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SLEEP STAGING BASED ON AUTONOMIC SIGNALS - A MULTI-CENTER BLINDED VALIDATION STUDY

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Introduction: One of the most important caveats of level 3 ambulatory devices is the inability to record and stage sleep. In the current study we sought to validate a previously developed and published algorithm to detect sleep stages based on autonomic signals (derived from a Watch_PAT100 device), utilizing epoch-by-epoch comparisons to standard polysomnography (PSG). A previous algorithm to only distinguish sleep and wakefulness has already been published on this cohort. The current study is a validation of a novel advanced algorithm determining 4 different stages: Wake, light sleep, deep sleep and REM sleep based on peripheral arterial tone, actigraphy, heart rate, and oxygen saturation.
Methods: Design: Application of a novel algorithm on a previously published prospective multi-center blinded cohort study. Setting: Three university hospital sleep laboratories. Methods: 38 normal subjects and 189 patients with obstructive sleep apnea (OSA) from three centers (Skara, Boston, Haifa) underwent simultaneous recording of PSG and Watch_PAT100. The PSG was manually scored by a blinded experienced scorer, while the Watch_PAT100 data was automatically scored by the embedded algorithm (zzzPAT). For the purpose of agreement between the PSG and the Watch_PAT100, stages 1 and 2 of the PSG were classified as light sleep.
Results: The agreement in detecting deep vs. light sleep ranged from 87.1±5.1% in the normal subjects to 86.4±4.5%, 87.5±6.0% and 93.5±4.9% in the mild, moderate and severe OSA patients, respectively. The agreement in detecting REM vs. NREM sleep was similar for all OSA subgroups and averaged 88.7±5.5%. There was a good agreement between PSG and Watch_PAT 100 in quantifying sleep latency (56.8 ± 31.4 vs 43.3 ± 45.4 epochs, NS), sleep efficiency (78.4 ± 9.9 vs 78.8 ± 13.4%, NS), REM latency (236.5±147.8 vs 224.9±159min, NS), REM percentage (14.4± 6.5 vs 19.3± 8.7%, NS) and total sleep time (690 ± 152 vs 690 ± 154 epochs, NS) respectively.
Conclusion: These data demonstrate acceptably accurate sleep staging in normal subjects and patients with varying severity of OSA, based on recordings from the Watch_PAT100. These results are of substantial importance in the era of a shift toward unattended ambulatory sleep recordings.

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ACTIGRAPHY AND FUNCTIONAL DATA ANALYSIS FOR OBJECTIVE MEASUREMENT OF FATIGUE: A CASE STUDY IN HIV/AIDS

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Withdrawn

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VALIDATION OF A STATE FATIGUE SCALE

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Introduction: There are currently no scales assessing state fatigue levels. Such an instrument would enable multiple measurements of fatigue within a shorter time frame. The aim of this study is to validate a state Fatigue Scale (FS).
Methods: The 7-item FS, similar in format to the SSS, consists of 7 statements ranging from "Full of energy; enough to manage my usual physical activities" to "Totally physically exhausted: unable to undertake the least activity". Respondents are asked to pick the statement that best describes their current level of fatigue. The FS, Brief Fatigue Inventory (BFI), Fatigue Severity Scale (FSS), Fatigue Assessment Inventory (FAI) and the FACES fatigue adjective checklist were administered in the morning (between 7 and 8am) to 195 sleep clinic patients. For test re-test analysis, 133 other patients were asked to complete the FS scale twice within 10 days. Statistical tests for discriminate validity, correlations with other measures of fatigue and test, re-test stability were conducted.
Results: 178 completed questionnaires were collected: the mean FS score was 3.6±1.5. Using the FSS as the gold standard, scores indicative of normal and abnormal fatigue levels on the FS were found to be 2.4±1.3 and 4.2±1.3, respectively, with FSS-defined abnormal values on the FS significantly different ($p<0.0001$) from the normal FS values. The FS was moderately correlated with the BFI, FAI, FSS, and FACES, r= 0.54, 0.39, 0.51 and 0.47, respectively. The Reliability Correlation Coefficient indicated good test, re-test stability (alpha=0.74).
Conclusion: The FS is the first state fatigue scale. It is easy to use and shows modest levels of correlation with trait fatigue scales. A higher correlation between state and trait scales would not be expected. Further, the FS is able to distinguish fatigued from non-fatigued individuals and shows strong test re-test validity despite the FS being a state scale. The FS should prove extremely useful for future studies.

