.3 mg of clonidine orally. The following ventilatory parameters were measured during wakefulness and stable NREM sleep: tidal volume (VT), minute ventilation (VI), respiratory frequency (f), end tidal PCO2 (PETCO2), inspiratory and expiratory upper airway resistance (RUA).
Results: During wakefulness, for placebo and clonidine respectively, administration of clonidine resulted in decreased VI (7.5 ± 0.4L versus 6.2 ± 0.4L) and respiratory frequency (14.9 ± 1.9/min versus 11.2 ± 2.3/min) but not VT (0.53 ± 0.07L versus 0.64 ± 0.06L) in all three subjects. PETCO2 was 40.6 ± 2.3 mmHg and 44 ± 1.8 mmHg; inspiratory RUA was 8.6 ± 2.8 cmH2O/L/sec and 6.9 ± 4.7 cmH2O/L/sec; expiratory RUA was 10.0 ± 7.7 cmH2O/L/sec and 8.9 ± 7.4 cmH2O/L/sec. There was no difference in ventilation or timing during NREM sleep (frequency: 13.9 ± 3.4/min, and 12.8 ± 2.3/min; VT, 0.49 ± 0.09L and 0.49 ± 0.06L; VI, 6.7 ± 0.4L, and 6.2 ± 0.4L); PETCO2, 42.5 ± 0.9 mmHg and 44.4 ± 2.0 mmHg) Likewise, there was no difference in RUA during inspiration (4.7 ± 1.6 cmH2O/L/sec v. 5.1 ± 2.5 cmH2O/L/sec), or expiration (8.4 ± 7.9 cmH2O/L/sec v. 7.2 ± 6.8 cmH2O/L/sec)
Conclusion: 1) Clonidine is associated with reduced respiratory rate during wakefulness but not sleep. 2) Clonidine does not cause increased upper airway resistance during sleep.

0932

PRESCHOOLER BEDTIME ROUTINES IN A DISADVANTAGED POPULATION: A LONGITUDINAL ANALYSIS OF BEHAVIORAL, COGNITIVE, AND HEALTH OUTCOMES

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Introduction: Despite interest in assuring preschool children obtain adequate sleep, current understanding of whether advised sleep-related techniques (e.g., regular bedtimes, earlier bedtimes, soothing routines) promote child wellbeing in disadvantaged populations is poor.
Methods: We use data on approximately 2,300 children from birth to age 5, drawn from the Fragile Families and Child Wellbeing Study (FFCW). FFCW is a longitudinal birth cohort study of children born between 1998 and 2000 in 20 U.S. cities with populations over 200,000. The study includes a substantial over sample of unmarried births, such that children are more likely to live in low-income families, to have nonresident fathers, to be Black or Hispanic, and to have parents with lower levels of education than children in a nationally-representative sample. We use ordinary least squares (for continuous outcomes) and probit regressions (for dichotomous outcomes) to estimate associations of sleep-related routines and behaviors at age 3 with cognitive, behavioral, and health outcomes at age 5, net of the full set of child and family background characteristics.
Results: We observed a positive association between the interactive bedtime routines (i.e. reading a story, singing a song) and increased verbal test scores, net of other child and family characteristics. Regular and earlier bedtimes are associated with some decreased behavior problems (i.e. anxious behavior and withdrawn behavior, but not aggressive behavior). While bedtime routines are associated with decreased behavioral problems at age 5, adjustment for family background characteristics attenuates the association. We find little evidence of associations between sleep-related behaviors and routines with overall health, being overweight, or being obese in this sample. Results are similar whether we use the outcome variables at age 3 or the outcome variables at age 5.
Conclusion: This research has implications for interventions intended to reduce behavior problems and increase verbal test scores among disadvantaged children.
Support (If Any): R21HD060208 K01HD054421

0933

OBJECTIVELY MEASURED AND SELF-REPORTED SLEEP: SENTINEL MARKERS TO RELATIONSHIP SATISFACTION AMONG POSTPARTUM COUPLES

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Introduction: Separate research areas indicate that both sleep quality and relationship satisfaction decline among couples during the postpartum period. The goal of the present study was to integrate these complimentary areas and evaluate the influence of objectively measured and self-reported sleep on relationship satisfaction among first-time parents during the early postpartum period.
Methods: Twenty-two first-time postpartum mother-father dyads (N = 22 couples, parents were 27.6 [SD ± 5.1] years, infants were 6.91 [SD ± 1.28] weeks at data collection), contributed one week of continuous wrist actigraphy from which sleep efficiency and total sleep time were calculated. Each morning participants used a PalmPilot to report the number of times they awoke during the night, the cumulative duration of their nocturnal awakenings, and their sleep quality (100-point scale). Without discussing their sleep, couples made the same (counterbalanced) daily reports about their partner's sleep. At the end of this week, participants reported on their own and their partner's relationship satisfaction using the Comprehensive Marital/Relationship Satisfaction Scale.
Results: Self-reported relationship satisfaction was strongly associated with actigraphically-recorded total sleep time for both mothers ($r = .66$ $P = .001$) and fathers ($r = .55$ $P = .01$). However, there were no significant associations between self-reported sleep variables and relationship satisfaction. Mothers significantly underestimated ($F[1,21] = 7.4$, $P < .05$) fathers' self-reported relationship satisfaction. Mothers also underestimated ($F[1,20] = 4.5$, $P < .05$) fathers' self-reported nocturnal awakenings, but overestimated ($F[1,20] = 13.9$, $P < .001$) fathers' self-reported sleep quality. Fathers underestimated ($F[1,20] = 7.1$, $P < .05$) mothers' self-reported length of nocturnal awakenings and mothers' self-reported sleep quality ($F[1,20] = 4.8$, $P < .05$).
Conclusion: Relationship satisfaction was associated with objectively measured total sleep time, but not self-reported sleep during the early postpartum period. Relationship satisfaction usually begins to decrease around the seventh postpartum week; preventative measures that target sleep could be used to buffer against decreases in postpartum relationship satisfaction. Information about the relations between sleep and relationship satisfaction might also be used to prepare first-time parents for their transition to parenthood.
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0934

CHANGES IN SLEEP TIMING, DURATION, AND QUALITY AS CHILDREN TRANSITION FROM PRESCHOOL TO KINDERGARTEN

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Introduction: Little is known of the factors influencing changes in sleep during early childhood. Kindergarten is the first major life transition for many children due to parental separation, increases in academic and social demands, and perhaps changes in nocturnal and diurnal sleep. The following are results of a longitudinal study of children tracked from the summer prior to kindergarten into and beyond their transition to kindergarten.
Methods: Caretakers of 5-year-old children (n = 37) were recruited from local preschools and/or daycares. Each child wore a wrist actigraph for 7 days at three time points: the summer prior to kindergarten, following the first week of kindergarten, and following the first month of kindergarten. Caretakers completed a 7-day sleep diary at each time point to cross-validate actigraph measures. Caretakers also completed the CSWS, a measure of sleep quality for children. Participants were excluded if they did not complete all three time points (n = 3).
Results: Weekday (WD) sleep (as measured by actigraphy) decreased by 45 min following kindergarten $F(2, 66) = 11.56$, $P < .01$, $\eta 2 = .259$; mainly due to reduced napping as nocturnal sleep remained stable. Weekend (WE) sleep remained stable across kindergarten. Children were rated as having less difficulty going to bed $F(2, 44) = 5.89$, $P < .01$, $\eta 2 = .211$ and falling asleep $F(2, 44) = 4.09$, $P < .05$, $\eta 2 = .157$, but more difficulty waking in the morning $F(2, 44) = 3.35$, $P < .05$, $\eta 2 = .132$. Objectively, sleep was less fragmented, $F(2, 66) = 4.72$, $P < .01$, $\eta 2 = .125$. Post-kindergarten advances were observed for WD bedtimes (mean = 64 minutes) $F(2, 66) = 4.60$, $P < .05$, $\eta 2 = .122$ and WD rise times (mean = 75 minutes) $F(2, 66) = 16.78$, $P < .001$, $\eta 2 = .337$. Smaller advances were seen in WE bedtimes (mean = 35 minutes) $F(2, 66) = 8.20$, $P < .001$, $\eta 2 = .199$ and WE rise times (mean = 25 minutes) $F(2, 66) = 5.31$, $P < .01$, $\eta 2 = .139$.

Conclusion: WD sleep was reduced for children as they transitioned to kindergarten. This is likely due to reduced nap opportunities in the kindergarten setting. Caretakers advanced the WD nocturnal sleep period presumably to prevent sleep loss as children transition to kindergarten. Earlier WE bedtimes and rise times suggest an advance in the circadian period. Further research is warranted to better understand the effect of sleep loss and changes in circadian processes on behavioral and physiological functioning.
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0935

ADOLESCENT SLOW-WAVE SLEEP DECREASES WITH AGE RATHER THAN PUBERTY IN A LONGITUDINAL SAMPLE

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Introduction: Time spent in slow wave sleep declines over the course of puberty. However, as advancing pubertal status is correlated with age, it can be difficult to separate these effects. Using a longitudinal sample that covers the age range of pubertal development, these analyses aim to uniquely separate the effects of puberty from those of age.
Methods: 28 participants (Age range: 6.6-15.9 years) completed multiple polysomnography (PSG) studies over the course of 7 years (Mean = 4.5 studies). Participants spent at least two nights in the lab at every study (max = 5) and also completed sleep diaries. Tanner staging for pubertal development was performed by trained research nurses, and participants were classified as pre/early (Tanner breast/genital score = 1 or 2) or mid/late (Tanner score = 3-5) pubertal status. PSG data were scored by coders trained to reliability. Results from night one were used in the analyses because of procedural differences in subsequent nights. Mixed models were conducted using pubertal status and age as predictor variables for each sleep variable. Variables included were sleep latency, time spent in each Stage of non-REM sleep (1-4), total REM sleep, REM activity, REM sleep latency, sleep efficiency, self-reported sleep quality and ease of waking.
Results: In this longitudinal sample, stage 3 sleep, stage 4 sleep, and REM latency decreased with age. Decreases were unrelated to pubertal status.
Conclusion: Results suggest that age, independent of pubertal development, accounts for some of the normal changes in sleep at this point in the lifespan, consistent with recent findings from other studies. Adolescence is a time of simultaneous biological, social, and emotional changes, and all of these could contribute to changes in sleep. Since some of the changes in sleep are related to pubertal development, it is interesting that changes in sleep architecture seem to be more closely related to age.

0936

MEASURING SLEEP LATENCY IN PEDIATRIC INSOMNIA TRIALS: ROLE OF ACTIGRAPHY IN RELATION TO POLYSOMNOGRAPHY

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Introduction: Polysomnography (PSG) is a standard outcome measure for insomnia trials. However, actigraphy may have advantages over PSG in tolerability, cost, and ease of repeated measurements. We studied the tolerability and ability of actigraphy to detect change in sleep latency (SL) in children with autism participating in a pilot trial of supplemental melatonin.
Methods: Children had a clinical diagnosis of autism confirmed by the Autism Diagnostic Observation Schedule and the Autism Diagnostic Interview-Revised. All children had sleep-onset insomnia, with SL > 30 minutes at least 3 nights a week. After 3 weeks of baseline data were obtained, melatonin (Natrol®) was begun at 1 mg, with dose increased every three weeks (to 3 mg, then 6 mg) until the child achieved an actigraphically-measured SL < 30 minutes on 5 or more nights/week. Actigraphy (Phillips Respironics) was obtained each night for 17 weeks, with PSG obtained at baseline and each dose of melatonin in a subset of children.
Results: Fifteen children participated, age 6.5 years (2.2) [mean (standard deviation (SD)]. All children tolerated actigraphy, with average proportion of 0.72 scorable nights for each child. Four of seven children tolerated baseline PSG studies. Sleep latency measured simultaneously by actigraphy and PSG was highly correlated ($r = 0.77$; $P < 0.001$; Spearman correlation) and did not differ for PSG [50.5 (46.5)] vs. actigraphy [47.6 (52.8)]; $P = 0.50$; Mann-Whitney test. Actigraphy-based SL was 44.5 minutes (23.8) at baseline and 23.7 minutes (8) at end of study ($P = 0.05$; Wilcoxon-signed rank test). Actigraphy-based SL was stable in the 2nd and 3rd weeks, as compared to the first week, of each dosing period.
Conclusion: In this 17-week trial, actigraphy was accurate, better tolerated than PSG, and able to detect change in SL after intervention, supporting its use as an outcome measure in pediatric insomnia trials.
Support (If Any): Grant support received from Autism Speaks, National Institute of Child Health and Human Development (1R01HD059253), and Vanderbilt Institute for Clinical and Translational Research (RR024975).

0937

RESIDENT BONE MARROW STEM CELLS ARE RECRUITED TO PERIPHERAL CIRCULATION IN CHILDREN WITH OSA: RELEVANCE TO ENDOTHELIAL FUNCTION

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Introduction: Endothelial dysfunction is a potential complication of obstructive sleep apnea syndrome (OSAS) in children, and has been ascribed to systemic inflammatory changes. However, not all children with OSAS will manifest endothelial dysfunction. We hypothesized that the variability in endothelial function in OSAS may be related to the ability to recruit repair mechanisms such as bone marrow derived stem cells (BMSC).
Methods: Pre-pubertal non-hypertensive children with or without polysomonographically-confirmed OSAS were recruited. Endothelial function was assessed in a morning fasted state, using a modified hyperemic test involving cuff-induced occlusion of the radial and ulnar arteries. Blood was drawn and 3 types of BMSC were assessed by flow cytometry, namely endothelial progenitor cells (EPC), hematopoietic stem cells (HSC), and very small embryonic-like stem cells (VSEL).
Results: 25 children with OSAS (mean age 7.6 ± 1.5 years, mean BMI z-score: 1.23 ± 0.6) and 10 age-, gender-, ethnicity-, and BMI-matched controls (CO) were studied. Compared to CO, significant delays to peak capillary reperfusion after occlusion release (Tmax) occurred in the OSAS children as a group, but substantial individual variability was present. Similarly, EPC, HSC, and VSEL counts were significantly higher in OSAS children compared to CO ($P < 0.01$). However, Tmax was significantly and inversely correlated with EPC ($P < 0.01$), but not with HSC or VSEL.
Conclusion: OSAS in children is associated with increases in BMSC in peripheral blood. Endothelial dysfunction is a frequent, yet not universal consequence of OSAS in children. The variance in endothelial functional phenotype in pediatric OSAS appears to be associated with the ability to recruit BMSC, and more specifically EPC.
Support (If Any): NIH HL 65270

0938

SNORING IS NOT ASSOCIATED WITH ADVERSE EFFECTS ON BLOOD PRESSURE, ARTERIAL STRUCTURE OR FUNCTION IN 8 YEAR OLD CHILDREN: THE CHILDHOOD ASTHMA PREVENTION STUDY (CAPS)

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Introduction: Obstructive sleep apnea is a risk factor for hypertension, cardiovascular events and premature mortality in adults. The effect of snoring in childhood on cardiovascular risk factors has not been well studied.
Methods: A population-based birth cohort, who had been participants in a randomised controlled trial of interventions to prevent asthma up to age five years, were assessed at age eight years. The presence and frequency of snoring was assessed by parent-completed questionnaire. We measured non-fasting serum lipoproteins, blood pressure, high sensitivity c-reactive protein, carotid artery intima media thickness (CIMT, by ultrasound), brachial pulse wave velocity (PWVb) and augmentation index (AIx, by applanation tonometry).
Results: Of 409 children whose snoring status was assessed at age 8 years, 317 had lipid and 386 had arterial structure and function measurements. Snoring was not significantly associated with blood pressure, CIMT, or measures of arterial stiffness (all $P > 0.05$, after adjustment for confounders). Increasing snoring frequency was independently associated with lower HDL cholesterol (-0.032 g/dL per step, 95%CI -0.060 to -0.003) although the difference in HDL between snorers and non-snorers was not significant ($P = 0.052$). An association of snoring frequency with PWVb differed according to BMI ($P = 0.03$). Among those with BMI below the median, increasing snoring frequency was associated with lower PWVb ($P = 0.003$); the reverse of that expected.
Conclusion: Overall, snoring was not independently associated with adverse effects on metabolic or vascular structure or function in 8 year old children. An apparent adverse trend with increasing snoring frequency for HDL cholesterol requires confirmation in further studies.
Support (If Any): National Health and Medical Research Council of Australia Cooperative Research Centre for Asthma and Airways Pfizer Australia CVL Grant (for blood investigations)

0939

DEVELOPMENT OF THE PEDIATRIC RESTLESS LEGS SYNDROME SEVERITY SCALE (P-RLS-SS)©: A PATIENT-REPORTED OUTCOME MEASURE OF PEDIATRIC RLS SYMPTOMS AND IMPACT

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Introduction: The objective was to develop a multidimensional, patient-reported outcome (PRO) measure of pediatric restless legs syndrome symptoms and impact to be used in clinical research.
Methods: Following specific qualitative methods recommended by regulatory agencies and PRO experts, the development included: 1) concept elicitation interviews, 2) item generation, 3) cognitive debriefing interviews, and 4) scale revision. Thirty-three children and adolescents diagnosed with definite RLS, ages 6-17 years, and their parents participated in the concept elicitation interviews. Open-ended questioning provided qualitative patient quotes about RLS symptoms and impact. Transcripts were coded and analyzed using grounded-theory methods and the findings were used to develop a draft questionnaire. Cognitive debriefing interviews with 21 of the same children/adolescents and 15 of their parents were used to evaluate the questionnaire. Expert clinicians provided clinical guidance throughout.
Results: Draft severity questions were generated to measure the four symptom and four impact domains identified from the concept elicitation interviews: RLS sensations, move/rub due to RLS, relief from move/rub, hurt/pain, and impact of RLS on sleep, awake activities, emotions, and tiredness. Based on cognitive debriefing interviews and expert clinician review, extra response options were added to most items, several items were revised, and 11 items were deleted, resulting in a severity scale with 16 morning and 24 evening items. Caution regarding self-administration in children ages 6-8 years is recommended. To complement the child/adolescent measures, a separate parent questionnaire was also developed.
Conclusion: The P-RLS-SS© was constructed based on detailed input from children and adolescents with RLS, their parents, and clinical experts, thus providing a scale with strong content validity that is intended to be comprehensive, clinically relevant, and important to patients. Validation of this scale is recommended.
Support (If Any): Boehringer Ingelheim International GmbH.

0940

DO MATERNAL FACTORS (ANXIOUS STYLE OF ATTACHMENT & BEDTIME BEHAVIORS) AFFECT PREMATURE INFANTS' PROBLEMATIC NIGHT WAKING?

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Introduction: Infants' night sleep patterns, in particular problematic night waking, are common concerns for parents. Between one-quarter and one-third of infants aged six months to five years have sleeping problems. Many factors can influence the development of infants' night sleep patterns and sleep problems, although none are have been shown as causal. The aim of this study was to test the relationship between mothers' anxious style of attachment and maternal bedtime behaviors, and premature infants' signaled night waking.
Methods: Using a cross-sectional survey, online data were collected from mothers of premature infants aged 5-6 months (corrected). The main outcome measures were frequency of signaled night waking, total duration of signaled night waking and maternal perception of infant sleep problems. Multiple regression analyses, adjusting for factors such as family functioning, maternal happiness and infant birth order, were used to investigate associations among mothers' anxious style of attachment and settling behaviors and premature infants' signaled night waking. Logistic regression analysis was performed to test the predictive ability of mothers' anxious style of attachment and bedtime settling behaviors for infant sleep status.
Results: Data were available for 105 premature infants. Mothers reported that 55% percent of children had sleep problems and 17% of mothers rated the problem as serious. The regression analyses revealed the total duration of night waking was significantly associated with mothers' anxious style of attachment and maternal bedtime (physical comforting) behaviors at bedtime. Physical comforting behavior was also associated with infants' frequency of night waking and differentiated between infants with sleep problems and without sleep problems.
Conclusion: Mothers' anxious style of attachment and physical comforting behaviors at bedtime were associated with premature infants'

night waking and sleep problems. More research is warranted to explain the mechanism of this association and to determine whether this association is causal.

0941

THE RELATION BETWEEN SLEEPINESS, SLEEP HABITS, ACADEMIC MOTIVATION AND SCHOOL PERFORMANCE IN ADOLESCENTS

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Introduction: About 40% of adolescents report excessive daytime sleepiness (EDS) associated with performance impairments in class. Whether EDS in teenagers has an impact on academic motivation and consequently on school dropouts needs to be investigated. The present study aims at verifying if sleepiness in high school students is related to sleep habits, academic motivation and perception of competency at school.
Methods: A total of 1184 adolescents (45% boys, 55% girls, 13 to 20 years old, grade 9th to 11th) from 3 High Schools completed a questionnaire on sleep habits, academic motivation and performance. Correlations between sleepiness and 1) sleep habits during school and weekend nights, 2) academic motivation, 3) feeling of competency at school and 4) academic performance were performed.
Results: Results shows a significant negative correlation between sleepiness and total sleep time during school nights ($r = - 0,23$, $P < 0.0001$) and weekend nights ($r = - 0,07$, $P < 0,014$) and a positive correlation between sleepiness and bedtime on school nights ($r = 0,18$, $P < 0.0001$) and weekend nights ($r = 0,19$, $P < 0.0001$). Results also shows a positive correlation between sleepiness and the level of decrease academic motivation ($r = 0,60$, $P < 0.0001$) and a negative correlation between sleepiness and feeling of competency at school ($r = -0,34$, $P < 0.0001$) and reported academic performance ($r = -0,26$, $P < 0.0001$).
Conclusion: These results confirm that adolescents who sleep less and go to bed later are more likely to be sleepy during the day. These results also suggest that this sleepiness seems to be associated with a decrease in academic motivation and school performance but also with a feeling of being less competent in school. Further studies will be done to investigate this issue.

0942

GENDER DIFFERENCES IN SLEEP PATTERN OF TEENAGERS DURING SCHOOL NIGHTS AND WEEK-END NIGHTS

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Introduction: Over the last few years, researchers have shown that many sleep problems adolescents are experiencing are related to a delay in the biological clock occurring during this period. Social and school demands seem to play also a key role in sleep disturbances in teenagers. Whether boys and girls are similarly affected by those changes and demands is examined in the present study.
Methods: A total of 1184 adolescents (45% boys, 55% girls, 13 to 20 years old, grade 9th to 11th) from 3 High Schools completed a questionnaire on sleep habits, academic motivation and performance. Independent t-tests comparing sleep habits of girls and boys during school nights (SN) and weekend nights (WN) were performed on bedtime (BT), sleep onset latency (SOL), time in bed (TIB), total sleep time (TST), and rise time (RT).
Results: Results shows significant differences between girls and boys on school nights for BT (girls = 10:26PM ± 00:55, boys = 10:43PM ± 1:06; $P < 0,0001$) and RT (girls = 6:42AM ± 00:35, boys = 6:55AM ± 1:41; $P < 0,0001$). During weekend nights, significant differences were found for BT (girls = 00:14AM ± 1:31, boys = 00:41AM ± 1:40; $P < 0,0001$), TIB (girls = 9:32 hours ± 1:40, boys = 9:08 hours ± 1:45; $P < 0,0001$), and TST (girls = 9:13 hours ± 1:40, boys = 8:51 hours ± 1:51; $P < 0,0001$).
Conclusion: These results suggest that teenage girls and boys seem to have different sleep habits. First, boys seem to be slightly more delayed than girls during school nights. Also, girls seem to compensate their lack of sleep by having slightly earlier bedtime and longer sleep time during weekends. Whether these differences are related to physiological, psychological or social differences needs to be further investigated.

0943

FACTORS ASSOCIATED WITH THE READJUSTMENT DURATION OF SLEEP-WAKE SCHEDULE FOLLOWING LONG-VOCATION IN HIGH SCHOOL STUDENTS

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Introduction: Teenagers tend to shift their circadian preferences to "evening type" during puberty. The associated delayed sleep-wake pattern typically leads to accumulation of sleep debt in school days, and extension of sleep duration on non-school days. Especially after long vacation, it usually takes a great effort to realign their intrinsic circadian rhythm to school-term sleep patterns. The current study aims to explore the factors that can predict the duration needed to readjust sleep-wake pattern following winter vocation among senior high school students.
Methods: A package of questionnaires concerning sleep pattern, achievement motivation, and Morningness-Eveningness preference was administered to 608 students from the 10th grade to the 12th grade around seven to fourteen days after start of school following winter vocation. The participants were recruited from senior high schools in Taipei using stratified cluster sampling method. A total of 510 valid questionnaires were obtained. Pearson's correlation and stepwise linear regression was used to examine the relationship among the variables.
Results: The results showed that about 10% of the participants reported that the adjustment period lasted longer than 1 month after coming back to school. The discrepancy of sleep schedule between school day and holiday($r = .184$, $P < .001$), circadian type($r = -.502$, $P < .001$), and achievement motivation($r = -.148$, $P = .001$) correlate significantly with adjustment duration. Moreover, circadian preference ($\beta = -.479$, $P < .001$) and academic motivation ($\beta = -.094$, $P = .018$) can significantly predict the adaptive duration, which account for 25% of the variance in adjustment duration.
Conclusion: The current study found that although the sleep schedule in long vocation may be associated with difficulty in re-adjustment to school schedule, individual traits including circadian type and achievement motivation have greater impacts. While evening type is a risk factor for the adjustment difficulty, achievement motivation may on the other hand facilitate the adjustment process in these students.

0944

SLEEP AND DROWSY DRIVING IN A SAMPLE OF HIGH SCHOOL STUDENTS

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Introduction: About 60% of adult drivers have had drowsy driving experiences, but data from high school students are lacking. High school students usually do not get sufficient sleep during school nights, even though some of them have started to drive to school daily.
Methods: A self-designed questionnaire was distributed to six classes through science teachers of 10th-12th grades in a high school located in San Diego, California. A total of 154 questionnaires were distributed and 100% were retrieved. Of the 154 respondents, data from 151 students

were included in analyses (one 9th grader and two who missed more than half of the questions were excluded). Data were analyzed with SAS v9.2. Paired t tests, ANOVA and Chi-square tests, binary logistic and linear regressions were performed. This project was approved by the UCSD IRB.

Results: For the 151 students (mean age = 16.5 ± 1.0 years, range = 14.8-19.7), 67 (50.0%) were male; 80 (53.0%) were Caucasian, 35 (23.2%) were Asian; 55 (36.6%) were 10th graders, 52 (34.4%) were 11th graders, and 44 (29%) were 12th graders. Students slept significantly less during weekday nights than during weekend nights (6.97 ± 1.01 hours vs. 9.21 ± 1.55, t = -16.13, P < 0.0001). Sixty-two (41.1%) students took naps during weekends (mean daily nap time: 1.75 ± 0.91 hours). There were no significant gender and ethnicity differences overall, but there was a significant grade difference in the weekend total sleep time (WNDTST), with 10th graders reported longer WNDTST than the 12th graders (9.69 ± 1.62 vs. 8.70 ± 1.48 hours), even after controlling for gender and age (F = 3.89, P = 0.023). Fifty-eight (38.4%) students had a driver's license and 33 (56.9%) had drowsy driving experiences. Report of drowsy driving was predicted by shorter WNDTST even after controlling for gender, age and grade (OR = 1.85, 95%CI = 1.08-3.17, P = 0.024); number of drowsy driving events was also negatively correlated with the WNDTST after controlling for gender, age and grade (F = 4.79, P = 0.033); but these two relationships were both lost after controlling for weekend nap times.

Conclusion: High school students sleep much less on school nights than on weekends. Less than half of the students take weekend naps. More than half of the drivers have had at least one drowsy driving experience. Students try to compensate for their sleep debt during weekend nights, but this compensation may not be enough for those who drive.

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0945

THE IMPACT OF NAPPING ON NEUROCOGNITIVE FUNCTION IN PRESCHOOL-AGED CHILDREN

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Introduction: Daytime naps decline from ages of 2-5 years as biphasic sleep/wake patterns gives rise to consolidated rest periods at night. The role of napping in cognitive development has not been studied in preschoolers and napping requirements for task performance are unknown. This issue is pressing because alertness may impact learning potential and cognitive development. We hypothesized that daytime napping in preschoolers would be associated with better cognitive performance.

Methods: Healthy, normally developing children, aged 3-5 years, receiving full-time child care were recruited from local day care centers. The Peabody Picture Vocabulary Test (PPVT-IV) and the Children's Sleep Habits Questionnaire were screening tools. Sleep habits were measured over 7 days by actigraphy and parent logs. Neuropsychological testing included tests of sustained attention, auditory span, and motor persistence.

Results: 55 children (52% female, 48% male) completed the study. 33% were age 3, 48% were age 4, and 19% were age 5. Average daily nap time 62.72 minutes (71 minutes at age 3, 74.5 minutes at age 4, 21.22 minutes at age 5). Average daily night time sleep was 512.76 minutes. There was a negative association between average weekday napping time and the PPVT-IV (P = 0.0003) and auditory span (P = 0.0037). Conversely, weekday nighttime (P = 0.01) was positively correlated with the PPVT-IV. Total weekly nap time was negatively correlated with total night time sleep (P < 0.0001).

Conclusion: Greater napping is associated with poorer vocabulary and auditory span among preschoolers, while increased nighttime sleep is associated with better vocabulary. Possibly, more napping translates to less night time sleep, worsening neurocognitive impairment. Nighttime sleep may impact performance more than nap time. This effect may be attributed to brain maturation since older children will nap less and perform better; however, identical effects were observed when controlling for age. Our findings suggest the need for an interventional study of nap restriction on neurocognitive function.

Support (If Any): This project is supported by a NIH K12RR023250 grant through the Multidisciplinary Clinical Research Career Development Program at the University of Maryland.

0946

GENDER DIFFERENCES IN THE RELATION BETWEEN INFANT SLEEP AND INTERNALIZING AND EXTERNALIZING BEHAVIOR PROBLEMS: A LONGITUDINAL DESIGN

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Introduction: Internalizing and externalizing behavior problems constitute the most common forms of psychological difficulty in early childhood. There is evidence of a relation between sleep and behavior problems in preschoolers and school-age children (Gregory et al., 2004; Touchette et al., 2007). However, few studies have examined these links starting in infancy, and with a longitudinal design. Furthermore, studies of children's sleep often use general and retrospective questionnaires, which do not correlate with objective sleep measures (Sadeh, 2008). Finally, despite preliminary evidence that girls consolidate their sleep patterns earlier than boys (Dearing et al., 2001), previous studies have not considered boys and girls separately. The aim of this study was to investigate the relations between girls' and boys' sleep in infancy, assessed with a sleep diary, and later behavior problems.

Methods: 55 infants (29 girls) were assessed at 12 and 26 months. Infant sleep was assessed at T1 using a sleep diary completed by mothers on three consecutive days. Two parameters were derived: the longest uninterrupted sleep period and the longest wake period. At T2, mothers completed the Child Behavior Checklist to assess children's internalizing and externalizing problems.

Results: Results indicated that, for girls, the length of the longest sleep period was negatively associated with internalizing problems (r = -.37, P < .05) and the length of the longest wake period was positively correlated with externalizing problems (r = .48, P < .01). These links were not found for boys. Moderation analyses revealed significant and marginal interactions between gender and sleep for externalizing and internalizing problems, respectively.

Conclusion: The findings with girls are consistent with previous results based on concurrent designs and older children. However, the specificity of the links highlights possible gender differences (Dearing et al., 2001) in the nature and magnitude of the links between infant sleep and later behavioral and emotional regulation.

0947

CHARACTERISATION OF OXYGEN SATURATION IN HEALTHY SLEEPING NEONATES USING HIGH TEMPORAL RESOLUTION PULSE OXIMETRY

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Introduction: Measurement of the oxygen desaturation response to apnoea during sleep is fundamental to the diagnosis and management of sleep disordered breathing. Long time averaging is commonly employed on pulse oximeters to reduce noise susceptibility, which can reduce the

detection and magnitude of rapid short desaturations. To better characterise oxygen desaturations in normal sleeping neonates we have used high temporal resolution pulse oximetry (HTRPO).
Methods: Thirty-one healthy neonates with mean age 13.6 days (range 5-18) were studied overnight with a HTRPO employing 2 second averaging during full PSG studies. The SpO2 signal was acquired at 1 Hz and analysed offline.
Results: The mean observed SpO2 was 97.4% (SD = 1.1, range 94.8-99.0). The mean frequencies of observed desaturations > 3%, > 4% and > 10% below baseline were found to be 26/hour (range 5.9-69.8), 17.8/hr (2.3-55.8) and 4.64 (0.5-23.2) respectively. SpO2 dips from 3 to 4% below baseline had mean nadir 94.9% and mean duration 2.9 seconds. The minimum SpO2 value for each study was below 87%. Desaturations were associated with central events. Such rapid short desaturations may not be observed by oximetry using long time averaging.
Conclusion: The mean SpO2 observed was consistent with other neonatal studies. However, HTRPO reveals frequent, rapid short desaturations in neonates which has not been reported to date. It also found considerable variability between healthy neonates.

0948

ASSOCIATIONS AMONG SLEEP, CALORIC INTAKE, INSULIN RESISTANCE, AND BODY MASS INDEX IN ADOLESCENTS

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Introduction: Diabetes mellitus (type 2) and its intermediate metabolic traits such as insulin resistance are increasingly prevalent among adolescents, likely due at least in part to increasing body weight among teens. Body mass index (BMI) is directly correlated with caloric intake and inversely correlated with total sleep time (TST). It is not clear whether TST is associated with caloric intake or metabolic traits such as insulin resistance in adolescents. The purpose of this study is to explore the associations between TST, caloric intake, insulin resistance, and BMI in otherwise healthy adolescents.
Methods: As part of an ongoing study, participants aged 12 to 18 years were recruited from the community. Participants completed questionnaires regarding demographic characteristics, pubertal status (self-rated), and sleep duration (self-reported). Mean caloric and nutrient intake was measured by multiple interview-administered 24-hour diet recalls. Weight and height were measured and fasting (> 8 hours) blood was assayed for serum insulin and glucose. Insulin resistance (homeostasis model assessment of insulin resistance; HOMA-IR) was calculated as fasting serum insulin (μU/ml) × fasting serum glucose (mg/dL)/405. Descriptive and partial correlations were used for data analyses (α = .05).
Results: The sample (n = 30) included 56.7% (17) females, 76.7% (23) White adolescents. The mean age was 15.7 ± 2.0 years. Mean BMI was 24.4 ± 5.4 kg/m2, with 40% being obese or overweight. Mean caloric intake was 2,310 ± 585 kilocalories and HOMA-IR index was 1.96 ± 1.1 (> 2 = "pathological"). Mean nocturnal TST was 7.7 ± .92 hours per night, less than the 8.5 - 9.25 recommended. Mean fasting serum glucose and insulin levels were (94.4 ± 6.4 mg/dL and 8.5 ± 5.0 μU/mL), respectively. All fasting glucose levels were in the nondiabetic range. Controlling for age, gender, BMI, and pubertal status, decreased TST was significantly associated with increased carbohydrate (r = -.46, P = .02) and sugar (r = -.55, P < .01) intake. TST was not associated with HOMA-IR, kilocalories, or BMI.
Conclusion: Collectively, the sample was sleep deprived. This exploratory study was limited by the small sample size. However, the findings suggest that similar to previous findings in young adults, decreased TST was associated an increase in appetite for calorie-dense foods with high carbohydrate content; eating behaviors that potentially lead to obesity or endocrine and metabolic disorders.
Support (If Any): This study was supported by the Research Intramural Funding Program (RIFP), School of Nursing, University of Washington.

0949

ASSOCIATIONS BETWEEN PARENT REPORT OF ADHD SYMPTOMS, SLEEPINESS AND PHYSICAL DISRUPTORS OF SLEEP

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Introduction: Previous studies have examined the relationships between sleep-related breathing disorders (SRBD), Restless Leg Syndrome (RLS), periodic limb movements during sleep (PLMS), and ADHD symptoms and positive correlations with ADHD symptoms have been demonstrated. It is unknown whether these relationships vary across different age groups in a pediatric sleep referred population. Our objective was to assess for relationships between parent report of ADHD symptoms, daytime sleepiness, and physical sleep disruptors in children and adolescents.
Methods: The Pediatric Sleep Questionnaire (PSQ) was completed by parents of children referred to a sleep clinic. ADHD score was calculated as the sum of 6 DSM-IV-derived symptom-items on the PSQ. An overall SRBD score minus ADHD items (SRDB-16) was computed, as were validated subscales for sleepiness, RLS/PLMS, and sleep and breathing (SB). Correlations between ADHD score and calculated subscales were explored within each of three age groups: 3-6 (n = 94), 6-12 (n = 152) and 12-18 years (n = 118).
Results: ADHD score generally correlated with sleepiness for each age group, (r = 0.35, P < 0.002; r = 0.19, P < 0.03; r = 0.17, P < 0.07). Sleepiness (≥ 2 of 4 symptoms) was reported for 60, 71 and 87%, of each age group, respectively. ADHD score correlated positively with RLS/PLMS for 3-6 years (r = 0.49, P < 0.001) but not other ages. ADHD score retained marginal correlation with sleepiness after adjustment for RLS/PLMS (r = 0.18, P < 0.08) at 3-6 years. ADHD score and SRBD-16 were inversely correlated at 6-12 years (r = -0.23, P < 0.02) but not other ages. ADHD score and SB showed a marginal inverse correlation for 12-18 years (r = -0.176, P < 0.08) but not other ages. At both 6-12 and 12-18 years, sleepiness remained correlated with ADHD score after adjustment for SB (r = 0.181, P < 0.04; r = 0.210, P < 0.04).
Conclusion: Sleepiness is common in a pediatric sleep clinic population, and correlates with ADHD-like behavior across age groups. Within a group referred predominantly for suspected SRBDs, children with less severe SRBD as judged by snoring and breathing symptoms sometimes have more severe hyperactivity. These counterintuitive findings nonetheless corroborate previous research using polysomnography and cognitive testing.

0950

LIGHT MAY BE BENEFICIAL FOR INFANT CIRCADIAN ENTRAINMENT

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Introduction: The purpose of this study was to examine the relation between light exposure and rest-activity pattern in infants. The research questions included: 1) What is the level and duration of infant light exposure in the home environment? 2) Is there a correlation between circadian pattern of infant light exposure and activity? 3) What is the minimum light level that influences infant rest-activity pattern?
Methods: Twenty-two healthy infants (postnatal age 49.8 ± 17.1 days) continuously wore a combined light and activity monitor for seven days in their natural home environment. The ambient light experience and

rest-activity patterns were examined using descriptive and cosinor analysis methods.
Results: Infant exposure to light was limited. During the daytime hours (06:00 h-21:59 h), mean minutes (percent of time) that infants spent > 50 lux, > 100 lux, > 500 lux, and > 1000 lux were 191 ± 79 (19.92 ± 8.27%), 123 ± 60 (12.89 ± 6.33%), 37 ± 27 (3.86 ± 2.84%), and 23 ± 18 (2.38 ± 1.88%), respectively. Nonetheless there was a strong relation between timing of light exposure and peak activity. There was a significant linear correlation between the acrophase of light and the acrophase of activity ($r = 0.66$, $P = 0.001$). Separate linear regression analyses controlling for infant postnatal age in each model showed that minutes spent in light > 50 lux and > 100 lux during the daytime hours, as well as the amplitude of light, were significant predictors of the amplitude of infant 24-hour rest-activity rhythms.
Conclusion: Results suggest that increasing daytime exposure with low to moderate light intensities and maximizing light-dark differences in a 24-hour day may promote infant circadian entrainment during the early postnatal weeks. Light intensity and the amount of light increase during the day may have clinically importance in establishing an infant's day-night sleep-wake cycle.
Support (If Any): Hester McLaw Nursing Scholarship, University of Washington School of Nursing; Virginia Henderson Research Grant and Psi Chaper-at-Large Research Grant, Sigma Theta Tau Nursing International Honor Society.

0951

IMPACT OF INSUFFICIENT AND DELAYED SLEEP ON EARLY ADOLESCENTS' BEHAVIORAL WELL-BEING

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Introduction: Sleep alters many aspects of functioning such as mood, cognitions, and behavior. Prior studies have demonstrated that children with ongoing behavioral problems have poor sleep compared with their peers and self-reported insufficient and inconsistent sleep patterns are connected with lower grades in adolescents. This study examined the influence of actigraphically estimated sleep on behavioral well-being in early adolescents.
Methods: Seventh graders (N = 143, 81 females) from 2 urban middle schools (SST = 8:37am) wore an actigraph, kept a sleep diary, and completed the Achenbach Youth Self Report (YSR) and Center for Epidemiologic Studies Depression Scale (CESD). Parents completed a background questionnaire and Child Behavior Checklist (CBCL). School performance was obtained through transcripts. Close to 60% resided in households earning $60,000/year or less. Controlling for income/sex, participants' behavioral well-being, academic performance, and school behaviors were examined for 7th graders with adequate (> 510 min.) vs. inadequate (< 510 min.) school-night sleep; earlier (< 2:53am) vs. later (> 2:53am) midsleep times, and short (< 1 hr.) vs. long (> 1 hr.) weekend bedtime delays.
Results: Parent and adolescent scores on CBCL and YSR were significantly correlated (mean $r = .64$, $P's < .001$); therefore, subsequent analyses focused on the YSR. Actigraphic sleep variables were significantly associated with academic performance, school behaviors, and behavioral well-being ($r's = .20$ - $.37$, $P's < .05$). Multivariate analyses revealed that adolescents who obtained adequate sleep and/or had earlier midsleep times reported lower externalizing and internalizing problem scores and fewer tardies from school ($P's < .05$); however no differences in average grades or depressed mood. Seventh graders with shorter vs. longer weekend bedtime delays didn't differ on academic or behavioral variables.
Conclusion: Results suggest that young adolescents with insufficient sleep and/or delayed sleep schedules report more behavioral difficulties, increased tardiness, and poorer academic performance in comparison to their peers.
Support (If Any): NIH, NICHD, 5 R01 HD047928-05

0952

RELATIONSHIPS BETWEEN EVENINGNESS, SLEEP PATTERNS, DAYTIME FUNCTIONING AND QUALITY OF LIFE IN YOUNG ISRAELI ADOLESCENTS

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Introduction: Eveningness is a hallmark of adolescent sleep patterns. It is characterized by a preference for later bedtimes and wake-times, and is associated with reduced daytime functioning. The effects of eveningness and its correlates on quality of life (QOL) in young adolescents have yet to be examined. We assessed relationships between eveningness, sleep patterns, sleep-related daytime functioning and QOL, and examined predictors of QOL in young Israeli adolescents.
Methods: Four-hundred and forty-nine 8th and 9th grade students in Israel (mean age: 14 ± 0.08) completed validated questionnaires assessing eveningness, sleep patterns (bedtime, wake-time, sleep latency, sleep duration), related daytime functioning (sleep problem behaviors, sleepiness, depressed mood) and QOL (physical, emotional, social, school and psychosocial subscales and overall QOL). Pearson correlations with Bonferroni correction were used to evaluate associations between measures. Linear regression was used to examine significant predictors of QOL.
Results: Bedtime, wake-time, sleep duration (hours:minutes) and sleep latency (minutes) were 23:02 ± 55; 6:46 ± 32; 7:22 ± 1:96; 26 ± 27 on weekdays, and 01:46 ± 1:45; 11:29 ± 1:59; 9:53 ± 1:49; 22 ± 41 on weekends, respectively. Eveningness was significantly associated with later bedtime and wake-time, longer sleep latency and shorter sleep duration on weekdays; and later bedtime and wake-time and longer sleep duration on weekends ($P < 0.001$). Eveningness was significantly related to more sleep problem behaviors, sleepiness, depressed mood, and to lower QOL on all subscales (except social functioning, $P = 0.009$) and overall QOL ($P \leq 0.001$). Significant predictors of overall QOL were depressed mood, eveningness, sleepiness, weekday bedtime and weekend wake-time ($P < 0.05$).
Conclusion: An evening preference in young adolescents is reflected in poor sleep patterns and is associated with poor daytime functioning, which in turn have deleterious effects on QOL. These findings raise the need to increase public awareness and to explore possible interventions to reduce the negative consequences of an evening preference in adolescence.

0953

CHILDHOOD INSOMNIA IS ASSOCIATED WITH PARENTAL STRESS

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Introduction: Pediatric insomnia affects 1-6% of children in the general population and up to 50-75% of children with neurodevelopmental or psychiatric comorbidities, and may also contribute to parental stress. This study was designed to test the hypothesis that insomnia was associated with higher levels of parental stress.
Methods: Participants were 35 children participating in research studies at Vanderbilt University. Twenty-one had a diagnosis of autism spectrum disorder (ASD). Fourteen had a diagnosis of Angelman syndrome (AS). Time in bed (TIB), total sleep time (TST), sleep initiation (sleep latency), sleep maintenance (wake after sleep onset (WASO)) and movement and fragmentation index (MFI) were measured with wrist actigraphy (Phillips/Respironics) for an average of 18.3 days. Parental stress was

evaluated with the Parenting Stress Index Short Form (PSI-SF) (Psychological Assessment Resources, Inc). The association of each sleep variable with each scale on the PAR-SF was evaluated using linear models adjusted for diagnosis and age. In particular, we modeled the average and standard deviation (SD) for each sleep variable separately.
Results: Mean age (standard deviation; SD) was 6.5(3.1) years. The SD of WASO and MFI were significantly associated with higher levels of parental stress on the: Parent-Child Dysfunctional Interaction Scale (P = 0.02 and P = 0.03, respectively); Parental Distress Scale (P = 0.04 and 0.08, respectively). Average TIB was significantly associated with the total parental stress score (P = 0.05), although this differed by the diagnosis.
Conclusion: Across the sample, after adjusting for diagnosis and age, parents of children with more nightly variation in sleep maintenance reported higher levels of stress in several key domains. Improvement in nighttime sleep continuity in children may result in reduced parent stress.
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0954

NIGHTTIME SLEEP DURATION AND DAYTIME SLEEPINESS PREDICT NAPPING IN AT-RISK ADOLESCENTS

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Introduction: Prior research suggests that adults nap to compensate for lost sleep, to prepare for impending sleep loss, and/or for enjoyment. How these factors contribute to adolescent napping is unclear. This study investigates the hypothesis that sleep loss predicts napping in at-risk adolescents.
Methods: 49 adolescents in the Maternal Lifestyle Study (aged 13-14, 56 % female, 50% minority, 42% below the poverty line, and 82 % with prenatal drug exposure) filled out a sleep habits survey, kept an 8-day sleep diary while wearing an actigraph. Their parents completed surveys regarding the adolescents' sleep habits. These measures yielded estimates of daytime impairment due to sleepiness (12-item parent-report scale; 20-item participant-report scale [higher scores indicate increased impairment from sleepiness, e.g., falling asleep, disrupted activities, difficulty staying awake]) and nighttime sleep duration (M actigraphic sleep minutes across weeknights). All actigraphically scored sleep epochs outside the main sleep interval and within subject-reported naptimes were considered "napping."
Results: Parent-report of impairment due to sleepiness, adolescent-report of impairment due to sleepiness, and nighttime sleep duration were predictors of napping, together explaining 81.2 % of the variance of napping. Parent-report of impairment due to sleepiness explained 41.6 % of the variance, P < .001. Participant-report of impairment due to sleepiness explained an additional 16.9 % of the variance, P < .001. Above and beyond impairment due to sleepiness, nighttime sleep duration explained an additional 7.5 % of the variance, P = .004.
Conclusion: We found that the less sleep teens obtained at night and the sleepier they were during the day, the more they napped. Though causation cannot be inferred from this study, these findings support the hypothesis that at-risk teens are napping to compensate for sleepiness and insufficient sleep. Further investigating napping patterns and daytime functioning will inform sleep education and interventions tailored to promote optimal adolescent health and functioning.
Support (If Any): This study was funded by National Institute on Drug Abuse (NIDA), grant 5U10DA024119-02.

