

RESULTS: AET in asthma group (for both ovalbumin and HDM model of asthma) significantly reduced the number of total cells ($p < 0.01$) and eosinophils ($p < 0.01$) in BAL as well as the levels of IL-5 in BAL ($p < 0.01$), serum ($p < 0.01$) and in the supernatant of mediastinal lymph nodes ($p < 0.01$), spleen ($p < 0.01$) and thymus ($p < 0.01$), while increased the levels of IL-10 in BAL ($p < 0.01$), serum ($p < 0.01$) and in the supernatant of mediastinal lymph nodes ($p < 0.01$), spleen ($p < 0.01$) and thymus ($p < 0.01$). The results also demonstrated that AET reduced the levels of extracellular ATP in BAL and that AET reduced the expression of P2X7 receptor in the lungs.

CONCLUSIONS: Aerobic exercise training reduces asthma phenotype by reducing lymphatic organs activation and these results seem to be, at least partially, by inhibition of P2X7 receptor.

3443 **Board #87** May 31, 9:30 AM - 11:00 AM

Serum Cytokines in Black and White Males After Eccentrically Biased Aerobic Exercise

Andrew J. McKune¹, Stuart Semple², Lucille Smith³. ¹University of KwaZulu-Natal, Durban, South Africa. ²University of Canberra, Canberra, Australia. ³Tshwane University of Technology, Pretoria, South Africa. (Sponsor: Professor Robert Hickner, FACSM)
(No relationships reported)

PURPOSE: To determine the effect of eccentrically biased aerobic exercise and ethnic group on circulating cytokine levels.

METHODS: Seven black and eight white males (18 - 22 years), active but untrained, participated in the study. Subjects performed a 60-minute downhill run on a treadmill (gradient - 13.5%) at a speed eliciting 75% of their VO_2 peak on a level grade. Venipunctures were performed before, immediately after (IA) and then at 3, 6, 9, 12, hours and at 1, 2 and 3 weeks after the run. Plasma creatine kinase (CK) activity and percentage change (pre vs each post time point) in 18 serum cytokines concentrations (measured using Bio-Plex Cytokine Assays, Bio-Rad, Hercules, CA) were compared using a two way (2 x 9) repeated measures ANOVA. Significance was set at $P \leq 0.05$.

RESULTS: There was an interaction ($P = 0.0055$) and ethnic group effect ($P < 0.0001$) for CK activity with consistently higher levels in the black group. CK increased over time after the run, peaking at 12 h for both groups. There were significant interaction effects for the percentage change in cytokine levels. These were significantly higher (ranging from 25% to 132%) in the black compared with the white group at multiple time points for IL-10 ($P = 0.02$, T-helper 2 cytokine), IFN- γ ($P = 0.03$, T-helper 1 cytokine), TNF- α ($P = 0.05$, pro-inflammatory), the chemokines CXCL 10 ($P = 0.001$), eotaxin ($P = 0.02$) and IL-8 ($P = 0.05$), G-CSF ($P = 0.05$, colony stimulating factor) and VEGF ($P = 0.005$, angiogenesis).

CONCLUSIONS: CK was significantly higher in the black group suggesting greater muscle damage. Differences in the percentage change in the serum cytokines, in particular the chemokines and VEGF suggest a heightened immunological/inflammatory milieu in the circulation of the black group that may be the consequence of the extent of the exercise-induced muscle damage. The performance and health implications of this finding warrant further investigation.

3444 **Board #88** May 31, 9:30 AM - 11:00 AM

Effect Of Exercise-induced Dehydration And Subsequent Overnight Fluid Restriction On Immunity At The Ocular Surface

Helen G. Hanstock, Matthew B. Fortes, Alexander Carswell, Kyle H. F. Bendell, Bethany C. Diment, Jonathan P. Moore, Neil P. Walsh. *Bangor University, Bangor, United Kingdom.*
(No relationships reported)

The ocular surface is a portal for transmission of pathogens, including common upper respiratory infections such as influenza (Bischoff *et al.*, (2011) *J Infect Dis*, 204:193-99). Dehydration has been found to reduce the secretion rate of saliva antimicrobial proteins (AMPs) important for host defence (Fortes *et al.*, (2012) *Appl Physiol Nutr Metab*, 37:850-59), but the effect of dehydration on the availability of tear fluid AMPs remains unexplored.

PURPOSE: To investigate the effect of dehydration on the concentrations and secretion rates of three key AMPs in tear fluid; secretory IgA (SIgA), lactoferrin (Lf) and lysozyme (Lys).
METHODS: Thirteen healthy adult males exercised in the heat until 3% body mass loss (BML) was achieved (total exercise duration = 106 ± 14 min); either with fluid restriction from pre-exercise on day 1 until 0800h day 2 (DEH), or with fluids to offset body mass losses during exercise (CON). Measures of plasma osmolality (POsm) and timed unstimulated tear samples of approx. 1 μ l volume (microcapillary method) were obtained pre-exercise at 1400h, at 1630h (2% BML) on day 1 and at 0800h and 1130h on day 2. Fluids equivalent to total BML were provided for rehydration purposes between 0800h and 1130h on day 2 in DEH. Tear samples were stored at -80°C and later assessed for concentrations of SIgA, Lf and Lys using ELISA.

RESULTS: POsm was significantly higher in DEH than CON at 2% BML (DEH: 294 ± 4 mOsm \cdot kg $^{-1}$; CON: 284 ± 4 mOsm \cdot kg $^{-1}$ $p < 0.01$) and at 0800h day 2 (DEH: 298 ± 3 mOsm \cdot kg $^{-1}$; CON: 287 ± 3 mOsm \cdot kg $^{-1}$ $p < 0.01$). Tear flow rate was unaffected by hydration status but a 62% increase in flow rate occurred due to diurnal variation between 1630h on day 1 and 0800h on day 2 ($p < 0.05$). DEH had no effect on tear SIgA, Lf or Lys concentration but a significant decrease occurred due to diurnal variation between 1630h day 1 and 0800h day 2 (SIgA: -45%, $p < 0.05$; Lf: -35%, $p < 0.05$; Lys: -38%, $p < 0.05$). There was no effect of hydration status or time of day on the secretion rate of SIgA, Lf or Lys.

CONCLUSION: Unlike previous work on saliva, the availability of AMPs in tear fluid is not reduced by exercise-induced dehydration and subsequent overnight fluid restriction. This work indicates dehydration does not compromise host defence at the ocular surface.

Project supported in part by the European Hydration Institute.

G-37 Free Communication/Poster - Musculoskeletal Injury and Muscle Damage

Saturday, May 31, 2014, 7:30 AM - 11:00 AM

Room: WB1

3445 **Board #89** May 31, 8:00 AM - 9:30 AM

Acute Ankle Sprain in a Mouse Model: Development of Knee Joint Degeneration

Tricia Hubbard-Turner, FACSM, Erik A. Wikstrom, FACSM, Michael J. Turner. *University of North Carolina @ Charlotte, Charlotte, NC.*
(No relationships reported)

Ankle sprains remain the most common musculoskeletal injuries. The influence ankle sprains have on the development of knee joint degeneration is currently unknown.

PURPOSE: To measure knee joint degeneration across the lifespan after an acute ankle sprain in a mouse model.