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COMPARISON BETWEEN ACTIGRAPHY AND POLYSOMNOGRAPHY IN A REAL WORLD ENVIRONMENT

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Introduction: The detrimental extent of sleep restriction in society is becoming increasingly prevalent. Actigraphy has been widely deployed to estimate sleep metrics in real-world situations where polysomnography (PSG) is not suitable. Its use for sleep assessment provides quantitative statistics, although PSG remains the gold standard for sleep measurement. The logistics of research in field settings may require the use of longer epochs to maximize the length of data collection in remote locations (e.g., during spaceflight). The aim of this analysis was to examine the accuracy of the sleep/wake algorithm provided by the Minimitter 'Actiware® - Sleep' scoring program with data collected using different epoch lengths.
Methods: Four PGY-1 medical residents working extended duration shifts wore two Actiwatch-Ls for at least 4 days (Mini-Mitter, Bend, OR); one was set to collect data in 1-minute epochs and the other in 2-minute epochs. Ambulatory PSG was also measured simultaneously (Vitaport, TEMEC Instruments, The Netherlands).
Results: PSG sleep duration was consistently underestimated by 4.16%±6.07% SD in actigraphy data collected using 1-minute epochs

whereas the actigraphy data collected using 2-minute epochs overestimated sleep duration by 6.05%±8.09% SD. Actigraphy-estimated sleep durations were consistently longer using data collected with 2-minute epochs compared with those data collected with 1-minute epochs (10.21%±8.33% SD).

Conclusion: In this small pilot study, sleep duration measured by actigraphy was underestimated by four percent using one-minute epochs and overestimated by six percent as compared to PSG scored every 30 seconds. Results from this limited study population suggest that actigraphy is a reliable estimator of sleep duration in a field environment and two minute epochs can be used when logistics demand long continuous collection episodes.

Support (optional): Data collection was supported by a grant from NIOSH (RO1 OH07567) and was conducted in a General Clinical Research Center (NCRR M01 RR02635). LW was supported by the Irish Research Council for Science Engineering and Technology (IRCSET) and FÁS Ireland.

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QUANTITATIVE CHANGES IN HIGH AND LOW FREQUENCY SPECTRAL DOMAINS IN PRIMARY INSOMNIA DISTRIBUTED IN TWO HOUR INTERVALS ACROSS THE ENTIRE NIGHT

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Introduction: Automated scoring of sleep has been shown to have high interscorer reliability compared with human scoring. Different frequency domains may correlate with wake/sleep states of the brain and quantify the pathology of sleep disorders. This study assesses signal processing outcomes using adaptive segmentation in adults identified with primary insomnia. Morpheus® is a system that performs automated analysis of sleep staging using a multidimensional mathematical analysis of EEG applying adaptive segmentation and fuzzy logic with Markov models.

Methods: 40 adults with a diagnosis of primary insomnia underwent a post-hoc analysis studying 2 nights using a cross-over design with 4 compounds. Patients received 3 different medications or placebo denoted by A, B, C and P(placebo). This represents first night analysis. Advanced spectral parameters were analyzed in 2 hour time intervals for each group and compared with the placebo group including % high frequency activity (HF) and % low frequency activity (LF).