0955

POSTPARTUM FEEDING METHODS AND MATERNAL SLEEP DISTURBANCE

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Introduction: Evidence suggests that formula-fed infants have improved sleep compared to breast-fed infants. Yet the effect of feeding methods on maternal sleep has rarely been objectively examined. Our goal was to compare longitudinal, actigraphically-measured sleep between mothers based on feeding method. Based on the effects of prolactin on both breastfeeding and sleep, we expected that breastfeeding mothers would have improved sleep compared to those who formula fed.
Methods: Participants in a longitudinal postpartum sleep study (n = 19 during postpartum weeks 2-13, n = 43 during weeks 9-15) were retrospectively interviewed about their feeding methods. Nocturnal sleep period (sleep onset to final morning awakening), total sleep time, sleep efficiency, and sleep fragmentation were objectively measured with wrist actigraphy. Sleep measures were averaged within postpartum weeks and compared among 3 groups at each week: breast-feeding, formula-feeding, and a combination of the two.
Results: Only one measure during postpartum week 4 differed significantly between feeding method groups. On this week, total sleep time was significantly higher (P = .042) among women who breast-fed (N = 22, 446.0 ± 57.1) than those who bottle-fed (N = 5, 389.7 ± 57.1) or who used both (N = 15, 406.7 ± 51.2); sleep fragmentation was marginally lower (P = .053) among women who bottle-fed (N = 5, 17.9 ± 5.0) and women who breast-fed (N = 22, 18.3 ± 4.7) compared to those who did both (N = 15, 22.6 ± 6.3). Based on postpartum week 4 feeding categories, there were no statistically significant demographic or medical differences between groups.
Conclusion: Our single finding was consistent with our expectation that hormones (particularly prolactin) that promote both breastfeeding and sleep would lead to increased sleep time among breastfeeding mothers. Yet, our general finding was that there are few objective sleep differences between mothers who breast versus formula feed their infants. This should be made clear to women who consider formula feeding on the rationale that they will gain more sleep.
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0956

OBJECTIVE SLEEP DURATION AND SLEEP PATTERNS IN COMMUNITY SCHOOL AGE CHILDREN

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Introduction: Acutely restricted sleep duration (TST) elicits metabolic alterations and is increasingly being linked to obesity; however, there are scarce objective data in children. The aim of this study was to characterize TST among normal weight, overweight, and obese school-aged children, and explore potential TST associations with Body Mass Index (BMI).
Methods: In 308 children from the community, 1-week actigraphy, height and weight were collected. Cohort demographics were: 7.2 ± 1.3 years; 49% boys; 71.4% White Non-Hispanics and 18.8% African American. This sample was subdivided based on BMI z score percentiles (BMIz pct) into: normal weight (C): BMIz pct 5th - 85th: n = 155, overweight (OV): BMIz pct 85th - 95th: n = 53, and obese (OB): BMIz pct > 95th: n = 100. Distribution by gender and ethnicity was comparable among the 3 groups, with OB (7.74 ± 1.3 years) being slightly older than C (6.88 ± 1.2 years) and OV (6.99 ± 1.3 years) (F(2,307) = 14.93, P < 0.001), such that age was included as covariate in all analyses.
Results: TST was similar among groups except on weekend days when OB consistently slept less. Trending of week TST showed that C have

more regular TST with a tendency for increased sleep during weekends; however, TST in C was short (~ 8hours) and clearly insufficient for this age range. The OB TST appears regular when school schedules are in place, but TST is shorter as the week progresses with shorter as well as unstable sleep patterns during the weekend. Conversely, OV showed reciprocally unstable and irregular sleep patterns that were associated with their body weight ($r = 0.29$, $P < 0.05$).

Conclusion: In school-age children, TST is modestly associated with the BMIz score. However, sleep trending characteristics during school days and weekend days are suggestive of divergent sleep patterns that appear to exert a more profound impact on body weight accrual.

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0957

SHORT SLEEP DURATION AND IRREGULAR SLEEP PATTERNS ARE ASSOCIATED WITH INCREASED METABOLIC RISK IN SCHOOL AGED CHILDREN

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Introduction: Inadequate sleep may potentially trigger disruption of metabolic homeostasis, and has recently been linked to obesity; however, these associations have not been thoroughly explored in children. We hypothesized that sleep variability and duration during the week and during week-ends would affect metabolic function.

Methods: Sleep duration was obtained by 1-week actigraphy in 308 children from the community (7.2 ± 1.3 years, 49.0% boys, and 71.3% Caucasian, 18.8% African American). This sample was subdivided based on sleep in schooldays and weekend days into 9 groups: Short-Short (SS), S(N)ormal, S(L)ong, NS, NN, NL, LS, LN, LL. Body Mass Index z score (BMI) and blood metabolic markers were collected.

Results: Based on the cohort, SS sleep ~6:30 hours, NN ~8 hours and LL ~9:30 hours, i.e., optimal sleep. SS and SN were inversely associated with CRP, LDL, and Total Cholesterol, while LL and LN emerged as protective. Although variability in BMI was similar between sleep pattern groups, the joint association of inadequate sleep and increased BMI revealed in these children a pattern of altered metabolic and inflammatory states (elevations in fasting insulin, CRP, and cholesterol).

Conclusion: Increased BMI and sleeping ~8 hours or less (e.g., SN, SS) are strongly associated with adverse health metabolic outcomes in children. Overall being at the lower end of sleep duration, either by irregularity, instability, or inadequacy of sleep, is clearly associated with an increased health risk in school-age children.

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0958

FALL PREVENTION POLICIES IN PEDIATRIC SLEEP LABORATORIES; MYTH OR REALITY?

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Introduction: Falls are a recognized complication observed during hospitalizations and emergency room visits. Well established guidelines have been developed for minimizing risks in vulnerable populations. The objective of this study was to obtain information regarding the incidence of falls, approaches for prevention, and intervention strategies in the pediatric sleep laboratory, an area which has received little attention.

Methods: At our request, a total of 1565 surveys were distributed by the AASM on bed safety to all accredited sleep laboratories in the United States. The survey primarily focused on fall prevention policies and the number of falls that occurred in the last year, and data analyzed on laboratories conducting sleep studies on children < 12 years of age.

Results: Of the 1565 surveys, 262 (16.7%) were completed. 187 respondents (71%) performed sleep-studies on patients < 12 years of age. Of these, only 93 laboratories (55%) had a falls prevention policy. 171 facilities (91%) answered the question of how many children have fallen from the bed/crib in the last year. 5 facilities reported having had a pediatric patient fall out of bed. Of note, two falls occurred when technicians failed to raise the bed rails and one child slipped through a raised bed rail. The fall policies of accredited laboratories and the published literature were combined to produce fall prevention guidelines for pediatric sleep laboratories.

Conclusion: This study confirms that falls during pediatric sleep studies are uncommon but potentially serious, and more importantly that there is little awareness about the problem. A fall prevention policy analogous to those used for hospitalized or emergency room pediatric patients needs to be adapted for pediatric sleep laboratories and should be incorporated into the process of AASM accreditation of sleep centers. Further research should be undertaken to determine the best available tools for fall risk assessment and prevention.

0959

SLEEP PATTERNS AND PLASTICITY IN CHILDREN OF ALCOHOLICS

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Introduction: Sleep disturbance in childhood predicts cognitive impairment and early onset of alcohol and substance use. Similarly, offspring of parents with a history of alcoholism are at higher risk for developing similar difficulties. It is unknown whether sleep contributes to the conferred risk. Here we test the hypothesis that children at risk are more likely to have sleep disruption, which in turn contributes to impaired measures of plasticity.

Methods: 36 children, ages 8-12, participated. During fMRI, 108 words from The Affective Norms for English Words (MM Bradley, PJ Lang, 1999) were presented, to which participants responded whether they understood the meaning of each word. After the scan, participants were tested for retention using a list of the same and new words. That day participants were given actiwatches, sleep diaries (SlpD), and their parents completed the Pediatric Sleep Questionnaire (PSQ). Actigraphy and sleep diaries were assessed for one week.

Results: 14 children had two parents with a lifetime diagnosis of alcoholism (CO2A), 14 had one (COA), and eight had none (NCOA). No differences in recall (68%, SD = 17), or false positives (18%, SD = 10) were found. NCOA had significantly lower reaction time ($P = 0.026$). Groups were comparable on most sleep measures, except a trend towards more total sleep time (TST) according to SlpD ($P = 0.069$) in NCOA. fMRI contrast between remembered and forgotten words yielded a significant activation in posterior dorsal hippocampus (uncorrected $P < 0.001$). Activation level did not differ between groups. Regression analysis revealed that across groups recall was predicted by sleep measures ($F = 3.14$, $P = 0.035$), with PSQ routine subscale ($t = -4.4$), actigraphy sleep efficiency (SE, $t = -4.6$), and TST from diaries ($t = -3.9$)

the strongest predictors. Similarly, regression with individual activation level (F = 5.08, P = 0.020) revealed PSQ apnea subscale (t = 2.8) and actigraphy SE (t = 2.9) as strongest predictors.
Conclusion: Sleep quality may be a mediator for transgenerational risk by affecting cognitive function.
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0960

SLEEP HYGIENE AND SLEEP DURATION IN A SAMPLE OF URBAN AFRICAN AMERICAN ADOLESCENT GIRLS

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Introduction: Much research suggests that adolescents face considerable sleep difficulties. However, few studies have examined adolescent sleep habits in non-Caucasian samples, especially girls from low socioeconomic backgrounds. Supporting the need for research on sleep in this population, recent evidence suggests that short sleep duration may be a risk factor for developing type 2 diabetes and obesity, two health conditions that disproportionately affect African American women. Additionally, studies with African American males show evidence of differing circadian period and poorer test performance, relative to Caucasians, following a week of disrupted sleep. No such investigations have been reported for a minority female adolescent population.
Methods: Participants are approximately 177 African American adolescent girls (ages 14-20) residing in low-income communities in Chicago. As part of a larger study, adolescents reported sleep patterns and answered questions related to sleep hygiene.
Results: Preliminary findings (N = 62) indicated an average sleep duration of 8h11m (+/- 1h47m) during the week and 9h42m (+/-2h11m) on weekends. Regarding sleep hygiene, only 44% reported having a bedtime routine, 88.9% reported having a TV or computer in their bedroom, and of those 84.1% reported watching TV or using a computer in their bedroom before going to sleep. Having a bedtime routine was associated with more sleep on weekdays ($r = .256$, $P < .05$) but not on weekends ($r = .112$, $P > .05$), and TV/computer use before bed was related to less sleep on both weekdays and weekends ($r = -.309$, $P < .05$; $r = -.332$, $P < .05$).
Conclusion: Similar to other adolescents, this population appears to sleep less than the recommended 9 hours during the week and to compensate with longer sleep duration on weekends. As found in younger populations, poor sleep hygiene may be related increased sleep onset latency and to less than optimal sleep duration. Implications for intervention with this population will be discussed.

0961

AN EPIDEMIOLOGICAL STUDY OF PEDIATRIC SLEEP DISORDERS IN JAPANESE CHILDREN BY USING JAPANESE CHILDREN'S SLEEP QUESTIONNAIRE

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Introduction: Sleep questionnaires are valuable tools for screening sleep-related problems. However, these should consider the cultural aspects of sleep, for example, co-sleeping in Japan. We have developed and standardized the original Japanese children's sleep questionnaire. This is a form in which caregivers complete 39 questions with a six-grade severity rating scale. The aim of this study is to investigate the prevalence of sleep disorders in Japanese pre-school children.
Methods: 2,997 pre-school children consisting of 1,154 recruited from the 42-month preventive care visit in Higashi-Osaka City, 1,655 from municipal nurseries in Sakai City (1-6 years old), and 188 from a private kindergarten in Nishi-Tokyo City (3-6 years old). We report here the summary of the responses regarding the presence of sleep disorders. In the analysis the terms "very fit", "fit", and "slightly fit" were collectively judged to be positive for the relevant symptoms.
Results: 11.2% of children were reported to be snoring loudly. Loud snorting and/or gasping and cessation of breathing were reported in 3.8% and 1.9%, respectively. If "cessation of breathing" represents Obstructive Sleep Apnea Syndrome (OSAS), its prevalence is similarly 2%: as described in the International Classification of SLEEP DISORDERS Second Edition. Furthermore, there was no difference among children in the three cities. Bruxism was reported in 19.1%. Symptoms of Restless Legs Syndrome (RLS) such as an uncomfortable sensation in the legs and the rubbing of legs were reported in 2.3 - 3.1%.
Conclusion: The prevalence of habitual snoring, OSAS, and Bruxism in Japanese pre-school children is similar to previous reports. The prevalence of child RLS has not been reported in Japan. However, it is suggested that RLS is not a rare disease in children.

0962

A PILOT STUDY: CROSS CULTURAL COMPARISON OF ACTIGRAPHY AND PARENTAL REPORT OF SLEEP IN CHILDREN FROM CHINA AND UNITED STATES

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Introduction: Pediatric sleep problems are universal and exist across all cultures. The International Pediatric Sleep Task Force highlighted the importance of examining cultural similarities and differences impacting sleep practices in children. The purpose of this pilot study was to describe the sleep behaviors and sleep quality in children, ages 7-9, (n = 14) participating in the Jintan China Health Project (n = 1650) and a cohort of children, ages 6-10, (n = 15) who participated in a larger cross-sectional study from Philadelphia, US.
Methods: Measures: Children's Sleep Habits Questionnaire(CSHQ), validated in Chinese population; Actigraphy: non-dominant wrist, Sadeh algorithm; Sleep diaries.
Results: The weekly sleep diary was completed by all parents. Night time sleep duration for the China cohort was 558 minutes as compared to 600 minutes for the US cohort (P = 0.042). However, 79% of the parents of the China cohort reported that their child napped during the day. The US cohort did not nap. Forty percent of the US and 36% of the China cohorts scored above the cutoff on the CSHQ. Similar sleep problems were identified for both cohorts: bedtime resistance, sleep anxiety and daytime sleepiness. Four children in the China cohort were co-sleepers vs one child in the US cohort. Eighty five percent of the China cohort and 100% of the US cohort used actigraphy. Children in the China cohort were curious about the actigraph technology and opened the watch breaking the water seal. As a result, only five of the twelve sets of data were able to be analyzed. There was no significant differences (P = 0.144) in total sleep time as measured by actigraphy between the two cohorts. Discrepancies between diary and actigraphy data on napping behaviors in China cohort were found.
Conclusion: Continuous actigraphy for seven days along with diary data are invaluable and feasible in both populations. Chinese parents may be overestimating napping behaviors at school.

0963

PREVALENCE OF SLEEP DISORDERS IN CHILDREN WITH PRADER-WILLI SYNDROME: A QUESTIONNAIRE-BASED STUDY

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Introduction: Prader-Willi syndrome (PWS) is a neurogenetic disorder associated with obesity and sleep disorders, most commonly sleep apnea. For assessment of sleep disorders in this population the Sleep Disturbance Scale for Children (SDSC) questionnaire (Bruni et al 1996) was used because it is able to screen 26 sleep problems, resulting in 6 sleep disorder subscales: difficulty in initiating and maintaining sleep (DIMS), sleep breathing disorders (SBD), arousal disorders (DA), sleep-wake transition disorders (SWTD), disorders of excessive somnolence (DOES), sleep hyperhydrosis (SHY). It has been validated for Brazilian Portuguese.
Methods: Sleep Disturbance Scale for Children (SDSC) questionnaire was applied to parents of 18 children with PWS. Age ranged from 3 to 18 years (10 boys and 8 girls), mean age: 11.91 years ± 5.12. Twelve children (66.7%) were obese (percentile > 95) and 8 children (44.4%) were using GH. Bruni et al. indicate that a T score of 55 is a good cut-off for clinical significance.
Results: On the SDSC, 72.23% of the children obtained a total score higher than the clinical cut-off of a T score of 55, considered significant for sleep disturbances. Looking at the subscales, the highest score was for SBD (100%) and the other scores were 7.7% for DIMS, 7.7% for DOES and 15.4% for SHY. Children using GH received the following scores: 87.5% had scores above the acceptable level for SBD (100%), DIMS (14.30%) and SHY (14.30%). Average total sleep was 8.3 ± 1.86 hours and sleep latency was 10.8 ± 6.42 minutes. Average sleep was lower in the group using GH (P = 0.020); SWTD score was also lower in GH group (P = 0.025). The pattern of correlations between the scores showed that the average total sleep correlated moderately and negatively to the DIMS (P = 0,025) and the sleep latency correlated moderately and negatively to the SHY (P = 0,011). The score DIMS correlated moderately and positively to the SBD (P = 0,021), the score DA correlated moderately and positively to the SWTD (P = 0,004) and the Total Score correlated moderately and positively to the DIMS (P = 0,037), SDB (P = 0,001), DA (P < 0,0001), SWTD (P = 0,007).
Conclusion: The results suggest the presence of sleep-related disorders in the majority of children (72%) with Prader-Willi syndrome. The use of GH does not seem to improve sleep disturbances in this group. The recognition and treatment of sleep disturbances in these children is important for long term follow-up and improvement of their quality of life.

0964

EFFICACY OF THE SLEEP-SMART PROGRAM FOR YOUNG ADOLESCENTS IN AN URBAN SCHOOL DISTRICT

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Introduction: School-based preventive health education is considered a critical tool for improving adolescents' health. One health behavior - the development of adequate, consistent sleep patterns - has received little attention. The aim of this study was to examine the effectiveness of the Sleep-Smart program to teach young adolescents healthy sleep/wake habits.
Methods: Cluster sampling of 7th graders from 2 urban, public middle schools (SST = 8:37am) was used with entire classes assigned to an 8-session Sleep-Smart (n = 54) or Comparison group (n = 61). A substantial proportion reported minority backgrounds (53%) and household incomes below $30,000 (34%). All participants wore an actigraph (AMI) for 7 days while keeping a sleep diary. Six variables averaged for school vs. weekend nights were examined pre/post-intervention: onset, offset, duration, midsleep, weekend onset delay, oversleep. Repeated measures ANOVA controlled income, sex, pubertal status.
Results: Although the Sleep-Smart group did not display significantly improved sleep patterns, trends emerged suggesting the need for further analysis and understanding of the intervention. Specifically, the Comparison group showed greater change in average weekend night midsleep in the direction of poorer sleep (36 min later), and the Sleep-Smart group averaged a 14 min improvement in weekend oversleep. While not statistically significant, the cumulative effect of these changes over the entire week is likely to be meaningful.
Conclusion: Even though these preliminary analyses suggest that the intervention did not impact sleep, substantive questions remain. Follow-up assessments in 8th grade may reveal a delayed impact of the intervention. The impact of socioeconomic status and pubertal status on the intervention's success needs to be explored. Finally, this report focused solely on the intervention's impact on actigraphically-measured sleep; however, the 7th graders' sleep knowledge, behavioral well-being, bedtime routines, and/or caffeine use may have been positively affected by the program and need to be examined.
Support (If Any): NIH, NICHD, 5 R01 HD047928-05

0965

ECG-BASED SLEEP ARCHITECTURE EVALUATION IN CHILDREN

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Introduction: A whole night sleep study in a lab inherently removes a child from his natural sleep environment and requires multiple sensors on the head, face and body. This influences sleep quality and architecture, is cumbersome for both patient and technician. Partial studies in the home ease the discomfort, yet they have the great limitation of lacking information regarding sleep architecture, mainly REM presence and arousals. An ECG-based method to score sleep in adults has been validated. Our objective is to estimate the validity of this method in a pediatric population.
Methods: 42 complete PSG recordings were collected of pediatric patients referred to the Shaare Zedek Sleep Disorders Clinic for suspected apnea. Average age was 5.5 years old (range 13 months-12.5 years), 21 female, 21 male, The recordings were scored according to gold standard criteria by a trained technician, and blindly and independently by the HC1000P sleep diagnostic system, results were then compared for agreement. HC1000P allows sleep staging based on HRV analysis in the time frequency domains, as a measure of fluctuations of the autonomic cardiovascular control with different sleep/wake states, while arousals, actually autonomic arousals are evaluated from accelerations of the heart rate in the time domain.
Results: Results of sleep staging by the automated system HC1000P correlated well with results of manual scoring. Wake was 60.4 ± 43.3 minutes by manual scoring, 53.1 ± 15.0 by HC1000P. REM was 69.7 ± 31.2 minutes by manual scoring, 91.9 ± 28.2 minutes by HC1000P, SWS 154 ± 38.8 minutes by manual scoring, 112.0 ± 25.3 minutes by HC1000P, and LS was 211.6 ± 42.2, 222.3 ± 42.2 by manual scoring and HC1000P respectively. Epoch by epoch agreement in determining wake/sleep was 87%. Agreement in determining NREM/REM was 80%.
Conclusion: ECG-based estimation of sleep architecture may be used as an important aid in sleep testing in children, allowing for reliable and cost-effective home sleep studies by adding information regarding sleep efficiency and REM presence to the information obtained from direct measurements of respiratory parameters.

0966

HOME DISCHARGE IN PRESENCE OF CARDIORESPIRATORY EVENTS: PRACTICES OF 53 NEONATAL INTENSIVE CARE UNITS WITH LEVEL 3 NURSERY IN FRANCE

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Introduction: Neonatologists daily have to consider the cardiorespiratory function of an infant to decide if he is ready to be discharged

home. This decision is sometimes difficult because of the lack of evidentiary data.
Methods: A group of physicians and researchers who are members of AASPP (American Association of SIDS Prevention Physicians) designed an online questionnaire to ascertain the discharge decisions of neonatologists. 7 of the 28 questions were clinical situations.
Results: We obtained the responses of 53 NICU (74,6%). 96,2% of surveyed maintained in hospital a 10 weeks old infant born at 26 GA if he was presenting one or several daily cardiorespiratory events without intervention needed. This figure dropped to 1,9% when an infant was no longer showing events (all the other surveyed discharging without monitor). 98,1 % of surveyed wait for a time lag without any cardiorespiratory event before authorising the discharge of infants with a history of apnea of prematurity. This average lag is of four days (3+/-2 days (2-8 days). 78.4 % of surveyed assessed symptoms by monitor alarms and 60.8 % by recording cardiorespiratory events.
Conclusion: Despite the lack of recommendations in the presence of cardiorespiratory events for the discharge of preterm babies from NICU, most of neonatologists share the same clinical practices. However, discrepancy exists for different clinical situations. Guidelines are needed

0967

YOUNG CHILDREN'S SLEEP PRACTICES IN PEDIATRIC PRIMARY CARE

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Introduction: Sleep problems are highly prevalent in young children; however little research has examined the documentation of early childhood sleep practices in the pediatric setting. The purpose of this study was to examine documented sleep practices during well-child visits in a large primary care network.
Methods: A chart review was conducted of well-child visit for all children less than 5 years of age seen across 32 pediatric practices affiliated with the Children's Hospital of Philadelphia in 2007. The sample included 22,427 infants (0-1 years), 30,208 toddlers (1-3 years) and 21,661 preschoolers (4-5 years); 51% were male, 54% Caucasian, and 27% African American.
Results: Seven percent of infants had documentation of a specific sleep practice. The most commonly documented sleep hygiene practices for all infants were feeding to sleep (2.7%) and same bed co-sleeping (1.8%). For infants 3-month olds and older, night wakings (5.3%) were the most common. In toddlers, problematic night wakings (5.9%) and bedtime resistance (0.5%) were the most common behaviorally based sleep problems, while 2.5% of toddlers were noted to co-sleep (same bed). Preschoolers were more likely to have documented "sleeping through the night" (20%) than night wakings (3.3%) or bedtime resistance (0.2%). Two percent of preschool-aged children were noted to same bed co-sleep with a caregiver, while 3% were noted to sleep in their own bed.
Conclusion: This study is one of the first studies to examine sleep practices in early childhood as documented during well-child visits. While sleep is one of the most common concerns of parents, most medical records did not make specific comments on sleep practices. Reporting of sleep problems followed a developmental progression. For example, sleep associations such as feeding to sleep, which is known to increase the risk for later sleep problems, was frequently reported in infants, while behavioral sleep problems, such as problematic night wakings and bedtime resistance, were frequently noted in toddlers and preschool-aged children. Rates of documented same bed co-sleeping remained relatively stable across age groups. Together these findings suggest that primary care pediatricians may be under-documenting and under-recognizing sleep practices that may contribute to current or developing sleep issues in early childhood. Results from this study suggest a significant need to provide education and support to pediatricians related to sleep issues.
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0968

BRAZILIAN SLEEP DISTURBANCE SCALE FOR CHILDREN (SDSC): FACTORIAL ANALYSIS

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Introduction: Questionnaires are an important tool for sleep disorders screening mostly to assess sleep behavior in children, where parents can give important information that sometimes children are not aware of. Although SDSC was validated and adapted for Brazilian Portuguese, may be some variables related to cultural and ethnic aspects were not considered. Our objective was to analyze which questions about children' sleep is more important for their parents in a Brazilian population.
Methods: We distributed 5400 questionnaires, based on Bruni et al. first version of SDSC, with 45 questions adapted for Brazilian Portuguese, in public schools for children 7-10 years old, in São Paulo city, Brazil, in 2000. Out of them, 3612 questionnaires answered by parents returned and 589 were excluded because they were incorrectly filled out. We analyzed 3023 questionnaires by factor analysis (Varimax with Kaiser Normalization).
Results: Out of the 45 questions, 23 questions showed a substantial correlation (above 0.7) with all the scale associated to the following themes: sleep time, sleep habits, behavioral insomnia, parasomnias, enuresis, and sleep disordered breathing. Twelve questions are similar to the final version of SDSC (with 26 questions) validated to Italian and to Portuguese. Eleven questions show what are taking in account by parents about sleep problems of children.
Conclusion: The complaints of our children or what their parents report as a sleep problem in their children show what is regarded as abnormal according to cultural features and sleep habits of this Brazilian population sample.

0969

SLEEP SPINDLES AND RISK FOR EARLY ONSET DEPRESSION

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Introduction: Major depressive disorder (MDD) is a pervasive disease more prevalent, severe, and chronic in adolescence than adulthood. Sleep disruption is one of the main characteristics of MDD, with sleep complaints in 90% of the patients. Sleep spindles, the hallmark of stage 2 NREM sleep, is more abundant in adolescence than adulthood. It is thought that spindles participate in brain plasticity processes by regulating and synchronizing information flow from subcortical to cortical structures. This study investigated SPA as potential biological risk marker for early-onset MDD.
Methods: 21 symptomatic, unmedicated MDD (11M, 10F), 21 at-risk, with positive family histories of MDD (11m, 10F), and 21 healthy controls with no personal or family history of MDD (11M, 10F) adolescents were studied. Participants maintained a regular sleep wake schedule for 5 days, followed by 2 nights of polysomnography in the laboratory. Spindle density (SD: number of spindles/number of stage 2 epochs) was scored in stage 2 epochs of the first four NREM sleep periods according to R & K (1968).
Results: SD differed significantly between groups, particularly in the second part of the night when SD was maximal. Although, the difference

was greatest between MDD and healthy adolescents, both the MDD and at-risk groups had decreased SD compared to healthy controls. Interestingly, SD decrease was more pronounced in females than males.
Conclusion: Low spindle activity characterizes adolescents at-risk for MDD prior to the onset of depressed symptoms suggesting that decreased spindle activity is a vulnerability factor for MDD. The finding that spindles reduction was largest in at-risk females than males is consistent with our previous work indicating greater sleep EEG abnormalities in females at-risk or already ill with MDD compared to males. Given the role of spindles in information processing, a decrease in this sleep rhythm may mediate some of the cognitive deficits observed in depressed patients.

0970

POSTPARTUM FREQUENCY OF AD-LIB, MULTI-DAILY FATIGUE REPORTS AND CHRONOTYPE

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Introduction: Previous research has demonstrated that participant adherence to research protocols is better with electronic versus paper diaries. No study has examined participant adherence to a long-term, ad-lib, electronic reporting protocol or in sleep research. Our goal was to examine the feasibility of use of this technology for multi-daily fatigue reporting. Specifically, we examined how maternal frequency of reports changed over a 12-week postpartum period. Though exploratory, we expected the frequency of ad-lib reports to decrease over time. We were also interested in variance based on chronotype.
Methods: As part of a larger study, 69 primiparous postpartum mothers were asked to complete visual analog of fatigue, Stanford Sleepiness Scale, and Epworth Sleepiness Scale during daytime infant feedings, or 4-5 times daily, during postpartum weeks 2-13 using personal digital assistants. The Morningness-Eveningness Scale was administered at postpartum week 2. Participants were categorized according to linear trends for number of reports/day (increasing/decreasing) and chronotype was used as a predictor. Ten participants with nonsignificant trendlines were excluded from this analysis.
Results: Number of daily fatigue reports was averaged within each postpartum week and ranged from 3.1(± 1.1) reports/day at postpartum week 2 to 2.4(± 1.1) reports/day at postpartum week 11. Linear trend analysis showed a significant decrease in survey completion over postpartum weeks 2 through 13 (Flinear trend(11,771) = 17.95, $P < .05$). Mothers with decreasing trendlines scored higher (more evening-type) on M-E (20.17 ± 4.58) compared to those with increasing slopes(16.83 ± 4.57) ($F(1,57) = 5.08; p < .05$).
Conclusion: Overall ad-lib report frequency decreased from postpartum weeks 2 to 11, yet a significant subgroup of mothers increased their number of daily reports over this period. Participants with decreasing survey completion were more likely to be evening-type than those with increasing survey completion, possibly pointing to circadian differences in ad-lib survey completion, or postpartum daytime performance. Use of computerized reporting appears to be feasible for longitudinal sleep studies.
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0971

VIOLENCE AND CHILDREN'S SLEEP ENVIRONMENTS

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Introduction: Each year, millions of children witness family and community violence. Sleep disturbances associated with violence-induced traumatic stress are well documented. However, to our knowledge, no previous investigations have systematically examined the sleep environment of children exposed to violence. Conducting home-based research on these children provides needed data about sleep in their natural environment and is important to provide cues for improving sleep.
Methods: A home-based, longitudinal study (baseline, 3-month and 6-month follow-ups) of a socio-culturally mixed sample of 46 children 8-16 years of age and who were exposed to family and/or community violence. Participants were recruited from a social-service agency providing counseling to children who witness violence and who are referred to the agency by police. Research methods included actigraphy, standardized sleep questionnaires, and systematic observations and interviews with children and parents about the children's sleep environments.
Results: Actigraphy and sleep-questionnaire data indicated sub-optimal sleep in the sample, and sleep-environment characteristics may be a contributing factor. Strikingly, over 1/3 of families moved at least once between the index violence event and 3-month follow up, often as a direct result of violence and its aftermath. Consequently, sleep arrangements were often temporary and improvised in nature. Children frequently described environmental features that disturbed their sleep: 50% bedroom temperature, 50% household noise or light, 41% neighborhood noise or light. Of note, 40% of families employed methods specifically to improve sleep. These could be viewed by professionals as 'indigenous solutions' that might be relevant for other families. Individual cases revealed the complex interrelationships among sleep, the sleep environment, safety, and violence.
Conclusion: Among its many deleterious effects, interpersonal violence may adversely shape the sleep environment itself. Where and how children sleep should be on the radar screen of health and social-service professionals caring for families affected by interpersonal violence.
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0972

CO-SLEEPING IN A NATIONALLY REPRESENTATIVE SAMPLE OF TWO YEAR OLDS: ETHNIC DIFFERENCES & CONCURRENT CORRELATIONS

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Introduction: Co-sleeping, defined as a child sharing a sleep environment with others, is a common practice in both industrialized and developing societies. Previous research has reported racial/ethnic differences in co-sleeping within the U.S. Few investigations have examined developmental correlates of co-sleeping or the prevalence of co-sleeping in a nationally representative sample.
Methods: Data from the Early Childhood Longitudinal Study-Birth Cohort, a nationally representative sample of children in the U.S., were analyzed to examine parent-reported sleeping environments (SEs) for their 2-year-old children, demographic differences in reported SEs, and possible relationships between SEs and child outcomes. In the 2-year interview (n = 8,944), parents were asked about the child's usual SE and bedtime routines. Children were assessed using the Bayley Short Form-Research Edition.
Results: 44% of 2-year-olds were reported to sleep alone, 41% shared a SE with parents, and 15% shared a SE with others. Significant ethnic differences were observed, with Asian families almost 15 times more likely to report a shared SE than White families (OR = 14.76; 95% CI: 8.87-24.55). Black and Hispanic families reported a shared SE about 5 and 4 times more often than White families, respectively (OR = 4.76; 95% CI: 3.63-6.25; OR = 3.52; 95% CI: 2.55-4.84). Families of higher socioeconomic status were 39% less likely to report shared SEs (OR = .61; 95% CI: .55-.68). Co-sleeping children were more likely to both lack a regular bedtime routine and need help to fall asleep at night compared to solitary-sleepers. Controlling for ethnicity, SES, and gender, solitary-sleepers scored higher on the Bayley Mental and Motor subscales compared to children who slept with their parents ($\beta = 1.76$, $P <$

.0001; β = 1.22, P < .05). Children who slept with parents did not differ from children who slept with others on either subscale.
Conclusion: Strong differences were observed between ethnic groups, with White families least likely to report shared SEs. Controlling for demographic variables, children who usually slept with others had lower mental and motor scores. Without more precise data on the nature of the sleep environment, and keeping in mind the relatively small effect size (ES < 0.1), firm conclusions on the potential impact of one's sleep environment on developmental outcomes cannot be drawn. These data do confirm, however, the high prevalence of shared sleep environments in the U.S., despite popular admonitions against them.

0973

BEDTIMES, CAFFEINE USE AND SLEEPINESS AMONG 7TH GRADERS - PRELIMINARY FINDINGS OF THE CAFFEINE LITERACY AND SLEEP STUDY (CLASS)

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Introduction: Adolescents commonly report variable weekday-weekend bedtimes, daytime sleepiness and use caffeinated beverages (CB) frequently. We report preliminary data in 7th graders from a larger survey of 7-8th graders at a public school in Cuyahoga County, OH, using (CLASS), and the recently validated Cleveland Adolescent Sleepiness Questionnaire (CASQ). CLASS is a 15 question pilot survey being designed by us to evaluate children's recall of caffeinated beverage use and concurrent sleep habits from the previous week.
Methods: After prior passive parental consent and an in-class opt-out option for subjects, surveys were distributed and collected anonymously on the same day in school. We expected to find increased sleepiness reported by caffeine users and those reporting later bedtimes.
Results: Of 134 7th graders, 7 opted-out. 127 (85%) surveys were returned (age 12.3 ± 0.45 yr; 55.1% male). Over 77% reported sleeping around or before 10 pm on weekdays but < 19% did so on weekends. Days napped per week were reported as none (52%), < 2(14%), 3-5(9%), > 5(5.5%) and unreported (19%). Sleep onset was described as hard (24%), easy (31%) or equivocal (44%) and 35% reported nocturnal awakenings (3.9% > 3 times per night). Only 13.4% reported no CB use. CASQ scores differed significantly between those drinking < 12 vs > 12 oz of caffeine per day (31.9 ± 9.4 vs 38.1 ± 13.1; P < 0.01), those sleeping before vs after midnight on weekends (29.8 ± 7.4 vs 40.1 ± 13.3; P < 0.001) and those sleeping around or before 10pm vs later on weeknights (33.3 ± 11.4 vs 39.5 ± 12; P = 0.01).
Conclusion: Our population of 7th graders reported delayed sleep times on weekends, napping, nocturnal awakenings, difficulty with sleep onset and use of CB commonly. Sleepiness scores were greater among late sleepers and caffeine users. This resonates with available national data.

0974

AWARENESS OF CAFFEINE CONTENT OF COMMON BEVERAGES AMONG 7TH GRADERS - PRELIMINARY FINDINGS OF THE CAFFEINE LITERACY AND SLEEP STUDY (CLASS)

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Introduction: Caffeine is commonly ingested by children and adolescents in the form of beverages. Relatively few studies have explored awareness about caffeine content of common beverages (CB) in this population. We report preliminary data on 7th graders from a larger survey of 7-8th graders at a public school in Cuyahoga County, OH.
Methods: CLASS is a 15 question pilot instrument being designed by us to evaluate children's recall of caffeinated beverage intake by type, quantity and timing, as well as concurrent sleep habits of the previous week. Awareness of presence or absence of caffeine in CB was assessed. A yes/no format was used to assess if lightly colored beverages were thought to be caffeinated. After prior passive parental consent and an in-class opt-out option for subjects, all anonymous surveys were distributed and collected on the same day in class. We expected low awareness of caffeine content of CB in this population.
Results: Of 134 7th graders, 7 opted-out. 127 (85% of class) surveys were returned and 108 (80.6%; age 12.7 ± 0.44 yr; 56.5% male) had complete data for parameters of interest. Only 24.1%, 38.9% 39.8%, 39.8% and 53.7% respectively, correctly reported 7-up, Sierra Mist, Ginger Ale, Sprite and Fresca lacked caffeine. Boys were incorrect on Ginger Ale more often than girls (60.7% vs 38.3%, P < 0.02). Only 43.5%, 50.9%, and 67.6% knew Arizona Green Tea, Mello Yellow, and A&W Cream soda respectively, were caffeinated. However, 96.3% and 93.5% did correctly report bottled water to be non-caffeinated and Mountain Dew to be caffeinated.
Conclusion: Our survey of 7th graders in a representative public school shows low awareness of caffeine status of lightly colored CB. This lack of knowledge may have significant implications as it may potentially confound the results of population surveys reporting on caffeine use in children.

0975

SLEEP AND EXECUTIVE FUNCTIONING IN TODDLERHOOD: A LONGITUDINAL PERSPECTIVE

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Introduction: There is convincing evidence that sleep quality is associated with infants' and children's cognitive functioning. Increasingly however, adult research suggests that the links may be more specific, in that higher-order cognitive functions requiring prefrontal cortex involvement (i.e., executive functions; EF) are more affected by sleep deprivation than performance on simple cognitive tasks. Although little research has been conducted with children, studies have begun to suggest that there may be a specific link between EF and sleep in childhood as well (e.g., Sadeh et al., 2002; 2003). Thus far however, these effects have been observed in children only 7 years and older. Given that major advances in EF take place between 1 and 6 years of age, and that neural density of the frontal lobes begins to decline at about 7 years of age, the potential impact of sleep on frontal/executive functions may be especially potent earlier in development, when the brain shows substantial plasticity. The aim of this paper is to investigate the prospective links between infant sleep regulation and subsequent EF.
Methods: Sleep regulation was assessed on three consecutive days through a parent sleep diary when children were 12 and 18 months old (N = 60). Child EF was assessed at 18 and 26 months, with age-appropriate measures of working memory, set-shifting and impulse control (Carlson, 2005).
Results: Higher proportions of total sleep occurring at night time, at both 12 and 18 months, were related to better performance on EF tasks, especially those involving impulse control. Further, sleep was associated with age-related increases in EF performance. Most relations held above family SES, prior mental development and concurrent verbal ability.
Conclusion: These findings add to previous results with school-age children in suggesting that the prefrontal cortex, largely implicated in executive functions, may be particularly sensitive to the homeostatic processes underlying sleep regulation.

0976

EVALUATING THE BENEFIT OF SEEING PATIENTS THE MORNING AFTER THE NPSG: RESULTS OF A QI PROJECT IN A PEDIATRIC SLEEP CENTER

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Introduction: We evaluated a model for delivering results of sleep studies, aiming to evaluate its efficacy in enhancing patient care by increas-

ing show rates to subsequent appointments. When families are seen the following morning, they are immediately provided with recommendations, scheduled for subsequent appointments, & leave with a treatment plan.
Methods: Data for 319 children studied in the pediatric sleep center was reviewed to answer two quality improvement questions: 1) Do the families stay for results? & 2) Does this model of service delivery increase the follow-through in treatment for the child's sleep disorder? We used logistic regression to identify significant factors in predicting if a family stays (age, gender, race) and in whether a family attends the subsequent appointment (age, gender, race, staying for results, type of appointment scheduled, time period until appointment, diagnosis from the NPSG, and disease severity). Further analyses were conducted using multivariable logistic regression. Once completed, it was clear that there are no comparisons or recommendations in the pediatric literature for service delivery models. We thus emailed a survey to attendees from pediatric sleep meeting 2009 and the PEDSLEEP listerve. Results among centers were quite variable, yet provide beneficial beginnings of discussion among pediatric centers regarding individual center practices.
Results: Approximately 80% of patients remained in the center the following morning. Of the patients that stayed and needed a subsequent appointment, 87.7% attending the subsequent appointment. Of the patients that didn't stay, only 42.5% of these patients attended the subsequent appointment. The morning contact significantly influences the medical care of pediatric patients. Using multivariate logistic regression, this relationship holds true, even while controlling for age, diagnosis, race, and time to appointment both individually ($P < .001$ for each variable) and simultaneously ($P < .001$).
Conclusion: This study evaluates a model for service delivery in pediatric sleep center. Families are highly likely to participate in immediate feedback the morning after the NPSG. This model of service delivery significantly enhances the likelihood of treatment for the identified sleep disorder. Results of a brief survey to the pediatric community also suggest variability in service delivery. Future research in effective service delivery is needed.

0977

PRESCHOOL SLEEP PROBLEMS AND BEDROOM TV: WHO IS MOST AT RISK?

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Introduction: The presence of a television in the bedroom has been repeatedly been shown to have a negative impact on sleep in older children, although it has been less studied in preschool-aged children. Furthermore, there is little known about whether TV in the bedroom affects some groups of children more than others. We hypothesize that preschool children with internalizing or externalizing symptoms may be at increased risk for sleep problems with bedroom TV.
Methods: This data was collected as part of the baseline parent-report survey in a RCT on healthy media use in preschool children ages 3-5 years. For this project, both study arms were used in a cross-sectional analysis. Using binomial regressions, we tested whether TV in the bedroom was associated with sleep problems and further whether effect modification occurred by internalizing or externalizing symptoms, as defined by clinical cut-offs on the Social Competence and Behavior Evaluation (SCBE). All regression analyses controlled for child gender, as well as for which parent responded to the survey.
Results: In this sample of 498 children, 9% of families reported having a TV in the child's bedroom at the baseline survey, and 20% reported experiencing sleep problems with the study child at least 5 nights a week. In the binomial regression analysis, having a TV in the bedroom was associated with an increased risk of sleep problems (RR = 1.83, 95%CI = 1.17 to 2.88). When we examined for potential effect modification, TV in the bedroom was associated with significantly increased risk in children with externalizing symptoms (RR = 2.97, 95%CI = 1.05 to 8.41), but not in children without externalizing symptoms (RR = 1.25, 95%CI = 0.67 to 2.30). No such effect modification was observed regarding internalizing symptoms.
Conclusion: TV in the bedroom is a significant risk for sleep problems in preschool-aged children, and this appears to be especially pronounced in children with concomitant externalizing symptoms. This may be due to differences in TV content or watching habits, or may be the result of physiologic differences in response to TV stimuli. Efforts to eliminate bedroom TV exposure may be especially warranted in this population.
Support (If Any): This project was supported by an R01 grant to Dr. Christakis from the NICHD, "Media Impact on Preschool Behavior" (5R01HD056506-02).

0978

VALIDATION OF PORTABLE SLEEP STUDIES AS A SCREENING TOOL FOR DIAGNOSING SLEEP DISORDERED BREATHING IN THE PAEDIATRIC POPULATION

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Introduction: Exponential increases in the demand for sleep studies in paediatric sleep laboratories is associated with an increase in the wait times to perform polysomnography (PSG) in children. Given the contribution of untreated sleep disordered breathing (SDB) to end organ dysfunction, the availability of a screening tool for paediatric SDB diagnosis is urgently required. To date, there are no studies that have assessed the utility of a level 4 portable sleep studies (PSS) in children. Thus the aim of this study was to evaluate one such PSS, the Apnealink(tm) monitor which has been validated in adults.
Methods: In this prospective comparative study, patients were recruited during routine full PSG to rule out SDB. The PSS was applied simultaneously with the standard PSG setup. Scoring of PSG was done according to the American Academy of Sleep Medicine 2007 standards. Scoring of the PSS was done manually by a registered polysomnographic technologist. Respiratory Disturbance index (RDI) was calculated from the PSG as the sum of the obstructive apnea-hypopnea index and central apnea index.
Results: To date, 27 patients (12 females) have been recruited. Their mean age was 10 years and their mean body mass index (BMI) was 20.47 kg/m2. Fifteen children had evidence of SDB (RDI $\geq$ 1.5 events/hour) of which 4 patients had severe SDB (RDI $\geq$ 10 events/hour). There was a significant correlation between the PSS RDI and PSG RDI ($r = 0.62$, $P = 0.0006$). The PSS RDI of 5 events/hour has a sensitivity of 93% and specificity of 50% to detect any SDB diagnosed by PSG and a sensitivity of 100% with a specificity of 30% to detect severe SDB.
Conclusion: These data indicate that the use of a PSS monitor may be a useful screening tool for triage in paediatric sleep laboratories.

0979

LEUKOCYTE TELOMERE LENGTH AND PLASMA CATESTATIN AND MYELOID RELATED PROTEIN 8/14 CONCENTRATIONS IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is common in children, and leads to multiple end-organ morbidities induced by the cumulative burden of oxidative stress and inflammation. Recent evidence has shown leukocyte telomere length (LTL) shortening has not only been linked

with aging and senescence, but also with an increased risk for age-related diseases, namely cardiovascular disease (CVD) and heart failure. We hypothesized that LTL would be decreased with children with OSA. Furthermore, we wished to examine whether the presence of significant systemic inflammation in OSA, such as illustrated by MRP 8/14 levels would be associated with LTL, and likewise, whether catestatin levels would be associated with blood pressure alterations and LTL in the context of pediatric OSA.

Methods: 213 children (Mean age: 7.7 ± 1.4 years) were included after a sleep study and a morning blood sample. LTL was examined by a quantitative polymerase chain reaction based method in a case-control setting involving 111 OSA children and 102 controls. Myeloid related protein 8/14 (MRP) and catestatin levels were also assayed using ELISA.

Results: Log LTL was significantly longer in children with OSA in a severity-dependent fashion. Correlation analyses demonstrated that LTL was positively related with AHI ($r = 0.236$, $P < 0.01$), and inversely correlated with age ($r = -0.145$, $P < 0.05$). However, LTL was not significantly associated with either MRP 8/14 levels ($r = 0.027$, $P > 0.05$) or with catestatin concentrations ($r = -0.119$, $P > 0.05$). In multivariate regression analysis, LTL was independently associated with AHI ($\beta = 0.28$, $P = 0.002$) after adjusting for age, gender, BMI z score, and race. Children with OSA had lower plasma catestatin levels compared to controls ($P = 0.009$). Moreover, children with lowest plasma catestatin levels (< 1.39 ng/ml) had 5.2 fold increased odds of moderate to severe OSA after adjusting for confounding variables.

Conclusion: In contrast to our expectations, LTL is increased and catestatin levels are lower in pediatric OSA in a severity-dependent manner. The short-term and long-term implications of these findings remain to be defined.

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0980

THE ASSOCIATION BETWEEN SLEEP-DISORDERED BREATHING, ACADEMIC GRADES, AND NEUROBEHAVIORAL FUNCTIONING AMONG OVERWEIGHT SUBJECTS DURING MIDDLE TO LATE CHILDHOOD

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Introduction: Although Sleep-Disordered Breathing (SDB) can cause neurobehavioral deficits in young children and adults, little is known about such morbidity in middle- to late-childhood. This under-researched age range is of particular interest because SDB-related morbidity can differ in adults versus young children. This study determined whether SDB was associated with neurobehavioral performance and school grades during middle- to late-childhood. Overweight subjects were targeted because excessive weight is a primary risk factor for SDB in this age range.

Methods: Subjects were 163 overweight children and adolescents aged 10-16.9 years who did not have a significant neurological history, craniofacial abnormality, developmental disorder or mental retardation, condition involving daytime hypoxia, or treatment for SDB within the past 2 years. All underwent overnight polysomnography and neurobehavioral assessments that gathered parent- and self-report of school grades and sleep, parent- and teacher-report of daytime behaviors, and office-based neuropsychological testing. The sample was divided into four groups based upon the obstructive apnea+hypopnea index (AHI) and parent report of snoring: Moderate-Severe OSA (AHI > 5, n = 42), Mild OSA (AHI = 1-5, n = 58), Snorers (AHI < 1 + snoring, n = 26), and No SDB (AHI < 1 and nonsnoring, n = 37).

Results: In multivariate analyses, greater SDB was linked to poorer academic grades ($P = .003$) and behavioral concerns expressed by parents ($P = .004$) and teachers ($P = .015$). These findings remained significant after covarying for subject sex, race, socioeconomic status, and school night sleep duration. Follow-up tests suggested that higher levels of SDB were particularly associated with inattention and learning problems in real-world situations. In contrast, effects were not significant on office-based tests of intelligence, memory, attention, problem-solving/planning, and fine motor functioning ($P > .10$).

Conclusion: SDB during middle- to late-childhood is related to important aspects of neurobehavioral functioning, especially inattention and poor study skills, that are more clearly evident in real-world situations than on office-based tests, and that may cause functional impairment at school.

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0981

THE ASSOCIATION BETWEEN SLEEP-DISORDERED BREATHING AND DIETARY CHOICES

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Introduction: Although there is strong evidence that excessive weight contributes to Sleep-Disordered Breathing (SDB), some have suggested that SDB may feed back into a spiral of worsening obesity. Here we present incidentally-collected data which allowed us to examine whether SDB is associated with the dietary choices of overweight individuals during middle- to late-childhood. It was hypothesized that SDB would be positively associated with caloric content of a meal order, independent of their common relationship with body mass.