METHODS: Thirty male mice (CBA/2J) were randomly placed into one of three groups: the transected CFL group, the transected ATFL/CFL group, and a SHAM group. Three days after surgery, all of the mice were individually housed in a cage containing a solid surface running wheel. Before surgery and every six weeks after surgery, a diagnostic ultrasound (SONOS 5500 Ultrasound and 15-6L ultrasound probe) was used to measure medial and lateral knee joint space in both hind limbs.

RESULTS: Right medial ($p=0.003$), right lateral ($p=0.002$), left medial ($p=0.03$), and left lateral ($p=0.002$) knee joint spaces decreased significantly across the lifespan. The mice in the ATFL/CFL group had significantly decreased right medial ($p=0.004$) and lateral joint space ($p=0.045$) compared to the SHAM and CFL group starting at 24 weeks of age. There were no significant differences in the contralateral knee joint degeneration between any of the groups.

Table 1. Right Medial Knee Joint Space (mm)

	ATF/CFL group	SHAM Group
Baseline (6 weeks of age)	.38 ±.04	.38±.03
12 weeks	.37 ±.07	.38±.04
24 weeks*	.34 ±.06	.37±.05
48 weeks*	.29 ±.07	.35±.04

(*Significantly different $p < .05$)

CONCLUSION: Based on current data, mice that sustained a severe ankle sprain developed greater joint degeneration in the ipsilateral knee. Knee degeneration could be a result of an accommodation to the laxity of the ankle, or biomechanical alterations secondary to ankle instability. A single surgically induced ankle sprain could significantly impact knee joint function.

Supported by UNC Charlotte Research Grant

3446 **Board #90** May 31, 8:00 AM - 9:30 AM

Age-Dependent Chemokine Protein Desensitization Following Stretch-Shortening Contraction Musculoskeletal Injury

Brent A. Baker, James Ensey. *NIOSH, Morgantown, WV.* (Sponsor: Stephen E. Alway, FACSM)

(No relationships reported)

Despite evidence that increased age negatively impacts the functional and physiological recovery of soft tissue following traumatic musculoskeletal injury, there is no consensus as to the mechanism(s) at the molecular/cellular level by which this takes place.

PURPOSE: To investigate if there is an age-dependent differential responsiveness to chemokine proteins following stretch-shortening contraction (SSC)-induced musculoskeletal injury.

METHODS: Using an *in vivo* rodent dynamometry model and an NIA-approved animal model of aging (Fisher 344 x Brown Norway Rat), we exposed young and old rats acutely to either zero (0) SSCs or 150 injurious SSCs and assessed multiple chemokine protein responses in tibialis anterior muscle at three days recovery in these populations (n = 8 rats/group). Two-way ANOVA was used for statistical analysis; significance was set at $p < 0.05$.

RESULTS: Following *in vivo* SSC-injury loading, young rats exhibited increased concentrations of the chemokine proteins RANTES/CCL5 ~5 Fold (164.2 ± 21.5 vs. 31.1 ± 7.6 pg/ml, $p < 0.01$), GRO-KC/CXCL2 ~13 Fold (157.6 ± 42.1 vs. 11.2 ± 3.0 pg/ml, $p < 0.001$), MCP-1/CCL2 ~48 Fold ($2,920.6 \pm 844.0$ vs. 60.2 ± 10.3 pg/ml, $p < 0.0001$), and MIP-1 α ~31 Fold (220.5 ± 65.6 vs. 7.2 ± 1.2 pg/ml $p < 0.0001$), whereas no such change was observed in old rats. Further, when normalized to old rats, young rats' chemokine protein concentrations were higher for GRO-KC/CXCL2 ~5 Fold (157.6 ± 42.1 vs. 29.2 ± 11.2 pg/ml, $p < 0.001$), MCP-1/CCL2 ~ 12 Fold ($2,920.6 \pm 844.0$ vs. 235.4 ± 46.7 pg/ml, $p < 0.0001$), and MIP-1 α ~19 Fold (220.5 ± 65.6 vs. 11.3 ± 2.3 pg/ml, $p < 0.0001$).

CONCLUSIONS: These *in vivo* data reveal that specific inflammatory mediators, specifically chemokines, in young rats may contribute to a positive healing response following SSC-injury loading; and, actually may become desensitized with increased age. These data may help contribute to explaining the delayed recovery kinetics at the functional level observed with aged populations following traumatic musculoskeletal injury.

3447 **Board #91** May 31, 8:00 AM - 9:30 AM

Loss Of FKBP12 Is Associated With Early Strength Deficits After Contraction Induced Skeletal Muscle Injury

Cory W. Baumann, Russell G. Rogers, III, Nidhi Gahlot, Christopher P. Ingalls. *Georgia State University, Atlanta, GA.*

(No relationships reported)

PURPOSE: Voltage-gated sarcoplasmic reticulum (SR) Ca²⁺ release occurs through the ryanodine receptor 1 (RyR1) and is regulated by ancillary binding proteins (e.g., FKBP12).

Reduced SR Ca²⁺ release contributes to strength deficits associated with contraction induced skeletal muscle injury. The study's purpose was to test the hypothesis that eccentric contractions disrupt FKBP12 content and alter skeletal muscle function.

METHODS: Anterior crural muscle [tibialis anterior (TA) and extensor digitorum longus (EDL)] function and FKBP12 content in pelleted and soluble protein fractions were measured before and after (0- to 14-d) single bouts of 150 concentric or eccentric contractions.

RESULTS: No changes in peak isometric tetanic torque or FKBP12 content occurred after the concentric protocol. Eccentric contractions reduced peak *in vitro* and *in vivo* isometric strength by 52-67% up to 3-d post injury, and resulted in an immediate 72% increase in resting tension *in vitro*. Compared to control immediately following injury, FKBP12 content was reduced by 43% in the pelleted fraction and correlated with *in vitro* ($R^2=.56$) and *in vivo* ($R^2=.45$) strength. By 3-d after injury, FKBP12 content in the soluble fraction increased 52% and the pelleted fraction returned to control values. FKBP12 content had returned to control values by 14-d despite peak muscle strength being reduced ~15%.

CONCLUSIONS: Loss of FKBP12 is associated with early reductions in strength following a bout of eccentric contractions in mouse skeletal muscle.

3448 **Board #92** May 31, 8:00 AM - 9:30 AM

Hamstring Injury Prevention In Soccer: Before Or After Training?

Ric Lovell, Jason Siegler, FACSM, Paul Marshall. *University of Western Sydney, Penrith, NSW, Australia.*

(No relationships reported)

In Soccer, the incidence of non-contact hamstring strains is high, and increases in the latter stages of each half. Muscle fatigue is considered an aetiological risk factor, and injury prevention programs such as the FIFA11+ are administered during the warm-up before training. We hypothesized that the adaptation to strengthening exercises may be optimized when performed in a "fatigued" state, after a soccer training session.

PURPOSE: To examine the effects of performing a program of Nordic hamstring exercises (NHE) before or after soccer training upon eccentric hamstring strength, motor-unit activation, and muscle architectural responses.

METHODS: Amateur soccer players were randomized into 3 training groups for a 12-week intervention. The control group (CON; n=10) undertook core stability exercises, whereas a periodized NHE program was delivered either during the warm-up (PRE; n=11) or the cool-down (POST; n=10) of bi-weekly training sessions. Outcome measures included peak torque

and concomitant peak surface electromyography signals (sEMG) of the hamstring muscles during maximal eccentric contractions of the knee flexors, performed at 30°·s⁻¹. Ultrasonography was used to determine muscle thickness and muscle fiber pennation angle. Magnitude based inferences were used to identify treatment effects.