Results: Means and standard deviations are measured as % of TST. For HF% hours 1-2: P=11.70(9.77); A=7.91(5.30); B=5.67(3.98); C=8.64(5.57). Hours 3-4: P=19.71(11.15); A=2.39(2.23); B=4.35(2.78); and C=4.88(4.16). Hours 5-6: P=12.17(13.19); A=2.58(2.31); B=6.31(4.51); and C=4.41(2.48). Hours 7-8: P=12.4(12.11); A= 3.58(3.41); B=8.98(5.91); and C=6.36(4.68). For LF% hours 1-2: P=2.89(2.72); A=4.17(3.05); B=6.12(3.65); C=3.69(3.12). Hours 3-4: P=4.47(3.55); A=8.08(3.55); B=5.10(2.66); and C=5.23(2.68). Hours 5-6: P=1.83(1.74); A=4.67(3.19); B=2.15(1.95); and C=3.59(2.49). Hours 7-8: P=1.34(2.6); A= 1.78(1.59); B=0.61(0.82); and C=1.47(1.81). T-tests of 2 hour intervals of HF% comparing the placebo group with other groups were significant $p<0.05$ except: hours 1-2 for HF% groups A, C and hours 7-8 group C. For LF% except: hours 1-2 group A,C; hours 3-4 group B, C; hours 5-6 group B; and hours 7-8 group C. A significant reduction in HF and increase in LF signal domains was seen with compound A ($p=<0.00001$).

Conclusion: Differences in the time distribution of the pharmacodynamic response in treated primary insomnia patients (HF and LF domains) is effectively demonstrated using spectral analysis.

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THE RELIABILITY OF THE FACTOR STRUCTURE OF THE PEDIATRIC DAYTIME SLEEPINESS SCALE IN BOTH A SPANISH-COLOMBIAN AND FRENCH-CANADIAN VERSIONS

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Introduction: Daytime sleepiness is characterized by an increased likelihood of falling asleep and adversely impacts youth's academic performance, behavior, and mood. The National Sleep Foundation Survey (2006) found almost 50% of youth sleep 1 to 2 hours less than the recommended 9 hours per night and 60% report daytime sleepiness. The Pediatric Daytime Sleepiness Scale (PDSS; Drake et al., 2003) is a self-report questionnaire used to evaluate the likelihood of youth falling asleep in various everyday situations. The original PDSS was developed with an English-speaking American sample (M_{age}=11.8; *SD*=.6 years), and the measure was thought to assess a uni-dimensional construct: daytime sleepiness. The PDSS has previously been translated into a Spanish version for an Argentinean sample (M_{age}=13.3; *SD*=1.5 years).

Methods: The current study evaluated the factor structure of the PDSS in two distinct samples: the first sample included 420 Spanish-speaking students from Bogota, Colombia (M_{age}=9.49, *SD*=.67 years). The second sample included 377 French-speaking students from Montréal, Québec (M_{age}=12.73; *SD*=.67 years) as part of the larger AdoQuest Study. The PDSS was translated into Spanish and French using back translation procedures and administered to their respective sample.

Results: Generalized least-squares method and varimax rotation were used; items with factor loadings >0.40 were retained. Exploratory factor analyses on both the Spanish and French versions revealed two factors: *daytime sleepiness* and *lark/morning preference*, which explained 49% and 56% of the variance, respectively. Daytime sleepiness included questions about feeling sleepy with factor loadings of .59 to .73 (Spanish version) and .73 to .91 (French version). Lark/morning preference included items about feeling alert after being awakened with factor loadings of .49 to .73 (Spanish) and .41 to .71 (French).

Conclusion: The original PDSS may tap into multiple constructs related to sleepiness, such as circadian phase/morningness/eveningness and sleep propensity. Differences in cultural and lifestyle behaviors (e.g., bed/wake-times, school start times, daytime napping) as well as interindividual differences in preferred timing of sleep/wake cycles may also play a role in the multiple constructs identified. Future research should further evaluate the validity of these subscales within the PDSS to determine their validity in relation to objective measures of circadian phase angle and sleep propensity.

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CLAIMS-BASED CASE-FINDING FOR INSOMNIA AND THE INSOMNIA SEVERITY INDEX

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Introduction: Administrative claims studies examine illnesses, comorbidities, and treatment patterns and rely on case-finding rules to identify patients with target diagnoses. For insomnia, it is not known if these techniques are accurate, or what degree of insomnia is reflected. The current analyses use a hybrid of claims and Insomnia Severity Index

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