Methods: The 42 overweight participants were aged 10-16.9 years and had no neurological history, craniofacial abnormalities, developmental disorder, condition involving daytime hypoxia, treatment for SDB within the past 2 years, or psychiatric medication use. All participants arrived for an afternoon evaluation and placed an order for dinner from a standardized hospital menu, which allowed us to later use a dietary compendium to calculate the macronutrient content of each order. Inpatient polysomnography occurred that night, yielding an obstructive apnea+hypopnea index (AHI). Subjects also wore actigraphs that measured typical sleep duration for a week proximal to the hospital visit and, in a subset of participants, the night before the visit.

Results: Primary analyses using Spearman rank-order correlations found that AHI was significantly associated with total calories and grams of fat and carbohydrate ($r = .39$ - $.40$, $P = .009$ - $.013$), but not protein ($P > .05$), in each order. These macronutrient variables did not correlate with typical sleep duration across a week of actigraphic monitoring, nor with sleep duration the night before the meal ($P > .05$). Findings were unchanged in partial correlations that adjusted for BMI or age- and gender-corrected BMI.

Conclusion: Severity of SDB appears to be associated with food preferences, with more severe SDB linked to calorie-dense foods that are high in fat and carbohydrate. These relationships can not be explained by their shared relationship with body weight.

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0982

INCIDENT AND PREVALENT HYPERTENSION, SLEEP DISORDERED BREATHING AND OBESITY AMONG ADOLESCENT CHILDREN IN THE TUCSON CHILDREN'S ASSESSMENT OF SLEEP APNEA STUDY (TuCASA)

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Introduction: Sleep disordered breathing (SDB) in children and it's association with hypertension and obesity has been understudied. This analysis aims to identify the incidence and prevalence of hypertension, in the adolescent age group, and its association with SDB and obesity in the adolescent age group.

Methods: TuCASA study is a prospective, cohort study that initially enrolled children between the ages of 6 and 11 years (Time 1) and subsequently re-studied them ~5 years later (Time 2). At both time points, in-home polysomnography as well as measurements of blood pressure, sleep symptoms, height and weight were obtained. SDB was determined to be present if a child had a respiratory disturbance index (RDI) ≥ 1 event per hour associated with a ≥ 3% oxygen desaturation. Hypertension was defined as blood pressure in the 90% percentile or systolic > 120 mm Hg or diastolic > 80 mm Hg. Obesity was identified as having a BMI > 95th percentile.

Results: Blood pressure measurements were obtained in 334 children at both time points. The mean interval between blood pressure measurements was 4.6 years. Incident hypertension was 3.6% and prevalent hypertension was 4.3%. Incident hypertension risk was greater in boys (OR = 10.8, 95% CI: 1.4 85.1). There was a trend for prevalent SDB to increase risk for incident hypertension (OR = 2.9, 95% CI: 0.8- 9.9). In addition, BMI percentile was higher in children with prevalent hypertension (73.1 vs 49.8, P = .02).

Conclusion: These finding suggest that boys are at a greater risk for hypertension, and that SDB and obesity may be additional risk factors.

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0983

IMPACT OF ADENOTONSILLECTOMY ON SLEEP STABILITY USING CARDIOPULMONARY COUPLING IN ASIAN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: We aimed to demonstrate postoperative change in the sleep stability in children with obstructive sleep apnea syndrome(OSAS) using cardiopulmonary coupling(CPC).

Methods: Thirty two children (mean age = 6.9 ± 2.7 years old, 24 male) with OSAS (12 mild, 1 ≤ AHI < 5; 20 moderate-severe, AHI ≥ 5) were enrolled. We analyzed the change of sleep parameters and respiratory parameters on full-attended polysomnography, and of various parameters [high frequency coupling (HFC), low frequency coupling (LFC), and elevated LFC (eLFC) and so on] on CPC (RemLogic 2.0 CPC analyzer, Embla Systems Inc, Broomfield, CO) before and after adenotonsillectomy.

Results: SWS did not change after surgery in either mild (from 28.6% to 27.1%, P = 0.53) or moderate-to-severe OSAS (from 27.0% to 26.6%, P = 0.74) although respiratory parameters such as apnea-hypopnea index was improved significantly in both OSAS groups. In moderate-severe OSAS, LFC (from 40.0% to 30.3%, P = 0.03), eLFC (from 23.4% to 15.6%, P = 0.05, and broad-band eLFC (from 22.7% to 14.3, P = 0.04) are significantly decreased. In addition, the amount of HFC band show increased tendency from 46.2% to 53.7% but not statistically significant (P = 0.076) in this group. However, in mild OSAS, there are no significantly changes in all parameters on CPC.

Conclusion: Based on these findings, we found the improvement of CPC parameters in children with moderate-severe OSAS after adenotonsillectomy,

0984

PREVALENCE OF SLEEP-DISORDERED BREATHING SYMPTOMS IN KOREAN CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

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Introduction: Children with sleep-disordered breathing (SDB) often show neurobehavioral dysfunction such as inattentiveness and hyperactivity, which can falsely lead to the diagnosis of attention-deficit/hyperactivity disorder(ADHD). We investigated the prevalence of SDB symptoms in normal and ADHD children in general population to elucidate the relationship of neurodevelopmental disorder and SDB.

Methods: Parents of 7- to 13 year-old children in Cheonan city in Korea were surveyed to screen ADHD children using DuPaul Parent and Teacher rating scale. They were also asked about children's snoring or noisy breathing. Age- and sex-matched children with reported symptoms of ADHD and control children were randomly selected and underwent further evaluation including pediatric sleep questionnaire, psychomotor tests and interviews with a psychiatrist and a sleep specialist.

Results: 13,347 children were surveyed and 8.0% (1,056/13,347) of children reported ADHD symptoms. The group with ADHD symptoms had significantly higher prevalence of habitual snoring (11.3% vs. 5.4%), loud snoring (9.3% vs. 4.8%) and noisy breathing (11.0% vs. 5.5%) than normal children. Each 55 out of normal and ADHD children (mean age, 7.1 ± 0.5years) underwent further evaluation. ADHD children reported significantly more frequent noisy breathing (32.7% vs. 13.7%), restless sleep (63.6% vs.35.3%), enuresis (30.9% vs.13.5%) and daytime mouth breathing (29.1% vs. 5.9%) than normal children. Other SDB symptoms including habitual or loud snoring, sleep apnea, labored breathing, night sweat and bruxism were also prevalent in ADHD children although statistically insignificant.

Conclusion: ADHD children have more frequent SDB symptoms, restless sleep and daytime mouth breathing than normal children, which highlights the need to assess SDB in ADHD children. A high prevalence of daytime mouth breathing in ADHD children also suggests nose breathing problem which might be related to the exposure to environmental allergen. Treating SDB and avoiding allergen potentially help alleviate ADHD symptoms in children.

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0985

ADHERENCE TO NON-INVASIVE POSITIVE PRESSURE VENTILATION IN A PAEDIATRIC POPULATION: A MULTIDISCIPLINARY MODEL

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Introduction: Patient adherence to non-invasive positive pressure ventilation (NIPPV) is a significant concern in the paediatric population partially due to unique behavioural challenges leading to both mask interface and positive pressure intolerance. Further, insufficient patient and family understanding of the treatment in addition to inadequate family support lead to overall low success rates of NIPPV in children.
Methods: We describe a novel NIPPV adherence clinic established at the Hospital for Sick Children, Toronto using a classroom based model that is patient and family centered. Following routine clinical assessment by a Paediatric Sleep Physician, patients and families interacted in a group setting using a 4 pronged approach. This involved 1) viewing a video describing sleep disordered breathing and its treatment with NIPPV 2) meeting with a Respiratory Therapist to provide a mask fit and equipment assessment 3) discussing with a Child Life Specialist individualized therapeutic interventions to assist with adherence 4) interacting in a group based open forum for family dialogue with the team. A paediatric nurse practitioner provided continuity throughout the clinic, class and in follow up. Phone follow up was provided regularly to both optimize strategies to improve patient adherence and monitor progress.
Results: Preliminary results demonstrated that 83% of the parents reported high to very high confidence that their child would adhere to NIPPV after attending the class. Future follow up will include measures of NIPPV compliance.
Conclusion: Preliminary findings suggest that group-based patient interaction is an effective model in improving adherence to NIPPV in children with sleep disordered breathing. Education, anticipatory guidance and individualized strategies for acclimatization are paramount for successful treatment.

0986

EFFICACY OF ADENOTONSILLECTOMY IN THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA (OSA) ACROSS THE SPAN OF PUBERTAL DEVELOPMENT

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Introduction: Efficacy of adenotonsillectomy (AT) is unknown in overweight/obese older children/adolescents. The purpose of this study was to examine the efficacy of AT along with effects of treatment on Quality of Life and sleep symptoms in overweight/obese older children/adolescents across levels of pubertal development.
Methods: 59 subjects (39 males; 20 African American)11.96 ± 2.84 years; BMIz-score 2.20 ± 0.46 with OSA underwent AT. Pre- and post-operative polysomnography was obtained along with Quality of Life (QOL) and symptoms surveys, Tanner stage, weight, height and BMI.
Results: Post-surgical AHI (5.74 ± 11.10) was statistically lower than pre-operative AHI (19.29 ± 20.38; P = 0.000). 81% of patients had a decrease in AHI by at least 50% and 44% had a post-operative AHI < 5 events/hour. Subjects in all Tanner stage groups experienced similar decrements in AHI (P = n.s.). 66% of subjects had clinically significant polysomnographic evidence of residual OSA (AHI > 5 events/hour) and there was no difference between Tanner stage groups (P = n.s). Age, gender, BMIz-score and tonsil size did not predict efficacy of AT. Symptoms of OSA (as assessed by the Pediatric Sleep Questionnaire, PSQ) decreased from 0.56 ± 0.19 to 0.33 ± 0.23 (P < 0.05) and were not different between Tanner stage groups (P = n.s.). Post-operative symptoms of OSA correlated positively with logAHI and negatively with subject and parent reports of overall QOL (P < 0.05). BMIz-score and sleep symptoms (PSQ), but not post-operative AHI predicted parent and child reported overall QOL (P < 0.05) after surgery.
Conclusion: AT has a positive effect on AHI and sleep symptoms (PSQ) in overweight/obese older children/adolescents although a high proportion of subjects have clinically significant residual sleep apnea. Symptoms of OSA are a better predictor of overall QOL in this population than AHI. Surgical response rates were not different between Tanner stage groups suggesting that even pubertally advanced overweight/obese adolescents may benefit from AT in the treatment of OSA.

0987

MATERNAL SNORING IS ASSOCIATED WITH INCREASED CORD BLOOD INTERLEUKIN-6 CONCENTRATIONS

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Introduction: Snoring is common among pregnant women and may bear a risk to the fetus. Increased umbilical cord levels of nucleated red blood cells (nRBCs) and erythropoietin were found in woman who snored during pregnancy indicating increased fetal erythropoiesis. In addition to erythropoietin, IL-6 plays an important role in elevation of fetal nRBCs count. Since systemic inflammation is one of the underlying mechanisms mediating sleep-disordered breathing and associated morbidities, our objective was to investigate whether maternal snoring is associated with increased cord blood levels of IL-6.
Methods: Women of singleton uncomplicated full-term pregnancies were recruited during labor. All participants together with their sleep partners completed a designated questionnaire that included information regarding BMI, age, smoking, medication use, pregnancy complications, snoring before and during the current pregnancy, sleep pauses and daytime sleepiness using the Epworth Sleepiness Scale. Subjects with frequent snoring (> 4 nights a week) were considered habitual snorers. Cord-blood was obtained immediately following delivery and IL-6 concentrations were measured using commercially available ELISA kit.
Results: Hundred and twenty-two women were recruited. The mean age was 30.5 ± 4.6 years. The mean gestational age was 39.5 ± 1.2 weeks and the mean BMI at the beginning of pregnancy was 22.0 ± 3.6 kg/m2. 39% of women reported habitual snoring during pregnancy. Of those, 35% were chronic snorers and 65% were new-onset snorers. Plasma IL-6 concentrations were significantly elevated in habitual snorers compared to non-snorers (5.6 ± 4.8 vs.3.4 ± 3.6 pg/ml; P = 0.01). Among the snorers study group, increased IL-6 concentrations were found in the new-onset snorers group compared with the non-snorers group (6.3 ± 4.4 vs. 3.4 ± 3.5; P = 0.005).
Conclusion: Maternal new onset snoring during pregnancy is associated with increased cord levels of IL-6. We suggest that systemic inflammation plays a major role in mediating maternal snoring and fetal outcome.
Support (If Any): This research was supported by The Legacy Heritage Clinical Research Initiative of the Israel Science Foundation (grant No. 1700/08)

0988

COMPLIANCE WITH PAP IN PEDIATRIC SPECIAL POPULATIONS

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Introduction: Children with special needs often have great difficulty tolerating new and/or uncomfortable medical regimens, such as posi-

tive airway pressure (PAP) for Obstructive Sleep Apnea Syndrome (OSAS). We examined the compliance data on children with Downs Syndrome, Autism Spectrum Disorder (ASD)/Prader Willie (PW), and/or with mental retardation (MR) to determine whether this therapy can be effectively utilized in this pediatric patient population.
Methods: 18 children with developmental disabilities also diagnosed with OSAS requiring PAP therapy were identified as eligible for evaluation. 11 were diagnosed with DS, 5 were diagnosed with ASD or PW, and 2 were diagnosed with MR. Ages ranged from 1 to 18 with a mean age of 10.9. Average AHI on the diagnostic NPSG was 37.9; average PAP therapy wasv7.9. Eleven subjects used a full face interface and 7 used a nasal interface. Compliance was calculated by dividing the # of nights with > than 4 hours of use by the total # of nights studied. Mixed models repeated measures analysis, assuming an unstructured covariance matrix, was used to examine the compliance, percent days with use, and range of days across 5 subsequent visits. Tukey-Kramer multiple comparisons test was used to determine which specific pairs of means were significantly different.
Results: Overall compliance data across 5 visits was 69%. Compliance for children with ASD/PW was 59.2% and compliance for children with DS was higher at 73.8%.Percent compliance across time (Visits 1 - 5) was found to be 48.8, 52.3, 55.6, 55.3, and 71.3 respectively. Compliance significantly increases across time, P = 0.012. Efforts at attempt were found to be high relative to the level of initial compliance. There is a statistically significant difference of efforts at attempted use (percent of days used) across time (P = 0.013). For visits 1-5 respectively, percent of days used was 84.4, 91.0, 83.6, 78.6, and 91.4.
Conclusion: PAP compliance can be achieved in special pediatric populations. Compliance levels may be initially low, however, efforts at "practicing" the medical regimen is relatively high. In addition, these children tend to be the most compliant over time once PAP is successfully built into their daily life and routine.

0989

NASAL NITRIC OXIDE LEVELS IN CHILDREN WITH SLEEP-DISORDERED BREATHINHG

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Introduction: Increased airway inflammation has been shown in adults and children with sleep-disordered breathing (SDB). Nasal nitric oxide (NO) concentration has been proposed as a surrogate marker for upper airway inflammation such as in the case of allergic rhinitis. Increased nasal NO levels were found in adults with SDB and decreased following treatment. Our objective was to measure nasal NO levels in children with SDB.
Methods: Children referred for an overnight sleep study due to suspected SDB were recruited to the study. In addition, healthy non-snoring controls were recruited. All children underwent nasal NO measurement using chemiluminescence technique during morning hours. Children with an history of asthma or allergy and obese children were excluded from the study.
Results: Sixty-nine children (69% male), mean age 12.3 ± 2.7 years were recruited. Of those 16 had obstructive sleep apnea (OSA) (mean AHI = 7.4), 26 had primary snoring (PS) and 27 were controls. Nasal NO levels showed a trend towards linearity between the 3 groups (978.8 ± 377.4 ppb for OSAS, 879.0 ± 340.0 ppb for PS and 761.9 ± 267.6 ppb for controls; P = 0.03). Nasal NO levels were significantly elevated in the OSA group compared to controls (P = 0.03).
Conclusion: Children with OSA have increased levels of nasal NO. This supports the notion of increased upper airway inflammation in children with SDB.
Support (If Any): This research was supported by The Legacy Heritage Clinical Research Initiative of the Israel Science Foundation (grant No. 1700/08)

0990

VASCULAR FUNCTION AND 24-HR BLOOD PRESSURE REGULATION IN CHILDREN WITH PRIMARY SNORING

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Introduction: Sleep Disordered Breathing (SDB) chronically affects around 10% of children. Adults with severe SDB (i.e. obstructive sleep apnea) have an increased risk of systemic inflammation, hypertension, diabetes, stroke and myocardial infarction. Whether childhood SDB also increases the risk of poor cardiovascular health remains to be shown. We examined whether children with SDB, predominantly mild primary snorers, displayed evidence of endothelial dysfunction and elevated blood pressures as compared to healthy children.
Methods: Subjects were 68 children aged between 5 to 14 years, separated into two groups: Controls (N = 27, mean age ± SEM = 10.2 ± 0.4, M:F = 12:15) and SDB (N = 41, mean age ± SEM = 8.2 ± 0.3, M:F = 20:21). All participants underwent overnight polysomnography, followed the next morning by assessment of endothelial function (Flow Mediated Dilatation), and a subset of N = 58 subjects also completed 24-hr ambulatory blood pressure and ECG monitoring.
Results: There were no group differences in FMD measurements of endothelium-dependent arterial reactivity (8.1 ± 0.9% vs. 7.3 ± 0.6%, for Controls and SDB groups respectively; P = 0.45). Co-varying for age or body mass index did not alter the results. As in other recent studies, the SDB group did have significantly higher night diastolic BP than Controls (52.0 ± 1.1 vs. 49.0 ± 0.8 mmHg) and night DBP index (BP as a percentage of 95th percentile value: 0.80 ± 0.01 vs. 0.75 ± 0.01; P = 0.03 for both). Correlation analyses failed to show any significant relationships between endothelial function and severity of SDB as measured by respiratory disturbance index (RDI).
Conclusion: Children with only mild primary snoring have elevated night time diastolic BP compared to healthy children, which may increase their risk of developing hypertension and cardiovascular disease in the future. Primary snoring in children does not appear to affect endothelial function, however it remains to be shown whether more severe obstruction and the resultant hypoxia during sleep can adversely affect endothelial function.
Support (If Any): NHMRC project grant #453637 and a University of Adelaide Faculty of Health Sciences Research Fellowship.

0991

NEUROCOGNITIVE AND ENDOTHELIAL FUNCTION ARE FREQUENTLY CONCORDANT IN SCHOOL-AGED CHILDREN WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Pediatric OSA is associated with cognitive and endothelial dysfunction. However, it is unclear whether these 2 frequent morbidities of OSA coincide.
Methods: Consecutive children (ages 5-8 years) with polysomnographically-based OSA underwent cognitive battery evaluation (DAS and NEPSY) and cuff-occlusion tests for assessment of endothelial function. The presence of neurocognitive deficits (NC(+)) was defined based on the presence of ≥ 2 abnormal cognitive tests. Endothelial dysfunction (ED(+)) was defined as time to maximal post-occlusive hyperemic response ≥ 45 sec (Tmax).
Results: 84 children completed both cognitive and endothelial tests. Mean age was 7.2 ± 0.8 years, 55% were male, 22.6% were AA, and

46.4% were obese (BMI z score > 1.65). Mean obstructive AHI was 11.7 ± 3.4 /hrTST, nadir SaO2 was 83.7 ± 4.1%, and respiratory arousal index was 5.7 ± 1.7 /hrTST. Of these, 45 children were NC(+) (53.6%). Similarly, 49 children had Tmax ≥ 45 sec (58.3%). The fraction of NC(+) and ED(+) was 46.4% (n = 39 of 84). The fraction of ED(+) children who were also NC(+) was 79.6%. Among children who were NC(-), only 25.6% were ED (+) (10 of 39), while among ED(-) only 17.1% were NC(+) (6 of 35). The sub-group of end-organ morbidity "resistant" children (NC(-) and ED(-)) consisted of 29 children, thereby accounting for approximately 1/3 of the cohort.
Conclusion: Endothelial dysfunction and neurocognitive deficits are more likely to co-exist than otherwise predicted from the frequency of each of these morbidities alone in pediatric OSA. Therefore, it is possible that both of these morbid consequences of OSA may share similar mechanisms, and that a simple test such as vascular function may detect a large proportion of at-risk patients. Alternatively, the presence of NC(+) may reflect underlying vascular dysfunction associated with OSA. Potential genomic variances that account for NC(+)-ED(+) and NC(-)ED(-) phenotypes should provide important insights into the pathophysiology of OSA-associated morbidities.
Support (If Any): NIH grant HL-65270

0992

OBSTRUCTIVE SLEEP APNEA, INSULIN RESISTANCE, AND FABP4 PLASMA LEVELS IN CHILDREN

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Introduction: Obstructive sleep apnea (OSA) increases the risk for insulin resistance and metabolic syndrome in both adults and children. FABP4 is a member of the intracellular lipid-binding protein family that is predominantly expressed in adipose tissue, and plays an important role in maintaining glucose and lipid homeostasis. The purpose of this study was to measure FABP4 plasma levels and their association with fasting glucose and insulin levels in children with OSA.
Methods: A total of 236 consecutive habitually snoring and non-snoring children ages 5-7 years undergoing polysomnography were recruited. Children were divided based on AHI into CO (non-snoring; ≤ 1/hrTST), primary snoring (PS; 1-2/hrTST) and OSA (≥ 2/hrTST). BMI z score > 1.65 was used as obesity criterion. Fasting plasma glucose, lipids, insulin, hsCRP, and FABP4 levels were measured. Homa-IR was used as correlate of insulin sensitivity.
Results: Homa-IR was significantly higher in children with OSA (2.6 ± 0.3) and in children with PS (2.2. ± 0.5) compared to controls (1.2 ± 0.2), even though there was similar distribution of obese and non-obese children across the 3 groups. Similarly, circulating FABP4 levels were increased in OSA (14.6 ± 1.0 ng/mL in CO vs.18.6 ± 1.9 ng/mL in OSA; P-value < 0.05), as were hsCRP levels (P < 0.05). There were no increases in either FABP4 and hsCRP in PS. Only a weak linear association emerged between FABP4 and Homa-IR (P = 0.06); however, in a stepwise logistic regression model, age, severity of sleep disordered breathing, BMI z score, hsCRP, and FABP4 were all retained for prediction of Homa-IR, and accounted for 78% of the variance in insulin sensitivity (P < 0.001).
Conclusion: Incorporation of metabolic (e.g., FABP4) and inflammatory (e.g., hsCRP) markers may yield improved prediction of children at risk for insulin resistance in the context of obesity, OSA, or both.
Support (If Any): NIH grant HL65270

0993

SPLIT-NIGHT POLYSOMNOGRAPHY IN MANAGING CHILDHOOD SLEEP DISORDERED BREATHING

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Introduction: Split-night polysomnography (SN-PSG) with positive airway pressure (PAP) titration is acceptable for managing adults with obstructive sleep apnea (OSA). Information about the effectiveness of SN-PSG in childhood OSA is, however, lacking. The objective of our study is to evaluate the feasibility of SN-PSG in childhood OSA.
Methods: The medical records of PSG-naïve patients, age less than 18 years, who had undergone SN-PSG with PAP titration between September 1999 and August 2009 were reviewed. Subjects with tracheostomy were excluded. Demographics, physical characteristics, and PSG findings were tabulated. In 28 subjects (22%) with both full-night (FN-PSG) and split-night studies carried out within four months, reliability and correlation of Apnea Hypopnea Index (AHI) and Respiratory Distress Index (RDI) were assessed using a Bland-Altman analysis and univariate linear regression model.
Results: There were 130 PSG-naïve subjects of age 2 months to 17 years, with median age of 14 years. The median body mass index (BMI) was 32 kg/m2; 69 of the 130 subjects (53%) had BMI > 30. During the diagnostic segment of the SN-PSG, the median sleep efficiency was 86%; 85% achieved REM sleep with an average duration of 25 ± 20 minutes. The median AHI was 9 with a mean of 18 ± 26.7. The median RDI (AHI + Respiratory Effort Related Arousal) was 16.5 with a mean of 30 ± 42. Of the 130 subjects, 122 had CPAP titration and the remainder Bi-Level devices; 116 of the 130 patients (89%) successfully completed PAP titration. In the 28 subjects who completed both SN-PSG and FN-PSG, there was good correlation for AHI and RDI with correlation coefficients of 0.84 and 0.85 and bias of 1.6 ± 11.2 and 0.13 ± 26.8, respectively.
Conclusion: Split-night polysomnography with PAP titration may be an effective alternative to the full-night polysomnography in managing childhood obstructive sleep apnea.

0994

SLEEP DISORDERED BREATHING SEVERITY IN CHILDREN EVALUATED FOR ADENOTONSILLECTOMY

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Introduction: The Childhood Adenotonsillectomy Trial (CHAT) is the first randomized controlled trial investigating the role of adenotonsillectomy (AT) in the management of pediatric obstructive sleep apnea. We report the characteristics of the first 627 children enrolled in the study, testing the hypothesis that severity of sleep apnea on presentation would be associated with obesity and ethnicity.
Methods: Children aged 5-9.9 years who had habitual snoring and operable tonsils were recruited from six academic medical centers from

a variety of sources, including otolaryngology, sleep and general pediatric clinics. Standardized polysomnography was performed prior to randomization to identify children who met study eligibility criteria of mild to moderately severe sleep apnea (apnea hypopnea index [AHI] of 2 to 30, or obstructive apnea index [OAI] of 1 to 20).
Results: Of the first 627 children screened with polysomnography for sleep apnea eligibility, only 47.5% of children had sleep apnea, defined as an AHI ≥ 2 or OAI ≥ 1. Fourteen (2.2%) had severe sleep apnea, defined as an AHI > 30 or AI > 20 and were not randomized. Of the 195 children with AHI in the eligibility range and randomized, 102 (52%) were male, 130 (67%) non-white, and 72 (37%) obese. A higher proportion of obese compared to non-obese children had more severe sleep apnea (AHI ≥ 5; 57% vs 41%; P = .03). More severe sleep apnea also tended to occur among non-white (51%) compared to white subjects (39%) (P = .10). There were no differences in sleep apnea severity between boys (47 of 102) and girls (44 of 93).
Conclusion: The majority of children referred for evaluation for AT because of snoring have low levels of AHI. A high proportion of children with sleep apnea are obese, and obesity is associated with more severe sleep apnea.
Support (If Any): NHLBI HL083075

0995

C-REACTIVE PROTEIN AS A MARKER OF RESIDUAL OSA AFTER ADENOTONSILLECTOMY (T&A)

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Introduction: T&A is the first line of treatment for pediatric OSA, and in the vast majority of patients leads to significant improvements in polysomnographic (PSG) outcomes. However, a large proportion exhibit residual OSA following T&A, which currently requires post-operative PSG to detect it. We hypothesized that serial serum CRP may serve a biomarker for T&A outcomes.
Methods: Nocturnal PSG was performed both pre- and post-operatively on otherwise healthy children undergoing T&A for the diagnosis of OSA. High-sensitivity C-reactive protein (CRP) serum concentrations were determined in all children. Curative resolution of OSA after T&A was indicated by a post-T&A apnea-hypopnea index (AHI) < 1/hrTST.
Results: T&A resulted in an improvement in AHI from 9.0 ± 10.4 to 2.5 ± 2.6/hr TST in 79 children. Of the 79 children, post-T&A AHI < 1/hr was seen in 47 children (59%), while post-T&A AHI > 5 was seen in 9 (11%). Mean initial CRP levels pre T&A were 0.97 ± 2.59 mg/dL and not significantly altered after T&A (0.90 ± 3.10 mg/dL). However, stratification into post T&A AHI groups corresponding to < 1/hr, 1/hr ≤ AHI < 5/hr, and AHI ≥ 5/hr revealed post T&A CRP levels of 0.19 ± 0.25, 1.05 ± 3.56, and 4.21 ± 6.59 mg/dL respectively (P = 0.001).
Conclusion: T&A leads to improvements in sleep disordered breathing in the vast majority of children. However, residual OSA is frequent. Pre-Post T&A high sensitivity CRP, an established marker of systemic inflammation, can provide a useful biomarker in the prediction of residual OSA.
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0996

MANDIBULAR DISTANCE PREDICTS OBSTRUCTIVE SLEEP APNOEA SEVERITY IN INFANTS WITH CLEFT LIP AND/OR PALATE

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Introduction: Infants with cleft lip and/or palate (CL/P) have smaller airways which predisposes them to obstructive sleep apnoea (OSA). While infants with CL/P in the context of a syndrome are know to have more severe SDB, other risk factors for SDB severity in this group have not been identified. We undertook a study of growth and facial measurements to determine if direct facial measurements could be used to predict the risk of severe SDB amongst infants with CL/P.
Methods: Infants with CL/P were prospectively recruited. Measurements of growth parameters and direct facial measurements were taken at the time of polysomnography. Polysomnography was completed to determine the severity of OSA which was defined by an obstructive apnoea-hypopnoea index (OAHI) ≥ 15 events/h. Seven facial measurements plus composite measures were analyzed for their association with OSA severity.
Results: Results from 44 infants < 12 months of age (2.7 ± 2.2 mos) were available for analysis; 34% were male and 36% had CL/P in association with a syndrome. Apnoea-hypopnoea index (AHI) was 22.3 ± 17.4 events/h with an OAHI of 12.4 ± 13.2 events/h and a desaturation index of 25.8 ± 21.2 event/s. Total mandibular distance (right OBI-GN + left OBI-GN distance) was significantly smaller in infants with severe OSA compared to infants without OSA and those with less severe OSA (18.6 ± 2.0 cm vs 15.8 ± 1.6 cm, t-stat 4.28, P < 0.001). Total mandibular distance was predictive of AHI independent of syndrome status and age; for each 10 mm increase in total mandibular distance, AHI increased by 3 events/h. Measures of growth and vertical facial height were not predictive of AHI, OAHI or desaturation index.
Conclusion: Measurement of total mandibular distance may assist in recognizing infants with CL/P at increased risk of severe SDB. This information could be used by clinicians to prioritize investigation and management of high risk infants with CL/P.

0997

DAYTIME NEUROCOGNITION IS UNAFFECTED IN A COMMUNITY SAMPLE OF CHILDREN WITH SLEEP DISORDERED BREATHING SYMPTOMS

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Introduction: Daytime neurocognitive deficits in children associated with sleep disordered breathing (SDB) have been consistently shown in clinically referred samples. This study, as part of an ongoing project, attempted to replicate the results of one recent report that showed no deficits in neurocognition related to SDB in a sample of children drawn from the general community.
Methods: Children with clinical indications of SDB (N = 37, 8.1 ± 1.5y, 37.8% males) and healthy controls (N = 58, 8.0 ± 1.6y, 37.9% males) were selected from the South Australian Paediatric Sleep Survey (SAPSS) database; an epidemiological study examining the prevalence of sleep problems in children aged 5-10y from the community. Groups were matched for age, gender and socioeconomic status. Symptoms of SDB were initially identified via a parent-report questionnaire. Neurocognitive functioning was assessed through the Differential Abilities

Scale (DAS) and Tower, Visual Attention, Phonological Processing, Speed Naming, Faces and Narrative Memory sub-tests from the NEPSY test. Assessment of sleep status and SDB severity were accomplished by a single night of laboratory polysomnography.
Results: Based on factor analysed sub-scales of the parent-report questionnaire, children with SDB symptoms in the mild to severe range also displayed significantly restless sleep ($P < 0.05$). However, no other indications of behavioural, neurocognitive or sleep problems were found. Correlations between SDB symptom scores and neurocognitive measures were not significant. Ongoing analysis of polysomnograms will confirm whether there are group differences in sleep and breathing parameters that explain these results.
Conclusion: Consistent with previous community-based findings, children with parentally-reported SDB symptoms were not different to controls in measures of daytime cognitive performance. Because significant deficits in neurocognition have repeatedly been found in clinical samples, the present results suggest that referral bias may contribute to the finding of neurocognitive deficits in children with SDB.
Support (If Any): DC Cicua-Navarro receives a University of South Australia Postgraduate Scholarship. The project is supported by NHMRC Project Grant #453636.

0998

SLEEP HABITS AND FATIGUE OF CHILDREN RECEIVING MAINTENANCE CHEMOTHERAPY FOR ACUTE LYMPHOBLASTIC LEUKEMIA AND THEIR PARENTS

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Introduction: Sleep disturbance is common in children with cancer but research has been limited to the effects of hospitalization and steroid medications. Little is known about parents' sleep when a child has cancer.
Methods: Children with acute lymphoblastic leukemia (ALL) on outpatient maintenance chemotherapy > 13 years old provided demographic data, reasons for nighttime awakenings, the Children's Sleep Habits Questionnaire (CSHQ) (Owens et al, 2000) and the Childhood Cancer Fatigue Scale -Adolescent (CCFS-A) (Hinds et al., 2007). If the child was < 13 years old, a parent completed the CSHQ and the CCFS-Parent (CCFS-P) version (Hinds et al., 1999). Parents reported on their sleep and fatigue using the General Sleep Disturbance Scale (GSDS) (Lee & DeJoseph, 1992) and the Fatigue Visual Analogue Scale (F-VAS) (Lee et al, 1991).
Results: 84 families were approached and 77 (92%) gave consent. The majority of children were male (80%), aged 4-7 (56%), and Caucasian (52%). Most children (74-97%) had scores on the CSHQ > 41, indicating significant sleep disturbance. Approximately half of the parents had GSDS scores > 42 and F-VAS mean scores ranged from 41-47, indicating significant sleep disturbance and fatigue. Reasons for nighttime awakenings included nightmares, waking too early, and being scared. While a number of families viewed sleep as a problem for their child (22-42%), many more felt that fatigue was a problem (43-53%). Most families (56-69%) felt there were changes in their child's sleep since diagnosis and many children in the youngest age group (43%) were now sleeping in a different location. For parents and children, fatigue and sleep disturbance scores were significantly positively correlated. This relationship also existed between parent and child fatigue, and parent and child sleep disturbance. No relationship was found between child fatigue and amount of nighttime sleep.
Conclusion: Sleep disturbance in children on ALL maintenance and their parents is common, likely contributes to increased fatigue and is a target for interventions.
Support (If Any): A seed grant from the Pediatric Oncology Group of Ontario funded this project. Dr. Stremler's work is supported by a New Investigator Award from the Canadian Institutes of Health Research.

0999

TREATMENT AND OUTCOMES OF PEDIATRIC RESTLESS LEGS SYNDROME (RLS)

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Introduction: Over the past 10-15 years, there has been increased awareness and diagnosis of RLS in children with sleep disturbances. However, there is limited data describing treatment outcomes or patient characteristics that may affect therapeutic success. We evaluated patient demographics, co-morbid conditions, ferritin levels, therapeutic interventions, and time to improvement/resolution from a sample of children in our clinic. Information will be used to refine processes for completion of all case reviews.
Methods: A retrospective study of 15% (n = 25) of 173 children seen between January 2005 and June 2009 with the diagnosis of RLS. Records were randomly selected for review. Statistical analysis was performed using SAS v9.1.
Results: There were 25 children (13 boys) with a mean age of 11.2yr (range 5.3-17.6yr) and predominantly of two races (80% White, 8% Black). Primary sleep diagnoses included: RLS only (84%), PLMD only (4%), and both RLS and PLMD (12%). The most common secondary sleep diagnoses were insomnia (36%) and obstructive sleep apnea (24%). Approximately half of the children had a co-morbid psychiatric diagnosis including ADHD (24%) and anxiety (20%). Co-existing orthopedic problems were reported in 20%; only one child had renal disease. 56% reported a family history of RLS. 64% had a ferritin < 30ng/mL with an average of 28.2ng/mL (6.4-126ng/mL). The ferritin was < 50ng/mL in all but one child. Iron replacement was the most common treatment (76%). Children also received melatonin (28%), gabapentin (16%), and ropinirole (8%). Of the children with follow-up (n = 22), 73% reported improvement/resolution. Of the children treated with iron, 84% improved/resolved. The median time from initial clinic visit to improvement/resolution was 3.2 months.
Conclusion: Supplemental iron is effective in management of pediatric RLS, especially if the ferritin level is < 30ng/mL. Comorbid medical and psychiatric diagnoses (i.e., orthopedic issues, or ADHD or anxiety, respectively) may adversely affect treatment results. Improvement/resolution can be seen within a relatively short time span for most children.

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PARENTAL ATTRIBUTIONS REGARDING SLEEP PROBLEMS OF CHILDREN WITH AN AUTISM SPECTRUM DISORDER OR DOWN SYNDROME

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Introduction: Despite the high levels of reported sleep disturbance in children with intellectual disabilities, there has been very little research on how caregivers conceptualise sleep difficulties and which aspects of their child's sleep and daytime performance they attribute to a sleep disorder and which they attribute to the disability. The aim of this study was use the Common Sense Model of Illness Representation to characterise the attributions for sleep problems amongst caregivers of children with an Autistic Spectrum Disorder (ASD) and those with children with Down Syndrome (DS).
Methods: Caregivers of children between the ages of 5 and 11 with both intellectual disabilities and sleep problems were recruited using

adverts on the websites of various charities designed for caregivers of children with intellectual disabilities. 128 parents (76 caregivers of children with ASD and 52 caregivers of children with DS) completed a modified version of the Illness Perception Questionnaire (IPQ) as well as providing data on their own levels of anxiety and depression and their child's current sleep problem.
Results: Both groups strongly agreed that their child's disability was a causal factor in their child's sleep problem (92%) and both groups reported high levels of anxiety and depression with 26% of the sample reaching clinically relevant anxiety and 43% of the sample reaching a clinical level of depression. Comparison of the IPQ cause dimension between parental groups showed that caregivers of children with ASD were more likely to suggest their child's personality (57% vs. 37%), emotional state (76% vs. 25%), and diet (11% vs. 8%) were independent factors that contributed to the sleep problems whereas caregivers of children with DS were more likely to state that 'other health problems' (35% vs. 12%) was the biggest independent predictor.
Conclusion: The results are consistent with previous research which suggests that caregivers of children with intellectual disabilities perceive the disability to be the main cause of their child's sleep problem. However, these findings highlight other independent factors which relate to the significant burden felt by caregivers of children with both intellectual disabilities and sleep problems, thus providing further avenues for support and intervention.

1001

SLEEP DIAGNOSES IN CHILDREN AND ADOLESCENTS WITH ADHD: UNIQUE EFFECTS OF STIMULANT MEDICATION AND ADHD SUBTYPE

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Introduction: ADHD is among the most common childhood psychiatric disorders, estimated to affect approximately 3% to 5% of elementary school-aged children, with 11% to 37% reporting sleep disturbance (American Psychiatric Association, 2000; Owens, Spirito, McGuinn, & Nobile, 2000). Disturbed sleep can result in daytime sleepiness and behavioral difficulties that affect cognitive functions in children, such as attention and memory, as well as exacerbate symptoms of ADHD (Fallone, Owens, & Deane, 1998; Owens, 2005). The primary aim of this study was to determine the prevalence of ICD-9 sleep disorders as diagnosed by pediatric primary care providers in children and adolescents with ADHD across medication status and ADHD subtype.
Methods: Electronic medical records were reviewed for 5916 patients (6-18 years) diagnosed with ADHD and seen for a well-child visit in 2007. Information was collected on ICD-9 sleep diagnoses, demographic variables (age, sex, race), ICD-9 ADHD subtype (ADHD with and without hyperactivity), and stimulant medications commonly used to treat ADHD.
Results: Across all ages, 7.3% of patients had an ICD-9 diagnosis for a sleep disorder. The most common diagnoses were nocturnal enuresis (3.2%), sleep disorder NOS (2.5%), and sleep disordered breathing (1.5%). Predictors of sleep disorders included age, ADHD subtype, and race. Specifically, children ages 6-12 years were more likely to have a sleep diagnosis than adolescents ages 13-18 (OR = 1.66); children with ADHD without hyperactivity were more likely than children with ADHD with hyperactivity to have a sleep diagnosis (OR = 1.40); and African-American children were more likely than Caucasian children to have a sleep diagnosis (OR = 1.68).
Conclusion: The 7.3% of patients given a ICD-9 sleep diagnosis is lower than prevalence rates reported in other epidemiological studies, suggesting that primary care providers may be under-diagnosing sleep disorders in this population of children and adolescents. Since sleep disorders in youth can be treated when recognized, these results suggest the need for additional education and support in the diagnosis of sleep disorders in children and adolescents with ADHD.

1002

A PILOT STUDY OF SLEEP AND MEDICATION ADHERENCE IN ADOLESCENT KIDNEY TRANSPLANT RECIPIENTS

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Introduction: The insufficient sleep, irregular sleep patterns, and sleepiness common to adolescents may play a role in medication non-adherence. The study aims were to describe sleep duration and sleepiness in adolescent kidney transplant recipients and to identify the frequency and effectiveness of organizing medications around sleep schedules.
Methods: The sample consisted of 16 adolescents ages 13-18 (mean = 15.81+1.76 years; 62.5 % male; 75% white). All completed the medication adherence module (MAM), a 24-hour recall interview, and a modified Epworth Sleepiness Scale.
Results: The mean total sleep time was 8.0 hours+1.0. Most adolescents (80%) slept less than recommended 9.25 hours and 27% slept less than 8 hours. The mean Epworth Sleepiness Scale score was 8.31+3.02, and 37.4% had a score > 10. Strategies used to remember to take medications at prescribed times (usually 12 hours apart) included taking them at bedtime (25%), wake time (31.3%), mealtimes (6.3%) or during other activities (6.3%). In contrast 68.8% said they used other, undefined strategies and 25% said they did not use any strategy. Regarding the effectiveness of their strategies, the majority (81.2%) had not forgotten to take any medications over this 2-week period, but 43.8% had been late. Reasons for missing or late medications, included oversleeping (25%) and going to bed late (13%), contrasting with 56% who just forgot.
Conclusion: Most adolescents in this sample slept less than recommended and one third reported being sleepy, which is consistent with studies of healthy adolescents. Additionally, using bedtime or wake time as a cue for taking medications was endorsed by many. Few adolescents reported forgetting medications entirely; however, many reported that variable sleep schedules caused medications to be taken late, which is important given that immunosuppressants are prescribed at specific intervals. Using sleep schedules may help adolescents remember to take medications yet may also cause them to be late.

1003

EFFICACY OF ADENOTONSILLECTOMY FOR SLEEP APNEA IN CHILDREN WITH DOWN SYNDROME

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Introduction: The prevalence of sleep apnea is high in children with Down syndrome. Adenotonsillectomy is the first line of treatment for pediatric sleep apnea, however results are variable in children with Down syndrome. We performed a retrospective chart review of Down

syndrome patients undergoing adenotonsillectomy to determine efficacy of the procedure in this patient population.
Methods: Retrospective chart review of 31 children with Down syndrome. Presence of sleep apnea before and after adenotonsillectomy was determined by polysomnography, scored per American Academy of Sleep Medicine pediatric guidelines. Results were analyzed using non-parametric statistical analysis.
Results: Mean Age: 8.9 years (range 1.5 to 20 years). Gender: Female 61.3%, Male 38.7%. Caucasian 90.3%, Hispanic 9.7%. Median Body Mass Index: 16.7. Mean baseline Apnea Hypopnea Index: 19.9/hour (Obstructive Index: 20.02/hour). Mean post surgery Apnea Hypopnea Index: 15.2/hour (Obstructive Index: 12.74/hour P = 0.03). Snoring was present in 43.3% of patients presurgery and decreased to 20% postsurgery (P = 0.065). There was a correlation between Body Mass Index and Apnea Hypopnea Index (r = 0.419 P = 0.02). At baseline, 10% of children had severe sleep apnea (apnea hypopnea index > 10/hour) and this proportion remained the same postsurgery; 53.3% had moderate sleep apnea which decreased to 30% of patients postsurgery; 33.3% had mild sleep apnea and this proportion increased to 43.3% postsurgery.
Conclusion: Adenotonsillectomy is beneficial for sleep apnea in some children with Down Syndrome. As a sole procedure it may not be sufficient in Down syndrome patients with moderate to severe sleep apnea.

1004

PAIN AS A MEDIATOR BETWEEN SLEEP QUALITY AND HEALTH-RELATED QUALITY OF LIFE IN CHILDREN WITH SICKLE CELL DISEASE

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Introduction: Children with sickle cell disease (SCD) have several risk factors for reduced health-related quality of life (HRQoL). Despite similar total sleep times when compared to healthy children, children with SCD experience more frequent night wakings, restless sleep, sleep disordered breathing, and enuresis, all of which may further disrupt HRQoL. The purpose of this study was to examine pain as a mediator between sleep quality and HRQoL.
Methods: As part of a 28-day diary study of pain and HRQoL, 22 children, ages 8-18, reported sleep quality and pain daily. Weekly averages of sleep quality were computed as well as total pain frequency for the week. Children completed a measure of HRQoL, the Pediatric Quality of Life Inventory, at baseline and again at the end of the month. Difference scores indicating changes in Physical Health subscale and the Psychosocial Health subscale from baseline to week 4 were computed.
Results: Preliminary correlations indicated moderate correlations between pain and sleep quality weekly, and less consistent relationships to QoL. Mediation models to examine pain as a mediator between sleep quality and change in Physical Health were significant for week 4 predicting Physical Health (R2 = .287, P = .040) but not Psychosocial Health. Surprisingly, sleep quality appeared to mediate the relationship between pain and Physical Health for week 3 data (R2 = .409, P = .007). Other models were not significant.
Conclusion: Sleep quality and pain are interrelated in pediatric SCD and proximal measurements of sleep quality and pain explain the change in HRQoL better than distal measurements. The relationship between sleep quality and change in HRQoL appears to be proximally caused by pain. These results underscore the importance of addressing sleep difficulties to improve HRQoL and the impact of pain on QoL. Further research is needed to understand the bi-directional sleep quality/pain relationship and these variables' influence on HRQoL.

1005

THE IMPACT OF SLEEP DURATION ON VIGILANCE IN CHILDREN WITH ADHD AND CONTROLS

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Introduction: Attention-Deficit/Hyperactivity Disorder (ADHD) is characterized by inattention, impulsivity and hyperactivity. It has been suggested that disrupted sleep may underlie symptoms in children with ADHD. In the present study, we examined the impact of experimental changes in sleep duration on the performance of children with ADHD and Controls on vigilance measures.
Methods: Nightly sleep actigraphic recordings were conducted in 24 children with ADHD, off-medication, and in 49 healthy controls, aged 7 to 11 years. Following a week of baseline recording, participants were assigned to a week of one hour extended or restricted sleep, relative to their baseline sleep duration. Vigilance was measured on the 5th (baseline) and 12th days using the Conners' Continuous Performance Test (CPT).
Results: Separate mixed ANOVAs were conducted for Extension and Restriction conditions, using Week (Baseline or Experimental) as the within-subjects factor and Group (ADHD or Control) as the between-subjects factor. Children in the Extension group made fewer Commission Errors ($F(1, 31) = 15.72$, $P < .05$), and were better at detecting targets from non-targets ($F(1, 31) = 4.20$, $P < .05$), while children in the Restriction group had more Omission Errors ($F(1, 38) = 7.38$, $P < .05$), a larger change in RT on the different ISIs ($F(1, 38) = 6.20$, $P < .05$) and higher Variability ($F(1, 38) = 7.60$, $P < .05$) during the Experimental week. In addition, for Restriction, post hoc t-tests revealed that Controls remained below clinical levels ($P < .05$), while scores for children with ADHD deteriorated beyond the clinical cut-off scores ($P > .05$), suggesting greater detriment to these children.
Conclusion: Changes in sleep duration resulted in significant changes in performance on Conners' CPT. In the ADHD group, sleep restriction was associated with clinically meaningful changes, suggesting that sleep intervention could improve vigilance in non-medicated children with ADHD.
Support (If Any): The study was funded by grants held by Dr. Reut Gruber from the Canadian Institutes of Health Research and Fonds De La Recherche en Santé.

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IS HEART RATE AUTONOMIC CONTROL ALTERED DURING SLEEP IN CHILDREN WITH PRADER-WILLI SYNDROME?