RESULTS: Performing the NHE derived *likely* small peak torque increases in both PRE (+12.5%; 90% confidence intervals [CI]: 2.8 to 23.1%) and POST groups (+8.2; CI: -2.2 to 19.8%), relative to CON. There were also *likely* small increases in muscle thickness (PRE: +6.0% [CI: 0.7 to 11.5%]; POST: 5.7% [CI: 2.6 to 8.8%]), and *most-likely* moderate increases pennation angle (PRE: +23.3% [CI: 15.6 to 31.5%]; POST: 17.5% [CI: 9.5 to 26.1%]) in the PRE and POST groups versus CON. Between-group differences in sEMG changes were *unclear*. Only pennation angle was different between treatment groups, with a *likely* greater (small) increase in PRE versus POST (+4.8; CI: -0.1 to 9.3%).

CONCLUSION: A 12-week eccentric hamstring-strengthening program increased strength and induced a hypertrophic response in amateur soccer players, but there was no further enhancement in the adaptive responses by training in a “fatigued” state.

Supported by NSW Sporting Injuries Committee Grant

3449 **Board #93** May 31, 8:00 AM - 9:30 AM

Iliopsoas Syndrome after Hip Arthroscopy

Farshad ADIB, William Hennrikus, Adam Nasreddine, Mininder Kocher, Yi-Meng Ten. *CHILDRENS HOSPITAL BOSTON, HARVARD MEDICAL SCHOOL, BOSTON, MA.*
(No relationships reported)

PURPOSE: Iliopsoas syndrome (IPS) is the inflammation of the tendon or bursa. IPS is a complication in first three months after surgery, which has been overlooked. No data has been published on incidence of IPS after hip arthroscopy.

One of presumed advantages of mid-anterior portal in two-portal-technique is the location of the hip cannula, which is farther from Iliopsoas comparing to anterior portal in the standard three-portal technique.

The purpose of this study is to identify the incidence rate of IPS among adolescents and young adults following hip arthroscopy and to evaluate the potential risk factors.

METHODS: Patients between 10 to 57 years old who underwent hip arthroscopy from 2005 to 2012 with minimum follow up of 3 months were included. Surgeon #1 uses standard anterior portal, while surgeon #2 uses mid-anterior portal. The IPS incidence rate was calculated by review of electronic medical records.

RESULTS: Upon IRB approval, 306 patients (104 male and 202 female) were included in the study. Mean age at the time of surgery was 21.9 years. One hundred fifty-two patients underwent hip arthroscopy by Surgeon #1; 154 patients underwent hip arthroscopy by Surgeon #2.

Seventy-eight patients (25%) had IPS after the hip arthroscopy. IPS rate was 18% and 29% in males and females, respectively. (p-value=0.039). All the patients were treated by physical therapy and 44 patients (14%) needed steroid injection for the treatment of IPS. Thirty-four females (17%) and ten males (10%) needed the steroid injection.

IPS rate was 25% and 26% for surgeon1 and 2 respectively (p-value=0.90). 27% of patients with pre-operative IPS symptoms and 25% patients without pre-operative symptoms had IPS after the surgery. Nine patients (2.9%) underwent surgery due to IPS.

CONCLUSION: This incidence of IPS after hip arthroscopy (25%) is quite considerable. IPS was more common in female patients (29% vs 18%). Different anterior portal placement and having pre-operative IPS symptoms did not seem to affect the incidence rate of IPS. Further studies are needed to investigate the reason for this complication.

Majority of IPS patients responds to non-operative treatment (89%). Clinicians should keep this diagnosis on their mind to prevent any misdiagnosis and unnecessary revision surgeries.

3450 **Board #94** May 31, 8:00 AM - 9:30 AM

Hamstring Injury and Physical Characteristics in Japanese Collegiate Sepak Takraw Players

Yoshiaki Kubo¹, Koichi Nakazato¹, Koji Koyama², Akiko Funaki¹, Yoshinori Tahara¹, Kenji Hiranuma¹. ¹*Nippon Sport Science University, Tokyo, Japan.* ²*Tokyo Ariake University of Medical and Health Sciences, Tokyo, Japan.*
(No relationships reported)

Sepak takraw is a combination of soccer, volleyball, badminton, and gymnastics. Although the rules are similar to volleyball, sepak takraw players can use only their head and feet, as in soccer. In sepak takraw, the spike-like overhead kick, as in soccer, is acrobatic and is a difficult skill to acquire. The spike kick is an exciting skill, but is associated with a risk of injury, which may be sustained during a game or while training. The injury frequently associated with such players is hamstring injury. This type of injury has been assessed by several researchers, but no studies have been reported of such injuries in sepak takraw players.

PURPOSE: To investigate the relationship between hamstring injury and physical characteristics of Japanese collegiate sepak takraw players.

METHODS: The subjects included 66 Japanese collegiate sepak takraw players (35 men and 31 women; mean age, 20.0 ± 1.3 years; height, 165.7 ± 7.6 cm; weight, 57.9 ± 7.5 kg, body mass index, 21.1 ± 1.9 kg/m²; sporting experience, 1.8 ± 1.1 years). We assessed the number of hamstring injuries sustained during the past year among the players by using a questionnaire. The subjects were divided into 2 groups: the injured group and uninjured group. The range of motion was measured at the hip, knee, ankle, and foot joints. Moreover, flexibility was assessed in the hamstring, quadriceps, iliopsoas, and triceps surae muscles. In addition, the finger-to-floor distance and FABERE's distance were estimated. The differences in the measurements were analyzed using unpaired t-tests and Logistic regression (P < 0.05).

RESULTS: Of the 66 subjects included, 11 were assigned to the injured group (16.7%) and 55 were assigned to the uninjured group (83.3%). Using an unpaired t-test, a significant difference in sporting experience and left hip external rotation was noted between the injured group and uninjured group. By using logistic regression analysis, the presence of a hamstring injury was found to be associated with sporting experience (adjusted odds ratio, 0.40; 95% confidence interval, 0.18-0.92), after adjusting for sex and left hip external rotation.

CONCLUSION: A lower duration of sporting experience is a predictor of hamstring injury in Japanese collegiate sepak takraw players.

3451 **Board #95** May 31, 8:00 AM - 9:30 AM

The Effect of Mesenchymal Stem Cells on Skeletal Muscle Injury

Patrick Meyer, Stacey Brickson, Ray Vanderby. *University of Wisconsin, Madison, WI.*
(No relationships reported)

Current trends in muscle injury research are aimed at discovering the optimal pro- and anti-inflammatory balance in order to facilitate early regeneration and limit fibrosis, thereby improving functional recovery and decreasing reinjury rates. Stem cells have shown promise as a therapeutic intervention for selectively enhancing skeletal muscle regeneration following muscle injury. However, studies evaluating efficacy of stem cell intervention following single stretch or eccentric contraction as the mechanism of injury are lacking.

PURPOSE: To determine the effect of mouse mesenchymal stem cells (MSCs) on immune-cell regulated healing following a single stretch injury in the calf muscle of mice.