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Introduction: Many symptoms imply an impaired hypothalamic functioning in Prader-Willi syndrome (PWS). Abnormally high number of sudden death are reported in this population, often during non specific infectious diseases or completely unexplained. Impairment of autonomic controls could be implicated in the susceptibility to these sudden deaths
Methods: We studied 17 children with PWS treated with growth hormone therapy ((5.9 years old (1.7-9.9), BMI z-score of 0.52 (-2.2-5.3)) and 14 controls matched for age and body mass indexes (5.5 years old (2.1-10.6) and z-score of 0.62 (-1.3-3.0)). All underwent overnight polysomnography. Sleep stages and sleep apnea were scored accord-

ing recommended criteria. We selected 6 series of 256 RR-intervals for each child. The sleep time was divided in three equivalent periods, and for each period we selected a RR-intervals recording during rapid eye movement (REM) sleep and slow wave sleep (SWS). A coarse graining spectral analysis was performed on these RR-intervals series.

Results: Polysomnography sleep parameters were not different between groups. There was a tendency of a shorter REM sleep latency in PWS (102 mn (1-203) vs 146 mn (57-213); P = 0.08). Heart rate was higher in PWS children than in controls, whatever sleep stage (RR for PWS/controls: 667 ms (519-887) / 773 ms (502-942);p < 0.0001 for SWS and 632 ms (508-831) / 744 ms (500-873); P = 0.0001) for REM sleep). The ratio of high frequency on total spectral power of HR variability was significantly lower in PWS children (HF/TP for PWS/controls : 40% (12-63) vs 47% (14-70) ; P = 0.05 during SWS and 8% (0-40) vs 12% (0-42); P = 0.02 during REM).

Conclusion: Children with PWS treated with GH have lower parasympathetic modulation of heart rate during sleep than controls. These results could suggest an involvement of autonomic dysfunction in the sudden death occurring during sleep in these children

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SLEEP DISTURBANCE AND BEHAVIOR IN CHILDREN WITH OROFACIAL CLEFTS

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Introduction: Case reports and small uncontrolled studies raise the concern that cleft palate repair (CPR) may provoke development of sleep-disordered breathing (SDB). Research suggests that children with CPR, in the absence of other medical conditions, are at high risk for cognitive and behavioral morbidity. The possibility that OSA could be an underlying cause has never been studied.

Methods: The sample, comprised of 108 children, ages 6-16 years (mean 10.2 ± 2.8 years), 63% male, with history of CPR, was recruited from a Midwest university medical center craniofacial anomalies clinic. Parents completed the Conners Parent Rating Scale - Revised (CPRS) and the Pediatric Sleep Questionnaire (PSQ). The PSQ includes a sleep-related breathing disorder (SRBD) scale, a snoring subscale, and a sleepiness subscale. A score ≥ 0.33 on any of these scales is considered risk for SDB/sleepiness.

Results: Twenty-five percent of children with CPR had PSQ scores indicating risk for SDB. Those with risk for SDB had higher CPRS DSM-IV ADHD Inattentive (63.7 ± 14.3 vs. 52.8 ± 11.8; P < 0.001) and Hyperactive-Impulsive (66.2 ± 17.9 vs. 54.7 ± 14.3; P < 0.01) scale T-scores compared to those without SDB risk. Of the SRBD component scales, daytime sleepiness correlated with CPRS DSM-IV Inattentive (r = .51 P < .001) and Hyperactive-Impulsive scores (r = 0.35, P < .001) but snoring did not. In linear regressions controlling for age and BMI, SRBD scores predicted CPRS DSM-IV Inattentive (adjusted $R^2 = 0.14$, P < 0.001) and Hyperactive-Impulsive T-scores (adjusted $R^2 = 0.09$, P < 0.01). In separate models that again controlled for age and BMI, sleepiness subscores predicted CPRS DSM-IV Inattentive (adjusted $R^2 = 0.25$, P < 0.001) and Hyperactive-Impulsive scores (adjusted $R^2 = 0.10$, P < 0.01), whereas snoring subscores did not.

Conclusion: Findings suggest that children with CPR are at significant risk for SDB and daytime sleepiness, with associated behavioral morbidity. Orofacial cleft clinics should screen for sleep disturbances and ADHD symptoms.

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SLEEP IN CHILDREN WITH WILLIAMS SYNDROME

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Introduction: Williams Syndrome is a human developmental disorder caused by a microdeletion of multiple genes in a distinct region of chromosome 7 (7q11.23). Parents of children with Williams Syndrome often report that their children have sleep difficulties. We wanted to analyze sleep in children with Williams Syndrome as compared to normal healthy controls in order to determine whether particular sleep features are characteristic of Williams Syndrome, and to explore associations between disturbed sleep and behavior.

Methods: 35 children with genetically-confirmed Williams Syndrome and 35 controls matched for age, gender, and ethnicity underwent overnight polysomnography and performance testing. Parents completed questionnaires regarding the subjects' sleep and behavior. All statistical analyses were based on paired data.

Results: Williams Syndrome subjects had significantly different sleep than controls, with decreased sleep efficiency compared to control children (mean difference = 4.5%, SD 9.9%; paired t = -2.67, df = 34, P = 0.012), increased respiratory-related arousals (mean difference = 0.50, SD 1.1, P = 0.014), and increased slow wave sleep on overnight polysomnography (the mean difference = 4.6%, SD 10%; paired t = -2.67, df = 34, P = 0.01). Williams Syndrome subjects were also noted to have more difficulty falling asleep, with greater restlessness and more arousals from sleep than controls. 53% of Williams Syndrome subjects had features of attention deficit- hyperactivity disorder. The status of children in the sample as Williams Syndrome subjects or controls could be accurately predicted based on a regression model of polysomnography and questionnaire variables.

Conclusion: Children with Williams Syndrome had significantly different sleep than controls in our sample, based on both subjective and objective data. These differences demonstrated in our study may in turn reflect genetic influences on sleep.

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1009

SLEEP RELATED DISORDERED BREATHING IN CHILDREN WITH CARDIOMYOPATHY

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Introduction: Pediatric cardiomyopathy is a rare and serious condition with a high mortality rate despite intensive medical management. Sleep disordered breathing (SDB) may contribute to cardiac dysfunction yet the prevalence and severity of SDB in a paediatric population with cardiac disease is not well documented. Therefore the aim of this prospective cross-sectional study is to evaluate the prevalence and severity of SDB in children with primary cardiomyopathy and further, its relationship to cardiomyopathy subtypes and cardiac function.

Methods: To date, at the Hospital for Sick Children, Toronto, patients with cardiomyopathy undergo a formal full polysomnography with simultaneous formal otolaryngiological examination, cardiac examination and transthoracic echocardiography.
Results: Eleven patients (10 males) have been recruited. Specific diagnoses were hypertrophic cardiomyopathy (n = 3), dilated cardiomyopathy (n = 5), restrictive cardiomyopathy (n = 1), left ventricular non-compaction cardiomyopathy (n = 1) and combined hypertrophic and dilated cardiomyopathy (n = 1).The mean age was 9.2 years and the mean body mass index (BMI) was 21.1 kg/m2. Their mean left ventricular ejection fraction was 58% (range 16-82%). Although, 8 out of 11 (72%) patients had a history of snoring, only 3/11 patients (27%) had evidence of obstructive sleep apnea (OSA) diagnosed with an obstructive apnea-hypopnea index [OAHI] > 2 events/hour of which one child had evidence of severe OSA (OAHI > 10 events/hour) Their sleep respiratory rate ranged between 11-60 breaths/minute and sleep heart rate ranged between 42-145 beats/minute. The mean SaO2 ranged between 83-99% and the minimum SaO2 ranged between 50-92%. The highest Co2 ranged between 35-52 mmHg.
Conclusion: Children with cardiomyopathy have an increased prevalence of sleep disordered breathing that cannot be predicted by a history of snoring.

1010

REM SLEEP DEFICIENCY IN CHILDREN WITH AUTISM COMPARED TO CHILDREN WITH DEVELOPMENTAL DELAY AND TYPICAL DEVELOPMENT

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Introduction: The developmental role of rapid eye movement (REM) sleep is unknown. REM sleep is driven by acetylcholine, is highest immediately after birth and declines to adult values over the first few years of life coincident with a period of active synaptogenesis. There is growing evidence from animal studies that REM may play a direct role in forming and stabilizing the durable synaptic connections that are necessary for normal development. REM sleep deficiency may both reflect abnormal neural organization and be a trait marker for autism, a disorder in which aberrant connectivity in the developing brain may result in abnormal development of language and social interaction.
Methods: Overnight polysomnographic recordings were scored for sleep architecture according to American Academy of Sleep Medicine criteria by a board certified sleep medicine specialist blind to diagnosis for 60 children with autism, 15 typically developing children and 13 children with developmental delay without autism. Total sleep time (TST), latencies to non-REM sleep and REM sleep and percentages of total sleep time for stages 1, 2, 3 or slow wave sleep (SWS), and REM sleep were calculated for the three cohorts.
Results: There were no differences in sleep variables for any parameters examined between the typical cohort and the developmentally delayed group. The group with autism differed from the typical group on measurements of TST, SWS percentage, and REM percentage. The autism group differed from the developmental delay group without autism on measurements of TST, stage 1 percentage, SWS percentage and REM percentage. The mean REM percentage in our autism group was 15.1. This is much lower than the expected norm for this age of 22-25% and significantly lower than our within-lab comparison group mean of 23.0% and 23.7% for our typical and developmental delay cohorts, respectively.
Conclusion: A relative deficiency of REM sleep as a percentage of total sleep time may indicate an abnormality in the neural organization in the brains of young children with autism that is not directly associated with or related to inherent intellectual disability but may serve as a window into understanding core features of this disorder.

1011

FREQUENT LIMB MOVEMENTS WITH AROUSALS DISRUPT SLEEP IN PEDIATRIC PATIENTS WITH CONGENITAL HEART DISEASE WHO HAVE UNDERGONE CARDIOPULMONARY BYPASS SURGERY

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Introduction: Periodic limb movement disorder (PLMD) is the presence of periodic limb movements of sleep (PLMS), as documented by polysomnography, that exceed norms for age, cause a clinical sleep disturbance, and occur in the absence of another primary sleep disorder or reason for the PLMS. Secondary PLMS have been associated with various chronic illnesses. To our knowledge, this is the first time that PLMS have been described in patients with congenital heart disease who have undergone cardiopulmonary bypass surgery.
Methods: We identified three children with congenital heart disease who underwent polysomnography for evaluation of sleep-disordered breathing. 2 of the children had tracheostomies in the past and 1 continues to have a tracheostomy. Sleep studies were scored according to AASM guidelines for children.
Results: All patients had cyanotic congenital heart disease with 2 or more cardiac surgeries requiring cardiopulmonary bypass. Their ages were 3.5, 9.5 and 10.5 years old. During their most recent polysomnography, there was a mean PLMI of 26 (range: 16.6 to 44.3). The limb movements were unusual in that the leg kicking was exaggerated and often associated with arm and/or body movements. The limb movements resulted in arousals or even awakenings. The PLMS were not associated with respiratory events.
Conclusion: Children with cyanotic congenital heart disease who have undergone surgery with cardiopulmonary bypass may be at risk for PLMD. It has been hypothesized that PLMS are caused by defects in the central dopaminergic system. Movement disorders have been reported in patients after cardiac bypass due to damage to the basal ganglia. We hypothesize that damage to the basal ganglia during bypass may be the etiology of the PLMS observed in our group of patients, and may explain why the semiology of these movements is different than the typical movements of PLMD. Because of our small sample size of medically complex patients, future studies are needed to further delineate if an association exists between PLMD and children with congenital heart disease who have undergone cardiac bypass.

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APNEA-HYPOPNEA INDEX IN KOREAN ASTHMATIC CHILDREN AND ITS ASSOCIATION WITH THE SEVERITY OF ASTHMA AND THE OXIDATIVE STRESS

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Introduction: It has been reported that the sleep apnea syndrome in the asthmatic patients is prevalent, however, the systematic study in this field using polysomnography has rarely been performed. The recent study has suggested the relationship between the apnea-hypopnea index(AHI) and

the severity of the asthma, which may be mediated through the oxidative stress and airway inflammation. We investigated the AHI in the asthmatic children and its association with the severity of asthma and the oxidative stress.
Methods: This study enrolled 26 male and 20 female asthmatic children aged 6-13 years (average 7.9 ± 1.5 years old). Complete overnight polysomnography, pulmonary function test, and the test for the oxidative stress markers were performed for the participants.
Results: Of the 46 asthmatic children, 34 (73.9%) met the diagnostic criteria of the pediatric sleep apnea and the average AHI was 1.8 ± 1.4/h. The children with higher AHI showed more severe degree of asthma (P = 0.023) and poorer pulmonary function (FEV1/FVC ratio: P = 0.005, FEV1%: P = 0.049). However, there was no significant correlation between the AHI and the oxidative stress markers (DNA damage, DNA repair activity, carbonyl content, GSH/GSSG ratio, total antioxidant capacity: P > 0.05).
Conclusion: These results suggest that the prevalence of the pediatric sleep apnea is very high among the asthmatic children and the severity of the sleep apnea correlates with the severity of asthma and the pulmonary function. This implies that the evaluation for the sleep problems might be important in the long-term management of the pediatric asthma. However, the case-control study to compare the AHI between the asthma and control groups is absolutely necessary because few normative data are available for the children. No relationship between AHI and oxidative stress markers may be attributed to that the severity of the sleep apnea in this group was mild degree, however, further larger-scale studies using the other statistical analysis is needed in the future.

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EFFECTS OF PLAY ACTIVITIES ON SLEEP OF HOSPITALIZED CHILDREN

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Introduction: Hospitalization affects children in many different ways, due to an interruption of daily activities among other things. Sleep may be altered during this period because of hospital routines besides the disease itself. Using play activities as an intervention, we studied sleep in hospitalized children to verify how the maintenance of this activity would influence sleep patterns.
Methods: We studied 139 children, hospitalized for respiratory diseases from 4-to 14 years old, and stratified the sample in 3 age groups: 4-7, 7.1-11, and 11.1 to 14 years old. 58 children were randomly assigned to no playing group (NPG), and 81 to the playing group (PG). Sleep during hospitalization was assessed using sleep logs.
Results: In NPG boys, total sleep time was 49% higher in ages 4-7 years old, 9.5% higher from 7.1 to 11 years old and 22% higher from 11.1 to 14 years old, than in boys in the PG. Girls from the two first age groups slept more in the PG (4% and 14% respectively), and the older ones slept 46.1% more in the NPG. Regarding naps during the day, NPG boys slept 26.2% more in age range 1, 46.2% in age range 2 and 35.5% in age range 3 than those in PG. NPG girls slept 22.47% more in age rang 2 and 58.7% in age range 3 compared to PG. In age range 1, PG girls slept 13.1% more during the day than those in the NPG.
Conclusion: Play activities with hospitalized children have different effects on sleep in relation to age and gender. Boys reacted similarly in the age groups studied (those in NPG slept more than in the PG), but sleep in girls varied according to age ranges.

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SLEEP DISTURBANCE, DAYTIME SLEEPINESS AND NEUROCOGNITIVE PERFORMANCE IN CHILDREN WITH JUVENILE IDIOPATHIC ARTHRITIS (JIA)

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Introduction: Children with JIA experience poor sleep quality and daytime sleepiness by self report and objective sleep measures. Daytime sleepiness associated with arousals, snoring, and AHI is thought to underlie poor school performance, negative mood and changes in behavior and neurobehavioral performance in school aged children. The purpose of this study was to compare self-report and physiological multiple sleep latency tests (MSLTs) measures of daytime sleepiness and neurobehavioral performance between children with active and inactive juvenile idiopathic arthritis (JIA), and to explore relations among polysomnographic indices of sleep disturbance (number of wake bouts, snoring, arousals, apnea/hypopnea index [AHI]), daytime sleepiness, and neurobehavioral performance.
Methods: Seventy children 6-to-11 years of age (mean 8.5 ± 1.9 years) with JIA (64 girls) participated in the study. Each child and a parent underwent two consecutive nights of polysomnography (PSG). In the morning after the second night, children underwent 4 MSLTs at 2 hour intervals beginning at 0900 hr to assess daytime sleepiness and completed self report measures of daytime sleepiness as well as a battery of neurobehavioral performance tests at 1000 hr and 1400 hr.
Results: Children with active disease (mean physician global rating score = 2.9 ± 1.9 SD) showed shorter mean MSLT latency (15 ± 6.0 min) compared to those with inactive disease (16.5 ± 5.5 min, P < 0.03). Scores on neurobehavioral performance tests showed no group differences. However, number of wake bouts predicted sustained visual attention (rapid visual processing, P < 0.05) and apnea hyponea index (AHI) predicted reaction time (P < 0.0001), after controlling for age, IQ, medication, and disease status.
Conclusion: Indices of sleep disturbance were associated with validated tests of neurobehavioral performance in JIA, regardless of disease activity. Additional research is needed about the extent of sleep disturbances in relation to neurocognitive performance in JIA and compared to healthy children.
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ASSOCIATION OF A SEROTONIN TRANSPORTER GENE POLYMORPHISM WITH SLEEP AND RESTRICTED BEHAVIOR IN AUTISM SPECTRUM DISORDERS

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Introduction: Insomnia is a common problem in children with an autism spectrum disorder (ASD), but its cause is elusive. A cardinal feature of ASD is restricted behavior which may contribute to difficulty initiating sleep. Selective serotonin reuptake inhibitors (SSRIs), which work by inhibiting the serotonin transporter, improve some of these

behaviors. An insertion/deletion polymorphism in the 5-HTTLPR promoter region of the serotonin transporter gene (SLC6A4) results in a short (S) or long (L) allele, each of which has been associated with behaviors that respond to SSRIs. We investigated whether a particular 5-HTTLPR genotype is associated with SSRI-responsive behaviors that can delay sleep onset.
Methods: Serum or buccal DNA was obtained from fourteen children aged 4-10 years (mean age of 6.2 years). All children had ASD confirmed by the Autism Diagnostic Observation Scale. Behaviors were rated using the Child Behavior Checklist and Repetitive Behavior Scale-Revised, validated scales that include behaviors commonly seen in ASD that can be responsive to SSRIs. Sleep latencies were measured objectively using polysomnography or actigraphy. DNA samples were assayed for the 5-HTTLPR polymorphism using PCR, heteroduplex formation, and temperature-gradient capillary electrophoresis. 5-HTTLPR genotypes were compared to behavior ratings and sleep latencies.
Results: Using the Kruskal-Wallis Test, 5-HTTLPR genotypes were significantly different on restricted behavior (P = 0.01) and self-injurious behavior (P = 0.03), but no other areas. The S/L genotype was associated with higher restricted behavior ratings. Longer sleep latencies (minutes) were seen with S/L and S/S genotypes (S/S 48.9, S/L 36, L/L 15.4; P = 0.27).
Conclusion: The S/L genotype was selectively associated with restricted behavior. Sleep latencies were also higher in those with an S allele (although significance was not reached likely due to the small sample size). Future study using a larger sample is needed to define the relation of 5-HTTLPR genotypes and restricted behavior to insomnia.
Support (If Any): Grant support received from Autism Speaks, National Institute of Child Health and Human Development (1R01HD059253), and Vanderbilt Institute for Clinical and Translational Research (RR024975).

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SLEEP AND BREATHING ISSUES IN PATIENTS WITH JOUBERT SYNDROME

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Introduction: Joubert syndrome is a rare autosomal recessive disease characterized by malformation of the cerebellar vermis causing ventilatory dysregulation (alternating hyperventilation, hypoventilation, and apnea) and multisystem abnormalities contributing to decreased lifespan. To date, little is known about sleep and the ventilatory dysregulation in this patient population.
Methods: A questionnaire targeted toward patients with Joubert syndrome was distributed at the Joubert Syndrome and Related Disorders Foundation Conference in July 2009. The questionnaire addressed neonatal breathing complications and other respiratory and sleep-related issues. Patients unable to complete the questionnaire (due to young age, neurological problems) had the survey completed by their parents or proxy. The protocol was approved by the Johns Hopkins University Institutional Review Board.
Results: To date we collected 20 surveys. The median (range) participant age was 8.3 years old (0.9-36.8), with median age of diagnosis 0.8 years (0.0-25.0). 8/20 of these subjects were hospitalized in a neonatal intensive care unit (NICU) at birth, and 11/20 experienced breathing problems after birth. Currently, 7/20 experience episodic tachypnea, and 4/20 have apnea (3 patients have both); each patient with tachypnea had breathing abnormalities at birth. Snoring occurs in 10/20, of whom 4 snore every night and 5 have co-existing daytime tachypnea. 8/20 patients had previously undergone a sleep study.
Conclusion: Joubert syndrome patients have a high prevalence of tachypnea, apnea, and snoring while sleeping. It appears that breathing problems experienced by these patients during the neonatal period are often but not always associated with tachypnea later in life. Further understanding of the breathing and sleep abnormalities may contribute to improved quality of life and outcomes for patients with Joubert Syndrome. We would like to acknowledge the Joubert Syndrome and Related Disorders Foundation for its support and assistance with this project.
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PREVALANCE OF SLEEP PROBLEMS IN WILLIAMS SYNDROME

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Introduction: Williams syndrome (WS), characterized by distinctive faces, cardiovascular disease, intellectual disability, characteristic cognitive profile, and idiopathic hypercalcemia, is caused by a submicroscopic chromosome deletion of 7q11.23. Behavioral problems often include sound hypersensitivity, anxiety and attention-deficit/hyperactivity disorder (ADHD). This questionnaire study assesses the prevalence of sleep problems in patients with WS.
Methods: The study group comprised 32 subjects with WS (17 F; 15 M) aged 1.1 - 48.1 years, (median 10.5 years ± 11.10); four subjects were over 21 years. Parents completed 4 questionnaires online (Intake Demographic Form; Pediatric Sleep Questionnaire; Pediatric Daytime Sleepiness Scale; Specific WS Questionnaire) through the WSPCR Registry.
Results: WS subjects had symptoms of sleep disordered breathing (56.3% snoring, 59.4% mouth breathing, 40.6% night sweating, 96.9% have intact tonsils), problems with sleep onset [difficulty falling asleep (53.1%) with half taking > 30 minutes to fall asleep], sleep maintenance [waking up at night screaming (43.8%), waking up more than twice (43.8%), and having trouble falling back to sleep (43.8%), waking up early in the morning (46.9%), and restless sleep (46.9%)]. Just over a third had dreams. There was no significant increase in symptoms suggestive of restless legs or growing pains. To fall asleep, the subjects had parents in the room (37.5%), shared a room (43.8%), and/or listened to TV or music (50%) indicating sleep-anxiety & sleep-associations. The use of anxiolytic medication (12.5%) did not diminish sleep-anxiety and sleep-associations. Symptoms of excessive daytime sleepiness were frequently reported [sleepiness during the day (31.3%), day-time naps (34.4%)]. Parents frequently observed their children with WS had difficulty organizing tasks (62.5%) and had easy distractibility (96.9%), with 37.5% being diagnosed with ADHD.
Conclusion: Sleep problems such as sleep-disordered breathing, sleep-related anxiety and sleep associations, disturbed sleep patterns at night, and excessive daytime sleepiness are frequently reported by parents of subjects with WS.

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DUAL-ENERGY X-RAY ABSORPTIOMETRY (DEXA) ANALYSIS OF BODY FAT COMPOSITION AND SLEEP RELATED BREATHING DISORDER (SRBD) IN OBESE LATINO ADOLESCENT MALES

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Introduction: Studies in adults demonstrate that not only obesity but specific regional fat distributions also constitute risk factor for SRBD. We hypothesized that body fat composition and its regional distribution by DEXA correlates with AHI and hypoxemia in obese children with SRBD.
Methods: Overnight Polysomnography was performed on obese Latino males with snoring and /or suspected apnea [10-18 years, BMI percentile > 95th for age/gender]. Total body fat mass, trunk fat mass, total body % fat and trunk % fat were determined by DEXA.
Results: 18 males [Age (mean+ SD) 13.0+ 1.8 yrs, BMI z-score 2.45 ± 0.32, Obstructive Apnea Hypopnea index (OAHI) 5.8 ± 5.7 events/hour, and desaturation index (≥ 3% drop in oxygen saturation from baseline) 11.1 ± 14.3 events/hr sleep] were studied. Desaturation index and OAHI were not normally distributed and were log transformed. There was a significant correlation between Log (OAHI) and Total body Fat (R = 0.50, P = 0.029). Log (Desaturation Index) was significantly correlated with Total body fat (R = 0.66, P = 0.003), Total body % fat (R = 0.58, P = 0.01) and Trunk % fat (R = 0.50, P = 0.03). Patients with total body fat of < 40,000 g or total body % fat < 40% or trunk % fat < 40% were more likely to have desaturation index < 10/hr (P = 0.04, P = 0.013, P = 0.013 respectively).
Conclusion: AHI correlates with total body fat composition whereas desaturation index correlates with total body fat composition and its regional distribution in obese Latino adolescent males. We speculate that DEXA scan can be useful to screen obese patients who are at high risk for hypoxemia during sleep.
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BODY POSITION AND OBSTRUCTIVE SLEEP APNEA IN CHILDREN WITH DOWN SYNDROME

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Introduction: Children with Down syndrome (DS) commonly have obstructive sleep apnea (OSA) and may assume a peculiar sleeping position not systematically described previously. We describe this sleep position in DS and explore its relationship with OSA in comparison to controls (DSC).
Methods: Overnight video-polysomnograms (PSG) of consecutive children with DS (age 2-18 y), referred to our center between April 2008 and October 2009, were retrospectively analyzed by a single scorer (ES). DSC group comprised age and gender matched, non-syndromic, neurologically intact children referred to us for suspected OSA over the same period.
Results: Each group had 17 subjects matched for age (6.4 y ± 3.8, range 2-16) and gender (64.7% female). DS group had higher BMI than DSC (20.3 ± 5.3 vs 16.7 ± 3.7; P = 0.03). There were however no significant differences between DS and DSC with respect to total sleep time (min) (457.8 ± 53.3 vs 442.6 ± 59.5), sleep efficiency (%) (88.4 ± 8.2 vs 86.9 ± 7.7), REM time (%) (18.7 ± 5.6 vs 18.4 ± 4.6), supine time (%) (41.6 ± 25.7 vs 25.5 ± 26.8, P 0.09), mean oxygen saturations (%) (95.1 ± 2.0 vs 95.35 ± 3.25), saturation nadir (87.2 ± 6.7 vs 87.2 ± 6.3) or total apnea-hypopnea index (7.7 ± 12.3 vs 8.7 ± 11.3). Despite these similarities between the groups, 9 (53%) of DS children slept seated bent forward with head resting on bed for at least part of the total sleep time (%) (7.8 ± 10.9, range 0.8-35.7).This was absent in the DSC group (P < 0.005).
Conclusion: Some DS children assume a peculiar sitting-flopped-forward body position with head resting on bed while asleep. This is absent in age and gender matched controls showing otherwise similar PSG characteristics. The reason for this posture is unclear from this study. We hypothesize it may play a role in protecting the airway. Differences between DS who do and do not lean forward should be further explored.

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SPECTRUM OF SLEEP PROBLEMS IN CHILDREN WITH AUTISM - AN EPIDEMIOLOGICAL ANALYSIS

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Introduction: Sleep problems are commonly reported by parents of children with autism. Several diagnostic tools exist to identify sleep problems. This study compares scales from the Children's Sleep Habits Questionnaire (CSHQ) to the Parental Concerns Questionnaire (PCQ) sleep question.
Methods: Participants included 1056 children, ages 3-18 years, participating in the Autism Treatment Network (ATN). Children have a clinical diagnosis of autism confirmed by the Autism Diagnostic Observation Schedule. Parents completed the CHSQ and the PCQ. The CSHQ is a multi-item questionnaire with subscales for multiple domains of sleep problems, with higher subscale scores indicating greater severity. The PCQ contains a single question with four possible responses indicating severity. Both are validated questionnaires used in children with a variety of conditions including ASD. Ordinal multivariate logistic regression evaluated the relationship between parental response (no, mild, moderate, or severe problem) to the question "describe the extent to which sleep disturbance (does not fall asleep easily, wakes often, etc) has been a problem for you within the past month" and responses on the CSHQ subscales.
Results: In an age-adjusted model, sleep delay, sleep duration (shortened), and night wakings were positively associated with parental reports of sleep problems on the PCQ. The adjusted odds ratios were 1.66, 1.40 and 1.06, respectively. Therefore, for each one-level increase in sleep delay, sleep duration, or night wakings, children had significantly increased odds of being in a higher versus lower category for sleep problems. No significant odds were found for sleep disordered breathing, parasomnia, and daytime sleepiness scales.
Conclusion: In a large epidemiological sample, PCQ response correlated most strongly with sleep delay, followed by short sleep duration, and night wakings; but not with sleep disordered breathing, parasomnias, or daytime sleepiness. Our findings suggest that sleep onset insomnia is the major concern facing parents of children with autism.
Support (If Any): Grant support received from the Autism Treatment Network, Health Resources and Services Administration (UA3 MC11054).

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UPPER AIRWAY AND SURROUNDING LYMPHOID TISSUE SIZE IN CHILDREN WITH SICKLE CELL DISEASE

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Introduction: The pathophysiology of sleep disordered breathing (SDB) in children with sickle cell disease (SCD) is not well established. It has been suggested by some investigators that children with SCD have larger adenoid and tonsillar tissues to compensate for their commonly-described functional asplenia, or as a result of recurrent upper respiratory infections because of lack of opsonization of bacterial pathogens. In the present study we quantified the upper airway and surrounding lymphoid size in children with SCD as compared to controls using MRI.
Methods: 30 SCD children (age 6.4 ± 4.2y) and 30 matched controls (age 6.1 ± 3.9y) underwent head and neck MRI using a 1.5T Siemens Vision system (Iselin, NJ). Axial and sagittal sequential T1-weighted (TR650/TE14) and T2 (TR6000/TE90) 3mm thick slices and 1 NEX were obtained from the orbital cavity to the larynx. Volumetric analysis of the upper airway and cervical lymphoid tissues including adenoid, tonsils, retropharyngeal, and deep cervical nodes was performed using commercial software.
Results: We noted no differences in the size of the upper airway and deep cervical nodes but significantly larger adenoid (7.5 ± 2.5cm3 vs. 4.6 ± 2.0cm3, $P < 0.001$), tonsils, (6.4 ± 3.0cm3 vs. 4.6 ± 2.3cm3, $P < 0.001$), and retropharyngeal nodes (2.9 ± 1.5cm3 vs. 2.2 ± 1.0cm3, $P < 0.05$), in SCD children as compared to controls.
Conclusion: These findings suggest that upper airway lymphoid hypertrophy is present in children with SCD compared to controls. We speculate that this may predispose SCD children to SDB.
Support (If Any): HL-79911

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SLEEP, GLUCOSE, AND DAYTIME FUNCTIONING: A MULTI-METHOD STUDY OF YOUTH WITH TYPE 1 DIABETES

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Introduction: Although there is strong evidence linking disturbed sleep as an independent risk factor in obesity and metabolic dysfunction, little research has focused on sleep in youth with Type 1 diabetes mellitus (T1DM).
Methods: We are conducting a prospective, single center study using polysomnography, actigraphy, and child and parent self-report measures to assess sleep, and continuous glucose monitors (CGM; subcutaneous device recording glucose levels every 5 minutes over 5-days), meters, and hemoglobin A1C to assess glucose control. To date, participants include 38 youth ages 10-16 with T1DM (24 males; 26 Caucasian, 8 Latino/Latina, 4 other; mean age 13.5 (SD = 1.97)).
Results: Following criteria set by the Tucson Assessment of Sleep Apnea study, sleep-disordered breathing (SDB) was present if the child had a respiratory disturbance index (RDI) of ≥ 1 event per hour (n = 14). Individuals with higher RDI's had significantly higher CGM glucose levels ($t(22) = -2.13$, $P < .05$) and a higher percentage of time experiencing hyperglycemia (glucose levels ≥ 180; ($t(22) = -2.35$, $P = .03$)). The pattern persisted even when a stricter RDI cutoff of 1.5 (n = 7) was used. Glucose levels were inversely related to the School Sleep Habits Survey (SSHS) Sleep Quality ($r(34) = -.46$, $P = .02$) and Daytime Sleepiness ($r(34) = .41$, $P < .05$) subscales. More time (%) spent in Stage 2, which negatively correlated with time spent in stage N3, was positively related to glucose levels ($r(23) = .49$, $P = .02$), problem behaviors reported by parents on the Pediatric Symptoms Checklist ($r(27) = .54$, $P < .01$), and the Grade subscale on the SHSS ($r(27) = -.47$, $P = .01$), and inversely related to the SHSS Sleep Quality ($r(27) = -.51$, $P < .01$) subscale.
Conclusion: These data support that sleep, glucose regulation, and behavioral and academic functioning are intricately related. Youth who evidenced SDB exhibited poorer glucose regulation. Future research needs to determine if and how sleep should be routinely assessed in diabetic youth, and the role that sleep plays in diabetes management.
Support (If Any): Father's Day Council in Tucson, Arizona; University of Arizona Faculty Small Grants Program

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SLEEP CHARACTERISTICS IN OLDER CHILDREN WITH DOWN SYNDROME

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Introduction: Children with Down syndrome (DS) are susceptible to the development of obstructive sleep apnea (OSA) due to midfacial and mandibular hypoplasia, glossoptosis, and adenoidal and tonsillar hypertrophy. Other predisposing factors to OSA in DS include obesity, hypothyroidism, and generalized hypotonia. Laboratory polysomnographic (PSG) studies have reported the presence of OSA in younger children with DS, estimated to be somewhere between 30-79% (de Miguel-Díez et al., 2003; Dyken et al., 2003; Fitzgerald et al., 2007; Schott et al., 2006). Problems with bedtime settling, sleep onset, sleep maintenance, and early morning waking have also been reported in children with DS (Stores et al., 1998; Cotton & Richdale, 2006; Levanon et al., 1999).
Methods: We performed in-home ambulatory overnight polysomnography in 17 older children with DS (age M = 12.73; 7 girls).
Results: Although nearly all of the children had an adenotonsillectomy prior to the study, we found that 15 of the 17 children (88%) met criteria for pediatric OSA (AHI ≥ 1.5). Six of these were classified as mild (AHI ≥ 1.5), three as moderate (AHI ≥ 5), and six were severe (AHI ≥ 10). The mean arousal index was 4.38, and the mean arterial oxygen saturation low point was 85%. Children in our sample did not appear to have difficulties falling asleep (SOL M = 17.44), but did have some difficulty maintaining asleep (WASO M = 48.15).
Conclusion: We found a high rate of OSA in an older sample of children with DS, nearly all of whom had had an adenotonsillectomy. This finding suggests that surgery does not completely eliminate OSA in this population. We also found some evidence of sleep maintenance problems.
Support (If Any): Down Syndrome Research and Treatment Foundation

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PEDIATRIC RESTLESS LEGS SYNDROME: QUALITATIVE ANALYSIS OF SYMPTOM DESCRIPTIONS AND DRAWINGS

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Introduction: The objectives were to collect and analyze detailed symptom descriptions from patients with pediatric restless legs syndrome

(P-RLS), ages 6-17 years, as well as assess symptom impact and the usefulness of drawings.
Methods: Trained qualitative interviewers conducted face-to-face audio-recorded interviews of children and adolescents with definite RLS. The sample included patients with and without comorbid attention-deficit/hyperactivity disorder (ADHD) and was age/ADHD stratified. Exclusionary criteria included secondary RLS, medication known to influence RLS symptoms, and ADHD medication. Open-ended questions were used to elicit patient-directed information. In addition, each child was asked to draw a picture of their RLS sensations. Verbatim transcripts were coded and analyzed using qualitative methods, including grounded theory, sensitizing concepts, and saturation.
Results: Thirty-three patients in three age groups used 16 different categories of descriptors for P-RLS sensations, with a mean of three or more categories used per patient in each age group. "Need to move/kick," "pain/hurts," "uncomfortable/can't get comfortable," and "like bugs or ants/crawling" were the most common descriptors. Two-thirds reported experiencing daytime RLS sensations and 48% some arm involvement. The children and adolescents described impact of RLS on sleep, cognitive function, and affect in 88%, 48%, and 58% of cases, respectively. The only significant difference for those with comorbid ADHD was that parents reported more sleep problems. Younger children provided less detail describing their symptoms and more often used the words "kick/kicking." Thirty of 33 drew a picture of their RLS sensations. These drawings present useful and often compelling diagnostic information.
Conclusion: The descriptions and drawings provide detailed empirical data that depict how children and adolescents, ages 6 to 17 years, can effectively communicate the symptoms and perceived impact of RLS. These data will be useful in clinical practice, as well as in the development of formal diagnostic tools and patient-reported outcome/severity measures.
Support (If Any): Boehringer Ingelheim International GmbH

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ASSOCIATIONS BETWEEN PARENTAL SUBSTANCE USE AND ADOLESCENT SLEEP PATTERNS

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Introduction: Inadequate parenting has been linked with developmental risks in children of alcohol-abusers. The link, however, between marijuana use among parents and functioning in adolescents is unclear. This study investigates sleep patterns of adolescents with alcohol- and marijuana-using parents.
Methods: In addition to yearly assessments tracking maternal substance use from pregnancy through postnatal year 12, 49 adolescents in the longitudinal Maternal Lifestyle Study (aged 13-14, 56 % female, 50% minority, 42% below the poverty line) completed a sleep habits survey and kept an 8-day sleep diary while wearing an actigraph. Parents also completed a survey regarding home, school, and sleep habits. Measures yielded actigraphic estimates of sleep efficiency (M percent of weeknight time in bed spent asleep) and sleep schedule variability (sum of SD of weeknight bedtimes and wake times).
Results: Cumulative maternal/caretaker marijuana use from pre- to postnatal year 12 predicted worse sleep efficiency among adolescents ($R2\Delta = .221$, $P = .02$) adjusting for the effect of number of caretaker changes. Furthermore, increased postnatal parental alcohol use predicted more variable sleep schedules among adolescents ($R2\Delta = .422$, $P < .001$) adjusting for the effect of poverty level. Postnatal parental alcohol use was correlated with parental-report of change in the home (e.g., of bed, room, house; $r = .569$, $P < .001$), and this change accounted for most (92.4%) of the variance explained by parental alcohol use.
Conclusion: Teens of marijuana-using parents spent longer in bed on average than their peers, resulting in more wake time during the night. This behavioral difference merits assessment of parenting of marijuana-users and of passive marijuana inhalation by these teens. Furthermore, consistent sleep and wake times are empirically supported protective factors for sufficient sleep. The link between increased parental alcohol use and increased adolescent sleep schedule variability further justifies including sleep education in parent training for this population.
Support (If Any): This study was funded by National Institute on Drug Abuse (NIDA), grant 5U10DA024119-02.

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CHANGES IN SLEEP AND FATIGUE IN NEWLY TREATED PEDIATRIC ONCOLOGY PATIENTS

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Introduction: This study presents findings on changes in sleep across the first eight weeks of treatment for children with newly diagnosed cancer. We address how sleep and fatigue change from time of diagnosis to 8 weeks following the onset of treatment as indicated by self and parent reports.
Methods: The prevalence of sleep problems and fatigue in pediatric oncology patients, ages 2 to 18, within 14 days of diagnosis and again 8 weeks later, was assessed by the Children's and Adolescent Sleep Hygiene Scales, Childhood Cancer Fatigue Scale, and Children's Report of Sleep Patterns.
Results: 88 children (55% male; mean age = 8.5; leukemia = 62; solid tumors = 17; brain tumors = 9) have been enrolled. Subjects reported a mean bedtime the previous night of 22:26 with a mean rise time of 7:28 at baseline, and a 25 minute later mean bedtime and 5 minute earlier mean rise time 8 weeks later. Children reported a 1.26 hour mean delay in bedtime and 2.2 hour delay in rise time from weekdays to weekends at baseline with a 1.05 hour bedtime delay and 1.83 hour risetime delay at Time 2. Parental report on the CSHS ($n = 68$) indicated a mean total sleep hygiene score of 4.59 at baseline and 4.49 8 weeks later. Adolescents ($n = 14$) reported a mean total sleep hygiene score of 4.54 at baseline with relatively little change at Time 2 (mean = 4.50). Mean parent-reported fatigue at baseline was 48.28 with a mean score of 39.79 at Time 2.
Conclusion: Children reported a trend of decrease in sleep across the first 8 weeks of treatment. Parents reported a trend of decrease in fatigue from time of diagnosis to 8 weeks into treatment. These preliminary data present potential for interventions to improve sleep early in the treatment of this population.

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THE ASSOCIATION WITH DAYTIME MOOD AND THAT NIGHT'S SLEEP IN YOUTH WITH AND WITHOUT AFFECTIVE DISORDERS

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Introduction: Previous studies have demonstrated relationships between mood and sleep, however less is known about this association in children and adolescents, especially those with an affective disorder.
Methods: Participants included 128 youth (Mean age = 11.95, 58% females) with and without a current diagnosis of an Affective Disorder; 24 with an anxiety disorder, 14 with major depressive disorder, 29 with comorbid anxiety and major depressive disorder, 29 at high familial risk for depression, and 32 at low familial risk for depression. Sleep was measured via actigraphy. Mood was assessed by Ecological Momentary Assessment

daily cell phone calls during which the Positive and Negative Affect scale - Child Version (PANAS-C) was administered for 5 extended weekends.
Results: Linear Mixed Models predicting each nights sleep from that day's mood showed that increases in negative mood during the day predicted less Time in Bed (TIB) (P = .03), and less Total Sleep Time (TST) (P = .03). Increases in negative mood during the day also predicted increased time spent awake at night across all puberty levels, (P = .01). Increased positive mood during the day predicted significantly less time awake at night (P = .02) and greater Sleep Efficiency (P = .01) for all participants. Clinical status was included in all models and was unrelated.
Conclusion: The data show that positive and negative daytime mood predict aspects of that night's sleep in children and adolescents with and without a diagnosis for an Affective Disorder. Worse daytime mood is associated with less TIB and TST, more time awake, and a lower SE. These relationships exist across all participants and were not moderated by the presence of psychological distress. Results suggest that during this developmental period, mood may impact sleep above and beyond any presence of an Affective disorder.

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MATERNAL DEPRESSION AND SLEEP DISORDERS IN THE CHILD UNTIL ADOLESCENCE

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Introduction: Numerous studies have shown a link between maternal depression and sleep disorders in children. Meanwhile, it is well-known that maternal depression is a risk factor for depression in children and adolescents, classically associated with specific sleep alterations. Thus, the question arises of the nature of the link between the maternal depression and the sleep disorders in the child. Are the sleep alterations a consequence of the mood disorders of the mother, or are they the classical parallel of the depressive state in the child or adolescent himself?
Methods: Sleep recordings were conducted in 30 children aged 4 to 12 years and in 21 adolescents aged 13 to 16 years examined in the sleep laboratories in Lyon. They were not on psychotropic treatments. In the same time, mothers were interviewed by phone in order to diagnose Depression at some point in their life (DSM-IV) and to complete a mood scale of the children.
Results: Compared to controls, children with depressed mother had a smaller percentage of REM sleep. This parameter was significantly associated with the maternal depression after control of the child depressive symptoms. In addition, adolescents with depressed mother exhibited a mild reduction of REM sleep and a decrease of the total sleep time and of the sleep efficiency. The decrease of total sleep time was significantly associated with the adolescent depressive symptoms themselves.
Conclusion: Our preliminary results support the hypothesis that maternal depression is a risk factor of sleep disorders, independently of mood disorders, only in children. The sleep disorders found in adolescents seem to be related to their own depressive symptoms.

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SLEEP, SLEEPINESS, AND MOOD IN OLDER ADOLESCENTS: PRELIMINARY RESULTS FROM AN ONLINE QUESTIONNAIRE

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Introduction: Sleep and waking behaviors change significantly during adolescence. We examined sleep/wake habits, subjective sleep quality, and mood and sleepiness to assess whether sleep habits (based on weekend bedtime delay and weekend sleep increase), subjective sleep quality, and napping were associated with increased complaints of sleepiness or depressed mood.
Methods: 146 participants recruited from a large sample of students recently admitted to college (ages 17-21, mean age of 18 years, 68 males) completed online questionnaires, including adolescents sleep habits survey, Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and Center for Epidemiologic Studies Depression Scale (CES-D). Sleep habits were assessed by weekend bedtime delay (difference of reported bedtimes on school nights (SN) and non-school nights (NSN) and the weekend sleep increase (difference of reported total sleep time on SN from).
Results: Two backwards stepwise regression were performed one with ESS score as the criterion variable and a second with CES-D. For both; sex, weekend bedtime delay, weekend sleep increase, napping, and PSQI score were entered as predictor variables. Weekend bedtime delay and napping accounted for a significant amount of overall variance in sleepiness (ESS), R2 = .148, P < .001. Sex, weekend sleep increase, and PSQI score were not significant predictors. In the second regression, poor subjective sleep quality (PSQI) accounted for a significant amount of overall variance in depressed mood (CES-D), R2 = .230, P < .001. PSQI remained a significant predictor of CES-D with its mood items removed. Sex, weekend delay, weekend sleep increase, and napping were not significant predictors of CES-D.
Conclusion: Whereas the ESS sleepiness scores were influenced by delayed bedtime on weekends and napping, depressed mood was predicted only by PSQI scores indicating poor sleep quality. One interpretation of these data is that delaying sleep on weekends without increasing weekend sleep may represent a sleep pattern that results in increased daytime sleepiness; in this context, napping may represent an alternate compensatory behavior to make up for increased sleep debt. Depressed mood, however, was unrelated to these sleep habits.
Support (If Any): National Institute for Mental Health (grant R01 MH079179)

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DISCREPANCY BETWEEN COGNITIVE AND BEHAVIORAL PROFILES OF YOUNG CHILDREN WITH SLEEP-DISORDERED BREATHING

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Introduction: All severities of sleep-disordered breathing (SDB) in school-aged children have been associated with cognitive and behavioral changes. Currently, developmental profiles of preschool children with SDB are not well described. Given the high prevalence of SDB during the preschool years, a vulnerable developmental period, a clinical imperative exists to determine which children may benefit from treatment.
Methods: Sixty one children (38M; 3-5 y) referred for SDB assessment and 9 non-snoring children (5M; 3-5 y) recruited from the community were studied. The clinical sample was grouped by diagnosis following overnight polysomnography based on the obstructive apnea-hypopnea index (OAHI): primary snoring (PS; OAHI ≤ 1; n = 33), mild obstructive sleep apnea syndrome (OSAS; OAHI > 1-5; n = 15), and moderate/severe (MS) OSAS (OAHI > 5; n = 13). Intellectual function was estimated with the Stanford Binet 5 Abbreviated Battery IQ

(ABIQ) and parents completed the Child Behavior Checklist (CBCL), Behavior Rating Inventory of Executive Function Preschool Version (BRIEF-P), and Adaptive Behaviour Assessment System Second Edition (ABAS-2). One way analyses of variance with Tukey HSD post hoc tests were conducted.
Results: The MS-OSAS group had reduced ABIQ relative to both the control and PS groups ($P < .05$). Conversely, the MS-OSAS group was not behaviorally different from controls on any measure and had fewer problems than both the PS and mild OSAS groups on the BRIEF-P ($P < .05$). Children with PS and mild OSAS had more behavioral dysfunction than controls on the BRIEF-P, CBCL, and ABAS-2 ($P < .05$).
Conclusion: Parents of children with mild SDB identified behavioral disturbances in the context of relatively intact cognitive development. On the other hand, children with MS-OSAS appeared to have reduced ABIQ in the absence of problematic behaviors. These results may reflect inherent biases within clinical samples or differences between direct measures of development and parental report. Simple developmental screening relying on only one assessment approach may not adequately inform treatment decisions.
Support (If Any): National Health and Medical Research Council of Australia

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RELATIONSHIP BETWEEN SLEEP PROBLEMS AND BEHAVIOR PROBLEMS: A SURVEY USING THE CHILD AND ADOLESCENT SLEEP CHECKLIST (CASC)

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Introduction: Sleep problems are common in children, and they are known to affect emotional, cognitive and social development of children. However, difference of impact of sleep problems on behavior problems in different age groups has not been elucidated. The aim of the study was to identify the relationship between sleep problems and behavior problems among kindergartener, elementary school children, junior and senior high-school children using a questionnaire.
Methods: The study involved all school children in a local city of Japan. Child and Adolescent Sleep Checklist (CASC) and Strengths and Difficulties Questionnaires (SDQ) was given to all students of the schools and was filled out by the parents for kindergarteners, filled out by the students under teachers' instructions for elementary school children, and filled out by the students for junior and senior high school students. 3643 subjects (mean age: 10.8 SD 5.3) who responded to the questionnaire properly (response rate: 86%) were included in the analysis. Total sleep problem score and subscales (bedtime, nighttime, daytime) of CASC were used as sleep parameters. SDQ total and subscale scores were used as behavior measures. Relationship between CASC scores and SDQ scores were investigated for all subjects and also for each school age group.
Results: Subjects with elevated CASC total sleep problem score showed significantly ($P < 0.01$) disturbed SDQ total score (12.4 vs 7.1) and emotional (2.8 vs 1.3), conduct (3.0 vs 1.8), hyperactivity (4.5 vs 2.7) and peer problems (2.2 vs 2.5) subscales scores. This relationship was equally observed in all school age groups. In addition, subjects with elevated subscale scores on bedtime domain, nighttime domain or daytime domain showed significantly disturbed SDQ scores respectively.
Conclusion: Sleep problems were related to behavior problems, and the relationship was observed regardless of the age groups. Screening of both behavior and sleep problems should be helpful in making sleep intervention for children with behavior problems.

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SUBJECTIVE AND OBJECTIVE SLEEP FINDINGS AMONG SURVIVORS OF CHILDHOOD HODGKIN LYMPHOMA

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Introduction: Survivors of childhood Hodgkin Lymphoma (HL) report sleep disturbance and excessive daytime sleepiness. To better understand the impact of sleep quality upon these symptoms, we explored the association between subjective sleep assessments and 5 day sleep diary and objective actigraph data collection.
Methods: The Epworth Sleepiness Scale (EES) and Pittsburgh Sleep Quality Index (PSQI) was examined in 20 long-term adult survivors of HL, aged 37 to 52 years and greater than 10 years from diagnosis. These subjective ratings were compared to Micro-mini wrist actigraphy over 5 days within the home environment.
Results: The mean EES was 6.95 with 40% of survivors having scores of 9 or greater, suggestive of excessive daytime sleepiness. The mean PSQI was 8.1 with 55% having a score of 8 or greater, which is indicative of disturbed sleep in cancer survivors. Actigraph data was consistent with insomnia defined as decreased sleep efficiency, increased sleep latency, increased wake after sleep onset and decreased sleep time. For the 20 patients, mean sleep efficiency was 86.9% with the range 10-100% and a mean sleep latency of 41.98 minutes with a range 0-484 minutes. The mean nocturnal awakenings were 7.7 and mean wake after sleep onset was 40.38 minutes. Overall mean sleep was 6.1 hours and mean wake was 1.5 hours.
Conclusion: Survivors of childhood HL have subjective findings of increased daytime sleepiness and disrupted sleep and objective actigraph findings of increased sleep latency, decreased sleep efficiency and increased wake after sleep onset, with a sleep mean of 6.1 hours. Further study is needed for classification of the sleep disorders among HL survivors, as well as interventional study.

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SLEEP COMPLAINTS AND FATIGUE DECLINE ACROSS THE LIFESPAN: GETTING OLDER DOES NOT NECESSARILY MEAN POOR SUBJECTIVE SLEEP AND DAYTIME FATIGUE

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Introduction: It is generally believed that sleep deteriorates with age. This concept is supported by a variety of studies that show increased prevalence of insomnia in older cohorts. To further explore the age by insomnia interaction, the occurrence of sleep initiation and maintenance problems and daytime fatigue complaints were evaluated in an existing, large scale database known as the Behavioral Risk Factor Surveillance System (BRFSS).
Methods: Sleep Initiation and Maintenance Problems (SIMP) and Daytime Fatigue Complaints (DFC) were explored in 159,856 adult (age = 18-99+yrs) participants of the BRFSS. SIMP was measured with, "Over the last 2 weeks, how many days have you had difficulty falling asleep or staying asleep or sleeping too much?" DFC was measured with, "Over the last 2 weeks, how many days have you felt tired or had little energy?" Responses were dichotomized, ≥ 6 days indicating a "complaint." Outcome variables were age, general health, and depression. All analyses adjusted for race/ethnicity, income, education and healthcare access.
Results: Across all age groups, women reported more SIMP and DFC. Further, decreasing general health and mild and severe depression were associated with SIMP and DFC. In contrast, both SIMP and DFC steadily declined across the lifespan, with fewest endorsements in the oldest respondents (80+yrs). For SIMP, ORs (reference = 80+) declined from 18-54yrs, rose slightly then declined again after 59yrs in men. The pattern was similar for women, except a more marked rise was noted, from 40-59yrs. The pattern was similar for DFC.
Conclusion: Despite the confirmatory findings that sex, health, and depression predict SIMP and DFC, age was not found to be associated with the reported frequency of sleep continuity disturbance or daytime fatigue complaints. These results suggest that the age by insomnia interaction is mediated by factors other than those associated with physiologic aging.
Support (If Any): This study was supported by T32HL007713 (PI Allan I. Pack) and the Center for Sleep and Respiratory Neurobiology at the University of Pennsylvania. Data were collected and provided by the CDC.

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NON-RESTORATIVE SLEEP IS DIFFERENT IN OLDER ADULTS

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Introduction: The aging process interacts with sleep in complex ways. For example, while the prevalence of sleep-related complaints, per se, increases significantly with age, the prevalence of diagnosed insomnia does not. This suggests that the experience of non-restorative sleep in older adults may not be the same as that reported by younger adults.
Methods: The study sample was 8,937 community-dwelling individuals, aged > 18; a representative sample of the populations of California, New York and Texas. 1593 of these individuals were aged > 65. Subjects were interviewed by telephone for sleeping habits, health, sleep and mental disorders using the Sleep-EVAL system. Associations among difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS), non-restorative sleep (NRS), sleep dissatisfaction, napping, age, health status, sleep apnea, depression, anxiety and cognitive impairment were examined.
Results: Compared to individuals reporting either DIS or DMS, individuals reporting NRS were significantly ($P < .0001$) more likely to report: poor health status, sleep dissatisfaction, sleep apnea, depression, anxiety, excessive daytime sleepiness and cognitive difficulties. NRS was significantly ($P < .0001$) less prevalent in older adults, declining from 16.1% in the 18-44 yr group to 7.4% in the > 65 yr group. Compared to younger adults reporting NRS, older adults reporting NRS were significantly ($P < .0001$) less likely to report: sleep dissatisfaction, sleep apnea, depression, anxiety, or cognitive difficulties; and significantly ($P < .0001$) more likely to report napping. Associations of DIS/DMS or of NRS with Health Status and with EDS were unaffected by age.
Conclusion: The pattern of associations between NRS and the other measures of interest observed in older adults is markedly different from that of younger adults. This suggests that the experience of NRS by older adults may be considerably different from that of younger adults.
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AGE AT ONSET OF CHRONIC INSOMNIA SYMPTOMS PRESENTING IN LATER LIFE: RELATIONSHIPS WITH HEALTH AND CLINICAL OUTCOMES

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Introduction: The category "late life insomnia" combines 2 sub-groupings: those whose insomnia symptoms originated before "later life" (typically age 65), and those whose symptoms originated after age 65 (Morgan, 2008). The clinical relevance of these differential histories, however, remains unclear. Using data from a representative sample of UK older people, the present analyses examine health status, symptom remission and survival in relation to the age at onset of "late life insomnia" symptoms.
Methods: Data were provided by the Medical Research Council Cognitive Function and Ageing Study (MRC CFAS). Of 13,004 people (in their 65th year and above) randomly sampled between 1990-1994, 12,560 provided information on sleep quality, with 2481 meeting criteria for "chronic insomnia symptoms" (weighted prevalence = 19.7%) Of these 2246 providing an age at which their sleep disturbance began: 1183 (weighted prevalence = 52.7%) reported insomnia symptom onset at or before age 65, the Earlier Life Onset (ELO) group; 1298 (weighted prevalence = 47.3%) reported symptom onset after age 65, the Later Life Onset (LLO) group. Health status, 2-year remission, and 14-year mortality within the ELO and LLO groups were compared using adjusted binary and Cox regression models respectively.
Results: Estimated ages at symptom onset ranged from < 25 to > 65. After adjustment, ELO was associated with younger age, being female, lower social class, lower levels of disability, and a > 2-fold increased odds of receiving hypnotic drugs (all $P < 0.01$). However, 2-year symptom remission (OR = 1.75, 95% CI = 1.35-2.27; $P < 0.001$) and 14-year (age adjusted) mortality (HR = 1.16, 95% CI = 1.04-1.30; $P = 0.009$) were significantly elevated in the LLO group.
Conclusion: ELO and LLO insomnia symptoms show clear differential associations with health status, insomnia treatment approaches, and clinical outcomes. LLO insomnia symptoms appear to more closely linked

with disease-related remissions and fatalities. ELO insomnia symptoms, comprising > 50% of all "late life" insomnia symptoms in this study, are more intractable, and more likely to result in hypnotic use, but are less linked to health status. While these differences should be recognised at assessment in older age, the data indicate that effective treatments in earlier adult life could substantially reduce levels of "late life insomnia".

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DEPRESSIVE SYMPTOMS AND SUBJECTIVE AND OBJECTIVE DISTURBANCES IN SLEEP IN COMMUNITY-DWELLING OLDER WOMEN

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Introduction: Depression and poor sleep are common complaints in older adults and are related in a complex, bidirectional manner. However, little is known about the relationship between objectively measured sleep disturbances and depression in older adults. We examined the relationship between depressive symptoms and subjective and objective sleep in community-dwelling older women.

Methods: We cross-sectionally studied 3045 women ages 70 and older, who were enrolled in a larger ongoing, prospective study. Depressive symptoms were assessed with the Geriatric Depression Scale categorizing participants as normal (0-2), some depressive symptoms (3-5), or depressed (≥ 6). Subjective sleep was assessed with the Pittsburgh Sleep Quality Index (PSQI). Objective sleep was assessed with wrist actigraphy. Sleep measures were expressed as continuous variables using linear regression. The least-squared means strategy was used to estimate means by depression level. Sleep variables were also expressed as dichotomous outcomes and association with depression level tested using logistic regression. Results were adjusted for multiple potential confounders.

Results: There was a strong association between poor subjective sleep quality and level of depressive symptoms ($P < 0.001$): women with some depressive symptoms (OR 2.01, CI 1.69-2.4) and depressed women (OR 3.36, CI 2.61-4.32) were at increased risk for reporting poor sleep (PSQI ≥ 5). Objective measurements revealed an association between depressive symptoms and time awake after sleep onset (WASO) ($P = 0.03$) and number of long-wake episodes (> 5 min) ($P = 0.006$). Women with some depressive symptoms (OR 1.45, CI 1.22-1.73) and depressed women (OR 1.73, CI 1.36-2.19) were at increased risk for having WASO ≥ 1 hour. Women with some depressive symptoms (OR 1.55, CI 1.29-1.86) and depressed women (OR 1.84, CI 1.45-2.33) were at increased risk for having ≥ 8 long-wake episodes. In contrast, we did not find an independent association between level of depressive symptoms and prolonged sleep latency, reduced sleep efficiency, or reduced total sleep time.

Conclusion: These data show a strong association between level of depressive symptoms and subjective sleep disturbance in community-dwelling older women. Level of depression may specifically be associated with difficulty staying asleep and increased sleep fragmentation.

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SLEEP DISCREPANCY AND ITS CORRELATES AMONG OLDER ADULTS

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Introduction: Discrepancy between subjective and objective measures of sleep increases with age and is associated with higher rates of late-life insomnia. The cause of age related sleep discrepancy (SD) is unclear, but as a potential mechanism of late-life insomnia, the consequences may be profound. Even occasional SD can be problematic when self-reported sleep onset latency (SOL) and wake after sleep onset (WASO) far exceed objective measurements of these events. This type of discrepancy (sometimes called sleep misperception), may contribute to negative evaluations of overall sleep and lead to protective behaviors that further disrupt sleep. Variables associated with SD in younger samples include caffeine consumption, bedtime, daytime sleepiness, depression, sleep complaint, and gender. The purpose of this study was to determine how these variables relate to SD in older adults.

Methods: 103 community dwelling older adults, *M*age = 72.81(0.70), wore an Actiwatch-L®(24hrs/day/2weeks) and concurrently completed sleep diaries. Daily values for actigraphically-measured SOL and WASO were subtracted from respective diary reports to calculate daily SD for SOL and WASO. Predictor variables were gender, sleep complaint status, caffeine consumption, bedtime, number of medical conditions, Epworth Sleepiness Scale score, and Beck Depression Inventory®-II score.

Results: Multilevel modeling (MLM) revealed that 1) SD decreased across 14 days, 2) earlier bedtime, female gender, and depression predicted greater SOL_{sd}, and 3) caffeine consumption, daytime sleepiness, sleep complaint, and depression predicted greater $WASO_{sd}$. Predictors explained 28% and 62% of the between-person variance in SOL_{sd} and $WASO_{sd}$, respectively.

Conclusion: Extending research findings from younger adult samples, this is the first study to model SD among older adults. By investigating SOL_{sd} and $WASO_{sd}$ separately, a more focused picture was obtained. Among older adults, SOL_{sd} and $WASO_{sd}$ may have distinct predictors and consequences. Because the causal role of these predictors in relationship to SD has yet to be explained, further research is warranted.

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SLEEP DISRUPTION AMONG AGING ADULTS IN THE HEALTH AND RETIREMENT STUDY

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Introduction: The purpose of this cross-sectional analysis was to examine the effect of sleep disruption on behavior in a population-based sample of aging adults using data from the 2004 wave (N = 20,129) of the longitudinal Health and Retirement Study (HRS).

Methods: The HRS is a biannual survey of community-dwelling aging adults born in the US between 1923-1953. Subjects are stratified by date of birth to provide five cohorts of aging elderly. In 2004, the Psychosocial Participant Lifestyle Questionnaire was given to a random sample of elders (n = 1,439; 52.5% male; 91.5% White; 5.2% Black; Response Rate 76.8%). A measure of sleep disruption was computed using responses to four items and compared to potentially sleep sensitive

behavioral outcomes (cynical hostility, optimism, pessimism and social integration) included in the Questionnaire.
Results: After controlling for sociodemographic variables (age, sex, race, marital status, comorbidities, education, and income) sleep disruption independently predicted social integration ($t = 2.135$, $P < .0001$), pessimism ($t = 3.995$, $P < .0001$), cynical hostility ($t = 3.854$, $P < .0001$), and negatively predicted optimism ($t = -4.876$, $P < .0001$). The oldest cohort (ages 80-91 years) had no greater sleep disruption than youngest cohort (ages 51-56 years) ($\chi 2 = 1.234$, $P = .872$), although 59% of the oldest-old subset reported frequent awakenings. Women reported more sleep disruption than men ($t = 3.270$, $P < .001$), even though many subjects reported frequent awakenings (Men = 58%; Women = 68%). Married participants reported more sleep disruption than divorced or widowed participants ($t = 2.161$, $P = .03$). Blacks had no greater sleep disruption than Whites ($t = .812$, $P = .417$). Higher education was the most influential SES predictor for sleep disruption ($F = 15.309$, $P < .0001$), and income did not independently predict sleep disruption ($t = 1.297$, $P = .195$).
Conclusion: When controlling for sociodemographic factors and having a balanced sample by sex, sleep disruption predicted negative behavioral outcomes in aging adults. Future research will examine the impact of sleep disruption in chronic disease measures and mortality in latter waves of data from the HRS.

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PHYSICAL ACTIVITY, SLEEP DURATION, AND BODY WEIGHT IN POSTMENOPAUSAL WOMEN: THE WOMEN'S HEALTH INITIATIVE STUDY

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Introduction: The post-menopausal status marks a period with high levels of sleep disturbance. Both short sleep duration and long sleep duration appear to have an adverse effect on several hormonal and metabolic parameters affecting body weight. Moderate intensity, regular physical activity (PA) is associated with more sleep of deeper quality and decreased sleep onset latency. Thus, physical activity may play an important explanatory role in understanding the relationship between sleep duration and body weight. To delineate the role of physical activity levels on sleep duration, anthropometric measurements (body weight, body mass index, waist-hip-ratio), and blood pressure, we examined the Women's Health Initiative's Observational Study (WHI OS) to determine if higher levels of PA are associate with greater sleep duration, lower anthropometrics, and decreased blood pressure.
Methods: We conducted a prospective study on 65,478 older women (aged 50-79 years) to investigate the relationship between physical activity levels, sleep duration (hours/night), and anthropometric measurements. Linear regression models were used to investigate putative associations, adjusting for age, sociodemographic and lifestyle factors, and depression.
Results: Results indicated higher levels of sleep duration and PA were independently associated with lower levels of body weight, body mass index, waist-to-hip ratios, and blood pressure ($P < 0.001$) up to 9 h of sleep per night. Among women with the least amount of PA (< 500 MET-mins/wk), systolic blood pressure decreased linearly with increasing sleep compared to women with the most PA (≥ 1200) where systolic blood pressure increased linearly with sleep ($P = 0.05$ for interaction). Similar interactions were not observed for the other anthropometric measurements.
Conclusion: The presented results demonstrated that increased PA and sleep duration are independently associated with decreased anthropometric measurements until sleep duration exceeds 9h; the association between systolic blood pressure and PA is modified by hours of sleep.

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EXERCISE BEHAVIOR PREDICTS DAILY SELF-REPORTED SLEEP IN COMMUNITY-DWELLING ELDERS

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Introduction: Exercise and sleep are both important health behaviors in older adults. Unfortunately, both exercise and sleep show significant age-related declines in their frequency, intensity, duration, and quality. However, while there are 'normal' age-related changes in both exercise and sleep, these changes do not appear resistant to efforts for remediation. The objective of the current investigation was to examine the relationship between daytime physical exercise and nocturnal self-reported sleep in a community-dwelling sample older adults (i.e., 50 years of age and older) at both the between-persons (mean-level) and within-persons (day-to-day variability) levels of association.
Methods: The study assessed home-based self-reports of exercise (via leisure-time exercise questionnaire) and sleep (via sleep diary) daily for 18 consecutive weeks (128 days) through a prospective cohort design. Participants included 82 community-dwelling, initially sedentary older adults ($M_{age} = 63.37$ years, $SD_{age} = 8.58$ years, range = 50-87 years).
Results: Separate multilevel models predicting sleep onset latency, wake time after sleep onset, and sleep quality rating revealed several findings: (1) older individuals who reported less exercise (on average) also reported having more than average amounts of wake time after sleep onset [$\beta = -0.36$, $t(68.09) = -2.76$, $P < 0.01$], and (2) following a day of above-average exercise older individuals experienced above-average sleep quality [$\beta = 0.06$, $t(31.79) = 2.18$, $P < .05$]. Exercise was not related to sleep onset latency.
Conclusion: Exercise may improve the subjective experience of sleep in elderly individuals, as exercise and sleep appear to covary over time (although the causal direction is not yet established). Future research can investigate potential mechanisms by which exercise could improve sleep (e.g., light exposure, temperature regulation, circadian alterations, mood), and whether such mechanisms predict both the chronic (or between-persons) and acute (or within-persons) associations between exercise and sleep in elderly individuals.
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LONGITUDINAL STUDY OF SLEEP QUALITY AND HEALTH IN COMMUNITY-DWELLING ADULTS 50 YEARS AND OLDER

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Introduction: Disrupted sleep, a common condition of older adults, is associated with anxiety, depression, poor self-rated health, and functional decline. Few studies have examined these relationships using objective measures of sleep over time. The aim of this investigation was to examine longitudinal relationships between sleep quality, mea-

sured by polysomnography, and selected health variables (subjective health, number of illnesses, anxiety, depression) in community-dwelling adults.
Methods: Data were from 321 adults (56% male), 50 - 71 years of age, enrolled in the WI Sleep Cohort Study, a population-based longitudinal study of sleep disorders. Subjects with data at three or more time points were utilized (1989-2009). Growth curve and growth mixture modeling were used to examine changes in sleep over time and whether declines in health predicted such changes.
Results: Overall, adults experienced significant decreases in total sleep time, sleep latency, and REM, and increases in sleep latency and wake after sleep onset with age. Declines in sleep quality fell into distinctly different patterns. For example, changes in sleep efficiency fell into three patterns: "normal" [M = 86%, β = -0.43 percent per 4 years, n = 253]; "declining" [M = 82%, β = -1.9, n = 58]; and "poor" [M = 66%, β = 0.71, n = 34]. Declines in physical health did not predict declines in sleep quality over time. However, baseline anxiety and depression predicted declines in total sleep time (β = -0.11 hours per 4 years, SE = 0.05; P = .02; β = -0.11, SE = 0.05, P = .02 respectively).
Conclusion: Overall community-dwelling adults experience declines in sleep quality with aging but different patterns of change occur in different measures of sleep quality. Baseline anxiety and depression predicted declines in sleep quantity.
Support (If Any): This research was supported by NIH grants R01HL62252, R01AG14124, and 1UL1RR025011.

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AGE RELATED CHANGES IN OBJECTIVELY MEASURED SLEEP OBSERVED IN A LARGE POPULATION IN THE HOME

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Introduction: The effects of age on objectively measured sleep patterns have been previously reported. These reports are mostly based on data obtained using polysomnography (PSG) in the laboratory setting. This study sought to examine the effects of age on sleep measured in subjects' homes over one or more nights.
Methods: The DOZER sleep registry is an IRB approved research database of objectively measured sleep in the home. Its participants purchase and use the Zeo Personal Sleep Coach, a new instrument that uses a fabric headband to comfortably measure their sleep in their homes, and does not require the assistance of a technician. Participants use the instrument and upload data to the registry as they see fit. Measures include Total Sleep Time (TST), Time in Deep sleep (stages 3 and 4), Time in REM, and wake time during sleep (WTDS). Subjects who contributed more than one night to the registry had their nights averaged for the analysis. Linear regressions were conducted, and the slope (b) of the best fit line was computed for changes with age.
Results: 1746 subjects (ages 17 to 84, 23% female) contributed 42,450 nights of data to the analysis. Several measures varied significantly with age (all P < 0.001), including TST (b = -6.55 min/decade), Deep (-7.55), REM (-3.13), and WTDS (7.32).
Conclusion: Age related changes in sleep as measured non-intrusively in the home are consistent with prior findings of age related changes in sleep measured in the laboratory. These findings may have important implications for our understanding of objective sleep in the home.
Support (If Any): Support for this study provided by Zeo, Inc.

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FIVE YEAR CHANGE IN ACTIGRAPHY DEFINED SLEEP IN A COHORT OF OLDER WOMEN

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Introduction: Difficulty sleeping is common with advancing age. Medical conditions, disability, and cognitive impairment are also common in older adults and are linked to poor sleep quality. Few studies have investigated the association between longitudinal changes in sleep and health outcomes. We examined 5-year changes in sleep and predictors of worsening sleep using actigraphy data collected at two time points.
Methods: 829 women in the Study of Osteoporotic Factures (SOF) study (mean age 82.5 ± 3.0y at baseline) wore wrist actigraphs for a minimum of 72-hours in 2002-2004 and in 2007-2008. Sleep parameters included total sleep time (TST), sleep efficiency (SE), wake after sleep onset (WASO), and sleep onset latency (SOL). Worsening sleep was defined as: increase of 20+ minutes for WASO and SOL; decrease of 5%+ for SE and 30+ minutes for TST. Multivariate-adjusted logistic regression estimated the odds of worsening sleep associated with health status, cognition, medication use, lifestyle factors, disability, and physical performance.
Results: On average, sleep parameters remained stable over 5.0 ± 0.6 years of follow-up. Women with poor sleep at the baseline tended to improve, while those with good sleep tended to worsen. Worsening sleep based on changes in TST, WASO, SOL, and SE occurred in 20.2%, 30.4%, 13.5%, and 21.7% of women, respectively. For all outcomes, women with ≥ 1 medical condition (odds ratio [OR] range 1.38 - 1.53) and those with poor self-rated health (OR range 1.18 - 5.39) had significantly higher odds of worsening sleep. Other factors studied were not consistently associated with changes in sleep.
Conclusion: While sleep remained stable in most women, a subset experienced worsening sleep during 5-years follow-up. When compared to women with stable sleep, those whose sleep worsened had poorer health status, as measured by medical morbidities and self-rated health. More longitudinal studies are needed to understand how sleep changes across the lifespan.
Support (If Any): This research was supported by National Institutes of Health grants AG05407, AR35582, AG05394, AR35584, AR35583, AG08415

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SLEEP DISORDERS IN MENOPAUSE: PRELIMINARY DATA FROM SICILY IN A MULTICENTER ITALIAN STUDY

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Introduction: Menopause in the female life cycle is a special period due to important hormonal, physical and phychological changes. Sleep is altered in 30% to 50% of this population, the most common causes being hot flashes, mood and sleep related breathing disorders (SRBD). We aimed at evaluating the prevalence, symptoms, risk factors and comorbidity of sleep disorders in a population of working women employed in two main Sicilian hospitals.
Methods: Questionnaires were sent out to all employed women, age 45-55. Subjects filling correctly the questionnaire were enrolled in our

study. Questions included screening on menarche, menstrual cycle, fertility, parity, and menopause, life habits, personal medical and sleep history and related treatment. Self-administered scales evaluated: sleep quality (PSQI), excessive daytime sleepiness (EDS) by the Epworth Sleepiness Scale (ESS), Beck Depression Inventory (BDI), Hamilton Anxiety Rating Scale (HARS), quality of life (SF-36 2v), IRLS diagnostic interview and Rating Scale. Uni and multivariate analysis were applied.

Results: Only 12 women out of 1000 probands completed their questionnaire. Mean age was 50.4 years, mean BMI 25.06, mean parity index 2.8; 37.6% menopausal. Migraine, hypertension, cardiac or thyroid disorders respectively in 57.6%, 16.5%, 2.8%, 8.3%; HRT in 16.9%. 22.8% reported snoring, 16.7% apneas, 2.8% sleepwalking, 28.2% periodic leg movements during sleep. 59.2% reported impaired sleep quality, 11% EDS (ESS $\geq$ 10), 14.1% RLS symptoms with a mean IRLS-RS 16.2. BDI indicated a mood alteration in 35.8%. Unfortunately answers on hot flashes occurrence were incomplete and not suitable for statistical evaluation. Multivariate analysis showed a positive correlation of BDI score with hypertension (P = 0.005, OR 1.1) and RLS (P = 0.001, OR 1.1).

Conclusion: Our preliminary data indicated insufficient awareness/education and/or stigmata about hot flashes and relatively high rate of SRBD and RLS, the latter significantly associated with depression and hypertension.

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SLEEP DURATION AND QUALITY IN ELDERS AND ITS RELATIONSHIP WITH HEALTH STATUS

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Introduction: Sleep has a large impact on the quality of life in elders. Previously, studies have associated both short and long sleep durations with the development of diabetes, cardiovascular disease, increased infection vulnerability, cognitive decline and chronic fatigue, but to date the role of sleep in the elderly is poorly understood. We aimed to test the hypothesis that sleep quality and duration in elders is associated with health by assessing differences across short, average and long sleepers.

Methods: Both "healthy" (n = 122) and "non-healthy" (n = 30) adults aged 65-95y (mean age 80 ± 6.5 years, 114 Females: 40 males) from the Birmingham Elders Group completed a 7-day sleep diary, the Pittsburgh Sleep Quality Index (PSQI) and the Horne-Ostberg Questionnaire (HO).

Results: Both short sleepers (< 7 hours) and long sleepers (> 8hours) were more likely to be in the non-healthy category compared to average sleepers (7-8 hours) who were more likely to be healthy (P < 0.0001). As well as this, younger elders (60-80 years) were more likely to be healthy and less likely to nap in the day (P < 0.0001) compared to older elders (81-95 Years) who were more likely to nap in the day and use both sleep modifying and prescribed medication (P < 0.0001). There was no significant relationship between the number of times awake in the night when comparing healthy with non-healthy participants (P > 0.05). Both healthy and non-healthy elders reported waking up to 3 times a night (76.9%).

Conclusion: Although sleep quality in elders was not found to be associated with health status, adequate sleep duration was shown to be associated with positive health status showing that average sleepers are more likely to report a better quality of life than both short and long sleepers. Finally these findings show that old age is associated with increased napping and medication use.

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RELATIONSHIP BETWEEN SLOW WAVE ACTIVITY IN NON-REM SLEEP AND COGNITIVE PERFORMANCE IN OLDER ADULTS

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Introduction: There is evidence for an association between higher slow wave activity (SWA) in the first half of the night of sleep with better reaction time and working memory (WM) in young adults. Since the amount and temporal distribution of SWA during sleep changes with age, we sought to determine the relationship between SWA and its distribution with cognitive performance in older adults.

Methods: Twenty-one older adults (mean 65y/o SD 5.61) were recruited. Each participant underwent 3 nights of standard nocturnal polysomnographic monitoring. Starting 2 hours after awakening, participants were given the continuous performance WM task, Sternberg 6 WM task, and simple reaction time (SRT) paradigm, every 2 hours for 12 hours. Performance measures were averaged at each of the 6 time points and were compared with total SWA (defined as non-REM absolute power in the 0.75 to 4.0-Hz frequency band) from the second night, and SWA distribution for the first three non-REM/REM cycles using a partial correlation controlling for age. PRANA software was used for quantitative EEG analysis.

Results: There was a significant negative correlation for WM tasks and a positive correlation for SRT performance with total SWA (r = -.444, P = .030;r = -.442, P = .030;r = .581, P = 0.004). There was no significant relationship between SWA and performance in the first two cycles. Higher absolute SWA power in the third cycle negatively correlated with WM (r = -.513, P = 0.01;r.-431, P = 0.04) and positively with SRT (r = .496, P = 0.014). A smaller decrease in SWA from the second to third cycle was associated with worse performance on WM (r = .474;p = .022;r = .482, P = 0.02) and SRT (r = -.367, P = 0.07).

Conclusion: In older adults, the level of SWA in the first 2 cycles of sleep was not correlated with performance. Higher SWA in the third cycle of non-REM sleep was associated with poorer performance on WM and SRT performance. It is possible that changes in the distribution of SWA in older age contribute to neurocognitive function.

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CAN THE ONSET OF DEPENDENCY IN ACTIVITIES OF DAILY LIVING (ADLs) BE DELAYED IN COGNITIVELY IMPAIRED OLDER ADULTS WITH SHORT TOTAL SLEEP TIME?

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Introduction: Nocturnal sleep in cognitively impaired nursing home residents is frequently short. Short sleep time in healthy adults impairs waking cognitive and motor function and accordingly may hasten onset of ADL dependency in cognitively impaired older adults. Social activity and exercise (walking/high-intensity resistance training) improves older adults' cognitive and motor functioning. However, it is unknown whether social activity and/or exercise will improve cognitively impaired nursing home residents' ability to complete ADLs. Therefore, this study examined the effect of 7-weeks of social activity, exercise, and combined social activity/exercise compared to usual care on ability to complete ADLs in cognitively impaired nursing home residents.

Methods: A secondary data analysis was conducted on a subset of thirty-two participants (mean age 80.28 + 9.35 years; 16 women; mean TST = 4.8 hours, SD + 2) from "Effect of Activities and Exercise on Sleep in Dementia" (R01 NR7771). Participants were randomized to social activity (n = 8), exercise (n = 9), social activity/exercise (n = 6), usual care (n = 8). The Nursing Home Physical Performance Test (performance test) and actigraphy measured outcomes at baseline and post-intervention.
Results: ANOVA revealed no statistically significant change in ability to complete ADLs. However, compared to baseline, the mean performance test score in the exercise group increased by .89 (+4.0) and by .50 (+3.1) in the social activity/exercise group, whereas, the usual care group decreased by .25 (+ 2.1). Mean total sleep time increased 24 minutes and 20 minutes in the exercise and social activity/exercise groups, respectively, while the usual care group mean decreased by 6 minutes.
Conclusion: Since a > 0.5 point change in the performance test indicates a clinically meaningful change, our findings indicate that exercise alone and exercise combined with social activity may improve ADL function and sleep. Further research is needed to investigate the relationships among exercise, function, and sleep in older adults with cognitive impairment.
Support (If Any): 5R01NR7771 (KR) T32NR009356 (RL)

1048

EXERCISE REDUCES APNEA-HYPOPNEA INDEX IN COGNITIVELY IMPAIRED OLDER ADULTS

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Introduction: In this study, we evaluated the effect of exercise (high intensity physical resistance strength training and walking) on the apnea-hypopnea index (AHI) in institutionalized older adults.
Methods: As a part of a randomized controlled trial, 97 institutionalized older adults (81.82 y; 52 F; Mini-Mental State Examination [MMSE] score = 20.44, SD = 6.97) received 7 weeks of high intensity strength training to the arm and hip extensors 3 days a week, and 2 days a week they walked with a research assistant for up to 60 minutes. Of the 35 possible intervention days the mean attendance was 29 days (SD = 7.2), 81% attendance. Muscle strength improved 107.69% for the arm extensors and 92.84% for the leg extensors. The control group (n = 47; 82.34 y; 30F; MMSE score = 20.34) did not receive any intervention and participated in the usual activities of nursing homes and assisted living centers. Two nights of polysomnography data were averaged at baseline and at post-intervention to obtain the AHI.
Results: ANCOVA, with the baseline AHI as covariate, showed a significant decrease in AHI for the exercise group relative to the control group (P = .04). Adjusted means showed a decrease in AHI from 20.22 (SE = 1.385) to 16.72 (SE = .964). Correlation of change in AHI with change in muscle strength was nonsignificant (arm extensors, r = .15; hip extensors, r = .18).
Conclusion: Strength training and walking improved the AHI in older adults. A potential mechanism is strengthening of the pharyngeal and glossal muscles during training.
Support (If Any): R01-007771 (Richards, PI)

1049

EXERCISE AS AN INTERVENTION TO ENHANCE SLEEP AND REDUCE FATIGUE IN WOMEN

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Introduction: Women have been studied in fewer intervention sleep studies, however, women report poorer sleep and more fatigue than men (Singh et al., 1997; Ceolim & Menna-Barreto, 2000; Li et al., 2004). Feelings of fatigue and energy have been shown to be associated with health and quality of life (O'Connor & Puetz, 2005). The purpose of this study was to test a 12-week exercise intervention and its effects on the sleep and fatigue of women, over 50 years of age.
Methods: After IRB approval, a convenience sample of 15 healthy community-dwelling women began an exercise routine. This study involved a 12-week exercise routine for at least 3 days each week that was at least 30 minutes in total time. Exercise was self-recorded daily in a diary. Sleep was measured by the Pittsburgh Sleep Quality Index (PSQI) and actigraphy. Fatigue was assessed by using the Visual Analog Scale for Fatigue. Sleep and fatigue were measured at baseline, 4th, 8th, and 12th week. Actigraphs were worn for 48 continuous hours at baseline and at the end of each of the 4-week intervals.
Results: Repeated Measures Analysis of Variance demonstrated no significant differences for sleep efficiency, sleep quality and levels of fatigue at the 4 measurement time periods. Mean sleep hours were 6.2, 6.7, 6.6 and 6.8 for the four respective measurements. Also, Pearson's Correlation Coefficient confirmed no significant relationship regarding the amount of exercise to self-reported sleep quality, sleep quantity and levels of fatigue.
Conclusion: Graphing the data resulting from this small sample shows that the trends are in a desirable direction. This study should be repeated with a larger sample size.
Support (If Any): This study was partially funded by Minnesota State University, Mankato by a Faculty Research Grant and Faculty Incentive Grant.

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DOSE-RESPONSE EFFECTS OF A 6-MONTH EXERCISE TRAINING PROGRAM ON THE SUBJECTIVE SLEEP QUALITY OF POSTMENOPAUSAL WOMEN

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Introduction: Although it is commonly assumed that exercise improves sleep quality, experimental studies have found only modest support for this assumption. The purpose of this study was to investigate whether a dose-response relationship exists between exercise and subjective sleep quality in a sample of sedentary postmenopausal women.
Methods: In a 6-month supervised intervention, 443 sedentary postmenopausal women were randomized to a non-exercise control treatment (n = 96) or one of three exercise dosages, designed to meet 50% (n = 151), 100% (n = 100), or 150% (n = 96) of NIH Consensus Development Panel physical activity recommendations. Dosages were structured to elicit energy expenditures of 0, 4, 8 or 12 kilocalories per kilogram of body weight per week (KKW), respectively. Training intensity was 50% of VO2peak. Sleep quality was assessed with six items from the Medical Outcomes Study Sleep Scale (MOS-S). Sleep Disturbance and Daytime Somnolence subscales and a Sleep Problems Index were calculated. Analysis of covariance on subscale change scores, with adjustment for age, BMI, sleep medication use, and baseline score, was used to examine differences among treatments. Dose-response effects were assessed using linear regression.
Results: Significant treatment effects were found for each MOS-S scale (P < 0.01), though only the 12-KKW group improved significantly more than the control group on each subscale (P < 0.05). Effect size differences between the control and 12-KKW groups were small (d = 0.3-0.4), with the 12-KKW group improving by only ~5 points more than control on each 100-point scale. A dose-response effect was found for the Sleep Disturbance subscale (P = 0.03) and Sleep Problems Index

(P = 0.02), but not for Daytime Somnolence (P = 0.08). Correlations between changes in sleep quality and aerobic fitness were not significant (each r < 0.10).
Conclusion: Exercise training induced significant, albeit modest, and dose-dependent improvements in subjective sleep quality in postmenopausal women. However, sleep quality improvements were not dependent upon changes in aerobic fitness.
Support (If Any): The study was supported by NIH grant HL66262.

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EXECUTIVE IMPAIRMENT AND GLOBAL COGNITIVE FUNCTION ARE ASSOCIATED WITH DECREASED SLEEP EFFICIENCY BUT NOT SLEEP-RELATED BREATHING EVENTS IN PATIENTS SEEN AT VA MEMORY CLINIC

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Introduction: Obstructive sleep apnea (OSA) has been associated with impaired executive function when evaluated using Digit Span, Trail Making test, Stroop color word test, Wisconsin Card Sorting, and others. CLOX1 scores are also a reliable marker of executive function that are easier to collect and score.
Methods: Retrospective review of 411 charts from memory clinic at the South Texas VA hospital revealed 40 patients who had undergone polysomnography and were included in analysis. Statistical analysis was performed using STATA, release 11. CLOX based dementia types were generated according to the criteria outlined in Royall 2004.
Results: Means (S.D.) for the sample are as follows: age 69.7 (8.5), AHI 34.3 (29), Sleep efficiency 64.2 (20.8), BMI 33.6 (7.9). Pairwise correlations found a statistically significant relationship between sleep efficiency (SE) and CLOX1 scores (R = 0.42, P = 0.01), CLOX2 scores (R = 0.34, P = 0.05), MMSE scores (R = 0.44, P < 0.01), and BMI (-0.35, P = 0.01). Linear regression of cognitive testing controlling for age revealed significant associations between SE and CLOX1 (P = 0.04) and MMSE (P = 0.03) scores. When controlling for BMI, SE showed a significant association with MMSE (P = 0.01) but not with CLOX1 (P = 0.06). The association between MMSE and SE was also present when controlling for BMI and age (P = 0.04). BMI, AHI, or O2 nadir did not show any significant relationships with CLOX1, CLOX2, MMSE, or CLOX types.
Conclusion: Global impairment in cognitive function (tested with MMSE score) is significantly associated with sleep efficiency despite age or BMI. Executive impairment (tested with the clock-drawing test) is associated with poor sleep efficiency when controlling for age but not BMI. In our patient population, sleep related breathing events were not associated with a decline in cognitive function.

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SLEEP/WAKE PATTERNS IN MILD COGNITIVE IMPAIRMENT: A PRELIMINARY STUDY OF SLEEP DISTURBANCE IN TRANSITIONAL COGNITIVE DECLINE

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Introduction: Extensive research has analyzed sleep disturbance in dementia patients, but few studies have focused on sleep/wake patterns in mild cognitive impairment (MCI), a transitional stage of cognitive decline between normal aging and dementia. This preliminary study addressed whether disturbed sleep/wake rhythms are present in MCI, and whether sleep patterns in MCI are distinguishable from those of normal aging or dementia.
Methods: Based on clinical data and performances on a neuropsychological testing battery, 25 older adult participants were separated into three demographically-matched groups: healthy older adults (OA), individuals with MCI, and individuals with Alzheimer's disease (AD). Participants wore wrist activity monitors for seven consecutive days. Actigraph data was analyzed for patterns in quantitative sleep measures.
Results: Compared to the OA group, the AD group exhibited a shorter latency to fall asleep, greater percentage of time spent asleep during 24-hour intervals, and more time awake after sleep onset. With the exception of total wake minutes, which revealed that the MCI group was awake less than the OA group (P = .017), the MCI group did not significantly differ from either of the other groups on any sleep measures. While this may suggest transitional stage sleep disturbance between normal aging and dementia, analysis of individual participant data revealed only a small subset of MCI participants whose scores significantly deviated from those of the healthy OAs.
Conclusion: Presence of disturbed sleep/wake patterns in AD participants is consistent with prior research findings. We found that a small subset of MCI participants (N = 2) demonstrated sleep/wake rhythms more similar to the AD group, while the remainder of MCI participants (N = 6) showed sleep/wake patterns more consistent with healthy OAs. Further longitudinal research is required to determine whether trends of recognizable sleep disturbance in MCI can identify individuals with a greater risk for progression to dementia.
Support (If Any): Life Sciences Discovery Fund (LSDF) of Washington State

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VISION PROBLEMS AND INSOMNIA SYPMTOMS AMONG OLDER RUSSIANS

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Introduction: This study ascertained associations between self-reported vision problems and insomnia symptoms in a community-based sample of older Russians.
Methods: A total of 307 community-residing older Russians (ages: 50-95 years, mean = 72.64 ± 9.62; women = 54% and men = 46%) participated in the study. Surveys were conducted in a semi-structured environment as part of a study assessing health-care needs and physical health characteristics in that population. Bilingual community outreach educators administered surveys in various community centers, enlisting representative Russian aggregates. Measures for the present analysis included demographic and health-related data. Respondents received $20 for their participation. Data were coded and entered in SPSS 15.0 for analysis.
Results: Eighty-nine percent of the volunteers had at least a High School degree; 27% were married and 73% were single, divorced, or separated. Forty-one percent lived alone, whereas 59% lived either with a spouse, their children, a family member, or a friend. Overall, 93% reported at least one of several major health problems: vision (48%), hearing (26%), breathing (13%), hypertension (53%), snoring (28%), diabetes (26%), arthritis (53%), cancer (11%), weight problems (34%), and depression (43%). Sixty-two percent reported insomnia symptoms, defined as difficulty initiating sleep, difficulty maintaining sleep, or early morning awakenings. Logistic regression analysis showed that individuals with vision problems were nearly three times as likely than those without to report insomnia symptoms [OR = 2.73, P < 0.01; 95% CI = 1.68-4.48].

Adjusting for the presence of social isolation and depressed moods reduced the odds [OR = 2.00, P < 0.01; 95% CI = 1.15-3.49].
Conclusion: Older Russians in Central Brooklyn have a higher prevalence of vision problems and insomnia than observed in the general US population. Older Russians with vision problems have twice the odds of reporting insomnia independently of depression and social isolation, two common problems affecting quality of life in that population.

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RATES AND RISK FACTORS FOR INSOMNIA AMONG OLDER PATIENTS UNDERGOING REHABILITATION

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Introduction: Insomnia is a significant clinical problem among older adults with medical comorbidities, and insomnia can contribute to functional decline and elevated mortality risk. This study examined factors related to insomnia [based on International Classification of Sleep Disorders (ICSD) diagnostic criteria] among older adults recovering from acute health events in a post-acute rehabilitation setting.
Methods: 260 older veterans [mean (SD) age = 72 (9) years, 97% male, 58% non-Hispanic white] admitted to inpatient post-acute rehabilitation wards at a Veterans Administration Medical Center completed a questionnaire addressing ICSD diagnostic criteria for insomnia. Data collected included demographics, Medical Outcomes Study SF-12 (to assess quality of life), Pittsburgh Sleep Quality Index (PSQI), Multidimensional Fatigue Inventory Scale (MFSI), Global Vigor and Affect Instrument (GVA), Mini-Mental State Exam (MMSE), Geriatric Pain Measure (GPM), and Cumulative Illness Rating Scale for Geriatrics (CIRS-G, to assess comorbidity). T-tests were used to compare those with/without insomnia on demographic and clinical measures. Variables differing between groups were entered into a logistic regression model predicting insomnia.
Results: 93 (35.6%) of 260 participants met ICSD diagnostic criteria for insomnia. 60 (23.1%) and 35 (13.5%) reported insomnia lasting > 1 month and > 1 year, respectively. Those with insomnia had worse quality of life (SF-12 Physical Component; P = .017), more pre-illness sleep disturbance (PSQI; P = .017), less vigor (GVA; P = .033), and more fatigue (MFSI; P = .048). In a logistic regression model (W = 7.57; P = .006) adjusting for age, gender and ethnicity, only higher SF-12 physical component (P = .005) and higher pre-illness PSQI (P = .045) scores predicted higher insomnia risk.
Conclusion: Insomnia is a common problem among older patients undergoing inpatient rehabilitation. Worse quality of life and greater pre-illness sleep disturbance identifies older adults who are at particular risk for meeting diagnostic criteria for insomnia during rehabilitation. These findings may help target insomnia interventions for older adults undergoing inpatient rehabilitation.
Support (If Any): NIH NIA K23 AG028452, NIMH T32 MH 019925-11; VA HSR&D IIR 04-321-2; VA Greater Los Angeles Healthcare System, Geriatric Research, Education and Clinical Center and UCLA Cousins Center for Psychoneuroimmunology.

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PREDICTORS OF INSOMNIA SEVERITY IN OLDER ADULTS UNDERGOING INPATIENT POST-ACUTE REHABILITATION

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Introduction: Insomnia is a debilitating and common sleep disorder. It is related to medical and psychiatric conditions and predicts mortality in older adults. Few studies have looked at rates of insomnia and factors associated with insomnia severity among older inpatients. This study examined rates of clinically significant insomnia symptoms and the factors associated with insomnia severity among older adults in a post-acute rehabilitation inpatient setting.
Methods: Participants were 301 older veterans (mean age = 73, SD = 9, range = [59-94], 97% male, 57% non-Hispanic white) admitted to an inpatient post-acute rehabilitation program in a Los Angeles Veterans Administration Hospital. Data collected included demographic characteristics, Insomnia Severity Index (ISI), sleep apnea risk (Berlin), Restless Legs Syndrome Question Set (RLS), Mini-Mental State Exam (MMSE), Geriatric Pain Measure (GPM), Geriatric Depression Scale (GDS-5), Cumulative Illness Rating Scale for Geriatrics (CIRS-G), Multidimensional Fatigue Inventory Scale (MFSI) and the Global Vigor and Affect Instrument (GVA). Descriptive statistics were run on all variables. In addition to demographic variables, variables with correlations of $P \leq 0.1$ with the ISI were included in regression models predicting insomnia severity (ISI total score).
Results: Clinically significant insomnia (ISI $\geq$ 8) was found in 46% of the sample, with 19% having moderate to severe insomnia (ISI $\geq$ 15). Significant predictors of insomnia severity were being non-Hispanic white (β = -0.13, t = -2.14, P = 0.03), having fatigue (β = 0.26, t = 3.90, P < 0.0005) and having pain (β = 0.22, t = 3.13, P = 0.002) when adjusted for other variables associated with insomnia such as depression and symptoms of sleep apnea and restless legs syndrome (Model adjusted R2 = 0.23, F9,199 = 7.72, P < 0.0005).
Conclusion: Insomnia was common in older adults undergoing post-acute rehabilitation. Race, fatigue and pain were factors associated with experiencing higher levels of insomnia severity in this setting. More research is needed to understand the role of race in experiencing and reporting insomnia symptoms, and the relationship between fatigue, pain and insomnia in this setting.
Support (If Any): Veterans Administration HSR&D (IIR 04-321-2); VA Greater Los Angeles Healthcare System, Geriatric Research, Education and Clinical Center (GRECC); and NIH NIA K23 AG028452.

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FREQUENCY OF CO-MORBID INSOMNIA, PAIN, AND DEPRESSION IN OLDER ADULTS WITH OSTEOARTHRITIS: PREDICTORS OF ENROLLMENT IN A RANDOMIZED TREATMENT TRIAL

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Introduction: Osteoarthritis (OA) is a common cause of pain and disability among older adults. This study examines the prevalence of co-morbid pain and insomnia in a primary care sample of older adults aged 60+, and how patients who volunteer for a cognitive-behavioral intervention for pain and sleep disturbances differ from non-volunteers.
Methods: This study was conducted at Group Health Cooperative, a large HMO. Patients with diagnosed OA (n = 1,236) were mailed surveys to assess levels of pain, sleep disturbance, and depression. There was a 56% response rate. Respondents (mean age = 73 years, range 60-100) with clinically significant co-morbid pain and sleep symptoms (n = 219) were compared to respondents without significant pain or sleep symptoms (n = 477). Respondents with significant symptoms were invited to participate in an ongoing randomized treatment trial. Persons who attended the first group class ("volunteers," n = 82) were then compared to "non-volunteers" (n = 137) to examine the generalizablity of the study's recruitment and enrollment strategy.
Results: Eligible respondents had significantly (P < .0001) higher levels of self-reported pain on the Graded Chronic Pain Scale, sleep disturbance on the Insomnia Severity Index, and depression on the Patient Health Questionnaire than non-eligible respondents. They were also

significantly more likely to be female (P = .0015), and to have been prescribed opioids (P < .0001) or sedative-hypnotics (P = .037) in the past 90 days. There were no significant differences between volunteers and non-volunteers except that volunteers were more likely to be retired (P = .006) and less likely to have been prescribed a sedative-hypnotics (P = .036).
Conclusion: Approximately one-third of survey respondents in this primary care sample of older OA patients had clinically significant levels of co-morbid pain, sleep disturbances, depression, and use of pain and sleep medications. Of these, persons still working or taking sedating medications were less likely to volunteer for participation in an ongoing behaviorally-based treatment trial.
Support (If Any): This study was supported by a grant from the National Institute on Aging (R01- AG031126).