METHODS: Twenty-four C57BL/67 WT mice were assigned to one of four groups (n=6): sham saline (SS), sham MSC (SM), injured saline (IS) or injured MSC (IM) and were evaluated at 2 time points, 7 or 14 days post-injury. A custom isokinetic device was used to induce a single stretch injury. 5x10⁵ MSCs in 50 µL DPBS or 50 µL of DPBS was injected intramuscularly 3 days post-injury or sham. Mechanical testing to measure isometric joint torque in vivo was done immediately and at 7 or 14 days post-injury. Susceptibility to reinjury was assessed in the soleus muscle by subjecting it to an in situ eccentric contraction (ECC) protocol, which consists of five maximal tetanic stimulations. Force drop across contractions was calculated and normalized to cross-sectional area (mN/mm²). Differences in treatment were assessed by one-way ANOVA and Tukey's post hoc test. Values are means ± SEM.

RESULTS: In vivo isometric torque dropped immediately following stretch injury by 50%. The drop in isometric torque continued to decline 7 days post injury in the IS group, and this deficit was attenuated in the IM group (P=0.03). After 14 days, there were no differences in torque deficit between groups. In situ ECC testing showed a significant specific force drop following injury in the IS group (P<0.001), with MSCs offering a protective effect at 14days (P=0.002).

CONCLUSIONS: Our results demonstrate transient improvement in muscle function (isometric torque) and reduced susceptibility (ECC) to injury following injection of MSCs post-single stretch injury.

3452 Board #96 May 31, 8:00 AM - 9:30 AM

Sedentary Behaviour and Musculoskeletal Health - A Systematic Literature Review

Eszter Füzéki, Winfried Banzer. *Goethe University Frankfurt, Frankfurt am Main, Germany.*
(No relationships reported)

PURPOSE: To date scientific interest in sedentary behavior (SB) has primarily focused on effects on cardiometabolic outcomes and cancer. Much less is known about the effects of SB on the musculoskeletal system. The aim of this review is to summarize and critically assess current literature on SB and musculoskeletal health in adults.

METHODS: We conducted a systematic literature search for reviews in Pubmed and EMBASE using the key terms sitting/sedentary in combination with pain, function, muscle and function in adults. Reference lists were manually checked for further reviews. Methodological quality was assessed using the AMSTAR instrument (Shea et al 2009). We included reviews if they studied the effect of sitting per se (being seated) on the musculoskeletal system in adults, including pain and function. Studies reporting on whole body vibration, awkward posture, lifting and bending, and studies focusing on computer work exclusively were excluded.

RESULTS: The first search yielded 2755 reviews. After removing duplicates and applying the inclusion and exclusion criteria 8 reviews were included. Relevant outcomes include: low-back pain (LBP; 4 reviews), neck pain (NP; 3 reviews) and osteoarthritis of the hip (OAH; 1 review). Quality of the reviews was high: 6/8 had AMSTAR scores of $\geq 9/11$. Reviews used varying definitions of outcomes (questionnaires, clinical diagnosis, clinical examination), as well as SB assessment and categorization (questionnaires with and without measures of plausibility, job title, screen/TV time). Only one review included original studies on leisure time sitting.

CONCLUSIONS: Data available to date consistently suggest that sitting per se, i.e. excluding factors such as whole body vibration, awkward posture, poorly adapted workstations, lifting and bending is not associated with an increased risk of developing LBP. In fact some studies suggest a protective effect. However, sitting seems to be associated with the development of NP. The limited data available on the relationship between sitting and OAH suggest that SB is not associated with this outcome. Since sitting is ubiquitous also in leisure time, future studies should assess also this context, and include further relevant musculoskeletal outcomes such as strength, muscle and sensory function, motor control.

3453 Board #97 May 31, 8:00 AM - 9:30 AM

Optimization Of Compression Protocol To Induce Deep Pressure Ulcer Injury In Skeletal Muscle Of Mice

Parco M. Siu, FACSM, Bjorn T. Tam, Angus P. Yu, Eric W. Tam. *Hong Kong Polytechnic University, Hong Kong, Hong Kong.*
(No relationships reported)

Deep pressure ulcer can be induced in skeletal muscle by moderate mechanical compression in a rat model established by our group. However, the compression protocol for rats cannot be applied directly on mice without optimization. Therefore, there is a need to optimize the design of compression protocol for adoption in mice.

PURPOSE: To determine the extent of skeletal muscle injury induced by different compression protocols in a newly established mouse compression device for inducing deep pressure ulcer injury.

METHODS: Animals were divided into 4 groups, 1 control group (C) and 3 compression groups, which are characterized by different compression forces. A single session of 4-hour compression with static pressure of 100 mmHg (L, light compression force), 150 mmHg (M, moderate compression force) and 200 mmHg (H, heavy compression force) was applied over the tibialis region of the right limb of mice. Muscle tissues were harvested 24 hours after compression. Haematoxylin and eosin staining was used to demonstrate the histology of the compressed and control muscle tissues. Number of nuclei in the interstitial space of the microscopic field with a 200x magnification of muscle cross-section was counted and used as an indicator of the extent of muscle injury.

RESULTS: The numbers of nuclei were significantly increased in the M group (33.4 vs. 7.4 nuclei, $P=0.032$) by 4.5-fold and H group (117 vs 7.4 nuclei, $P<0.0005$) by 15.9-fold when compared to Control.

CONCLUSION: Moderate (150 mmHg) & heavy (200 mmHg) compression force can effectively induce deep pressure ulcer in skeletal muscle of mice in our established experimental pressure ulcer model. This newly optimized compression protocol can be adopted to induce deep pressure ulcer injury in mice for further mechanistic investigations of the role of skeletal muscle in deep pressure ulcer.

Supported by Hong Kong Research Grants Council General Research Fund (PolyU 5632/10M)

3454 Board #98 May 31, 8:00 AM - 9:30 AM

Moderate Intensity Cycling Following Eccentric Contractions Does Not Affect Markers Of Muscle Damage: A Pilot Study

Nicholai C. Crawford¹, Brendan P. Major¹, Josh P. Nederveen², Charles L. Rice, FACSM¹, Greg D. Marsh¹. ¹*The University of Western Ontario, London, ON, Canada.* ²*McMaster University, Hamilton, ON, Canada.*
(No relationships reported)

Active recovery (AR) has been proposed as a measure to attenuate delayed onset muscle soreness (DOMs) as well as enhance subsequent performance. However, studies regarding the effectiveness of AR models for minimizing Exercise Induced Muscle Damage (EIMD) are few. The purpose of this study was to compare the effect of AR with passive recovery at 24, 48, 72, and 96h following EIMD. Non-invasive markers were used to assess the severity of EIMD, including: one repetition maximum leg press strength (1RM), dynamic muscle function (squat and counter movement jump), muscle swelling, delayed onset muscle soreness (DOMS), and changes in MRI transverse relaxation times (T2). Ten males, accustomed to strength training, aged 23 ± 1.5 y, completed an eccentric contraction protocol consisting of 10 sets of 10 reps at 110% of 1RM, followed by either passive recovery (PR, N = 5) or 30 min of moderate intensity cycling each day for 4 days (AR, N = 5). Following EIMD, cross-sectional area (CSA) of the Vastus Lateralis (VL) and Intermedius (VI) muscles of both groups increased from 8% -14%, peaking at 48hours. Similarly, T2 of the VL and VI increased from 7% - 14% reaching a maximum at 24h. Muscle soreness was greatest at 48h for both groups. 1RM was significantly decreased within 1 hour after EIMD and remained suppressed for 72h ($P<0.05$). The greatest decrements in strength were observed at 48h (~22% and ~18% in AR and PR respectively, $P> 0.05$). Squat jump (~32% and ~25%) and counter movement jump (~28% and 25%) heights for AR and PR also decreased at 48-72h, but were not significantly different. Despite the small numbers of subjects and high variability in responses, the lack of statistically significant differences between the AR and PR groups suggests that active recovery protocols are not effective. Moderate intensity cycling following intense eccentric contractions neither exacerbates EIMD nor aids in recovery. Whether this particular mode of active recovery (cycling) has limited effect or whether individuals respond differently to AR requires further study.