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WALKING, BRIGHT LIGHT, AND A COMBINATION INTERVENTION ALL IMPROVE SLEEP IN COMMUNITY-DWELLING PERSONS WITH ALZHEIMER'S DISEASE AND CAREGIVERS: RESULTS OF A RANDOMIZED, CONTROLLED TRIAL

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Introduction: Sleep and nocturnal disturbances are common among Alzheimer's disease (AD) patients, and increase risk for medical and psychological morbidity and institutionalization. An NIH task force has called for research to develop and evaluate non-pharmacological treatments suitable for use within this population.
Methods: Randomized controlled trial with blind assessments of patients and caregivers to evaluate the efficacy of walking, light exposure, and combination walking, light exposure, and sleep hygiene recommendations (NITE-AD) to reduce nocturnal disturbances in community-dwelling AD patients, compared to educational contact control. One hundred thirty two patient-caregiver dyads were randomized and completed baseline, 2-month post-test, and 6-month follow-up evaluations.
Results: Patients were 55% female, 86% Caucasian, with a mean MMSE = 18.9 (range 0-30), and mean age of 80.9 years (range 59-95). Caregivers were 65% female, 87% Caucasian, with a mean age of 71.3 years (range 36-96). Subjects randomized to active treatment (Walking, Light exposure, or Combination NITE-AD treatment) had significantly (P < .05) fewer nighttime awakenings, less total wake time, shorter sleep latencies, and better sleep efficiency at post-treatment compared to control subjects. Longitudinal analyses demonstrate that improvements in patient sleep efficiency and nighttime awakenings were maintained at 6-month follow-up, and significant improvements in caregiver total sleep time (P = .002) and sleep efficiency (P = .005) emerged. Twenty-five percent of active treatment patients at post-test had a 30 minute or greater increase in nighttime sleep, compared to 12% of control subjects; conversely, 19% of control subjects had 60+ minute increases in total wake time (worsening), compared to 3% of active treatment subjects. All three active treatments showed comparable treatment effects. Older patient age and depression, and caregiver stress and burden increased risk for treatment non-adherence and drop-out.
Conclusion: Outcome data support earlier evidence that a number of different non-pharmacological treatments are feasible and efficacious for improving sleep in community dwelling AD patients and caregivers.
Support (If Any): Supported by PHS grant R01-MH072736 (SMM).

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INCIDENTAL IMPROVEMENT OF DEPRESSION IN CAREGIVERS DURING NON-PHARMACOLOGIC TREATMENT OF SLEEP DISRUPTION IN INDIVIDUALS WITH MEMORY IMPAIRMENT

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Introduction: Bright light therapy to improve sleep has been used with varying degrees of success in a wide range of subject populations. Another non-pharmacologic intervention, sleep hygiene education, has also been used extensively, though its content is broadly defined. We examined the effect of a combination of bright light treatment and sleep hygiene education on sleep/wake in community-dwelling older adults with memory impairment, and in their caregivers. Since bright light therapy has been found to have effects on mood, we also examined the impact of treatment on a measure of depressive symptoms.
Methods: We conducted a randomized, controlled trial in which older (73.4 ± 11.7 years) caregiver/care recipient dyads received two weeks of daily morning (30 min) bright light (n = 31 dyads) or dim red light placebo (n = 24 dyads). All participants received sleep hygiene training at Days 0 and 7 and completed a modified Blake Gomez sleep hygiene scale (BG) and the Beck Depression Inventory (BDI-II) at Days 0 and 14.
Results: Caregivers had a 1.67 ± 0.31 point improvement (P < 0.001) on the BG; there was no difference according to lighting condition. They also had a 3.34 ± 0.54 point improvement in BDI scores (P < 0.001) with no difference between conditions. Changes in the BG and BDI were correlated (r = -0.31, P < 0.05) such that improvement in sleep hygiene was associated with a decrease in depressive symptoms in caregivers. These changes were not found for care recipients.
Conclusion: Caregivers in this randomized trial of bright light therapy showed improved sleep hygiene and decreased depressive symptoms immediately following treatment, regardless of treatment condition. This indicates that light treatment had no additional effect on depressive symptoms, beyond sleep hygiene and potential placebo effects of research participation. Findings also suggest that improvement of sleep hygiene is associated with improved depressive symptoms in caregivers of older adults with memory impairment.
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EFFECT OF SLEEP DISORDER ON CARDIOVASCULAR FUNCTION IN THE ELDERLY

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Introduction: The elderly complains about sleep disorders such as the difficult onset of sleep, a difficult sound sleep, and the early-morning awakening. Aging could be considered as a risk factor for the development of the sleep disorder. Short sleep is associated with increased risk of hypertension. Obstructive sleep apnea syndrome has adversely affect cardiocvascular function, cardiovascular changes in the elderly

with sleep disorder have not been fully elucidated, however. We have investigated the effect of sleep disorder on cardiovascular function in the elderly.
Methods: Fifty-five subjects (74.1 ± 6.1 years, male: 12 subjects, female: 43 subjects) who were agreed to cooperate in the sleep study were targeted. Subjective sleep symptoms, disturbances, and patterns were assessed with the Pittsburgh Sleep Quality Index (PSQI) and total sleep time (TST) was measured using actigraphy. We evaluated atherosclerosis from brachial-ankle pulse wave velocity (ba-PWV) and intima-media thickness (IMT) of carotid arteries by untrasonography. Apnea-hypopnea index (AHI) was measured by portable home monitoring. Standard echocardiography was performed for assessment of left ventricular function.
Results: PWV and IMT were significantly increased in sleep disorder group (PSQI ≥ 6) than in non-sleep disorder group (1822.1 ± 406.3 vs 1645.1 ± 284.4 cm/s, $P < 0.05$, 1.13 ± 0.47 vs 0.90 ± 0.23 mm, $P < 0.01$ respectively). PWV and IMT were significantly increased in TST < 7h group than in TST ≥ 7h group (1813.8 ± 323.2 vs 1521.5 ± 233.5 cm/s, $P < 0.01$, 1.24 ± 0.57 vs 0.91 ± 0.37 mm, $P < 0.05$ respectively). There were no significant differences in PWV and IMT between AHI ≥ 15/h group and AHI < 15/h group. Multivariate analysis with stepwise including ages, hypertension, diabetes mellitus, PSQI and TST revealed that TST and PSQI were significant factors for higher IMT(TST: $\beta = -0.435$, $P < 0.0001$, PSQI:$\beta = 0.245$, $P < 0.0001$), and ages and TST were for increased PWV (age:$\beta = 0.478$, $P < 0.0001$; TST:$\beta = 0.268$, $P < 0.0001$). There were no significant differences in left ventricular function between sleep disorder group and non-sleep disorder group.
Conclusion: Sleep disorder might play a role in pathophysiology of atherosclerosis in the elderly.

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RELATIONSHIP OF CARDIOPULMONARY PERFORMANCE AND SLOW WAVE ACTIVITY IN OLDER ADULTS WITH CHRONIC INSOMNIA

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Introduction: Exercise has been shown to increase the amount of slow wave sleep in older adults. The aim of this study was to examine associations between level of physical fitness and slow wave activity (SWA) and its temporal distribution in older adults with insomnia.
Methods: Seventeen sedentary older adults (> 55 year old) with chronic primary insomnia were recruited and underwent baseline cardiopulmonary exercise testing (CPET) followed by 3 days of standard nocturnal polysomnographic monitoring. Patients with other sleep disorders and unstable medical or psychiatric conditions were excluded. Cardiopulmonary fitness based on maximum oxygen consumption (VO2max) and total exercise time was compared to total SWA (defined as non-REM absolute power in the 0.75 to 4.0-Hz frequency band) from the second night, and SWA distribution for the first three non-REM/REM cycles. Statistical comparisons were performed using Pearson's correlation coefficients.
Results: There was a positive correlation between the magnitude of reduction of SWA from the second to the third cycle with VO2 max ($r = 0.507$, $P = 0.045$). While there was no correlation between VO2 max and SWA in cycle 1 and 2, there was a trend between less SWA in cycle 3 in patients with higher VO2 max ($r = -0.47$, $P = 0.066$). Furthermore, those with longer exercise time during CPET, tended to have less SWA in cycle 3 ($r = -0.483$, $P = 0.058$).
Conclusion: While there was no relationship in the total SWA in the first 2 cycles of the night with VO2max or total exercise time, there was a relationship between VO2max and the change in SWA between cycle 2 and 3. This suggests a relationship between cardiopulmonary fitness and the temporal dissipation of SWA during sleep.
Support (If Any): NIH/NIA AG11412

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GENDER DIFFERENCE IN CORRELATION BETWEEN URINARY SYMPTOMS AND SUBJECTIVE SLEEP QUALITY IN A POPULATION OF UROLOGY PATIENTS

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Introduction: Urinary symptoms and sleep complaints both increase with age. There is evidence that urinary problems may lead to sleep disruption. It is also possible that disrupted nighttime sleep can lead to voiding during the night. In a previous study, we explored the correlation between sleep and urinary complaints in sleep study volunteers; in the present study, we explored this relationship in a population of urology patients, and also examined whether there was a sex difference in this relationship.
Methods: Patients from the Brigham and Women's Hospital Urology Clinic responded to three questionnaires, the American Urological Association questionnaire (AUA), the Pittsburgh Sleep Quality Index (PSQI), and the Epworth Sleepiness Scale (ESS). We analyzed the correlation between the AUA and the PSQI global score, and between the AUA and the ESS global score for both sexes. We also divided the patients by their AUA severity score (< 10, 10-20 and ≥ 20), and created a sleep complaint score reflecting three levels of severity: no sleep complaint (PSQI and ESS < 5), mild sleep complaint (PSQI or ESS ≥ 5 with PSQI or ESS < 5), moderate-severe sleep complaint (PSQI and ESS ≥ 5). We then examined the relationship between severity of urinary complaint and sleep complaint by sex.
Results: A total of 114 patients were included (97 M; average age ± SD = 63.7 ± 9.1 years, no significant age difference between sexes). The mean AUA, PSQI, and ESS scores were comparable for both sexes. The correlation between urinary symptoms and sleep disruption was stronger in females than in males ($r = 0.61$ vs $r = 0.44$, respectively, $P < 0.01$). This was also true for the relationship between urinary symptoms and daytime sleepiness ($r = 0.63$ vs. $r = 0.25$; $P < 0.05$). For both sexes, severity of urinary symptoms paralleled severity of sleep complaints (Fisher's exact test, $P < 0.05$).
Conclusion: Urinary symptoms and sleep complaints are significantly correlated, and this relationship may be stronger in females. While urinary symptoms that disrupt sleep are often thought of as a male problem caused by BPH, our findings indicate that older women also experience urinary complaints that are associated with sleep disruption. Although the reason for this sex difference remains to be explored, it points at the complexity of the relationship between age-related urinary symptoms and sleep complaints.
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CAFFEINE INGESTION AND SLEEP EFFICIENCY IN ELDERLY PEOPLE WITH INSOMNIA OR SLEEP APNEA

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Introduction: Caffeine ingestion in high doses reduces sleep efficiency and should be avoided by people with insomnia, particularly by elderly people. Caffeine consumption in elderly individuals with insomnia complaint was not, to our knowledge, compared to that of middle age and young adults. We investigated whether at the Third Age insomniacs and sleep apnea patients have a different pattern of caffeine ingestion.
Methods: We examined retrospectively polysomnography results and questionnaires about caffeine ingestion in the day of the polysomnography from our computer database two age groups were compared: elderly adults (age > 65 years) and young adults (age 18 to 64 years). Symptoms groups were insomnia and sleep disordered breathing (IAH > 5 and no insomnia). Caffeine use was assessed by the estimated dose of caffeine

ingested during the day, in mg, and by the time elapsed between the last dose and the beginning of polysomnography. Outcome variable was sleep efficiency in polysomnography.

Results: Sleep efficiency was lower in the 104 elderly adults with insomnia than in the 109 young adults (67 ± 17%vs.79 ± 15%, respectively; $P < 0.000001$) as well as in the 316 elderly adults with sleep disordered breathing than in the 295 young adults (79 ± 12%vs.83 ± 11%; $P = 0.000001$). Caffeine dose in mg was lower in elderly adults than in young adults with insomnia (98 ± 87mg vs.141 ± 157mg; $P = 0.014$) but not with sleep disordered breathing (131 ± 125mg vs. 143 ± 126mg; $P = 0.23$). Interval since last dose was significantly shorter in elderly adults than in young adults with insomnia (7.5 ± 4 hours vs. 6 ± 3hours; $P = 0.03$) but not with sleep disordered breathing (6 ± 4 hours vs. 6 ± 4hours; $P = 0.23$). In insomnia patients, multivariate analysis showed that caffeine dose ($P = 0.018$) and caffeine-free interval before polysomnography ($P = 0.023$) can be predicted by age group, controlling for gender and body mass index.

Conclusion: Elderly people with insomnia and sleep disordered breathing have lower sleep efficiency, but those with insomnia complaints have a different pattern of caffeine ingestion.

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EEG POWER AS A METRIC OF DROWSY DRIVING BEHAVIORS

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Introduction: Drowsy driving is a significant cause of motor vehicle accidents. It is critically important to identify drowsiness before it contributes to driver error, but no valid methods exist. We previously failed to identify drowsiness using visual scoring of EEG. In this study, we evaluated the efficacy of using quantitative methods to identify drowsiness while driving.
Methods: Ten healthy male subjects (Mean Age = 21.9, SD ± 2.1 years) maintained a 5-hour sleep schedule for 5 consecutive days, confirmed by sleep diary, actigraphy and call-in protocol. They drove on a closed 4.43 km course until they were either too sleepy to continue or 2 hours had elapsed. The cars were instrumented to collect performance data and simultaneous 16-lead EEG was acquired using standard polysomnography software. Drowsy driving episodes were identified via video profiling. Two of the 10 subjects neither exhibited drowsy driving behaviors nor experienced scorable sleep. The alpha, theta, and delta frequencies (left head region) from three of these subjects, for the 30 seconds preceding these episodes, were subjected to power analysis. Data from these drowsy episodes were compared to the first 5 minutes of the driving task when there was no video evidence of drowsy driving.
Results: No significant differences in EEG power between the control and drowsy episodes were evident for most electrode sites, though differences in theta power (Mean: 10.2 ± 2.0 vs. 10.9 ± 1.8, $P < 0.053$) and the ratio of theta to alpha power (Mean: 1.24 ± 0.31 vs. 1.64 ± 0.25, $P = 0.029$) were statistically significant in the left parietal and central head regions respectively.
Conclusion: Preliminary findings indicate nearly no differences in EEG power between control and drowsy episodes. We will continue to evaluate the efficacy of this method with the additional 5 subjects and compare quantitative measures with driving behaviors.

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DETECTION OF CORTICAL AROUSALS IN SLEEP EEG

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Introduction: Cortical arousals (CA) are a transient albeit part of the sleep-wake system that may play an important role in characterizing sleep fragmentation and sleep disorders such as obstructive sleep apnea. AASM (2007) rules describe specific EEG frequency ranges and EEG and EMG signal morphology to identify CA. However, because of a lack or reliability in arousal detection, even among well-trained human scorers using the ASDA rules, CA has had limited utility in describing healthy sleep and/or in diagnosing sleep pathology. The purpose of this study is to increase the reliability of CA detection utilizing Power Spectrum Density (PSD) by identifying the exact frequency bands needed for CA detection based on sleep stages.
Methods: Previously recorded 30-seconds EEG sleep epochs from healthy adult subjects ($N > 30$) were used in this study. The average and standard deviation of the relative powers of all frequency bands were computed for all epochs and sorted by sleep stages. If the relative power of specific frequency bands was significantly higher than the average plus a multiple of the standard deviation, an arousal was considered to be present in that epoch. This experimental scoring technique was then compared with EEG epoch data scored by the Sleep Heart Center Study (SHHS) sleep scientists. An estimate of reliability was obtained using the Cohen kappa, sensitivity, and specificity measures.
Results: Optimum CA detection was found using a combination of explicit frequency ranges that were sleep stage dependent. Based on the reliability calculated from the Cohen kappa, the optimum frequency bands for stage1 were: Beta1, stage2: Beta1, or Gamma, stage SWS: Delta and Beta2, and stage REM: Delta and Beta1, Delta and Beta2, or Delta and Sigma.
Conclusion: A careful consideration of frequency band is necessary to increase the reliability of the detection of CA in EEG. Refinement of the ASDA rules for detecting CA in EEG should include a more explicit combination of the frequency ranges that should be used for reliable CA detection.
Support (If Any): We would like to acknowledge and thank the Sleep Heart Center Study (SHHS) for providing us with the EEG data.

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DISTINGUISHING REM SLEEP FROM AWAKE USING EEG

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Introduction: With visual inspection, a 30-second epoch of REM sleep EEG looks quite similar to that of Awake EEG. While analyzing the performance of our automatic sleep stager, it was obvious that the classifier distinguished between REM sleep and AWAKE very well using just one EEG channel. We investigate here the features that proved helpful in separating these classes.
Methods: We used data from the MIT Sleep-EDF database, which contains sleep data for 8 subjects. Three types of biosignals were recorded, but only data from a single EEG channel (Fpz referenced to Cz) were used for classification. Frequency based features, as well as features tailored to well-known sleep waveforms were extracted for each 30 second epoch. A search was performed to find the features that contributed most to REM and AWAKE stage classification accuracy.
Results: The tailored features which proved most useful in the classification of REM vs awake were a saw-tooth wave (STW) detector feature and a slow-eye-movement (SEM) detector feature. For SEMs, we measure 0.25-0.5 Hz activity in a sliding 3 second window, for STWs we use 3-7 Hz and a 5 second window. In both cases the power in the band of interest is normalized with the level of background EEG. Reported classification rates are 75% of AWAKE stages, with 2.8% misclassified as REM. For REM stages, 95% were correctly classified, with 0.73% misclassified as AWAKE.
Conclusion: The SEM and STW features were most helpful in distinguishing between REM and AWAKE stages. The features were made possible by the proximity of the electrode to the subjects' eyes. With the classification algorithm we were able to correctly classify 80% of the total sleep stages using just one channel of EEG. In the future we will apply our classifier to data from EEG recordings using a dry frontal sensor.

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IMPACT OF TWO ARTIFACT REJECTION METHODS ON REM SLEEP POWER SPECTRAL ANALYSIS

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Introduction: Phasic events during REM sleep can affect EEG data and power spectral analysis. We investigated the magnitude of the differences between an automated artifact rejection method alone and an automated method supplemented by visual artifact rejection and detection for whole-night spectral analysis of REM sleep.
Methods: The automated alone (Method 1) and automated + visual method (Method 2) were compared using polysomnographic records

collected in 45 adults (M age = 35.6 years old; 24 men). Method 1 is based on a segmented median method to detect 4-second epochs containing movement artifact in high EEG frequencies (26-32 Hz). Method 2 included the automated algorithm supplemented by visual inspection to exclude additional 4-second EEG epochs contaminated by rapid eye movements, sweat or ECG artifacts, or muscle twitches. Whole-night REM sleep absolute and relative power spectral values in delta (.5-4Hz), theta (4 - 8Hz), alpha (8Hz - 12Hz), beta1 (12-16Hz), and beta2 (16-32 Hz) were compared using multivariate repeated measures ANOVAs.

Results: Total power (.5 - 32Hz) was reduced by 23% with Method 2 compared to Method 1. Absolute spectral power values were significantly lower for all activity bands except beta2. Relative spectral power also significantly differed between the two methods across all activity bands.

Conclusion: Automated artifact detection and rejection methods have significant effects on absolute and relative quantitative EEG parameters in REM sleep. Refining available automated algorithms is an important step in facilitating the broader use of quantitative EEG analysis in REM sleep in psychiatric and sleep disordered samples.

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VISUAL SCORING RELIABILITY OF CYCLIC ALTERNATING PATTERN (CAP) DETECTED BY MODIFIED AASM RECOMMENDED DERIVATION

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Introduction: Cyclic alternating pattern (CAP) refers to periodic EEG activity occurred in non-REM sleep. It may indicate sleep instability and/or sensitive sleep fragmentation, and also be expected for the sleep parameter related to subjective sleep quality. We evaluated visual scoring reliability of CAP detected by modified AASM recommended montage which is included bipolar and monopole derivations (F3-C3, C3-O1, F4-C4, C4-O2, C3-A2, C4-A1).

Methods: We used 17 examples recorded under CAP standard montage (Fp1-F3, F3-C3, C3-P3, P3-O1, Fp2-F4, F4-C4, C4-P4, P4-O2, C3-A2, and C4-A2) for CAP scoring. 9 examples of those have scored it by CAP standard montage first and scored it under AASM modified montage successively. Remaining 8 examples have scored it by inverse order.

Results: Mean CAP rate scored by modified AASM montage was 52.7+-12.2%, which does not show significantly difference compared to that of scored by CAP standard montage; 54.5+-12.5%. Also as for CAP rate, a high correlation was accepted in both modified AASM montage and CAP standard montage.

Conclusion: Because no differences in CAP rate between CAP standard montage and modified AASM recommended montage and high correlation in both CAP rate were found, it was thought that even less derivations compared to the standard could use to evaluate CAP rate instead. This result could suggest that CAP might be routine evaluation.

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HIGH-END DATA ANALYSIS OF ACTIGRAPHY FOR MEASUREMENT OF FATIGUE

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Introduction: An actigraph is a watch-like device attached to the wrist that uses an accelerometer to measure movement nearly continuously over several days. Actigraphy is recognized by the AASM as a useful tool for detecting sleep in healthy individuals and in those with sleep disorders. Assessment of fatigue, however, is more challenging than assessment of sleep. With improved high-end statistical methods for analyzing this data, actigraphy has the potential to become more important as an objective diagnostic tool for determining fatigue.

Methods: Wrist actigraphy was collected from over 50 individuals presenting to the Washington University Multidisciplinary Sleep Center. Patients were evaluated by history and physical examination, patient questionnaires (on presentation and after treatment), and an overnight polysomnogram. In addition, actigraphy was collected on average for 7 days recording data at 15 second intervals. Functional Principal Component Analysis (functional PCA) was used to reduce the data complexity while retaining the information content.

Results: Principal components of the actigraphy data variability were identified and correlated with patient subgroups. Patient subgroups included insomnia, obstructive sleep apnea, and restless legs syndrome. In addition, actigraphy data and patient subgroups are correlated with clinical data and questionnaires such as PHQ-9 Depression Scale, Epworth Sleepiness Scale, Short Form 36 for quality of life, and others.

Conclusion: Functional data analysis of the principal components associated with wrist actigraphy data provides more detail into patient activity profiles and behavior than visual inspection alone.

Support (If Any): NIH R01-HL092347, "New Data Analysis Methods for Actigraphy in Sleep Medicine"

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COMPARISON OF FIVE ACTIGRAPHY SCORING METHODS IN BIPOLAR DISORDER: AN OBJECTIVE/SUBJECTIVE SPECTRUM OF PROCESSING

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Introduction: Increasing use of actigraphy in psychiatric populations raises questions on the standardization of actigraphy signal processing. The main objective of this study was to evaluate and compare five actigraphy scoring methods, and to quantify similarities and differences among actigraphy parameters across methods.

Methods: The study sample consisted of 18 adult remitted patients with bipolar disorder. Participants wore an actiwatch (AW-64, Phillips Respironics) on their non-dominant wrist over a mean of 7.83 (SD = 0.92) consecutive days. Concurrently, they also completed sleep diaries. Actigraphy records were processed using five different methods: the software provided automatic algorithm (A); the automatic algorithm supplemented by the event marker signaling lights out and time out of bed (AM); the sleep diary supplemented by the event marker (D); the event marker supplemented by the sleep diary (M); the visual inspection only (V).

Results: Both similarities and differences were observed in quantified actigraphy parameters among the five scoring methods. Compared to the other four methods, the A method significantly overestimated sleep duration. It also significantly overestimated time spent in bed and wake after sleep onset compared to the AM method and to the V method. The V method significantly underestimated sleep onset latency compared to the four other methods. Sleep efficiency differed significantly across all methods.

Conclusion: Differences among actigraphy scoring methods can be important, depending on the parameters of interest. Careful considerations should be given to factors such as patient subjective perception in completing the sleep diary and using the event maker, and the scorer's own subjective assessment during visual inspection. Replication with polysomnography is needed to further validate and compare the five scoring methods.

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CAN ACTIGRAPHY BE USED TO ADMINISTER THE MULTIPLE SLEEP LATENCY TEST?

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Introduction: Polysomnography (PSG) is the gold standard measure of sleep used to score sleep onset latency (SOL) for the Multiple Sleep Latency Test (MSLT), a clinically essential objective assessment of daytime sleepiness. Administration of the MSLT is relatively expensive, requires technological expertise, and is limited to laboratory settings. Actigraphy is a comparatively inexpensive ambulatory methodology that is valid for identifying sleep and wake among adults. However, the efficacy of its use as an instrument to conduct the MSLT has yet to be explored.
Methods: Forty-four adults (twenty-two first-time postpartum mother-father dyads participating in a larger study) (27.9 SD ± 5.2 years), with disturbed sleep due to infant caretaking, completed a standard four-nap MSLT with concurrent wrist actigraphy (MiniMitter AW-64). Participants pressed the actigraph event marker simultaneous with each MSLT 'lights-out.' For PSG, sleep onset was identified as the first epoch of unequivocal sleep; for actigraphy, sleep onset was identified using MiniMitter's Actiware® sleep/wake algorithm with default parameters (wake threshold value = 40, sleep onset beginning at 10-minutes of immobility). SOL values for the four naps were averaged for both PSG and actigraphy, these averages were compared.
Results: PSG-measured SOL was 9.9 (SD ± 4.7; range:0.88-20.0) minutes; actigraphically measured SOL was 6.8 (SD ± 5.7; range:0.1-20.0) minutes. SOL measured by PSG and actigraphy was significantly different (t[43] = 2.8, P = .008). Generally, actigraphy prematurely identified SOL; the average difference between the two measures was 3.1 (SD ± 7.4; range:-14.3-18.0) minutes. Compared to PSG, actigraphy classified participants into the standard SOL ranges 0-5, > 5-10, and > 10-20 minutes with accuracy rates of 50.0%, 25.0%, and 20.0%, respectively.
Conclusion: The actigraphy system with default algorithm settings is not a valid instrument to identify SOL during the MSLT; actigraphy can not be recommended as a replacement for PSG-administered MSLT at this time. We are currently exploring different algorithm parameters that may yield more accurate SOL values.
Support (If Any): NIH grant R21HD053836 (HMD); West Virginia University Doctoral Student Research Support (SI).

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COMPARISON OF POLYSOMNOGRAPHY (PSG) AND TWO ACTIGRAPHY DEVICES FOR ASSESSING THE EFFECTS OF ZOLPIDEM ON HEALTHY VOLUNTEERS—THE LIMITATIONS AND VALUE OF ACTIGRAPHY IN SLEEP STUDIES

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Introduction: Actigraphs provide an assessment of sleep through the analysis of motion measured by accelerometers. This study compared the BodyMedia Sensewear® Armband and the Respironics Actiwatch® Spectrum to PSG with respect to their ability to detect the effects of zolpidem (Ambien®) on sleep patterns in healthy volunteers.
Methods: The 11 subjects (seven females) with no reported sleep problems were 24 -55 years old. Each spent 4 nights in a clinical research unit where sleep was monitored with PSG, an Armband worn on the back of the arm, and an Actiwatch worn on the wrist. On nights 2, 3 and 4, subjects received placebo, or 5 or 10mg zolpidem. The primary endpoint was wake after sleep onset (WASO, minutes) measured by PSG and estimated by algorithms specific for the actigraphy devices. Motion measurements from the accelerometers for each device were also analyzed.
Results: PSG showed that zolpidem decreased WASO from 69 ± 66 (sd) minutes to 37 ± 21 and 40 ± 36 for the 5 and 10 mg doses respectively (P = 0.036, 0.056). The Actiwatch algorithm gave lower values (41 ± 31, 23 ± 10 and 25 ± 16) but had a similar ability to detect the changes (P = 0.031, 0.052). The Armband gave values similar to the Actiwatch (42 ± 56, 26 ± 23 and 37 ± 43) but was less effective at detecting the effects of zolpidem (P = 0.37, 0.81). Using only motion data from the accelerometers provided an endpoint that was either equally sensitive (Actiwatch, P = 0.033, 0.042) or more sensitive (Armband, P = 0.21, 0.19) than algorithm estimates of WASO for detecting the effect of zolpidem.
Conclusion: Actigraphy, which measures motion, is not the same as PSG which includes measures of brain activity. Therefore, attempts to estimate PSG endpoints, such as WASO, may not be the best way to analyze actigraphy data. Analysis of motion data may provide a more meaningful and useful way to quantify physical manifestations of sleep.
Support (If Any): Respironics loaned the actiwatches at no cost.

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AN INTELLIGENT ALARM SYSTEM THAT DETERMINES WAKE-UP TIMING BASED ON MOVEMENT DETECTION

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Introduction: Sleep inertia (SI) refers to the temporary decrement in alertness and cognitive performance occurring immediately after awakening. The extent of SI may vary depending on the sleep stage prior to awakening. Waking up from a deep sleep leads to more extension of SI than from the other stages. The present study was to examine the effect of an intelligent alarm system (iWakeUp) that can determine an appropriate timing for waking-up based on the movements inferred from a video-based monitoring system.
Methods: Nine university students (18-23 years) with good health participated in the study. All subjects came to the sleep laboratory for three nights: an adaptation night, a control night with traditional alarm clock, and an iWakeUp night. Subjects were asked to evaluate their level of subjective sleepiness and alertness on the Karolinska Sleepiness Scale (KSS) and visual analogue scales (VAS), and to complete a 2-minute addition task (ADD) once before bedtime as baseline and 6 times upon awakening with inter-session intervals of 10 minutes. 2(conditions) X 6(testing sessions) two-way ANOVAs were conducted to compare the measures.
Results: A near significant trend of Session effect was shown on ADD performance (F = 2.42, *P* = .059), indicating the manifestation of SI. A significant Condition x Session interaction was found in the subjective rating of alertness (F = 2.66, *P* = .039). Post-hoc comparisons showed that subjective alertness was near significantly higher in iWakeUp condition than in control condition at the sixth measurement session with a large effect size (t = -2.24, *P* = .060, d = -1.023). No Condition main effects or other interactions were found to be significant.
Conclusion: iWakeUp was shown to decrease SI as shown in lowered subjective alertness rating at an hour after awakening. However, it showed no benefit on cognitive performance upon awakening. Future research with larger subject size is needed to validate the effectiveness of the iWakeUp system.

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FEASIBILITY STUDY OF A NEW DRIVING SIMULATOR FOR SLEEP RESEARCH

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Introduction: Driving safety is sensitive to conditions and diseases that affect sleep, and individuals with obstructive sleep apnea syndrome have a high risk of at-fault accidents. Most driving simulators used for research are unrealistic, stationary, prohibitively expensive, or not specifically designed to study sleep disorders. The purpose of this study was to test the feasibility of a new low-cost, portable, realistic driving simulator intended for use in sleep disorders research.
Methods: Two 30 minute simulations were developed: a monotonous rural driving task and an urban driving task involving reaction time challenges in which drivers pressed the brake pedal in response to pseudo-randomly appearing balls. Driving parameters including speed and lane position during straight and curved roads were continuously recorded from 9 healthy subjects (7 women and 2 men) with an average ± SD age of 29.2 ± 12.2 years. Prior to simulations, subjective sleep quality and sleepiness questionnaires were administered. After each simulation, a realism and difficulty questionnaire, a sleepiness questionnaire, and a simulation sickness questionnaire were administered.
Results: All had normal subjective sleep quality and quantity. One subject withdrew due to nausea. The remaining subjects had no significant problems with simulation sickness. 8 subjects completed the city simulation. 4 subjects completed the rural simulation. For the city and rural simulations, respectively, subjects gave median realism ratings of 75% (10% to 95%) and 50% (20% to 75%) and median difficulty ratings of 20% (10% to 55%) and 55% (5% to 75%). Speeds of 25.1 ± 5.7 and 54.0 ± 0.3 miles per hour were maintained in the city and rural simulations, respectively. In the rural simulation, the center lane deviation was 0.24 ± 0.24 feet. All subjects reported increased subjective sleepiness after the first simulation.
Conclusion: The results suggest that, with modifications to improve realism, this simulator will be a useful tool to assess daytime cognition and performance in the context of sleep research.
Support (If Any): This project was supported by NIH Award F30HL097403 and by a gift from Joseph A and Marylou Piscopo.

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VALIDATION OF A POLYVINYLIDENE FLOURIDE IMPEDANCE SENSOR FOR RESPIRATORY EFFORT MEASUREMENT DURING POLYSOMNOGRAPHY

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Introduction: The AASM has recommended guidelines for using specific sensors in measuring apnea and hypopnea based on published reliability and validity data. As new technology emerges, these guidelines will likely need revision. One new sensor uses polyvinylidene fluoride (PVDF), a substance that rapidly reacts to changes in temperature, pressure and impedance, for measuring airflow and effort. We evaluated the comparability of respiratory event detection using PVDF impedance belts (PVDFb®; Dymedix Inc.) as compared to the currently recommended sensors, respiratory inductance plethysmograhy (RIP) in alternative scoring montages. Within-scorer reliability and agreement to nasal-oral pneumotachgraphy were also assessed.
Methods: Fifty subjects (mean AHI 26; 1 to 186) undergoing routine polysomnography were fitted with abdominal and thoracic PVDFb in addition to standard sensors. Studies were scored in four independent passes using four different montages by a single scorer blinded to specific signal identity. Each montage (M) included oxygen saturation. Included were respiratory signals in M1: NPT, thermistry and RIP; M2: NPT, thermistry and PVDFb; M3: thermistry and PVDFb; M4: PVDFb alone. Standard definitions were used to define obstructive/central apnea and hypopnea. Each experimental montage (M2-M4) was compared to the gold standard (M1) in the total events scored. Agreement was evaluated with the intraclass correlation coefficient (ICC).
Results: ICCs comparing event numbers by M1 to M 2, 3 and 4 were: 0.99, 0.93, and 0.91, respectively. Almost identical numbers of events were identified for M 1 and M2 (177.5 ± 122.7 vs 177.6 ± 123.2, respectively). Event subtypes also were nearly identically identified. Fewer events were identified in M3 and M4 compared to M1 and M2.
Conclusion: PVDFb was comparable to standard RIP in determining respiratory events during polysomnography. When incorporated into otherwise standardized montages (NPT and thermistry), respiratory event detection by subtype was nearly identical, suggesting that PVDFb can be used as an alternative to RIP for apnea/hypopnea evaluation.

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COMPARISON OF A SMALLER DIAMETER CPAP TUBING TO STANDARD TUBING

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Introduction: The current standard CPAP tubing (external diameter 23mm, internal diameter 19mm) is heavy and cumbersome, can cause tube drag and affect mask seal; this may fragment sleep and reduce compliance to therapy. A lighter more flexible CPAP tubing (SlimLine™) with a smaller diameter (external diameter 19mm, internal diameter 15mm) has been developed and assessed for efficacy of therapy and subjective preference.
Methods: 20 subjects with OSA, compliant on CPAP therapy (≥ 6 months) were recruited (16 males, 4 females; 14 APAP users, 6 CPAP users; 12 with humidification). Participants used the small tube and the standard tube for 7 consecutive nights each in a prospective randomised cross-over trial. A standard CPAP device (ResMed S9™ AutoSet™) was used with the subject's prescribed therapy settings and current mask. Analysis was performed on respiratory and therapy data collected by the CPAP device as well as subjective feedback through questionnaires.
Results: There were no statistical differences between the small tubing and standard tubing for any respiratory or therapy variables. Means (SD) for small vs. standard tube were as follows: AHI 1.40 (0.92) vs. 1.72 (1.39); 95%ile leak 20.0 (16.5) vs. 20.3 (17.6); 95%ile pressure 11.6 (1.9) vs. 11.6 (2.0); RR 14.6 (1.8) vs. 14.8 (1.8); MV 6.50 (1.57) vs. 6.72 (1.63); Vt 0.45 (0.13) vs. 0.46 (0.13); Respiratory Irregularity Index 26.9 (15.9) vs. 28.0 (15.9); peak inspiratory flow 26.3 (8.7) vs. 27.6 (10.3); average daily usage 6.82 (1.28) vs. 6.89 (1.28), respectively (all P-values > 0.05). 95% of participants preferred the small tube to the standard tube, and considered it to be lighter, with less tube drag and improved mask stability.
Conclusion: Objective measures showed that the smaller diameter CPAP tubing is as efficacious as standard diameter tubing. Subjective feedback showed a strong preference for the smaller diameter tube.

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QUANTIFYING THE OCCUPATIONAL IMPACT OF SLEEP DISORDERS: A NEW INSTRUMENT FOR RESEARCH AND CLINICAL PRACTICE

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Introduction: Despite the diagnostic emphasis placed on relationships between sleep quality and occupational performance in both ICSD-2 and DSM-IV, there is presently no scientific or clinical consensus on which aspects of occupational performance are most affected by sleep quality, or how such impairment should be measured at the individual level. The Occupational Impact of Sleep Project at Loughborough University was set up to develop a practical scale suitable as a screening, assessment and outcome instrument, with utility in research, clinical, public health and economic evaluations.
Methods: Development proceeded in four stages: 1) a literature review of key occupational domains affected by sleep dysfunction; 2) the collation and analysis of existing items addressing the impact of health and sleep factors on workplace performance; 3) in-depth focus groups conducted with OSA patients, insomnia patients, and 'good sleepers' addressing sleep-occupational performance relationships; and 4) the formal scaling and revision of resulting prototype questionnaires.
Results: The final 40 item additive scale (The Occupational Impact of Sleep Scale - OISS) covers punctuality, absenteeism, efficiency, productivity, satisfaction, stamina and communication. Analyses of OISS results from a volunteer panel of 180 employees (aged 21 - 63 years; PSQI range = 1-18) from a variety of occupational settings show: activity across the range of the scale (Score range 0-159); satisfactory levels of internal consistency (alpha = 0.97) and split half (r = 0.93) reliability; a modest, though significant degree of shared variance with PSQI scores($r = 0.55$; $P < 0.01$), and effective discrimination between those above and below the PSQI cutpoint(> 5) for 'clinically disturbed sleep' (PSQI < 5: mean OISS = 14.91,SD = 13.87; PSQI > 5: mean OISS = 42.25, SD = 26.96;($F(1,178) = 52.887$, $P < 001$).
Conclusion: Taking only 10-15 minutes to complete, the OISS provides a practical, reliable survey, screening and assessment instrument showing face and discriminant validity to meet the needs of researchers and clinicians.

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REVENUE GENERATION MODEL SCREENING FOR OSA DURING HOSPITALIZATIONS COMMONLY MONITORED WITH CAPNOGRAPHY

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Introduction: Obstructive sleep apnea, characterized by 5 or more apneic events per hour, is estimated to occur in 9% of women and 24% of men and that over 80% of them are undiagnosed. Patients with undiagnosed OSA commonly have comorbidities that require hospitalization. Capnography is used to monitor patient ventilation in a wide range of clinical applications and an opportunity exists to screen patients for OSA while being monitored. A "Smart Sleep Diagnostic" (SSDx)® algorithm (Pending 510K, Oridion Capnography Inc., Needham, MA) was designed to screen patients for OSA while they are being monitored for other purposes. In this study a model was created to evaluate the financial implications of using such an algorithm.
Methods: A financial model was built to calculate the revenues that could be generated by increased polysomnography testing if a hospital was able to clearly identify at risk patients who needed additional sleep testing and treatment. The model assumes that 10,000 patients are screened per year while wearing a capnography device, 20% of those patients are assumed to have been diagnosed with SDB and 20% are assumed to suffer from undiagnosed SDB. The model assumes the referral rate for PSG testing is 50% and that on average each referral results in 1.5 nights of testing at $718.16 per night. All the assumptions in the model can be changed by the user and labels describe every mathematical calculation performed in the Excel cells.
Results: Based on the assumptions detailed above, the financial model predicts that the "Annual Revenue Generated" would be $862,332.
Conclusion: As OSA is a common comorbidity in hospitalized patients and often undiagnosed, a algorithm included in a capnography monitoring platform provides another opportunity to identify and treat these patients. Investing in capnography devices which can screen for OSA creates an opportunity to generate additional revenue for a hospital.
Support (If Any): Oridion, Inc.

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A PILOT STUDY OF THE COMMUNITY BASED SLEEP APNEA SCREENING IN TAIWAN

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Introduction: Home sleep testing in Taiwan were often hospital-based. For early diagnosis and intervention of severe obstructive sleep apnea (OSA), our study is a community-based program designed to test the feasibility of performing home sleep testing, under the cooperation between hospitals and clinics.
Methods: The subjects were patients with severe snoring problems at local clinics. After basic history taking and local examination, they worn the test devices at the clinics and tested at their homes in a pay-for-screening model. The protocol used an initial portable sleep apnea recording device performed at home. If the respiratory disturbance indices (RDI) more than 15/hour, the patient would be referred to receive a diagnostic polysomnography (PSG) test at the hospital. With the standard operating procedure, the screening protocol and case management were controlled.
Results: From August to November 2009, a total of 29 clinics were recruited and 68 patients were tested. Initially, 24 of the patients (34.8%) passed. There were 4 patients lost to 1-month follow up. Only 40 (90.9%) of the patients who failed their initial home sleep screening (RDI > 15) underwent a follow up at the outpatient clinic of the hospital. Eleven patients refused to receive diagnostic PSG and asked for further treatment. The others received the further hospital PSG. Their severity of apnea-hyponea indices (AHI) were classified as < 5 (1/29), 5-15 (3/29), 15-30 (16/29), > 30 (9/29). Ultimately, 25 patients were diagnosed with moderate-severe OSA. Five of them received non-surgical therapy. The others received the surgical treatment.
Conclusion: This study was performed under the cooperation of 1 hospital and 29 clinics. There were 68 subjects received the home sleep test screening. Twenty-five patients with moderate-severe OSA have received further treatment within 2.1 months. Our strategy to promote sleep apnea screening in the community is feasible and well controlled.

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COGNITIVE TESTING OF SLEEP APNEA PATIENTS USING THE FRONTAL ASSESSMENT BATTERY (FAB)

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Introduction: Cognitive deficits, particularly those related to frontal lobe dysfunction are common in patients with obstructive sleep apnea syndrome (OSAS). The Frontal Assessment Battery (FAB) is a quick (5 to 10 minutes), easy to administer and validated bedside cognitive and

behavioral battery designed to assess the major frontal lobe functions. However, there have been no studies documenting the use of the FAB in testing cognitive function of patients with OSAS.
Methods: We conducted the FAB and Mini-Mental Status Exam (MMSE) on 30 patients (15 M, 15 F, mean age 48.7 years) with suspected OSAS who were scheduled to undergo nocturnal polysomnography (NPSG) at a sleep disorders center.
Results: Fourteen patients (93%) of the 15 patients who underwent NPSG met diagnostic criteria for OSAS, and 24 (80%) of all patients reported difficulty with memory and concentration. FAB scores were abnormal ($\leq$ 15/18) in 9 (30%), borderline (16/18) in 8 (27%), and normal ($\geq$ 17/18) in 13 (43%). The MMSE was abnormal ($\leq$ 24) in 1 (3%), borderline (25 to 26) in 2 (7%), and normal ($\geq$ 27) in 27 (90%) patients. There was trend (P = 0.38) towards lower FAB scores in patients with moderate to severe OSAS compared to patients with mild OSAS.
Conclusion: Many OSAS patients report memory and concentration problems and, despite normal MMSE scores, can have borderline or abnormal scores on the FAB. The FAB can be a useful tool for assessing frontal lobe cognitive function in OSAS patients. By the time of presentation a larger number of OSAS patients will have been studied and a correlation between FAB scores and either OSAS severity or daytime sleepiness will have been determined. Whether the FAB can demonstrate improvements in cognitive function as a response to the use of continuous positive airway pressure (CPAP) also requires study.

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VALIDITY AND REPRODUCIBILITY OF EPWORTH SLEEPINESS SCALE IN OMANI POPULATION

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Introduction: The Epworth sleepiness scale (ESS) is a self-administered eight-item questionnaire that was developed as a tool to measure subjective sleepiness in adults. The validity of ESS had been validated and tested in different population and ethnicity groups but not among Omani people or other Arabic speaking population. The aim of the study was to test the validity and reproducibility of ESS in Omani Arabic speaking population.
Methods: Subjects recruited from the general population and asked to participate in the study between May and October 2008. Bi-linguistic subjects were asked to complete the ESS questionnaire both in Arabic and English languages with a minimum of one day gap. gave an informed written consent and the study approved by local ethical committee.
Results: 97 subjects agreed to participate in the study; 37 males and 60 females, with mean age of 27.9 ± 9 years. Most of the participants do not snore (71.1%) and only 6.2% have sever snoring. Snoring is more among males (66.7%) than females (33.3%). Bland Altman plot showed that 95% limit of agreement (coefficient of agreement) was ± 2.689 with zero average Difference 95% Limits Of Agreement Average Std Dev. (Bland & Altman, 1986) - 0.000 1.369 -2.684 2.684 Correlation between difference and mean = 0.057 Bradley-Blackwood F = 0.153 (P = 0.85860).
Conclusion: this study showed that the Arabic version of ESS is compatible with the English one in healthy subjects and a valid tool to ass for daytime sleepiness among Omani Arabic speaking population.

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A TEST OF INTER-RATER RELIABILITY FOR THE DUKE STRUCTURED INTERVIEW FOR SLEEP DISORDERS

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Introduction: The Duke Structured Interview Schedule for Sleep Disorders (DSISD) was developed to meet the need for a valid and reliable assessment instrument for the full range of sleep disorders. In medical practice settings, a method of brief assessment may prove useful for identification of commonly undiagnosed sleep disorders. The objective of this study was to determine inter-rater reliability of the DSISD, which was modified to evaluate only current sleep disorders (not including parasomnias).
Methods: Two doctoral level clinicians trained in behavioral sleep medicine and general psychiatric diagnosis attended interviews with 17 subjects. In a randomized fashion, Clinician A (or B) interviewed and scored the DSISD while Clinician B (or A) observed and scored the DSISD. Administration and scoring criteria of current symptoms were followed per DSISD guidelines except as noted above. Assessments were coded for the following: primary insomnia, restless legs syndrome (RLS), sleep apnea, behaviorally induced insufficient sleep syndrome, excessive daytime sleepiness, other hypersomnia (inclusive for positive scores on all other hypersomnia diagnoses), and circadian disorders of the shift work, jet lag, and delayed types.
Results: Diagnosis-specific values of inter-rater reliability are as follows: Sleep Apnea (kappa = 0.86), Insomnia (kappa = 1.0), Problem Sleepiness (kappa = 1.0), Circadian Rhythm - Shift Work (kappa = 1.0), and No Disorder (kappa = 1.0). Where kappa values could not be obtained, simple inter-rater agreement was calculated: RLS = 0.93, Voluntary Sleep Deprivation = 1.0, Circadian Rhythm - Jet Lag 1.0, and Circadian Rhythm - Delayed = 1.0. Overall inter-rater reliability was high kappa = .90 (P < 0.05), 95% CI (0.81, 0.99).
Conclusion: The modified DSISD appears to have excellent inter-rater reliability when used in a medical setting. The DSISD can be used to provide reliable preliminary diagnosis of sleep disorders when administered by a clinician with appropriate training.

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COMPARISON OF NOVEL DAILY OBJECTIVE SLEEP MEASURES AND SELF-REPORT

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Introduction: It is well established that older adults have more trouble sleeping than younger adults. Subjective report of poor sleep does not appear to correlate well with actual sleep disturbances in this population. However, comparisons of objective and subjective sleep measures have compared self-report to overnight polysomnography, or a few days of actigraphy. These short-term objective assessments may not capture normal sleep behavior for a given individual. We investigated the use of a novel approach for objective assessment of sleep behaviors.
Methods: Thirty-seven ambulatory community-dwelling elderly subjects (86.8 ± 4.8 years) currently being monitored in their homes as part of an ongoing study were included in this analysis. All subjects had a GDS < 5 (not depressed), and an MMSE > 24 (not demented). The homes of these subjects have been instrumented with pyroelectric sensors, from which data we derived measures of time to bed, time to rise, sleep latency, number of times out of bed and using the bathroom, and restlessness at night over a four week period. Self-report measures of sleep quality were also collected for comparison.
Results: The daily measures of sleep latency, restlessness, time in bed, and number of times subjects got up at night varied widely throughout the month for the majority of subjects. There was a trend towards subjects underestimating their time in bed (t44 = 2.02, P = 0.10) and over-reporting their sleep latency (t43 = 1.78, P = 0.06). Subjects who under-reported their sleep latency actually had the longest sleep latency of any group. Subjects visited the bathroom 96.7% of the times they got up at night, suggesting this may have been the reason the subjects got up.
Conclusion: Self-report data did not correlate closely with our objective data. Further investigation of the detailed patterns of behavior revealed

by our in-home approach may provide additional insights into sleep patterns in this population.

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VALIDATION OF THE INSOMNIA SEVERITY INDEX IN THE SAO PAULO EPIDEMIOLOGIC SLEEP STUDY

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Introduction: Insomnia is one of the most prevalent sleep complaints. The Insomnia Severity Index (ISI) is broadly used as a screening tool for insomnia, and it has never been validated for the Brazilian population or in an epidemiologic study. This study aimed in evaluating the psychometric properties of the ISI (reliability, factor structure, convergent and criteria validity) and validating it, for the population of Sao Paulo city, in Brazil.

Methods: The ISI was administered to 1,042 subjects (mean age 42.34+14.39), representing the adult population according to gender, age (20-80 years), and socio-economic status, who participated in a population-based study concerning sleep. Factor and reliability analysis were performed for structure and internal-consistency of the ISI. Correlations and a linear regression model with the Pittsburgh Sleep Quality Index (PSQI), World Health Organization Quality-of-Life (WHOQOL-Brief), Beck Anxiety (BAI) and Depression (BDI) Inventories, and the Chalder Fatigue Scale (CFS) were used to test convergent validity, and a receiver-operating-characteristic (ROC) curve to test criteria validity (Insomnia by DSM-IV).

Results: The ISI mean score for the population was 7.87+6.06, with a median of 7.0, and a mode of 1.0; while the mean score for insomniacs was 17.33+4.02. Factor analysis evidenced one factor structure, explaining 56% of total variance. Reliability coefficient (Cronbach alpha) was 0.87. The PSQI ($r = 0.77$; beta = 1.1; $P < 0.01$), BAI ($r = 0.42$; beta = 0.05; $P < 0.01$), CFS ($r = 0.44$; beta = 0.17; $P < 0.01$), and physical domain of WHOQOL ($r = -0.52$; beta = -0.05; $P < 0.01$) were in the final model, predicting insomnia severity by the ISI. ROC curve identified a cut-off value of 7.5, with 98% Sensitivity and 80% Specificity detecting insomnia cases.

Conclusion: The ISI was found as an excellent insomnia screening tool, with high sensitivity and specificity. Reliability was also very satisfactory, and there was an important evidence of its measure validity for this population.

Support (If Any): AFIP/FAPESP/CNPq.

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PREDICTING USE OF PORTABLE MONITORING VERSUS POLYSOMNOGRAPHY IN THE PREOPERATIVE CLINIC

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Introduction: Obstructive sleep apnea is highly prevalent in the preoperative population and evidence suggests that it causes postoperative complications. One can use the simple STOP-Bang questionnaire to differentiate between preoperative patients at high or low risk for obstructive sleep apnea. However, even those found to be at high risk of obstructive sleep apnea need a sleep study to confirm the diagnosis. Most sleep centers cannot perform in-laboratory, preoperative, polysomnograms in a timely manner, but portable monitoring is more accessible in this setting.

Methods: We analyzed STOP-Bang scores collected on 996 patients in the Virginia Commonwealth University (VCU) preoperative clinic over a 6 week period. We stratified patients determined to be at high risk on STOP-Bang as to whether they should receive portable monitoring or polysomnograms based on recommendations from the American Academy of Sleep Medicine (AASM).

Results: We found that 43.3% of preoperative patients scored positive on the STOP-Bang questionnaire, a percentage higher than any previously published. Based on the American Academy of Sleep Medicine guidelines, 78.8% were eligible for portable monitoring and only 21.2% required in-laboratory polysomnograms. Clinical history and not the STOP-Bang score most strongly supported the need for a full polysomnogram. Although a near perfect correlation between rising body mass index and rising STOP-Bang values exists, only when the body mass index was 50 or higher did a significant percentage (30.8%) of the patients require polysomnogram.

Conclusion: Seventy-eight percent of preoperative patients scoring positive on the STOP-Bang questionnaire meet criteria for portable sleep apnea testing. Other than morbid obesity, no predictors exist for delineating between a high risk patient's need for portable monitoring or polysomnography.

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THE UTILITY OF A COMPUTERIZED TEST BATTERY FOR MEASUREMENT OF COGNITIVE PERFORMANCE IN OBSTRUCTIVE SLEEP APNEA: PRELIMINARY NORMATIVE VALUES

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Introduction: Neurocognitive impairment is a well documented consequence of obstructive sleep apnea (OSA) but cognitive testing of OSA patients is rarely performed. This is partially due to the costly and laborious nature of traditional testing methods and an absence of test batteries with normative data on OSA patients. This study uses a validated and reliable computerized battery of standardized neurocognitive tests, which can be self-administered in approximately 30 minutes, to assess OSA patients.

Methods: We studied 47 OSA patients diagnosed by polysomnography (Apnea Hypopnea Index [AHI] ≥ 5 or Respiratory Distress Index [RDI] ≥ 15 scored using current AASM guidelines). Each patient completed the Central Nervous System-Vital Signs (CNS-VS) test battery prior to OSA treatment. The CNS-VS battery includes tests of immediate and delayed verbal and visual memory; finger tapping; symbol digit coding; Stroop test; shifting attention; and continuous performance. Results of the CNS-VS are reported as Standard Scores in which the normative sample has a mean of 100 with a standard deviation of 15.

Results: The sample was 44% male. The mean age was 47.8 years old. The mean BMI was 32.5. The mean AHI and RDI were 31.5 and 42.6 respectively. Mean Standard Scores for each neurocognitive domain are: Neurocognitive Index 87.6, Composite Memory 95.6, Verbal Memory 93.0, Visual Memory 99.9, Psychomotor Speed 85.3, Reaction Time 91.0, Complex Attention 82.6, Cognitive Flexibility 85.9, Processing Speed 91.0, and Executive Function 85.0.

Conclusion: OSA patients in this study scored an average of 10.4 points (0.69 standard deviations) below the normative population mean. This is consistent with previous research on cognitive function using traditional testing methods and suggests that computerized neurocognitive tests may be an accessible method of evaluating cognitive performance associated with OSA. These values may provide a preliminary reference point for clinical interpretation of neurocognitive scores in OSA patients.

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FORMANT ANALYSIS OF SNORE SOUNDS IN SIMPLE SNORERS AND OSA PATIENTS

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Introduction: Formant frequencies of snore sounds represent resonance in the upper airways; hence, they may be used as the characteristics features of the upper airways to distinguish between simple snorers (SS) and patients with obstructive sleep apneas (OSA). However, having a priori information about the frequency ranges of each formant improves the accuracy of finding the formants. This information can also be used to classify SS from OSA patients.
Methods: Snore sounds were recorded by a Sony microphone placed over the trachea of 15 (3 females) patients referred to the sleep lab for full night sleep study. Formant frequencies of snore sounds were calculated and automatically grouped into 7 clusters. For each formant, the union of the corresponding formant's clusters in the two groups of SS and OSA patients was assigned as the optimum range of the formant. These ranges were then used as the preliminary information to recalculate the formants of snore sounds of each subject and use the formant frequencies to classify SS from OSA patients.
Results: The optimum frequency ranges of the first three formants (most characteristic) of snore segments were found to be [0-300], [240-640] and [470-1030] Hz; the overlap between the ranges represents the variation in the patients' snore sounds due to different causes of snore. The second formant (F2, ~520 Hz) was found to be significantly different between the two groups. Classification based on using F2 resulted in only one misclassified patient out of 15.
Conclusion: Formant frequency analysis was found to be a promising non-invasive tool for studying snore sounds and classifying the SS from OSA patients. Furthermore, we suggest using the snore sounds recorded over the trachea as they convey more information about the airway structure; hence, resulting in more accurate classification between the SS and OSA patients.
Support (If Any): This project was supported financially by the TR-Labs Winnipeg.

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COMPARISON OF RESPONSES ON TWO SUBJECTIVE SLEEPINESS SCALES IN YOUNG AND OLDER ADULTS

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Introduction: The Karolinska Sleepiness Scale (KSS), a 9-point Likert scale, was developed as a one-dimensional scale of sleepiness. Similarly, visual analog scales (VAS) were developed for the evaluation of instantaneous subjective mood using a non-numeric scale. The aim of this study was to compare responses on the KSS with those on a bipolar VAS (sleepy-alert), to see how closely the responses correspond under different experimental conditions, and in subjects of different ages.
Methods: 25 young subjects (24.8 ± 7.48,7F) and 10 older subjects (63.3 ± 8.08,6F) took part in a 12- or 13-day inpatient sleep-circadian rhythm study. In both studies, subjects took performance test batteries that included the KSS and VAS given in succession. The young subjects experienced a constant routine which consisted of a period of extended wakefulness lasting for 36h. We examined the correlation between KSS and VAS within and across subjects, and further compared this relationship between young and older subjects using paired t-tests. In the young subjects, we also examined the influence of sleep deprivation on the KSS-VAS relationship by comparing data from an 8-hour window that began 2h after wake time to the same window beginning after 26h of sleep deprivation (24h later).
Results: Data from 3 subjects were excluded due to non-compliance with the testing protocol. Overall, scores on the KSS and VAS were highly correlated ($r2 = 0.7243$, $P < 0.0001$). Individual subject correlations ranged from 0.438 to 0.877. There were no significant differences in correlation between the two age groups ($P = 0.417$). The KSS-VAS correlation with and without sleep deprivation could only be done on a subset ($n = 8$) of the young subjects; we did not find a significant difference under the two conditions ($P = 0.6046$).
Conclusion: We found that subjective sleepiness assessments using the KSS and VAS were highly correlated in both young and older subjects, and that ~24h of sleep deprivation did not change this relationship significantly.
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A RANDOMIZED, DOUBLE BLIND, PLACEBO CONTROLLED, CROSSOVER EVALUATION OF NATURAL FREQUENCY TECHNOLOGY ON SLEEP IN NORMAL SUBJECTS WITH UN-REFRESHING SLEEP

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Introduction: The purpose of this study was to test the impact of the Natural Frequency Technology (NFT) found in Phillip Stein™ Watches on sleep parameters in normal healthy individuals who routinely experience un-refreshing sleep. NFT is a sub 7Hz combination of frequencies that are emitted from a watch worn by the sleeper.
Methods: Females (20) and males (8) with an average age of 37.7 years and BMI of 26.5. Subjects underwent two consecutive nights in the sleep laboratory for each of the conditions (Placebo and NFT). There was a 5-7 day washout period between sessions. This was a double blind experiment. Subjects arrived 2 hours before habitual bedtime. They went to sleep at their habitual bedtime and stayed in bed until they woke the next morning. Upon awakening, subjects were asked to complete questionnaires regarding their: Total Sleep Time, Sleep Onset Latency, Minutes Awake in the Middle of the Night, Perception of Refreshment, Epworth Sleepiness Scale, and Dream Quality.
Results: Data analysis was performed using a repeated measures ANOVA and Bonferoni t-tests for post hoc analysis. There were no statistically significant differences noted when comparing placebo to the NFT condition. However, 96% of subjects responded to at least one variable, and the results of those responders indicate: 43% of responders reported feeling more refreshed, 52% reported dreaming was more pleasant, 47% reported falling asleep faster, 39% reported sleeping more minutes, and 36% reported fewer minutes awake when using NFT than placebo.
Conclusion: While the current results are not statistically significant, a substantial number of subjects demonstrated improvements in sleep parameters. Feeling more refreshed after sleep was the primary outcome measure that most clearly separated from placebo. Future studies to determine clinical effectiveness of NFT are suggested in the home environment.
Support (If Any): Support for this study by Phillip Stein, Inc.

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COMPARISON OF TWO CRITERIA FOR SCORING HYPOPNEAS: IMPACT ON THE PREVALENCE OF OSA IN THE GENERAL POPULATION

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Introduction: Apnea-hypopnea index (AHI) is the main polysomnographic measure to diagnose obstructive sleep apnea (OSA) and to assess its severity. The aim of our study was to evaluate the impact of two standard hypopnea definitions on the prevalence of OSA in a middle aged general population sample.

Methods: We analyzed the first 50 subjects (60% women, aged 41-60 years) participating in an ongoing population-based cohort study (HypnoLaus, Lausanne, Switzerland)2. All subjects underwent a complete polysomnographic recording at home, using nasal cannula-pressure transducer for detecting airflow reduction. AHI was calculated using two hypopnea criteria: « Chicago » criteria (> 50% decrease in airflow or a lesser airflow reduction in association with oxygen desaturation > 3% or an arousal) and 2007 American Academy of Sleep Medicine (AASM) recommended criteria (≥ 30% airflow reduction and ≥ 4% oxygen desaturation).

Results: Mean BMI was 25.9 ± 5.6 kg/m2 and mean Epworth sleepiness scale (ESS) was 7.7 ± 4.9. For the whole group, the mean AHI was 10.3 ± 10.1/h using the Chicago criteria and 4.3 ± 6.1/h using the AASM criteria ($P < 0.001$). Considering an AHI threshold of ≥ 5 the prevalence of OSA was 70.2% using the Chicago criteria and 42.5% using the AASM criteria. For an AHI threshold of ≥ 15, OSA prevalence was 25.5% using the Chicago criteria and 4.2% using the AASM criteria. 18% of the subjects had an ESS > 10 and an AHI-CHICAGO ≥ 5 vs 8% when considering an ESS > 10 and an AHI-AASM ≥ 5/h.

Conclusion: Our study demonstrates large differences in OSA prevalence in middle-aged general population when two different definitions are used to score hypopneas. This could have important implications in public health policy and highlights the importance of standardizing methodology in epidemiological studies.

Support (If Any): Swiss National Science Foundation, Center for Investigation and Research in Sleep (CIRS/Lausanne), Glaxo-Smith-Kline

1090

DOUBLE-BLINDING AND SHAM-PLACEBO-CONTROL OF TURBINATE REDUCTION

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Introduction: There is a paucity of randomized, double-blinded, placebo-controlled trials of surgical interventions for obstructive sleep apnea. This pilot study tested the hypothesis that it was possible to blind patients and the surgeon (double-blind) with respect to active versus sham-placebo radiofrequency turbinate reduction.

Methods: In preparation for the surgical trial "Turbinate reduction & CPAP Use: a Randomized, Blinded, OSA Trial" (TURBO Trial), we conducted a pilot randomized, double-blind, sham-placebo-controlled cross-over trial of blinding effectiveness in sleep apnea patients undergoing first-time radiofrequency turbinate reduction. Each patient was treated in standard fashion including local anesthesia and also consented for an additional sham-placebo treatment period immediately before or after (randomly assigned) each active turbinate treatment. After each treatment, the patient and surgeon independently guessed the treatment order and quantified their confidence on a 10-cm visual analog scale (VAS, 0 = absolutely uncertain, 10 = absolutely certain). Perfect blinding would result in 50% wrong guesses (random guessing), and complete unblinding would result in 0% wrong guesses. The percent wrong guesses were statistically compared against 0%, and VAS confidence mean +/- standard deviations were calculated.

Results: We enrolled 30 patients (58 turbinates tested). Patients guessed wrong on 34% of the treatments, statistically greater than complete unblinding (0%, $P < 0.001$). Their VAS confidence shows uncertainty (mean VAS 4.0+/-3.8), even when guessing correctly (mean VAS 4.4+/-3.7). The surgeon guessed wrong 40% of the treatments, statistically greater than complete unblinding (0%, $P < 0.001$). His VAS confidence shows uncertainty (mean VAS 2.9+/-3.3), even when guessing correctly (mean VAS 3.5+/-3.6).

Conclusion: These data demonstrate uncertainty created by blinding to treatment assignment for both the patients and surgeon. While perfect blinding was not achieved, there was a highly significant blinding effect and quantifiable uncertainty. These findings support the feasibility of sham-placebo control and double-blinding in The TURBO Trial. Further methods of sham-placebo control and blinding will be discussed.

Support (If Any): NIH K23 HL068849 (PI Weaver), NIH R01 HL084139 (PI Weaver)

1091

PERCEIVED GAPS IN MULTIDISCIPLINARY TEAM MANAGEMENT OF SLEEP DISORDERS: A MIXED-METHODS APPROACH

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Introduction: The healthcare system as a whole has not adapted to care of patients with sleep disorders (SD). Research investigating inter-disciplinary teams in primary care has identified challenges in team structures and processes. This study examines the challenges of primary care professionals (PCP) in providing inter-disciplinary care for SD, particularly focusing on PCPs and specialists.

Methods: An IRB approved mixed-method approach was employed: qualitative (semi-structured interviews, discussion groups) and quantitative (online surveys) methods. Two studies were carried out: care of patients with (1) Obstructive Sleep Apnea (OSA) Participants: PCP n = 165, Specialists (internists, neurologists, psychiatrists, pulmonologists) n = 12, Patients n = 10 and (2) Shift Work Disorder (SWD) Participants: PCPs n = 216, Specialists n = 108, Patients n = 8.

Results: Healthcare team roles and responsibilities regarding SD were found to be unclear. PCPs appeared more inclined towards an individual approach (with themselves playing a key role) while specialists seemed more inclined towards coordinated care. PCPs reported lacking clarity regarding which SD patients to refer (X OSA = 3.76/5, SD = 0.91; X SWD = 2.88/5, SD = 1.18), and who to refer to (X OSA = 3.96/5, SD = 0.94; X SWD = 3.13/5, SD = 1.21); lack of coordination between PCPs and specialists in treatment and management of SWD patients; and a perception that there is no added value to be gained for patients in referring to specialists and sleep centers. PCPs did not recognize sleep medicine as a distinct specialty, characterizing it as a poorly defined area of expertise. Furthermore, all participant groups reported lack of uniformity in training for sleep specialists, further hindering full recognition of sleep medicine. Participants across OSA and SWD questioned whether specialists know much more than PCPs about sleep disorders.

Conclusion: Gaps have been identified in the inter-disciplinary care of patients with SD. Performance improvement initiatives that address attitudes and team roles and responsibilities are needed. Further, development of a recognized specialist pool is required to support primary care.

Support (If Any): This study was funded by an unrestricted educational research grant from Cephalon Inc.

1092

CAN A ONE-TIME SLEEP SPECIALTY CONSULTATION ENHANCE PROVIDERS' ATTENTION TO SLEEP PROBLEMS IN PRIMARY CARE?

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Introduction: Previous research suggests sleep disorders often are not adequately addressed in the primary care setting. The current study was conducted to determine if recommendations provided by a sleep specialist might positively influence primary care providers' clinical attention to their patient's sleep complaints.

Methods: The study design was a prospective, randomized, clinical intervention trial. The subjects were 141 veterans enrolled in the Primary Care Clinics of the Durham VA Medical Center, with the present analyses including only participants who completed the study thus far (N = 80). Eligible study participants had a sleep complaint > 1 month duration, ≥ 6 on the Pittsburgh Sleep Quality Index, ≥ 24 on the Folstein MMSE, no unstable medical or psychiatric disorders, and no previous sleep specialist treatment. Patients enrolled were randomized to an intervention (INT; N = 40) or wait-list control (WLC; N = 40) group. INT consisted of one meeting with a sleep specialist who administered structured interviews assessing sleep pathology and DSM-IV psychiatric disorders, and then provided manualized treatment recommendations to patients and their respective primary care providers. Providers' referral patterns were then monitored for the 10 month period their respective patients were enrolled in the trial.

Results: Average provider adherence across recommendations was 86% and ranged from 67% (sleep clinic for nightmare rescripting) to 95% (PSG for sleep apnea). Provider-initiated sleep-focused interventions were significantly more frequent in the INT group compared to the WLC group in regard to PSG referrals for Apnea, $\chi 2$ (1, N = 80) = 17.64, P < .0001, PSG referrals any reason, $\chi 2$ (1, N = 80) = 19.24, P < .0001, mental health clinic referrals, $\chi 2$ (1, N = 80) = 6.28, P < .05, and medication for restless legs, $\chi 2$ (1, N = 80) = 4.21, P < .05. INT was not significantly different from WLC for referrals to sleep clinic, PTSD clinic, substance abuse clinic, or the blood lab to check ferritin levels.

Conclusion: A one-time sleep consultation significantly increased primary care providers' attention to sleep problems among their patients.

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1093

"SPONTANEOUS KEY WORDS" (SKY) ENHANCES IDENTIFICATION OF OBSTRUCTIVE SLEEP APNEA PATIENTS BY AGE AND GENDER GROUPS DURING ENCOUNTERS WITH PHYSICIANS

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Introduction: Only 10% of Obstructive Sleep Apnea (OSA) patients are identified during an encounter with a physician. Goals: To identify keywords given spontaneously by the patient during an encounter with a physician, and create a novel "Spontaneous Keywords tool" (SKY) to facilitate OSA diagnosis.

Methods: Between 2002 and 2007, data from 1,984 subjects were collected prospectively prior to the polysomnographic (PSG) study. Statistical analysis: Univariate Analysis, Multiple Response method, Factor analysis. Multiple logistic regression models created SKY. Models were validated versus PSG studies from three sleep centers in Israel. SKY was built among five age groups; four graded models were built in each group. Each model contains the previous model's information plus additions. This approach enables identification of OSA patients in accordance with different levels of information.

Results: The complete model (the fourth in each group) reveals predictive variables for OSA: Among men < 40 years: Complaints > 1: snoring or breathing difficulties, no co-morbidity; spouse report on ≥ 1: deficient daily performance, disruption of quality of family life; BMI ≥ 25 or neck circumference ≥ 40 cm (AUC = 0.693-0.748). Among men 40-64.9 years: Complaints ≥ 1: daily tiredness, snoring, sleep breathing distress; spouse report on falling asleep and decreased daily function; BMI ≥ 28; ≥ 1 co-morbidity: hypertension, diabetes, hyperlipidemia (AUC = 0.620-0.699). Among men > 65 years: ≥ 1 co-morbidity: hypertension, hyperlipidemia; BMI ≥ 30 (AUC = 0.724). Among women < 55 years (before Menopause): Snoring; hypertension; spouse report ≥ 1 not

sleeping in same room, falling asleep during the day, syndrome is ranked as severe; neck circumference ≥ 37 cm (AUC = 0.654-0.674). Among women ≥ 55 years: Breathing difficulties during sleep; drug consumption for mental disorders; neck circumference ≥ 38 cm; no report by a spouse (AUC = 0.609-0.746).
Conclusion: SKY may enhance OSA diagnosis according to gender and age groups.

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PATIENT SATISFACTION: A COMPARISON BETWEEN VIDEOCONFERENCE AND IN-PERSON PATIENT-PHYSICIAN INTERACTIONS

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Introduction: Telemedicine is used in various medical settings. Obstructive sleep apnea is under diagnosed. This will likely continue due to a limited supply of sleep specialists; however, telemedicine may improve access to care. This study compares patient satisfaction in videoconference to in-person interactions in sleep medicine. If satisfaction is equal, sleep specialists may be encouraged to apply telemedicine to increase patient access to specialty care. If patient satisfaction differs, further investigation may be helpful to determine whether the difference affects care, and if so, how to improve patient acceptance.
Methods: A three-question survey regarding patients' satisfaction with their physician was administered at check-out to new patients seen via videoconference or in-person at the Illinois Neurological Institute Sleep Center in Morton, Illinois. Each question was scored on a scale of 1-5; the sum was the patient satisfaction score. Equivalence analysis and chi-square tests were performed using SAS 9.2 software (SAS Institute Inc., Cary, NC).
Results: 210 new patients were seen at the Illinois Neurological Institute Sleep Center - Morton between July and November 2009. Survey results from 63 subjects who met the sleep physician either in-person (n = 40) or via videoconference (n = 23) were analyzed. The groups were similar in age, gender, and ethnicity. A two-sample equivalence t-test using the patient satisfaction scores showed that the two groups are statistically equivalent (mean score for subjects seen in-person, 15.0, and by video, 14.9, P = 0.0002).
Conclusion: The findings indicate patients were equally satisfied with their physician interaction whether they were seen in-person or via video. Videoconferencing may be an effective tool to improve access to patient care without compromising satisfaction with the patient-physician interaction.

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OVERVIEW OF SLEEP RESEARCH GRANTS FUNDED BY THE NATIONAL INSTITUTES OF HEALTH

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Introduction: Sleep and circadian research funding for new and established investigators is supported by virtually all 27 Institutes and Centers of the NIH. As a follow-up to a 1999 publication (Kiley, et al), National Center on Sleep Disorders Research analyzed current funding and research trends.
Methods: Active NIH sleep-related grants during fiscal year 2009 were analyzed to evaluate trends in broad content (i.e. clinical versus basic) and characteristics of investigators. All relevant grant mechanisms, including investigator-initiated and training grants, were included in the analyses.
Results: Of all NIH funded sleep-related grants, 50% of 643 total grants constitute clinical research (CR). The same percentage was reported in 1999 (Kiley et al.) indicating a steady level of CR funded by the NIH. Importantly, three CR grants are Phase III randomized clinical trials (RCTs). The NIH has been committed to encouraging new investigators (NIs) and has recently announced policies to identify early stage investigators (ESIs). They currently represent 21% and 12% of sleep research grants respectively. A higher proportion of NIs (60%) are engaged in CR compared to 49% for senior investigators (P < 0.03). In addition, the proportion of CR applications with human subject (HS) protection issues was higher in ESIs (12%) vs. 4% for non-ESI (P < 0.02).
Conclusion: This evaluation suggests a steady commitment to CR at the NIH. Compared to senior investigators, a higher proportion of NIs is engaged in CR vs. animal or other basic research (P < .03). A higher proportion of ESI grants have significant HS protection issues, which in some cases can impact the success of applications in peer review. This suggests that junior investigators may benefit from guidance on HS issues. Phase III clinical trials are a new development and an added dimension for the NIH-supported sleep research field and this aligns with recent NIH prioritization of translational and comparative effectiveness research.

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THE EFFECT OF A RULE-BASED SLEEP-IMPROVING PROGRAM ON ACTIGRAPHIC SLEEP IN COLLEGE STUDENTS

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Introduction: College students tend to sacrifice their sleep for academic and/or social purposes. Although the sleep problem may have an impact on their emotion regularity, cognitive performances and academic performances, many students may neglect the problem or not being able to find an effective solution to it. The current study is to test the effect of a rule-based sleep-improving program based on the principles of cognitive behavior therapy for insomnia and sleep hygiene education in college students.
Methods: Six college students with Pittsburgh Sleep Quality Index (PSQI) scores > 5 participated in the study. They had to wear actigraphy and record sleep logs for 4 weeks. The participants had to return to the lab to retrieve actigraphy data and to receive advisory on their sleep every 3 or 4 days. Some rule-based instructions were given for them to adjust their sleep schedule according to their sleep from actigraphy. In addition, they were required to fill out the Insomnia Severity Index (ISI) and the Epworth Sleepiness Scale (ESS) prior to the start of the program, 2 weeks after, and after completion of the 4-week program. They were also required to fill out the PSQI before and after the program. Nonparametric analysis was used to examine the intervention effects.
Results: Participants were shown to improve significantly on the PSQI (Z = -2.041, P = .041) and the ESS (Chi-square = 8.435, P = .015) and approach significantly on the ISI (Chi-square = 5.727, P = .057). On the actigraphy, significant improvement was obtained on sleep efficiency (Chi-square = 14.133, P = .007) only, but not on the other sleep parameters.
Conclusion: The results supported that a rule-based program based on actigraphic sleep may be able to enhance sleep quality and to decrease sleep disturbances and daytime sleepiness in college students.

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SLEEP PRESCRIPTION EFFICACY ON SELF-IMPOSED SLEEP DEBTORS' OBESITY/COGNITIVE RISK

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Introduction: Women habitually curtail sleep to respond to family, work, and lifestyle demands resulting in sleep debt. Chronic sleep debt

is robustly associated with signs of metabolic syndrome such as obesity and diabetes risk, impaired cognitive acuity, and mood state liability. But, sleep deficits are generally treatable by interventions.
Methods: Proposed aims are to: 1) test the efficacy of a brief sleep hygiene prescription, Sleep Yourself Thin and Sharp (Pillar I), a 12 week commitment to 8 hours of sleep nightly for women with self-imposed, chronic sleep debt and daytime sleepiness; and, 2) account for the influence of Nurse Coaching (Pillar II), a weekly nurse motivational telephone call to participants to strategize behavioral adoption of the sleep prescription. A sample of 180 healthy, but overweight-to-moderately obese women with metabolic syndrome indicators but without diabetes or sleep disorders will be enrolled. A portable polysomnography/actigraphy system evaluation in the home will rule out sleep disorders. Participants will be randomly assigned to the sleep intervention with a Nurse Coach (n = 60), sleep intervention without a Nurse Coach (n = 60), or control group (n = 60). Data collection will be conducted at baselines, mid-intervention (week 7), and post-intervention (week 12). The control group will receive basic information about healthy living including optimal sleep hygiene upon enrollment. Sleep measures include sleep profile: history, efficiency, daytime sleepiness, cumulative sleep/debt will be evaluated with portable polysomnography/actigraphy system.
Results: Sleep measures, metabolic factors, cognitive acuity and mood, lifestyle/cultural barriers to sleep, and intervention drift will be evaluated. A mixed model of repeated measures and logistic regression analysis will be used to model unique and relational contributions on optimal sleep achievement.
Conclusion: If a brief, cost-effective sleep prescription shows efficacy, a population based prevention strategy that transcends science of health disparities is possible to mitigate sleep debt's contribution to the national obesity epidemic.
Support (If Any): A pilot project has been funded by Laura W. Bush Institute for Women's Health for the 2009-2010 Women's Health Innovation Fund Grant program.

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ICF CORE SETS FOR PERSONS WITH SLEEP DISORDERS: RESULTS FROM THE MAY 2009 CONSENSUS CONFERENCE

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Introduction: The International Classification of Functioning, Disability, and Health (ICF) is the WHO framework for measuring health and disability at both individual and population levels. The ICF is based on an integrative bio-psychological model and includes 1424 etiologically neutral and mutually exclusive categories. The ICF Core Sets are a selection of categories of the ICF, which are relevant to specific health conditions or settings. An initiative to develop ICF Core Sets for Sleep Disorders was jointly sponsored by the World Association of Sleep Medicine (WASM), and the WHO.
Methods: During the preparatory phase of Phase I, four studies were conducted to identify an initial subset of ICF categories relevant to sleep and sleep disorders (n = 227). The final step of Phase I included an ICF Consensus Conference held at Notwill, Switzerland from May 28-30, 2009. An invited, international panel of 26 sleep clinicians and researchers, stratified by WHO region, professional specialty, and gender used the 227 candidate categories to iteratively reach consensus.
Results: The final Comprehensive ICF Core Set for Sleep Disorders includes 120 categories and the Brief ICF Core Set for Sleep Disorders includes 15 categories: 5 body functions (sleep, energy and drive, attention, consciousness, respiration functions); 3 body structures (brain, respiratory system, pharynx); 4 activities and participation (focusing attention, driving, handling stress and other psychological demands, carrying out daily routine); and 3 environmental factors (immediate family, health system, and health professionals).
Conclusion: A formal consensus process integrating evidence and expert opinion based on the ICF led to the adoption of the ICF Core Sets for Sleep Disorders. Phase II will involve implementation and validation of these Core Sets by WASM members.

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"SPONTANEOUS KEY WORDS" (SKY) GIVEN BY PATIENTS DURING ENCOUNTERS WITH PHYSICIANS CAN IDENTIFY OBSTRUCTIVE SLEEP APNEA (OSA) BY GENDER

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Introduction: Despite the widespread use of questionnaires, only 10% of OSA patients are identified during encounters with their primary care physician. Goals: To examine a novel tool that may ameliorate OSA diagnosis in accordance with gender, using "Spontaneous Key Words"(SKY) expressed by patients during patient-physician encounters.
Methods: During 2002-7 we recruited, prospectively, 1,734 subjects. Data were collected prior to the Polysomnographic (PSG) study. Statistical analysis: Univariate Analysis (independent variables were grouped into four categories: physical measures, complaints, co-morbidity, complaints reported by spouse), Multiple Response method, and Factor analysis. With multiple logistic regression models we created the SKY tool for OSA diagnosis. Models were validated versus PSG studies from three sleep centers in Israel. Four graded models were built in each group. Each model contains the previous model's information plus additions. This approach enables identification of OSA patients in accordance with different levels of information. In the SKY tool, variables (words) were grouped according to the following example: "sleep breathing distress" represents complaints of "sleep breathing difficulties", "choking", or "nocturnal breathing pauses".
Results: The complete model (the fourth in each group) reveals predictive variables for OSA: Among men: BMI $\geq$ 28; presence of $\geq$ 1 morbidity: hypertension, diabetes, hyperlipidemia; complaints $\geq$ 1: excessive day time sleepiness, snoring, breathing difficulties during sleep; spouse reporting patient falling asleep and decreased daily function. Among women: neck circumference $\geq$ 37 cm; habitual snoring; hypertension and/or drug consumption for mental disorders five years preceding OSA diagnosis. Validation of the key words tools yielded sensitivity between 67.6% and 73.2% for men (AUC = 0.650-0.697), and sensitivity range of 52.9%-75.6% for women (AUC = 0.648-0.771). PPV was 82.4% and 88% among men and women, respectively.
Conclusion: Keywords expressed spontaneously during patient-physician encounters may help physician to increase the level of suspicion for the presence of OSA.

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CAN VIDEO EDUCATION IMPROVE COMPLIANCE WITH POSITIVE AIRWAY PRESSURE (PAP) AND ENHANCE PATIENT SELF-EFFICACY IN MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA (OSA)?

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Introduction: Despite advances in device technology, adherence to PAP is challenging. Herein, we report the results of a study designed to

explore the impact of a PAP education video on self efficacy and PAP adherence.
Methods: Prospective, randomized controlled study of newly diagnosed OSA patients starting PAP who received usual care (n = 78) versus usual care and plus video education (n = 78). At baseline and 1-month follow-up, functional outcomes, self efficacy, and PAP compliance were measured. Video participants completed a survey rating their perceptions of video effect using a 1-9 point Likert-type response scale.
Results: Average PAP hours of use per night on days used (P = .214) and percent nights of PAP use (P = .843) did not differ between groups. Total Functional Outcome of Sleep Questionnaire (FOSQ) scores increased significantly from baseline to one month in both groups (P = .000) even after adjusting for baseline scores (P = 0.000). Video groups scores averaged 3.300 (SD = .464) at baseline and 17.90 (SD = 1.87) at one month; usual care scores averaged 3.21 (SD = .548) at baseline and 17.953 (SD = 1.814). The Stanford Self Efficacy score increased significantly for the video group (P = 0.0042) compared to usual care (P = 0.2575). However, using ANCOVA to adjust for baseline scores resulted in no significant differences between groups. Sixty-two percent of participants reported the video had very positive (score of 8-9) impact on their attitude; 52% reported it greatly impacted their use of PAP; and 68% reported it greatly increased self-confidence.
Conclusion: Findings are mixed. Although the majority of patients receiving video education in addition to usual care reported positive impacts of the video, no objective differences were found in PAP compliance or questionnaire responses regarding functional outcomes and self-efficacy.
Support (If Any): This study is funded by the Department of Pulmonary Critical Care and Department of Nursing Mayo Clinic Rochester, MN

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CPAP ADHERENCE DOES NOT DIFFER IF PATIENTS ARE SEEN BY THE PHYSICIAN VIA VIDEOCONFERENCE OR IN-PERSON

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Introduction: The primary treatment for obstructive sleep apnea is continuous positive airway pressure (CPAP). Access to diagnosis and adherence to treatment remain barriers to success. Telemedicine may allow greater access to care, however its effect on treatment adherence is unknown. This study compares treatment adherence of patients seen by videoconference versus those seen in-person. If adherence does not differ, sleep specialists may be encouraged to apply telemedicine to increase access.
Methods: A retrospective data analysis using the database of patients treated at the Illinois Neurological Institute Sleep Center - Morton was performed. Patients were initially seen by videoconference or in-person. CPAP adherence was compared using two variables over two consecutive weeks (percentage of nights CPAP is used for ≥ four hours and average minutes of CPAP use per night). SAS 9.2 (SAS Institute Inc., Cary, NC) was used to perform two-sample t-tests and a chi-square test for the analysis.
Results: 98 subjects who met the sleep physician either in person (n = 50) or via videoconference (n = 48) were selected for analysis. The groups were similar in age and gender. Mean percent of nights CPAP was used over four hours did not differ between groups (62.88% for in-person, and 62.92% for video visits, P = 0.99). Average minutes per night of CPAP use also did not differ between groups (302.0 minutes for in-person, and 293.4 minutes for video visits, P = 0.80). Since the P-values are greater than 0.05, the null hypothesis will not be rejected and we can conclude there is no difference between the groups.
Conclusion: The findings indicate that treatment adherence is not compromised with the use of videoconferencing to communicate with patients. This suggests that videoconferencing may be an effective tool to increase access to patient care.

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WHAT DOES THE GENERAL PUBLIC ASK ABOUT ON A SLEEP HEALTH WEBSITE? COMPARISON TO SLEEP CLINIC DIAGNOSES

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Introduction: Netwellness™ is a non-profit consumer health web site that provides high quality information by medical faculty at the University of Cincinnati, Case Western Reserve University, and The Ohio State University. Any individual with internet access can submit free anonymous health questions that will be answered by a health-care professional in the topic area of question, including Sleep Medicine. We hypothesized that sleep questions submitted would reflect common sleep disorders seen in Sleep Clinics.
Methods: All sleep-related questions submitted between March of 2004 and December of 2008 were categorized according to the International Classification of Sleep Disorders (ICSD) by a Board Certified Sleep Specialist. Questions lacking sufficient information for a presumptive diagnosis were listed as unspecified. The major diagnostic categories were then compared to the primary sleep diagnoses for new patients seen in an urban academic Sleep Clinic between January and June of 2008. Chi-square analysis was used to compare diagnoses.
Results: Three hundred and eleven questions were received during 57 months of data collection (average 5.5 / month). The presumptive diagnoses were compared to the diagnoses of 544 new patient Sleep Clinic encounters. Internet questions covered the full spectrum of sleep disorders. The profile of diagnoses by internet questions was significantly different compared to Sleep Clinic diagnoses (P < 0.001): hypersomnia 10 vs. 3.3%, parasomnias 21.5 vs.0.4%, circadian rhythm disorders 5.1 vs. 0.9%, sleep-related breathing disorders 15.4 vs. 54.6%, insomnia 10.6 vs. 8.6%, movement disorders 3.9 vs. 4.6%, and unspecified 18.6 vs. 27.6%. An additional 14.8% of the internet questions could be classified by the ICSD as isolated symptoms, other sleep disorders, appendix A disorders and appendix B disorders.
Conclusion: Sleep health information sought by internet users differs from what is seen in Sleep Clinic. Limited knowledge about sleep disorders or a reluctance to seek medical help for certain sleep disorders may be important factors.

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QUALITY IMPROVEMENT EXPERIENCE OF A COMMUNITY BASED SLEEP CENTER

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Introduction: Delivering quality medical care in a cost effective manner has become a very important landmark of health care services. This abstract focuses on key indicators of patient satisfaction; essentially "Overall Rating of Care".
Methods: Patients who underwent overnight polysomnogram in our Sleep Center were surveyed by an outside research organization. Based on responses, staff focused on initiatives emphasizing patient education and communication. Historically, patient feedback indicated greatest gain occurred focusing on "Information and Education" of the patient equaling a high correlation to "Overall Rating of Care". Specific initiatives included; patient education, detailed explanation of interventions during the study, availability of "Over the Counter" medications, and referring providers ensuring quicker follow up after the sleep study.
Results: "Overall Rating of Care" is calculated by combining patient responses of excellent, very good, and good for the time period (April 2008 - September 2009). Our sleep Center scored an average positive score of

96.88%. This is significantly higher than the time period of January 2007 through March 2008. (96.12%) The 0.76% improvement in positive score between the two time periods may not appear significant; however with a sample size of 15 per month, it takes one patient to significantly influence our scores either positively or negatively. The fourth fiscal quarter (July - September) 2009, we have experienced ZERO negative responses to the overall rating of care question. This compares to the vendors comparative data base where national and state sleep centers scored 96.1 % positive score. This data is compared nationally and in the state of Wisconsin among other sleep centers participating in this survey process.

Conclusion: Optimum patient comfort is extremely important in improving sleep efficiency and overall yield of the Sleep Study. Rectifying minor patient problems yields major improvement in overall quality of patient's experience at the Sleep Center.

1104

A SURVEY OF PSYCHOLOGISTS ASSESSING THE TRAINING AND AVAILABILITY OF PSYCHOLOGICAL SERVICES FOR THE TREATMENT OF INSOMNIA

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Introduction: Research suggests that approximately 10-30% of psychiatric and primary care patients report symptoms of insomnia. Although extensive research on Cognitive Behavioral Treatments for Insomnia (CBT-I) has been conducted, elucidating that effects of CBT-I are faster acting and longer lasting than pharmacological treatments, these methods are still greatly underutilized by psychologists and healthcare practitioners alike.

Methods: Psychologists were surveyed to investigate their familiarity with interventions for the treatment and management of insomnia and their utilization of these interventions. The link to a 10-item web survey was distributed via listserv to members of a state psychological association. To date, 38 psychologists have completed the survey.

Results: Participants reported an average of 45.6% of clients in their practices experiencing some symptoms of insomnia - higher than previous research estimates. Approximately 10% reported not having received any training to treat insomnia, while 84% report using books/treatment manuals to educate themselves, and 55% reported receiving training through continuing education workshops. Only a small percentage (< 25%) have received formal specialized training. All but one participant reported utilizing relaxation techniques as an intervention strategy to help alleviate insomnia symptoms. When asked to rate the effectiveness of various interventions (from 1 not at all effective to 5 extremely effective, and 6 don't know), respondents rated relaxation techniques the highest (mean rating 4.1) with cognitive therapy to address sleep-related worries and hypnosis rated as the next highest (each receiving a rating of 3.7). Moreover 52.6% and 32% indicated they were unaware of the effectiveness of sleep restriction and stimulus control, respectively.

Conclusion: Preliminary results provide support for increased dissemination of research findings and insomnia intervention training, especially considering the relatively large percentage of patients experiencing insomnia symptoms that present to psychologists.

1105

SLEEP, SLEEPINESS, AND MOOD IN PEDIATRIC RESIDENTS BEFORE AND AFTER ACGME WORK HOUR CHANGES

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Introduction: In July 2003, ACGME mandated work hour restrictions for all U.S. residency training programs. Few studies have evaluated the impact of these regulations on resident functioning and on sleep habits. We compared sleep, sleepiness, and mood in pediatric residents during light and heavy call months before and after work hour changes.

Methods: Between 10/2001 and 7/2003, sleep and functioning were assessed in 34 pediatric residents (PRE; 18 women, 14 PL-1s, mean age 28.7 ± 2.7 years) at the end of a month of light/no call (LC) and a month of heavy call (HC; q 4 or q 5). Sleep was monitored by actigraphy for the week before each session. Participants also completed a questionnaire about sleepiness (Epworth Sleepiness Scale [ESS]) and mood (Profile of Mood States [POMS]) for the previous month. From 4/2006 to 11/2008, 34 pediatric residents (POST; 23 women, 22 PL-1s, mean age 28.1 ± 2.1 years) completed the same actigraphy and questionnaire procedures at the end of a light and heavy call month.

Results: One-week actigraphy indicated that sleep duration was shorter (323.6 ± 52.0 vs. 369.1 ± 75.9, P = .018) for the HC PRE vs POST sample. ESS scores were higher during HC vs LC months (P < .001) for both groups, but HC and LC ESS scores did not differ between groups. POMS subscale scores for both groups were higher during HC vs LC for Tension/Anxiety (P < .001), Depression/Dejection (P = .001), Anger/Hostility (P < .001), and Confusion (P = .001). Fatigue scores were higher (P = .001) and Vigor scores were lower (P < .001) during the heavy call month for the PRE sample only.

Conclusion: Residents continue to experience sleepiness and worse mood during heavy call despite reduced work hours; in particular off-duty sleep duration did not change. Mechanisms responsible for behavior changes require further examination.

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RECOGNITION OF DRIVING PERFORMANCE IN POST CALL RESIDENTS

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Introduction: The performance of post call residents is known to be deteriorated and prompted several work hour regulations in the United States. There is few data regarding driving performance in post call residents. It is also known that subjective recognition is often times dissociated with objective performance in sleep deprived subjects.

Methods: We evaluated driving performance in 4 healthy volunteered residents on post call day and non-post call day. Questionnaires including self estimated driving ability (SEDA) and Epworth sleepiness scale (ESS) were asked. Subsequently, driving simulator study (DSS) was performed. Correlation between questionnaires (including SEDA and ESS) and objective driving performance was analyzed.

Results: Average age was 25.5 and all of them were men. Average self-reported sleep time was 2.5 hours on post call day and 5.3 hours on non-post call day. On post call day, there is significant worsening of lane variability in 3 individuals out of 4. There is significant difference in average SEDA before and after DSS (72.5% vs 53.8%, P = 0.043). On non-post call day, there was no difference (91.3% vs 83.5%, P = 0.1). Only SEDA after DSS was negatively correlated with lane variability in DSS with statistical significance (correlation coefficient = -0.79, P = 0.02)(Fig 5). ESS and SEDA before DSS did not show statistically significant correlation with lane variability (P = 0.067, P = 0.052).

Conclusion: Even with limited sample size, it seems that ESS and self estimated driving ability without DSS may not be used as appropriate parameters of actual driving performance. Self estimation of actual driving ability can possibly be disturbed as well as driving performance itself on post call day.

1107

THE INCREASING ROLE OF PHYSICIANS' ASSISTANTS AND NURSE PRACTITIONERS IN SLEEP MEDICINE: EDUCATIONAL AND PRACTICE IMPLICATIONS

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Introduction: The field of Sleep Medicine is growing exponentially, with a greater number of Sleep Physicians and, increasingly, the valuable resource of physician's assistants (PAs) and nurse practitioners (NPs). However, there currently is no formal Sleep Medicine track in the curriculum of these clinicians to provide a firm foundation of sleep knowledge and expertise. Incorporating a sleep disorders educational module is suggested to fill this need, particularly in light of the looming significant yearly decrease in the supply of board-certified Sleep Specialists.
Methods: Statistics from AASM, ABIM and national organizations representing PAs and NPs were analyzed; in addition, interviews and surveys were reviewed from over 125 NPs and PAs who attended sleep-themed seminars and courses.
Results: Public education initiatives regarding sleep and sleep disorders have greatly enhanced awareness regarding sleep and demand for sleep medicine services, accompanied by a steep rise in the number of board-certified Sleep Specialists over the last decade. However, after the 2011 exam only fellowship-trained sleep physicians (now approximately 160/year) will be board eligible. PAs and NPs already play a crucial role in a variety of medical practices. Many have received post-graduate Sleep Medicine training on the job or in courses (some now specifically designed for NPs and PAs), and currently practice clinical Sleep Medicine- including medication oversight, behavioral medicine intervention, and CPAP monitoring and compliance, uniformly enhancing value to their practices.
Conclusion: Looking ahead, increasing numbers of patients and decreasing numbers of physicians eligible for board certification will result in non-physician clinicians playing an increasingly important role in Sleep Medicine. Sleep-related issues now also wield considerable influence in shaping public health policy, further escalating the need for Sleep Medicine expertise. The goal of effectively meeting that demand would be more readily achieved by training PAs and NPs comprehensively in Sleep Medicine as part of their core curriculum which would enhance patient care in primary care, specialty medicine, and sleep medicine practices.