3455 Board #99 May 31, 8:00 AM - 9:30 AM

Creatine Kinase Responses 24-36 Hours After Elite Official Basketball Games. A 6-years Follow-up Study.

Xavi Schelling i del Alcázar¹, Lorena Torres-Ronda², Julio Calleja-González³, Nicolás Terrados⁴, Jeff Mjaanes, FACSM⁵. ¹*Basquet Manresa SAD, Manresa, Spain.* ²*National Institute of Physical Activity and Sport Sciences of Catalonia (INEFC), Barcelona, Spain.* ³*Faculty of Physical Activity and Sport Sciences. Laboratory of Sport Performance (UPV-EHU), Vitoria, Spain.* ⁴*Sport Medicine Regional Unit of Principality of Asturias, Oviedo, Spain.* ⁵*Rush University Medical Center, Chicago, IL.*
(No relationships reported)

BACKGROUND: The serum concentration of creatine kinase ([CK]) is used widely as an index of skeletal muscle fiber damage in sport, as well as to interpret the recovery state due to overreaching or trauma.

OBJECTIVE: The aim of this study was to investigate [CK] after 24-36 h post-game, throughout six consecutive whole seasons in professional basketball players (Spanish 1st Division).

METHODS: 72 males from the same team take part in this study (age: 26.8 ± 4.8 yr; height: 198.1 ± 8.0 cm; body mass: 94.0 ± 11.0 kg; Fat%: 13.5 ± 2.8). Blood samples were collected every 4-6 weeks during whole season (496 samples and 29 games) to analyze [CK] according to race, playing time, playing role and season phase. Non-parametric statistic and Cliff's delta (Δ) were carried out.

RESULTS: Black players showed higher [CK] than White players (+37%, Δ : 9.8). Forwards (3) showed the least [CK] (3 vs. 1: -66%, Δ : 8.0; 3 vs. 2: -54%, Δ : 7.6; 3 vs. 4: -42%, Δ : 9.3; 3 vs. 5: -42%, Δ : 0.06). Who played more than 25 minutes showed the highest [CK] (>25 vs. <13: +34%, Δ : 6.7; >25 vs. 13-25: +18%, Δ : 0.1; 13-25 vs. <13: +19%, Δ : 0.3). [CK] increases progressively along the season (Aug vs. Apr.: +32%, Δ : 0.8).

CONCLUSIONS: CK status was race-, playing time-, playing role- and season phase- dependent. As the season progresses, muscle damage state is worst, and it is necessary to take into account according to playing time (especially when it is more than 25 min) and for specific playing position. [CK] monitoring is a useful tool to better control recovery.

3456 **Board #100**

May 31, 8:00 AM - 9:30 AM

The Effect of Passive Warm-Up After Eccentric Exercise Induced Muscle Damage

Meng Yu Chang, Kuo-Wei Tseng, Hui-mei Lin, Yu-Hua Tseng, Jen-Chun Lo. *University of Taipei, Taipei, Taiwan.*

(No relationships reported)

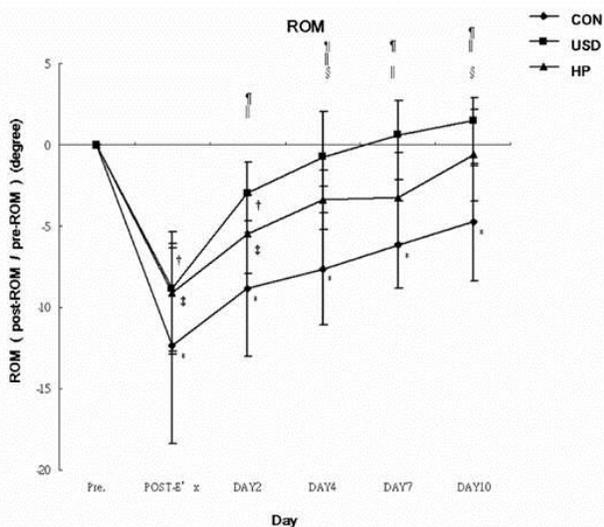
BACKGROUND: Warm-up before exercise could increase blood flow of whole body, increase muscles and skin temperature and prevent injury within exercise. Passive warm-up can increase temperature of muscles as active warm-up do, but it won't cause the muscle fatigue. To use heat packs or ultrasound is the way for passive warm-up.

PURPOSE: To determine the effects of two different modalities of passive warm-up and exercise without warm-up in exercise performance and recovery on muscle damage.

METHODS: Eight volunteers were participated in this study (age = 23.88 ± 5.06 y/o), and all of them were involved into three groups as control group (CON), heat packing group (HP) and ultrasound group (USD). CON never received any warm-up protocol before eccentric exercise, HP received 15 minutes of superficial heat with electrical heat pack before exercise, and USD received 7 minutes of deep heat with ultrasound diathermy before exercise. Each subject processed 30 repeated bouts of eccentric exercise with 80% MVC level. Serum CK, MVC, ROM and CIR were measured before, immediately after exercise and at 2nd, 4th, 7th, and 10th days post-exercise.

RESULTS: When measuring serum CK and CIR, there were no significant difference between CON, HP and USD ($p > 0.05$). When measuring ROM and MVC, there were significant difference between CON, HP and USD ($p < 0.05$).

CONCLUSION: USD and HP have better muscle strength and performance than CON. According to the recovery procedure, USD took lesser damage than HP and CON. USD had lesser swelling than HP and CON in recovery stage after exercise.



3457 **Board #101**

May 31, 8:00 AM - 9:30 AM

Low-intensity Eccentric Contractions Attenuate Maximal Eccentric Contraction-induced Muscle Damage of the Knee Extensors

Trevor C. Chen¹, Hsin-Lian Chen², Ming-Ju Lin², Kuan-Chieh Chen², Bo-Han Wu³, Kazunori Nosaka⁴. ¹National Taiwan Normal University, Taipei City, Taiwan. ²National Chiayi University, Chiayi County, Taiwan. ³National Pingtung University of Science and Technology, Pingtung County, Taiwan. ⁴Edith Cowan University, Western Australia, Australia.

(No relationships reported)

Low-intensity eccentric contractions confer protection against muscle damage induced by maximal eccentric contractions (MaxECC) performed within 2 weeks for the elbow flexors (EF) and within 1 week for knee flexors (KF) of young adults. However, it is not known whether such effect is evident for the knee extensors (KE), and how long the effect lasts.

PURPOSE: This study investigated the time course of the protection conferred by 10% eccentric contractions (10%ECC) on MaxECC of the KE performed 2-21 days later.