1108

NAPPING DURING NIGHT SHIFT: NATIONAL PERSPECTIVES OF CRITICAL CARE NURSE MANAGERS

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Introduction: The critical care environment requires nurses to have specialized skills and to engage in rapid decision-making on a 24-hour basis. Nurses working night shifts experience sleep deprivation, sleep disturbance, and fatigue contributing to impaired health, errors and injury. Napping is a known effective strategy to improve work performance, reduce fatigue, and increase vigilance, yet is not well supported in nursing. Perceptions of nurse managers with respect to napping have not been fully explored. Addressing this knowledge gap may help explain the lack of universal adoption of napping by critical care nurses and offer direction for effecting organizational change.
Methods: A Canada-wide, web-based survey of nurse manager members was conducted through the Canadian Association of Critical Care Nurses. The 30-item survey contained closed and open-ended questions related to management perceptions of napping practices by staff on the manager's unit, the impact of napping or not napping on nurse and patient safety, and organizational factors associated with napping or not napping.
Results: Forty-eight nurse managers from across 9/13 provinces and territories participated in the online survey. The majority of subjects (89%) had over 10 years critical care experience, 56% had six or more years in the role of manager, and 71% worked in a mixed intensive care unit, where staff typically worked 12 hour shifts (83%). Most (96%) were aware nursing staff napped, yet had no designated nap room (83%) or written napping policy (75%). Although only 17% somewhat or strongly disapproved of nurses napping, 46% felt management colleagues somewhat or strongly disapproved, and 52% felt senior administration somewhat or strongly disapproved of nursing staff napping during breaks on night shift. Tiredness was identified with incidents of patient safety (40%), nurse work injury/near injury (19%), and accidents/near accidents on the drive home (46%). Sleep inertia, safe patient coverage and problems related to a lack of a designated nap room were identified by managers as concerns associated with nurses napping.
Conclusion: Nurse managers recognize benefits, barriers and concerns related to napping by critical care nursing staff on night shift breaks. The findings of this study support that comprehensive educational and organizational approaches that address the needs and issues of all key stakeholders are fundamental to facilitating napping as a safe, effective and supported strategy for critical care nurses.
Support (If Any): Program of research supported by the Dr. John Wade Research Award, Manitoba Institute for Patient Safety.

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FIVE-YEAR TRENDS OF SEDATIVE-HYPNOTICS USE IN JAPAN

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Introduction: Although many epidemiological studies have shown that insomnia and comorbid mental disorders are very common in Japan, the Japanese generally hesitate to take sedative-hypnotics for their symptoms. As a result, prescription rate of sedative-hypnotics in Japan is believed to be lower than Western countries, however, we lack sufficient data from large-scale surveys. This study aimed to reveal the current status and 5-year-trend of sedative-hypnotics use among Japanese with the use of large-sized health insurance data from the general population.
Methods: Data were derived from medical fee receipts of approximately 330,000 people enrolled in multiple health insurance associations in Japan between 2005 and 2009. The data sets for three-month-period (April 1 - June 30) each year were retrieved from patients (0 to 74 years) who were prescribed at least one sedative-hypnotics and/or antidepressants available in Japan (including 22 hypnotics, 19 antidepressants, 21 anxiolytics and 32 antipsychotics) during the study period.
Results: Three months prescription rates of hypnotics, antidepressants, anxiolytics and antipsychotics in 2005 were 2.9%, 1.7%, 3.6% and 0.6%, respectively. The prescription rate of hypnotics and anxiolytics increased with advancing age in both men and women, and consistently increased during the 5 years especially in women of 65 and older. The prescription rate of antidepressants was highest among men aged around 40 and among women aged 65 and over, and also consistently increased during the 5 years. Though the prescription rate of antipsychotics slightly increased with advancing age in men and women, these rates remained unaltered during the 5 years. Conversely, dosage of sedative-hypnotics, antidepressants, anxiolytics and antipsychotics remained unchanged in all age groups throughout the 5 years.
Conclusion: Prescription rates of sedative-hypnotics in Japan remained at a low level as of 2005. However, we revealed that the rates are increasing yearly.

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MORTALITY HAZARD ASSOCIATED WITH ANXIOLYTIC AND HYPNOTIC DRUG USE

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Introduction: Although widely used in the general population, anxiolytic and hypnotic drugs have been associated with undesirable outcomes. Reports about the association of these drugs with an elevated mortality rate are inconsistent and controversial. This study was designed to assess the mortality hazard associated with anxiolytic and hypnotic drug use in the National Population Health Survey in Canada. It was hypothesized that anxiolytic and hypnotic drug use would be associated with an elevated mortality hazard.

Methods: A population-based sample of 14,117 individuals aged 18 to 102 years participated in a longitudinal panel survey, with data collected every second year from 1994 to 2007. The primary outcome measures reported in this study are self-report use of anxiolytic and hypnotic drugs, and death. Mortality risk model was calculated using a discrete time survival analysis, with times of observation and sedative drug use as time-varying covariates. A second model controlled for confounding factors by including time-constant covariates (sociodemographic variables) and time-varying covariates (lifestyle and health variables).

Results: During the 12 years of observation, prevalence of hypnotic drug use ranged from 3.16% to 6.02%, and prevalence of anxiolytic drug use ranged from 2.99% to 4.60%. Respondents who reported either anxiolytic or hypnotic drug use in the past month had a significantly higher mortality ratio (3.22 [95%CI 2.70 to 3.84]) than those who did not use anxiolytic or hypnotic drugs in the past month. After controlling for confounding sociodemographic, lifestyle, and health factors (including depression), the odds ratio was reduced to 1.36 [95%CI 1.09 to 1.70], but remained significant.

Conclusion: Sedative drug use is associated with a small but significant increase in mortality risk. Further research is required to confirm the mechanisms by which sedative drug use increases mortality risk. Where possible, physicians should systematically consider possibilities for non-pharmacological treatment of sleep disturbances and anxiety.

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MODAFINIL USE IN A FEDERAL HEALTHCARE FACILITY

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Introduction: Modafinil is an FDA approved wakefulness-promoting agent for the treatment of excessive daytime sleepiness in narcolepsy, residual sleepiness after CPAP therapy for sleep apnea, and for shift work sleep disorder. We undertook a survey of prescribing practice for modafinil in a large tertiary-care federal hospital to determine the prescriptive patterns, indications, and off-label usage.

Methods: This is a retrospective, descriptive study utilizing electronic chart review, of current active modafinil and methylphenidate prescriptions. The modafinil charts were reviewed for demographics, dosage, indications determined by ICD-9 code, length of therapy, and prescribing service. At this facility there are > 90,000 registered patients and modafinil must be approved by pharmacy service before it is dispensed.

Results: At the time of review there were 77 active modafinil prescriptions (as compared to 103 active prescriptions methylphenidate, all formulations, which does not require prior approval). Males accounted for 88% and females, 12%, age range 40 to 91 years. Dosages ranged from 100 to 800mg daily, and length of use from 1 month to 9 years. Indications were for sleep disorders 58% of the time with the remainder under the category of off-label usage. The most common indication was narcolepsy/ cataplexy (36% of all prescriptions), followed by residual sleepiness after CPAP therapy for sleep apnea; None were for shift work sleep disorder. Prescribing services for FDA indicated usage were heavily weighted with pulmonary/sleep disorder service and primary care providers. Off-label indications were predominantly for multiple sclerosis (35% of all patients) and some psychiatric disorders (7%), and were prescribed by the appropriate services.

Conclusion: Modafinil is issued almost as much as methylphenidate formulations. More than half of modafinil prescriptions were for what might be considered FDA indications but in a center where issuing drugs requires prior pharmacy approval, 42% fell under off-label indications.

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CORRELATION BETWEEN BODY MASS INDEX, SLEEP DURATION AND SLEEP QUALITY: AN EPIDEMIOLOGICAL STUDY

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Introduction: Sleep duration has been associated to obesity in many epidemiological studies. Most of them relied on sleep questionnaires. Our study is aimed to evaluate the association between sleep duration measured by actigraphy, sleep quality measured by polysomnography and body mass index.
Methods: A significant sample of the city of Sao Paulo (Brazil) including 1042 individuals, from both genders, was assigned to participate to this protocol. All volunteers performed actigraphy for 3 days and whole night polysomnography. Weight and height were measured at the entrance. Sleep duration was calculated by analysis of the actigraphic register. Sleep quality index (SQI) formula was: slow wave sleep + REM sleep time / stage 1+stage 2. Linear regression analysis was performed between sleep and weight parameters.
Results: Sleep duration measured by actigraphy was negatively correlated to body mass index (BMI) (R-0.104 P = 0.041 n = 1042), this correlation was significant for both genders. Correlation between BMI and sleep duration was not significant when BMI > 25 or BMI < 18. Correlation was not significant when age > 65 years. Correlation was not significant when apnea/hypopnea index (AHI) < 5 or > 30. SQI correlated negatively with BMI (R = -0.138 P < 0.05). This correlation was significant for women (R = -108 P < 0.05) but not for all men Negative correlation between SQI and BMI was significant for men with BMI > 18 and < 24 as well as for women.
Conclusion: There was a significant negative correlation between sleep duration and BMI when AHI > 5 and < 30, and age < 65. There was a significant negative correlation between sleep quality and BMI. These data suggest an association between sleep shortage and overweight during intermediate stages of weight gain and sleep apnea.

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OVERLAP IN DIFFERENT SLEEP DISORDERS IN THE SAO PAULO EPIDEMIOLOGIC SLEEP STUDY

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Introduction: The aim of this study was to evaluate the prevalence of the most important sleep disorders in the adult population of Sao Paulo city, Brazil, and to investigate overlap in the frequencies of these disorders.
Methods: A population based survey adopting a probabilistic three-stage cluster sample of the Sao Paulo city was used to represent the population according to gender, age (20-80 years), and socioeconomic status. Questionnaires and full night in-lab polysomnography were used to determine 1) Obstructive Sleep Apnea Syndrome (OSAS) defined according to the International Classification of Sleep Disorders-2, 2) Insomnia (INS) defined according to the Diagnostic and Statistical Manual of Mental Disorders-IV, and 3) Restless Legs Syndrome (RLS) defined by the International Restless Legs Scale.
Results: A total of 1042 volunteers underwent to polysomnography (refusal rate = 5.4%). Mean age was 42 ± 14 yrs, 54% were women, and 60% presented body mass index > 25 kg/m2. From the entire population, 55.4% (95%CI 50.9-59.8) presented no sleep disorders. The prevalence of OSAS was 32.9% (28.5-37.5), INS was 15% (12.0-18.5), and RLS was 6% (4.3-8.3). A Total of 25.2% (21.3-29.6) showed OSAS only, 7.7% (5.2-10.1) INS only, and 3.1% (2.1-4.5) RLS only. Overlap of OSAS+INS was observed in 5.8% (3.7-9.0), OSAS+RLS in 1.5% (0.7-2.3), INS+RLS in 1.0% (0.5-2.3), and OSAS+INS+RLS in 0.4% (0.1-1.2).
Conclusion: Almost half of the adult population of Sao Paulo city presented at least one of the three most important sleep disorders. OSAS was the highest in prevalence. Approximately half of subjects who had INS or RLS had also an overlap with other sleep disorder, while OSAS for the majority happened by itself.
Support (If Any): AFIP, FAPESP, CNPq

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CORRELATES OF ELEVATED FATIGUE AND SLEEPINESS IN THE GENERAL POPULATION

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Introduction: While fatigue and sleepiness are considered distinct symptoms, few studies have examined them simultaneously and there is a dearth of evidence regarding their respective correlates. The aim of this study was to examine the demographic, sleep, physical and mental health correlates of elevated fatigue and sleepiness in a population-based sample.
Methods: Participants were 1583 adults (mean age = 49.7; 64.2% women) taking part in an epidemiological study on insomnia in the general population. They completed postal questionnaires, including the Epworth Sleepiness Scale (ESS) and the Multidimensional Fatigue Inventory (MFI). To identify participants with elevated sleepiness or fatigue, cut-off scores corresponding to one standard deviation above the whole sample mean on the ESS (x > 12.72) and MFI (x > 60.21) total scores were determined. Using these cut-off scores, participants were then classified as having either elevated sleepiness (n = 198), elevated fatigue (n = 185), both elevated sleepiness and fatigue (n = 78), or neither fatigue nor sleepiness (n = 1122). Chi-square tests were computed to examine the associations of fatigue and sleepiness subgroups with demographic variables as well as the presence of insomnia, other sleep disorders, chronic health conditions and psychological disorders.
Results: Compared to those with neither sleepiness nor fatigue, those with sleepiness alone were significantly (P < .05) more likely to be employed or studying, and to report any sleep disorder other than insomnia (e.g., sleep apnea, RLS). Those with fatigue or co-occurring fatigue and sleepiness were both more likely to be female and to have a diagnosis of insomnia, other sleep disorders, medical conditions or psychological disorders. Compared to those with only fatigue, those with both sleepiness and fatigue were more likely to have insomnia associated with a comorbid medical condition.
Conclusion: Sleepiness appears to occur more frequently in those with sleep disorders other than insomnia, while fatigue seems associated to a much broader range of disorders, including insomnia, medical and psychological disorders. While fatigue and sleepiness are related constructs, they seem to be differentially associated to medical, psychological and sleep disorders.
Support (If Any): Supported by the Canadian Institutes of Health Research (#42504)

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HEALTH LITERACY AND SLEEP CHOICES IN URBAN TEENAGERS

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Introduction: Health care literacy, the skill to obtain and use health information and services, is required to make daily healthy choices and to utilize health care resources. According to a 2004 Institute of Medicine report, nearly half of Americans have inadequate or marginal

health literacy skills. Studies show that those without adequate health literacy have poorer disease outcomes, higher costs and health care use, and riskier health-related behaviors. This processing dysfunction may be most salient in adolescents who are developing choice skills and who are unfamiliar with possible consequences of basic health care decisions such as eating and sleeping habits.
Methods: 139 urban public upper school students completed: (1) demographic health and sleep related questionnaires (2) the 7 minute timed S-TOFHLA, a validated measure of health literacy. Health literacy scores were grouped as adequate (23-36), marginal (17-22), and inadequate (0-16). Chi-square and Fischer's exact tests were used to compare health care literacy scores to (1) healthy choices such as sleep times, TV on/off all night, and caffeine consumption (2) health outcomes such as obesity (BMI), # medications, and # ER/MD visits.
Results: Students included 59 males (44%) and 76 females (56%). Mean age was 16.6 years (SD 1.2; range 15-19). Mean BMI was 22.9 (SD 4.6) with 10% underweight, 69% normal, 18% overweight, and 3% obese. Mean total sleep time was 7.0 hours (SD 1.4) on school nights and 9.4 hours (SD 2.0) on weekends. TV was on at 11:30pm for 52% of students and on all night for 25%. 46% went to bed midnight or later. 49% reported falling asleep in class that week. Mean # caffeines was 3.7 cups (SD 2.9). 26% took > 1 daily medication. 29% had been to the ER/MD 3 or more times. The mean health literacy score was 28.7 (SD 8.8). 21% of total students had marginal (9%) or inadequate (12%) health literacy. Marginal and inadequate health literacy (MIHL) correlated with increased # medications ($P < 0.01$), male gender ($P < 0.009$), believing sleep is not important ($P < 0.03$), and by increasing # caffeines ($P < 0.007$). MIHL trended with increased # MD/ER visits ($P < 0.28$), BMI ($P < 0.22$), and bedtime after midnight ($P < 0.21$) but did not correlate with age, grade, sleep times, or falling asleep in class.
Conclusion: The urban teenager population has unique health literacy variables. Defining health literacy dysfunctions and healthy eating and sleeping choices in this formative population may impact on later adult healthy choices and medical problems.

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SALIVARY CORTISOL AND ESTIMATED SLEEP PATTERNS IN COLLEGE STUDENTS

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Introduction: Sleep restriction and poor sleep quality appear to be associated with increased cortisol levels. Research suggests that the overactivation of the HPA axis may represent a negative means of coping with stress, which may explain sleep disruptions. Children and adolescents with increased sleep disruptions, shorter sleep duration, later bedtimes, and poorer sleep quality have higher levels of afternoon cortisol and exaggerated cortisol responses to acute lab stressors compared to those with better sleep patterns. This study examined the influence of actigraphically estimated sleep on cortisol, hypothesizing that short sleep duration and more delayed and irregular sleep schedules would be associated with higher cortisol levels.
Methods: Fourteen 1st/2nd year college-age participants wore an actigraph for 1 week, completed a daily stress/sleep diary, and provided salivary cortisol samples 5 times per day for 2 weekdays. Actigraph data were analyzed using Action-W2 and a validated algorithm to estimate sleep duration, onset, offset, and midsleep times. Based on the MacArthur Research Network, saliva samples were collected at: wakeup, 45 minutes, 2.5 hours, 10.5 hours from wake-up and bedtime. Salivary cortisol was measured using an enzyme immunoassay kit and examined via the area-under-the-curve statistic (AUC).
Results: We examined associations between actigraphically estimated sleep variables and AUC for class and weekend nights. Shorter class-night sleep duration ($r = -.53$) and more delayed sleep onset ($r = .78$) were significantly correlated with higher cortisol concentrations ($P's < .05$). Weekend sleep variables were not significantly correlated with AUC; however weekend oversleep was highly positively correlated with AUC.
Conclusion: Inadequate sleep, delayed schedules, and weekly irregularity are closely connected to higher cortisol levels. Less desirable health behaviors, such as insufficient sleep, may alter stress response, which may be associated with sleep-wake dysregulation. Findings from this small sample suggest the need to understand the sleep-physiological stress dynamic in young adults.
Support (If Any): NIH, NICHD, 5 R01 HD047928-05

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PREVALENCE OF SLEEP DISORDERS AMONG APPLICANTS FOR MILITARY SERVICE

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Introduction: Under emerging network-centric warfighting human error attributed to failures of cognitive performance becomes a critical issue. Restricting sleep- either due to primary or secondary sleep disorders - can cause a range of cognitive and behavioral deficits. While secondary sleep disorders have been thoroughly investigated and projects are operating to develop neurocognitive monitors and contrameasures, the role of primary sleep disorders in the members of the military has not been thoroughly investigated. Our work made efforts to investigate their prevalence in military population.
Methods: Study population comprised 204 men (age 18-42, BMI: 23-27) applying for military service. Those with an Epworth Sleepiness Scale score above 10 (n:20) or Berlin questionnaries score of 2 (n:3) were recrutied to undergo diagnostic polysomnography.
Results: Out of the 23 polysomnography study in 3 cases OSAS with intermittent hypoxia-reoxigenation, in 2 cases OSAS with desaturation but without hypoxia, in 8 cases sleep fragmentation due to respiratory effort related arousals, and in 3 cases periodic leg movement with sleep fragmentation was established. In 7 cases apart from simple snoring the study was unremarkable.
Conclusion: Our results underlines the importance of screening for primary sleep disorders among applicants for military service.

1118
ETHNIC DIFFERENCES AND THE EFFECT OF ACCULTURATION ON SLEEP DURATION IN NON-HISPANIC WHITES AND HISPANICS OF MEXICAN DESCENT

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Introduction: Long and short sleep duration has emerged as an important health factor. Little is known about the effect of ethnicity on sleep duration in the U.S. We studied sleep duration in non-Hispanic Whites (NHW) and Hispanics of Mexican Descent (HMD) living in San Diego County, and examined the effect of acculturation.
Methods: We performed a population-based, random digit dialing telephone survey. Sleep duration over the last month and on weekends was by self-report. Acculturation was measured by the Acculturation Rating Scale for Mexican Americans II.
Results: A total of 3632 adults (1892 NHW and 1740 HMD; 1731 female, 1901 male) participated. No significant difference in mean sleep duration was found between NHW and HMD (6.83 hrs ± 1.38 vs. 6.87 hrs ± 1.48, $P = 0.44$), after controlling for age and gender. No significant difference in mean sleep duration was found between less acculturated and highly acculturated HMD (6.91 ± 1.49 vs. 6.81 ± 1.48, $P = 1.84$). When sleep duration was analyzed as a categori-

cal variable, NHW were more likely to sleep the recommended 7-8 hours than HMD (33.6% vs. 26.5%, P < 0.001). HMD had significantly longer sleep duration on weekends (7.72 ± 1.54 vs. 7.41 ± 1.47, P < 0.001), after controlling for age and gender. HMD were more likely than NWH to have long sleep duration (> 9 hours) on weekends (26.8% vs. 17.2%, P = < 0.001). Highly acculturated HMD had shorter sleep duration on weekends compared to less acculturated HMD (7.59 ± 1.56 vs. 8.16 ± 5.62, P = 0.01).
Conclusion: There was no difference in reported sleep duration over a month between NHW and HMD. However, HMD were more likely to have long sleep duration on weekends, especially the least acculturated. Our findings suggest that acculturation may play a significant role in sleep duration of HMD.
Support (If Any): R01 HL075639

1119

SLEEP QUALITY, FATIGUE, AND PERCEIVED STRESS IN A COMMUNITY SAMPLE OF LATINO WOMEN IN SOUTH TEXAS

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Introduction: Increased fatigue and stress are common responses to poor sleep quality. Few studies have examined fatigue, stress, and sleep quality in Latino women. The purpose of this study was to examine the relationships among fatigue, stress, and sleep quality in Latino women.
Methods: Forty women of Mexican descent were recruited from the Galveston/Houston, Texas area. Data were collected with The Pittsburgh Sleep Quality Index (PSQI), the Multidimensional Assessment of Fatigue Scale (MAFS), and the Perceived Stress Scale (PSS). Anthropometric and demographic data were also collected. Pearson's r was used to determine the relationship among the variables.
Results: The mean age was 30.0 years (SD = 5.67). The mean scores for the PSQI was 6.0 (SD = 3.97) with 50% of the sample above the clinically significant cut of score of five. The mean score for the MAFS was 22.46 (SD = 11.64) indicating a moderate degree of fatigue during a week, and the PSS mean score was 24.8 (SD = 8.09) indicating a low to moderate stress level. The mean Body Mass Index (BMI) was 32.0 (SD = 8.15). In this sample 85.5% of the women were overweight or obese. There were significant correlations between sleep quality and fatigue (r = 0.32; P = 0.043) and fatigue and perceived stress (r = .43; P = 0.006). A correlation between sleep quality and perceived stress tended toward significance (r = .30; P = 0.06).
Conclusion: The results suggest that there is a relationship between sleep quality and fatigue and possibly between sleep quality and perceived stress in this group. Although no significant relationship was noted, the prevalence of overweight could be associated with sleep quality, stress, and fatigue. Increased feelings of fatigue can lead to decreased physical activity. Perceived stress can result in an increased food intake as way to cope with stress. Further investigation using objective measures of sleep is warranted to examine the nature of sleep quality in this population.
Support (If Any): Rebecca Sealy Research Award

1120

THE RELATIONSHIP AMONG BODY COMPOSITION AND SLEEP QUALITY AND DURATION IN LATINO WOMEN

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Introduction: Most of the studies describing the relationship between sleep and obesity have focused on non-Latino populations. Because Latinos experience high rates of overweight and obesity, it is necessary explore the relationship of sleep quality/duration and body composition in this fast growing, vulnerable population. The purpose of this study is to examine the relationship among body composition (measured by BMI and Body Fat Analysis), and sleep quality and sleep duration.
Methods: Participants were recruited from the Galveston/Houston, Texas area. Demographic information and anthropometric data to calculate body mass index (BMI) and body fat analysis (BFA) were collected. Pearson's r was used to determine the association of body composition measures and sleep measures. Sleep quality was obtained from The Pittsburgh Sleep Quality Index (PSQI). Sleep duration was self-reported from a single item in the PSQI.
Results: All 40 participants were of Mexican descent. The mean age was 30.0 years (SD = 5.67). The mean BMI was 32.0 (SD = 8.15), and the BFA mean was 38.9%. Seven (17.5%) participants had a normal BMI; 13 (32.8%) were classified as overweight; and 20 (50%) were obese. The mean scores for the PSQI was 6.0 (SD = 3.97) with 50% of the sample above the clinically significant cut of score of five. The mean score for sleep duration was 6.9 (SD = 1.53). There were no significant correlations among the body composition measures and sleep quality and sleep duration.
Conclusion: These results are not consistent with previous studies that link the rise of obesity with a decline in sleep, suggesting that the link may be specific to certain genders and ethnic groups. Further research is warranted to explore factors affecting sleep quality and duration in this vulnerable population.
Support (If Any): Rebecca Sealy Research Award

1121

PREVALENCE OF MATERNAL AND PATERNAL SLEEP DISTURBANCE: PRE-CONCEPTION, PREGNANCY, AND POSTPARTUM

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Introduction: No study has examined gender differences in the prevalence of sleep disturbance during reproductive transitions. Research suggests, for women, pregnancy may be a risk factor for developing a sleep disturbance. The prevalence of sleep disturbance in expectant fathers is not well understood. Reproductive transitions may impact sleep duration and quality because they are developmentally stressful events characterized by physiological, psychosocial, and environmental changes.
Methods: The data source was the National Population Health Survey (NPHS). The NPHS collects health-related information from a representative sample of Canadians every two years (since 1994). During the last three cycles (2002-03, 2004-05, 2006-07) four questions were used to assess sleep duration, onset, maintenance, and daytime wakefulness. The prevalence of sleep disturbance is described in males and females traversing a reproductive transition during the period of observation.
Results: In total, 635 women and 470 men experienced at least one reproductive transition. Preliminary results reveal that more pregnant women reported difficulties with sleep onset or sleep maintenance than expectant fathers (45% women, 33% men; P < .02) and difficulties with daytime wakefulness (28% women, 20% males; P < 0.05). Likewise, more women assessed during the postpartum period reported difficulties with low sleep duration (i.e., less than 6 hours) than men (24% women, 16% males; P < 0.05). Please note, final results will be available at the time of presentation.
Conclusion: Sleep disturbances are more common among women than men during reproductive transitions. Gender differences are apparent in sleep duration, sleep quality, and daytime wakefulness. These findings may have relevance for maternal, paternal and family adjustment and reproductive care.

1122
SLEEP DISRUPTION IN MULTIPLE GESTATION PREGNANCIES

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Introduction: Sleep disruption is a common complaint of pregnant women. Literature shows that several sleep disorders are more frequent during pregnancy and are associated with maternal and fetal morbidities. Multiple gestation pregnancies are high risk and increasingly common, yet the prevalence of sleep disturbances has not yet been characterized in this population.
Methods: As part of a larger ongoing study women pregnant with multiples were surveyed during the last trimester about their sleep. Validated assessments included screens for sleep-disordered breathing, general sleep disturbance (including poor sleep quality, poor daytime functioning, and use of aides to induce sleep), restless leg syndrome, and excessive daytime sleepiness.
Results: Thus far women with1346 singleton and 48 multiple gestation pregnancies have been recruited (12.5% triplets, 87.5% twins). There were no differences in demographic information between women carrying multiples verses singletons (age 30.3 ± 5.2 vs. 29.7 ± 5.7 years, pre-pregnancy BMI 26.5 ± 7.0 vs. 25.7 ± 8.4kg/m^2, 3rd-trimester BMI 32.4 ± 6.8 vs. 30.6 ± 7.5kg/m^2 respectively; $P > 0.1$ for all comparisons). However women carrying multiples gained more weight than those with singletons (35.1 ± 13.4 vs. 28.0 ± 16.6lbs; $P = 0.02$). Women with multiple gestations compared to those without were not found to be at a significantly increased risk for any sleep problem (habitual snoring 37% vs. 35%, pregnancy-onset habitual snoring 33% vs. 28%, poor sleep quality 72% vs. 71%, poor daytime functioning 70% vs. 71%, use of sleep aides 25.5% vs. 19%, restless legs 33% vs. 36%, excessive daytime sleepiness 42% vs. 41%; $P > 0.3$ for all comparisons.
Conclusion: Our findings suggest that sleep problems are common in pregnancy but do not affect women carrying multiple gestation pregnancies any more than those with singleton pregnancies.
Support (If Any): NHLBI HL089918 University of Michigan Institute for Clinical and Health Research University of Michigan Institute for Research on Women and Gender The Gilmore Fund

1123
THE EVERYDAY EXPERIENCE OF POSTPARTUM FATIGUE IN LOWER-INCOME URBAN WOMEN

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Introduction: Severe fatigue is commonly experienced by postpartum women suffering from depression symptoms. The everyday experience of postpartum fatigue lower-income mothers living with significant depression symptoms is unknown. Purpose: To construct a theory explaining the everyday experience of fatigue across the first 6 months postpartum in lower-income urban women with depression symptoms.
Methods: Using grounded theory methodology, mothers (n = 19) screening positive on the Postpartum Depression Screening Scale at 1 month postpartum were interviewed at 1, 3, and 6 months. The sample was on average 27 years, high school educated, partnered (79% boyfriend or married), African-American (63%), and had 2.8 children.
Results: A period of postpartum rest and recovery was essentially nonexistent. At 1 month, fatigue was all-consuming and unrelenting; attributed to sleep deprivation and stress securing basic necessities (housing, food). Infant sleep was unpredictable. Infants were 'mixed up' on days and nights. Women struggled with multiple stressors, intense worry, irritability, frustration, and expressed an inability to think clearly. Women coped by engaging in 'Self-Preservation' in which they withdrew from family and friends and attempted to establish a routine. By 3 months, infant sleep for half of moms became more predictable, easing fatigue. Over half of infants, though, were still 'mixed up' remaining awake hours each night. Women 'Trudged On' at 3 months. Social support was an essential fatigue management strategy. Immediate and extended families formed a complex, yet functional network, that women maneuvered within seeking respite from fatigue and sleep deprivation and to secure basic necessities. Six months saw dramatic improvements in mood, fatigue, and functioning. Stressors remained, but none were so pressing as they were previously. Happiness, normalcy, and optimism began to work back into life.
Conclusion: Postpartum fatigue presented major challenges to everyday functioning. We recommend a strengths-based approach to promote the health of lower-income postpartum women with depression symptoms.
Support (If Any): Midwest Nursing Research Society New Investigator Award

1124
IMPAIRED SLEEP QUALITY, METABOLIC AND INFLAMMATORY MARKERS IN PRE- AND POST-MENOPAUSAL WOMEN

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Introduction: Short sleep duration is associated with metabolic abnormalities, inflammation and higher blood pressure (BP). In some studies these associations appear stronger in women relative to men. We assessed the relationship between sleep quality and metabolic and inflammatory parameters, and blood pressure in healthy pre- and post-menopausal women.
Methods: Participants were 44 pre-menopausal (age 39 ± 10 years) and 39 post-menopausal women (54 ± 5 years), free of any diagnosed medical or psychiatric condition. Medical history, anthropometric measures, fasting blood sample, 24-hour ambulatory blood pressure, and the Pittsburgh Sleep Quality index (PSQI) were assessed. Poor sleep quality was defined as a PSQI global score > 5, and preserved sleep as a PSQI global score ≤ 5. Outcome measures were fasting glucose and insulin, serum hs-CRP, night-time and daytime systolic and diastolic BP (SBP and DBP).
Results: Post-menopausal women with poor sleep (N = 21) compared to those with preserved sleep (N = 18) had higher fasting glucose (5.7 ± 0.9 mmol/L vs 5.2 ± 0.4 mmol/L, $P = 0.001$), insulin (63 ± 39 pmol/L vs 41 ± 31 pmol/L, $P = 0.006$) and hs-CRP (2.6 ± 2.2 mg/L vs 1.2 ± 2.2 mg/L, $P = 0.013$). In post-menopausal women, a hs-CRP ≥ 3mg/L was found in 8 subjects with poor sleep (29%) and one subject with good sleep (5%) ($P = 0.01$). No group differences were observed for day and night BP. Among pre-menopausal women, no significant differences emerged as a function of sleep quality on any of the outcome measures considered.
Conclusion: Poor sleep quality is associated with alterations in glucose metabolism and indices of inflammation in postmenopausal but not pre-menopausal women. Further investigations are required to clarify which mechanisms are involved in this association.

1125
SUBJECTIVE SLEEP DURATION IN A POPULATION OF ELITE ATHLETES

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Introduction: Determining an athlete's total sleep need and ongoing sleep debt is likely a critical factor affecting performance (Samuels

2008). Previous field studies have shown that sleep extension in athletes improves athletic performance (Mah 2009). According to the National Sleep Foundation (NSF), adults need 7-9 hours of sleep each night. Sleep needs of elite athletes may differ from the general population with its effect on neurobehavioral function being the outcome most relevant to performance. The purpose of this study is to evaluate self reported sleep duration in a large Canadian population of elite athletes.
Methods: Elite athletes (N = 199) were screened using the Pittsburgh Sleep Quality Index (PSQI) to determine the prevalence of poor sleep quality. Average age was 23 years, with a range of 14-45. Fifty-six percent were female (N = 105/187). The self reported sleep duration (SSD) was derived from Question 4 within the PSQI asking, "During the past month, how many hours of actual sleep did you get at night?".
Results: Analysis was performed on 187 valid PSQI responses. Mean SSD was 7.8 hours (range 4.5 hours-10.5 hours, SD = 1.08 hours). The percentage of athletes with a SSD less than 7 hours was 13.9% (26/187), 7-8 hours was 49.7% (93/187) and greater than 8 hours was 34.5% (68/187).
Conclusion: Mean SSD of 7.8 hours is within the amount recommended for adults by the NSF. It is unclear whether the 14% of athletes with a SSD less than 7 hours are short sleepers or carry a sleep debt. Previous research has shown that individuals with short versus long habitual sleep duration carry a higher sleep debt (Klerman 2005). Further investigation should explore the extent to which athletes carry a chronic sleep debt. This can be achieved from a subjective perspective by comparing self report sleep need to SSD.

1126

COMPARATIVE ANALYSIS OF A SELF-REPORT PSYCHOMETRIC EVALUATION OF SLEEP QUALITY, CHRONOTYPE AND SLEEP DISORDERED BREATHING VERSUS A STRUCTURED CLINICAL INTERVIEW BY A SLEEP SPECIALIST IN ELITE ATHLETES

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Introduction: The amount, quality and circadian timing of sleep are considered to be important factors that can impact an elite athlete's ability to train, maximize the training response and recover from injury and overtraining. While there is great interest in the effect of sleep and circadian rhythms on athletic performance, current sleep screening tools/questionnaires are inadequate. The purpose of this project is to compare self-report questionnaires to the gold standard; A structured clinical interview (SCI) by a sleep specialist. The comparison will identify weaknesses in the current psychometric tools and will inform the development of a valid and reliable screening tool.
Methods: Elite winter-sport athletes (N = 30) were screened using three standardized self-report questionnaires; Adjusted Neck Circumference (ANC), Athlete Morningness/Eveningness Scale (AMES), Pittsburgh Sleep Quality Index (PSQI). Each athlete then underwent a structured clinical interview (SCI) by a sleep specialist. The SCI followed the format of the self-report questionnaires, but allowed for the addition of probing questions by the sleep specialist, establishing the 'gold standard'. Average age was 32.83 years old, with a range of 19-36. Fifty-six percent were male (17/30).
Results: The ANC correctly detected the risk for sleep disordered breathing in 83% (25/30) of cases versus the SCI. The AMES correctly detected sleep phase in 57% (17/30) of cases versus SCI. The PSQI Global Score correctly detected sleep quality in 53% (16/30) of cases versus SCI assessment of the PSQI score range.
Conclusion: Overall, the results suggest that the current screening tools/questionnaires are inadequate for assessing sleep related problems in elite athletes when compared to the gold standard SCI. These findings emphasize the need to develop a valid and reliable sleep screening tool for this population to provide athletes, coaches and trainers with useful clinical tools for assessing sleep problems in athletes and identifying those athletes who may benefit from consulation and intervention.
Support (If Any): Own The Podium 2010

1127

SLEEP QUALITY, CHRONOTYPE AND RISK FOR SLEEP APNEA IN A POPULATION OF ELITE ATHLETES

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Introduction: The prevalence of poor sleep quality in elite athletes has been described in previous pilot studies; Samuels (2008) and Samuels (2009). More recently Fietze (2009), using objective measures of the sleep/wake cycle, reported a decline in sleep quality and sleep duration in a sample of ballet dancers over two months leading up to a ballet premiere. In follow-up to the previous pilot studies, a larger sample of athletes has been screened to determine the prevalence of poor sleep quality, chrontoype and risk for sleep apnea.
Methods: Elite athletes (N = 199) were screened using three standardized questionnaires; Pittsburgh Sleep Quality Index (PSQI), Athlete Morningness/Eveningness Scale (AMES), and the Adjusted Neck Circumference. Average age was 23 years old, with a range of 14-45. Fifty-seven percent were female (N = 112/199).
Results: The prevalence of poor sleep quality, using a standard PSQI cutoff score of > 5 was 43.6% (82/188). Using a more conservative cutoff score of > 8, yielded a prevalence of 13.29% (25/188). Eighty-eight percent of athletes (171/194) were identified as being either "Moderate Morning or Mid Range" chronotype. Prevalence of moderate to high risk for sleep apnea was 8.6% (13/150). Thirty-five percent (53/150) of athletes indicated that they snore, which is clinically signficant.
Conclusion: The results confirm the findings of previous pilot studies; There is a high prevalence of poor sleep quality in an otherwise healthy population. The presence of snoring, is clinically significant due to the association with poor sleep quality and sleep disturbance. The results reinforce the need to develop a valid and reliable sleep screening tool for elite athletes. The results suggest that athletes should be properly screened, identified and referred to a sleep specialist for a comprehensive sleep assessment.

1128

PERSONALITY PROFILES OF CLINIC VS. GENERAL POPULATION MORBIDLY OBESE: ADDICTION VS. STRESS

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Introduction: Studies on the psychological profiles of morbidly obese in clinical setting have shown an addictive-type of personality. The personality profile of morbidly obese in the general population has not been assessed. The goal of this study was to compare the profile of morbidly obese in the general population to that of morbidly obese patents presenting for treatment.
Methods: 122 morbidly obese (BMI ≥ 40) individuals randomly selected from the Penn State Adult Sleep Cohort and 237 bariatric surgery patients (BMI ≥ 40) completed an 8-h polysomnography and the Minnesota Multiphasic Personality Inventory (MMPI-2). Multivariate ANOVA was used to examine differences between the 2 groups in MMPI-2 clinical, Ego Strength (ES), and MacAndrew Addiction (MAC-R) scales, while

controlling for confounding factors. The groups were further compared in terms of clinically significant elevations on these scales with multivariate logistic regression.
Results: The personality profile of general population morbidly obese was consistent with high levels of emotional stress (code type: 123) and low ES. In contrast, morbidly obese patients showed a profile consistent with an "addictive personality" (code type: 423), i.e. elevated scores in 4-Psychopathic Deviate, 9-Hypomania, 3-Hysteria, and MAC-R.
Conclusion: These results suggest that morbidly obese in the general population are associated with high emotional stress and poor coping resources, whereas morbidly obese seeking treatment are associated with addictive traits, such as impulsivity and low intolerance frustration. It appears that the morbidly obese in the general population use food as a way to reduce their stress (i.e., "comfort food"), whereas morbidly obese seeking treatment, use food to satisfy their addictive cravings. These two groups might benefit from different psychobiological treatment approaches.
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1129

EFFECTS OF SMOKING ON SLEEP CONTINUITY

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Introduction: Sleep disturbances are common among cigarette smokers. While there is a higher prevalence of insomnia complaints among current smokers, the effects of smoking on objective sleep quality have not been well defined. The primary objective of this study was to examine the effects of smoking on the duration of contiguous sleep stages.
Methods: The current study was based on polysomnographic data derived from the Sleep Heart Health Study. Duration of state was defined as the time spent in each segment of non-rapid eye movement (non-REM) and REM sleep. Self-reported smoking status was classified as never, former, and current. Multistate survival analysis techniques were used to model the effects of smoking on duration of contiguous sleep stages while accounting for confounding factors including age, sex, race, body mass index, sleep apnea severity, and chronic medical conditions.
Results: The study sample (N = 5,764) included 2658 (46.1%) never smokers, 2469 (42.8%) former smokers, and 637 (11.1%) current smokers. Compared to never smokers, current smokers showed marked differences in the duration of contiguous sleep stages. After accounting for several confounding variables, cigarette smoking continued to be associated with marked impairments in sleep continuity, as evidence by shorter bouts of contiguous sleep. For example, current smokers spent less contiguous time in non-REM sleep prior to transitioning to wakefulness (11.6 vs. 12.2 minutes; $P < 0.027$).
Conclusion: Cigarette smoking is associated with alterations in sleep quality, as assessed by the duration of contiguous sleep. Exposure to nicotine in cigarette smoke may adversely influence the neural regulation of sleep and thus alter sleep continuity and increase the frequency of sleep-related complaints.
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1130

CIGARETTE SMOKING AND RATE OF SLEEP STAGE TRANSITIONS

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Introduction: Cigarette smoking is associated with adverse health consequences including chronic obstructive lung disease, cardiovascular disease, and premature mortality. However, the effects of smoking on sleep quality have not been well characterized. The primary objective of this study was to examine the independent association between smoking and the rate of sleep stage transitions.
Methods: The current study analyzed polysomnographic data from the Sleep Heart Health Study. Using the visually scored hypnogram, the frequency of sleep stage transitions between wake, non-rapid eye movement (non-REM) sleep, and REM sleep were tabulated for each participant. Self-reported smoking status was classified as never, former, and current. Multivariable regression methods were used to model the effects of smoking on sleep stage transitions independent of confounding factors such as age, gender, race, sleep apnea severity, chronic medical conditions, and consumption of caffeinated products.
Results: The analytical sample (N = 5,764) included 2658 (46.1%) never smokers, 2469 (42.8%) former smokers, and 637 (11.1%) current smokers. Because sleep was assessed using three states (i.e., wake, non-REM, and REM), six different transition types were possible. Compared to never smokers, current smokers showed higher rates of non-REM sleep to wake transitions (2.86 vs. 3.23 transitions/hr; $P < 0.001$) and wake to non-REM sleep transitions (3.24 vs. 3.54 transitions/hr; $P < 0.008$). After accounting for several confounding variables, smoking continued to be associated with higher rates of between non-REM sleep and wake.
Conclusion: Cigarette smoking is associated with poor sleep quality, as assessed by the rate of sleep stage transitions in a large community sample of middle-aged and older adults. Exposure to nicotine in cigarette smoke may have detrimental effects on sleep. Smoking-related impairments in sleep quality may augment the burden of negative health consequences and potentially decrease the effectiveness of various approaches for smoking cessation.
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1131

SINGLE-BLIND STUDY OF MATTRESS DESIGNED TO IMPROVE SLEEP QUALITY

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Introduction: The present study evaluated the NightCare mattress and the effect on sleep fragmentation and quality of sleep.
Methods: Thirty healthy adults (25-64 years old) were randomized into two groups (A, B). Each group consisted of 15 subjects closely matched for gender, age, and with/without bed partners. In a crossover design, subjects in both conditions slept for 5 days on their current mattress and 5 days on a new mattress designed to improve sleep quality and reduce areas of high pressure on the body. Group A began on their current mattress followed by the new mattress and vice versa for group B. The first 3 days of the 5-day period was an acclimation phase followed by 2 nights of overnight recording in which subjects were monitored for changes in body position and actigraphy was used to record estimates of sleep/wake activity. Subjects repeated the 5-day protocol after switching mattresses. Questionnaires on quality of sleep were completed following the 5-day period on each mattress and subjects also completed daily sleep journals.
Results: Subjects rated the quality of sleep as significantly better while sleeping on the new mattress compared to their current mattresses on 3 different subjective sleep assessment tools. The Pittsburgh Sleep Quality Index indicated a significant decrease in sleep latency and disturbed sleep on the new mattress. Subjects also reported significantly less pain, stiffness, fatigue, and tossing and turning, as well as significantly more energy and sleep satisfaction on the new mattress. Epworth scores significantly decreased (4.8 vs. 3.3) indicating less daytime sleepiness. Objective measures revealed fewer body position transitions on the new

mattress vs. current mattresses. There were no significant differences in the objectively-measured and self-reported number of awakenings, time spent awake after sleep onset, and total sleep time.
Conclusion: Subjective and objective assessments of sleep quality and sleep fragmentation significantly improved on the new mattress vs. current mattresses.

1132
IMPROVING SLEEP QUALITY CORRELATES WITH LOWER WEIGHT—A LONGITUDINAL OUTCOMES STUDY

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Introduction: Numerous cross-sectional studies have shown an association between shorter total sleep time (TST) and increased weight. However, longitudinal studies examining weight as a function of TST have shown mixed results. In order to examine the relationship between sleep and weight loss, we measured sleep quality rather than TST alone in a longitudinal outcomes study.
Methods: The Integrative Cardiac Health Project (ICHP) is a heart health program with goals of improving diet, exercise, sleep and stress. At program entry and at graduation, participants were weighed and completed the Pittsburgh Sleep Quality Index (PSQI) which includes sleep duration along with sleep latency, sleep fragmentation, perceived restfulness, daytime functioning, nocturnal behaviors, and use of sleep aids. Subjects were divided into groups that improved PSQI score and those that did not. Differences between groups were compared using unpaired t-test.
Results: 78 consecutive graduates completed ICHP at a mean of 9.4 ± 2.7 mo. Nine subjects had a body mass index (BMI) < 25 kg/m^2 at enrollment and were excluded from analysis. The other 69 graduates were overweight (mean BMI = 31.1 ± 5.0 kg/m^2), had a mean age of 59.0 ± 12.7 yrs, included 31 men (45%), and were racially diverse (34 Caucasian, 30 African-American, 4 Hispanic, and 1 Asian). Of these 69 participants, 43 (age 58.2 ± 13.4 yrs, 17 or 40% men) showed mean improvement in PSQI of 3.5 ± 3.1 points along with mean decrease in BMI = 0.74 ± 1.3 kg/m^2. In contrast, 26 subjects (age 60.5 ± 11.6 yrs, 14 men or 54%) showed worsening PSQI score of 1.2 ± 1.4 points and a limited decrease in BMI = 0.09 ± 1.01 kg/m^2, P = 0.04.
Conclusion: In overweight subjects, improvements in sleep quality correlated with greater weight loss. Global assessment of sleep quality, rather than a focus on TST alone, may clarify the mechanism between sleep and weight loss. Identifying these components of sleep quality also provides targets for therapeutic intervention.
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ABNORMAL HEART RATE TURBULENCE FROM PSGs IS ASSOCIATED WITH CARDIOVASCULAR MORTALITY IN THE ELDERLY: RESULTS FROM THE SLEEP HEART HEALTH STUDY

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Introduction: Heart rate turbulence (HRT) quantifies the oscillatory behavior of the heart rate in response to the changes in cardiac output associated with a ventricular premature beat (VPB). Low heart rate turbulence suggests decreased baroreceptor functioning. Abnormal HRT from 24-hour Holter recordings is a significant predictor of cardiovascular mortality in cardiac patients and older adults. However, the predictive information from HRT indices derived from overnight polysomnography (PSG) is not known.
Methods: The ECG channels from N = 532 overnight PSGs from the first wave of the Sleep Heart Health Study (SHHS) were analyzed using standard Holter techniques. Participants, aged 76.6 ± 4.2 yrs, (217M, 313F), were also enrolled in the Cardiovascular Health Study. Two measures of HRT were calculated, turbulence slope (TS) and turbulence onset (TO) for those with > 5 VPBs on the PSG. N = 11 with > 5 VPBs on whom HRT could not be calculated were excluded. Participants were categorized as having normal HRT if both TS (> 3.0 ms/beat) and TO (< 0%) were normal (N = 171) or if they had < 5 VPBs on their PSG (N = 228). All others were categorized as having abnormal HRT (N = 132). Cox regression analysis was used to quantify the associations of abnormal HRT with cardiovascular (CV, N = 37) or non-cardiovascular (non-CV, N = 59) mortality on 5 year follow-up. Analyses were adjusted for age, gender, diabetes, and history of myocardial infarction.
Results: Having abnormal HRT was associated with a 3.45 Hazard ratio (HazRat) for CV mortality (P < 0.001, 95% CI 1.76-6.78). Only age was also significant in the model (HazRat = 1.13 per year, P < 0.001). Having abnormal HRT was not associated with non-CV mortality (P = 0.21), and only age was significant in the model (HazRat = 1.15, P < 0.001). Having ≥ 5 VPBs by itself in the model had a borderline association with CV mortality (P = 0.072). When the analysis was restricted to only those with ≥ 5 VPBs, the HazRat for CV death with abnormal HRT was 3.27 (95% CI 1.43-7.56, P = 0.005)
Conclusion: HRT results from overnight PSGs could help to identify older adults at increased risk for cardiovascular mortality.
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