METHODS: Sixty-five untrained young men were randomly assigned (n=13/group) to 2 (2d), 7 (7d), 14 (14d), 21 days (21d), or control group (CON) by matching the pre-exercise maximal voluntary isometric contraction (MVC) strength of KE. All groups except CON performed 10%ECC (6 x 10 contractions) followed 2, 7, 14, or 21 days later by MaxECC (6 x 10 contractions) of KE, and the subjects in CON performed only MaxECC. In 10%ECC, subjects lowered the weight corresponding to 10% MVC from an extended position (10°) to a flexed position (100°) in 3 s on a leg extension machine. The MaxECC was performed on an isokinetic dynamometer at an angular velocity of 30°/s in a similar way to 10%ECC. Maximal voluntary concentric contraction torque, optimum angle, ROM, upper thigh circumference, muscle soreness, plasma creatine kinase activity and myoglobin concentration and B-mode ultrasound echo-intensity were measured before to 2 or 5 days after 10%ECC, and before to 5 days after MaxECC. Changes in these variables following MaxECC were compared among groups by a mixed model two-way ANOVA.

RESULTS: 10%ECC did not result in significant changes in any variables. Changes in all variables following MaxECC were smaller for the 2d and 7d groups compared with the CON and other groups ($P < 0.05$), and no significant differences in the changes were evident among the CON, 14d and 21d groups.

CONCLUSIONS: These results show that 10%ECC conferred protection against muscle damage induced by maximal eccentric exercise performed within a week but not more than 2 weeks. The duration of the protective effect remains for KE is similar to that of KF but shorter than EF. This suggests that leg muscles adapt similarly to 10%ECC, but their shorter protective effect than EF may be associated with the difference in exposure to eccentric contractions in daily activities.

3458 Board #102 May 31, 8:00 AM - 9:30 AM

Upper versus Lower Body Pressing Yields Greater Increases in Creatine Kinase Activity and Muscle Soreness

Alexander J. Koch¹, Marco Machado², Jerry L. Mayhew³. ¹*Lenoir-Rhyne University, Hickory, NC.* ²*Universitary Foundation of Itaperuna (FUNITA), Itaperuna, Brazil.* ³*Truman State University, Hickory, MO.*
(No relationships reported)

Previous research has found upper body eccentric contractions evoke greater muscle damage than lower body eccentric contractions of the same relative intensity. Whether these differences persist for conventional movements, consisting of both concentric and eccentric muscle actions and performed on isoinertial equipment is unknown.

PURPOSE: To compare perceived muscle soreness (MS) and serum creatine kinase (CK) activity after upper body or lower body resistance exercise using isoinertial equipment.

METHODS: Sixty-four previously sedentary men were randomized into two groups: bench press (BP; n=32, age = 22.6 ± 4.6 y, body mass = 74.8 ± 11.5 kg,) or leg press (LP; n=32, age = 22.7 ± 4.8 y, body mass = 72.9 ± 7.6 kg). Subjects were tested for 1RM for their respective exercise. Two weeks later, subjects performed four sets to failure at 85% 1RM. MS and serum CK activity were assessed before exercise and 24, 48, and 72h after exercise.

RESULTS: Volume load lifted was significantly greater during LP than BP (2428.2 ± 356.5 kg vs. 1146.9 ± 281.7 kg, respectively; p < 0.001). Despite a lesser volume load, BP elicited greater MS (p < 0.001) and peak CK activity (p < 0.001) than LP after exercise at each time period. MS was modestly correlated to volume load lifted during LP (r = 0.35, p = 0.05) but not during BP (p > 0.05). CK activity was not correlated with volume load for either BP or LP. In addition, MS was not significantly correlated with CK at any time period (r = -0.13-0.12).

CONCLUSIONS: These data indicate that upper body resistance exercise at the same relative intensity elicits greater levels of MS and CK than does lower body exercise in untrained men and suggest that both factors appear to be more dependent on the muscle group engaged rather than the amount of weight lifted.

3459 Board #103 May 31, 8:00 AM - 9:30 AM

Laminin-111 Improves Skeletal Muscle Repair Following Eccentric Exercise-Induced Damage

Kai Zou, Michael De Lisio, Matthew A. Miller, Dami Olatunbosun, Emily Samuel, Marni D. Boppart. *University of Illinois at Urbana-Champaign, Urbana, IL.*
(No relationships reported)

Laminins are major extracellular matrix proteins found in the basal lamina of skeletal muscle. Laminin-111(α1, β1, γ1) (LM-111) is the predominant isoform during embryonic skeletal muscle development. Injection of LM-111 can effectively prevent muscle damage and enhance muscle regeneration capacity in different mouse models of muscle diseases.

PURPOSE: The purpose of this study was to determine the extent to which LM-111 can contribute to muscle repair in response to eccentric exercise-induced muscle damage.

METHODS: Each mouse was injected intramuscularly in both gastrocnemius (GAS) muscles with either 100 μL 1 mg/ml EHS LM-111 (n=12) or sterile TBS (Saline, n=12). At 1 week post-injection, mice either completed a single bout of downhill running exercise to induce muscle damage (-20o, 17 m/min, 30 min) (EX, n=6/group) or remained sedentary (SED, n=6/group). Twenty-four hours following the eccentric exercise, gastrocnemius-soleus complexes were rapidly dissected and collected for further analysis.

RESULTS: The percentage of myofibers with centrally located nuclei was similar between Saline/SED (5.5±1.6) and LM-111/SED (4.9±1.1), but after eccentric exercise was significantly lower in LM-111/EX (4.4±1.1) compared to Saline/EX (9.5±0.6) (P<0.05). In addition, the percentage of satellite cells (Pax7+, 4.5±0.4), the number of proliferating satellite cell (Pax7+ and Ki67+, 16.0±3.1) and newly synthesized myofibers (eMHC+, 3.9±0.6) were all significantly elevated to a greater extent in LM-111/EX than Saline/EX (2.3±0.4, 8.0±1.5, and 1.2±0.7, respectively) following eccentric exercise (P<0.05).

CONCLUSION: The results from this study suggest that LM-111 can successfully improve muscle repair following eccentric exercise-induced muscle damage.

3460 Board #104 May 31, 8:00 AM - 9:30 AM

Antagonizing Pparg Improves Muscle Force Production And Reduces Lipid Infiltration After Chronic Muscle Injury

Jonathan P. Gumucio, Michael Flood, Stuart Roche, Christopher Mendias. *University of Michigan, Ann Arbor, MI.* (Sponsor: John Faulkner, FACSM)
(No relationships reported)

Following chronic tears, certain muscle groups develop an accumulation of ectopic fat within muscle fibers, as well as in plaques within the extracellular matrix. Muscle atrophy, fibrosis and inflammation often accompany this fat infiltration, and these changes are commonly referred to as “fatty degeneration.”

PURPOSE: PPARγ is a potent inducer of adipogenesis, we tested the hypothesis that antagonizing PPARγ signaling would reduce fatty degeneration and increase muscle fiber specific force production in a rat full-thickness severe rotator cuff tear model.

METHODS: As the rotator cuff muscle group is especially prone to the development of fatty degeneration, rats were subjected to a full thickness tenotomy of the supraspinatus and infraspinatus tendons and received either standard chow or chow infused with the PPARγ antagonist GW9662. Thirty days after tear, muscles were harvested and prepared for muscle fiber contractility, histology, and RNA isolation.

RESULTS: Compared with control rats, torn muscles from PPARγ antagonist rats exhibited a 15% increase in specific force production. Additionally, antagonizing PPARγ reduced the amount of lipid plaques, along with a downregulation of several mRNA transcripts involved in canonical muscle lipid metabolism, macrophage accumulation, atrophy, autophagy and fibrosis.

CONCLUSIONS: While further studies are necessary, the results from the current work support PPARγ as a potential therapeutic target for the treatment of fatty degeneration in chronic muscle tears.

3461 Board #105 May 31, 8:00 AM - 9:30 AM

Wrist Position Affects the Magnitude of Eccentric Exercise-Induced Muscle Damage of the Elbow Flexors

Kazunori Nosaka, Wing Yin Lau. *Edith Cowan University, Joondalup, Australia.*
(No relationships reported)

Previous studies reported eccentric exercise-induced muscle damage (EIMD) of the elbow flexors in a supinated position, but it seems likely that the wrist position would affect the magnitude of EIMD. No previous studies have systematically compared between supinated and neutral wrist positions on EIMD.

PURPOSE: The present study tested the hypothesis that eccentric contractions of the elbow flexors in a neutral position would induce less EIMD than those in a supinated position.

METHODS: Ten non-resistance trained men (21-39 y) performed two exercise bouts consisting of 10 sets of 6 maximal isokinetic eccentric contractions of the elbow flexors in a different wrist position (supinated vs neutral) for each arm separated by 4 weeks in a randomised, counterbalanced order. During the eccentric contractions, the elbow joint was forcibly extended from a flexed (60°) to a fully extended position. The movements of the biceps brachii aponeurosis were recorded by B-mode ultrasonography, and the movement distance of the aponeurosis origin from the beginning to the end of each contraction was calculated. Maximal voluntary isometric contraction strength (MVC), range of motion (ROM), muscle soreness and serum creatine kinase (CK) activity were assessed before, immediately after and 1-7 days after each exercise bout. Changes in these variables over time and changes in the aponeurosis elongation over sets were compared between supinated and neutral wrist conditions by a two-way repeated measure ANOVA.

RESULTS: Peak torque produced during eccentric contractions was similar between conditions. The aponeurosis origin was extended during eccentric contractions, and the average aponeurosis elongation increased ($P < 0.05$) from the 1st set (8.0 ± 2.0 mm) to the 10th set (15.8 ± 1.9 mm) for the supinated condition; however, no significant increases were found in the neutral condition (1st set: 5.1 ± 1.0 mm, 10th set: 5.0 ± 0.8 mm). Compared with the supinated condition, changes in MVC, ROM, muscle soreness and serum CK activity after exercise were smaller ($P < 0.05$) for the neutral condition.

CONCLUSIONS: These results suggest that EIMD is less for the neutral than the supinated position, and this was likely associated with the smaller strain to muscle fibers and surrounding connective tissue in the neutral than the supinated condition.

3462 **Board #106** May 31, 8:00 AM - 9:30 AM

Pericyte NF- κ B Activation Enhances Endothelial Cell Proliferation And Proangiogenic Cytokine Secretion

Katherine E. LaBarbera¹, Robert D. Hyldahl², Sarah Witkowski¹. ¹University of Massachusetts Amherst, Amherst, MA. ²Brigham Young University, Provo, UT. (Sponsor: Patty Freedson, FACSM)

(No relationships reported)

Pericytes are skeletal muscle resident, multipotent stem cells that are localized to capillaries. They respond to damage through activation of nuclear-factor kappa-B (NF- κ B), a transcription factor that regulates many cellular processes including inflammation. Research has shown that pericyte NF- κ B activation positively affects myoblast proliferation. It is unknown how pericyte NF- κ B affects signaling and proliferation of endothelial cells, an important component of muscle tissue microcirculation.

PURPOSE: To determine the effects of altered pericyte NF- κ B activity on endothelial cell proliferation and identify inflammatory factors involved in this cell-cell signaling.

METHODS: Human primary pericytes were transfected with vectors designed to increase or decrease NF- κ B activity (or empty vector control). Transfected pericytes were co-cultured with human microvascular endothelial cells (HMVECs) using transwell inserts. HMVEC proliferation was assessed via cell counting at 24 and 48 hr. Secreted cytokines in cell culture supernatants were screened using a Luminex multiplex assay.

RESULTS: HMVEC proliferation was greater in the increased pericyte NF- κ B activity condition compared to the decreased NF- κ B condition at 24 and 48 hr (1.3 fold, $p = 0.002$). At 24 hr, cytokine secretion was greater in the increased NF- κ B condition compared to control for 14 cytokines, including interleukin-8 (IL-8; 6.4 fold, $p < 0.01$), monocyte chemoattractant protein-1 (MCP-1; 4.4 fold, $p < 0.01$), and regulated on activation, normal T cell expressed and secreted (RANTES; 10.6 fold, $p < 0.01$).

CONCLUSIONS: NF- κ B activation in pericytes caused increased HMVEC proliferation, which may have been mediated by proinflammatory and proangiogenic cytokines known to be under the transcriptional regulation of NF- κ B.

Supported by: ACSM Foundation Doctoral Student Research Grant

3463 **Board #107** May 31, 8:00 AM - 9:30 AM

Gastrocnemius and Soleus Muscles of FVB Mice are Not Damaged by 30 Minutes of Downhill Running

Allen C. Parcell, FACSM, Brenda Benson, Ryan Magoffin, Robert D. Hyldahl, David Thomson, Gary W. Mack, FACSM. Brigham Young University, Provo, UT.

(No relationships reported)

Downhill treadmill running (DHR) is a common method for inducing muscle damage in rats and mice. Previous studies have evaluated which muscles are affected by DHR in rats however the same research in mice shows inconsistencies with regards to which muscles are damaged.

PURPOSE: This study assessed muscle damage as evidenced by Evans Blue Dye (EBD) positive cells in the hindlimb of mice after a single bout of DHR with the intent to identify which muscles in the mouse are most affected.

METHODS: Wild-type, male FVB mice were assigned to either a control (C) or downhill running (D) group. To identify damaged cells, mice were injected with EBD (1% solution @ 0.5mg/10g bw, ip) 24h prior to downhill running (D) or sacrifice (C). Mice in D were run downhill (-20°) at 20 meters per minute for 30 minutes. Twenty-four hours after exercise, the gastrocnemius (n=8) and soleus (n=6) muscles were harvested. Tissue cross-sections were mounted, fixed and viewed on a fluorescent microscope to identify cells infiltrated with EBD.

RESULTS: The total number of cells in the solei cross sections averaged 210 ± 39 and 238 ± 84 in C and D, respectively. Total cross section cell counts in the gastrocnemius of C and D were 1956 ± 181 and 1840 ± 134 , respectively. The average number of EBD positive (damaged) cells in the soleus muscles of C and D was 2.7 ± 1 and 4.7 ± 1 , respectively. For the gastrocnemius the EBD positive counts were 67 ± 13 and 68 ± 24 , C and D respectively. No significant difference in EBD positive cells between C and D was found in the soleus or gastrocnemius following downhill treadmill running in D ($p > 0.05$).

CONCLUSION: These data demonstrate that downhill running in wild-type, male FVB mice does not result in increased EBD positive cells in the soleus or gastrocnemius muscles compared to control. This is in disagreement with previous published literature involving downhill running in mice and suggests that downhill running in mice may be a poor model for causing muscle damage. Methodological differences among studies, mouse strain and gender may factor into the discrepant findings of the current study.

3464 **Board #108** May 31, 8:00 AM - 9:30 AM

Intra- And Inter-rater Reliability Of Sonographic Cross-sectional Area Measurements In Asymptomatic Patella Tendons

Antje Reschke, Michael Cassel, Konstantina Intziagianni, Frank Mayer. University of Potsdam, Potsdam, Germany.

(No relationships reported)

Sonographic measures of patella tendon cross-sectional area (PT-CSA) have been shown to be reliable within and between experienced observers. Despite its importance in daily practice, reliability of PT-CSA examinations by ultrasound has neither been investigated within inexperienced investigators nor between experienced (EI) and inexperienced investigators (II).

PURPOSE: To evaluate intra- and inter-rater reliability of sonographic PT-CSA measurements for two investigators with different experience levels.

METHODS: Thirteen healthy subjects (m/f: 7/6; 29 ± 7 yrs., 1.75 ± 0.11 m, 74 ± 13 kg) were included in the test (M1) - retest (M2) design. In randomized order, bilateral PT-CSA (mm²) was sonographically measured by an EI (10 yrs of experience) and an II (2 wks of practice) at 3 different locations: 1 cm from proximal insertion (L1); at mid-section (L2) and 1 cm from distal insertion (L3). Subsequently, images were evaluated independently by both investigators. Data were analysed descriptively (mean \pm SD of differences; intra-rater differences M1-M2; inter-rater differences M2; at L1 to L3). Intra- (M1-M2) and inter-rater reliability (M1, M2) (mean of L1 to L3) were assessed by ICC (2,1), test-retest variability [%] (TRV \pm SD) and Bland-Altman analysis (Bias, limits of agreement [LoA]).

RESULTS: Intra-rater differences of PT-CSA ranged from 7 ± 5 mm² (L2) to 10 ± 7 mm² (L1) in the EI and from 6 ± 5 mm² (L3) to 12 ± 6 mm² (L1) in the II. Inter-rater differences varied from 8 ± 6 mm² (L3) to 11 ± 10 mm² (L1). Intra-rater reliability for EI revealed a TRV of $6.9 \pm 10.3\%$, ICC of 0.85, Bias of -1.13 mm² [LoA: -21.8 mm²; 18.5 mm²], whereas in the II a

TRV of 9.6±9.6%, ICC of 0.88, Bias of 3.58 mm2 [LoA: -15.3 mm2; 22.4 mm2] was demonstrated. Inter-rater reliability at M1 yielded a TRV of 11.3±10.5%, ICC of 0.79, Bias of 5.51 mm2 [LoA: -15.1 mm2; 26.1 mm2] and at M2 a TRV of 9.3±12.0%, ICC of 0.75 and Bias of 0.29 mm2 [LoA: -23.1 mm2; 23.7 mm2].

CONCLUSION: Measures of PT- CSA showed high reliability within differently experienced investigators. Moderate to high values of reliability were shown between both investigators. Thus, under standardized conditions, the experience level has only marginal influence on reproducibility of PT-CSA scans. However, reliability of PT-CSA measurements in healthy subjects depends highly on the location examined.

3465 **Board #109** May 31, 8:00 AM - 9:30 AM

Time-Course of Reduction in Peak Oxygen Consumption and Ventilatory Threshold Following Exercise-Induced Muscle Damage

Robby E. Hight¹, Alexander R. Gonglach¹, Kristin Casagrand², Luke Burnett², Christopher D. Black¹. ¹University of Oklahoma, Norman, OK. ²University of Mississippi, Oxford, MS. (Sponsor: Patrick O'Connor, FACSM)

(No relationships reported)

Peak oxygen consumption has been shown to be reduced following exercise-induced muscle damage (EIMD). The mechanism behind this reduction is unclear, but may be related to decreased strength, a lowered ventilatory threshold, and increased perceptions of pain. Tracking changes in VO₂ peak following EIMD as strength and soreness dissipate could provide insight into the functional consequences of EIMD.

PURPOSE: To examine changes in VO₂ peak and ventilatory threshold in the days following EIMD.

METHODS: Eight (5 male, 3 female) college aged participants performed a series of maximal exercise tests prior to (Pre), immediately following (iPost), and 2 (D2), 4 (D4) and 7 (D7) days after a bout of high intensity resistance exercise. Three sets of single-legged eccentric split squats were performed with 40% of body weight to volitional failure. EIMD was assessed using maximal voluntary strength (MVC) of the quadriceps and ratings of muscle pain/soreness. The maximal exercise test was performed on a treadmill and participants ran at a comfortable speed and the grade was progressively increased by 2% every 2 minutes until exhaustion was reached. Cardiorespiratory variables were collected continuously during the test, rating of muscle pain and sense of effort (RPE) were obtained at the end of each minute and blood lactate was analyzed 2 minutes after the end of the test.

RESULTS: The presence of EIMD was confirmed as MVC declined 21% and 22% at iPost and 2D, respectively (p=0.006). Muscle pain/soreness was evident at iPost (37.5±22.2mm), peaked at 2D (57.6±26.4), and persisted through D7 (10.0±6.9; p<0.005 for each). Peak values for VO₂ were reduced at all time points compared to Pre (p≤0.02 for each) with values falling from 55.5±6.0 (Pre) to 49.9±5.6, 51.3±5.8, 52.3±6.0, and 52.8±6.7 at iPost, D2, D4, and D7, respectively. Ventilatory threshold was reduced at all time points following EIMD (p≤0.02). No differences were observed in peak values for any other variable associated with attainment of maximal oxygen consumption during the exercise test (HR, RER, blood lactate, RPE).

CONCLUSIONS: EIMD resulted in a small, but consistent, and prolonged reduction in peak VO₂ and ventilatory threshold. These data are valuable to those prescribing aerobic exercise in the days following novel resistance training.

3466 **Board #110** May 31, 8:00 AM - 9:30 AM

Treatment of Delayed Onset Muscle Soreness Using a Topical Analgesic Containing Glucosamine and Chondroitin

John K. Petrella, FACSM, Jake H. Mills, Donna L. Dunaway. *Samford University, Birmingham, AL.*

(No relationships reported)

PURPOSE: This study compared the effects of two topical analgesics containing glucosamine and chondroitin in the ability to alleviate exercise induced muscle soreness.

METHODS: Twenty-eight college aged adults (21.2 ± 1 yrs, 172.7 ± 8 cm, 74.1 ± 17 kg) were randomized into 3 groups based on type of topical analgesic: topical containing glucosamine/chondroitin (GC, n=9), topical containing GC + menthol (GCM, n=10), and a topical control (CON, n=9). All participants were measured at baseline on the non-dominant biceps brachii for soreness with movement and palpation. Soreness with movement was measured during a full range of motion from extension to flexion with a 100 point visual analog scale. Soreness with palpation was measured using a pressure algometer (FDN-100, Wagner Instruments) with a 1 cm² stylus pressed into the gaster of muscle until 40 Nm of pressure was achieved. Participants then rated soreness using the visual analog scale. After all baseline measures, participants completed an eccentric exercise bout designed to induce muscle soreness in the non-dominant biceps brachii. For 48 hrs, participants were instructed not to treat or alleviate the muscle soreness. After 48 hrs, participants returned for the first application of the topical treatment which was applied to the skin and absorbed for 20 minutes. All soreness measures were again assessed 20 and 40 minutes after the initial application. Participants were given single dose applications to apply every 4 waking hours over the next 24 hours. After 24 hrs, a final application was placed with follow up testing after 20 and 40 minutes.

RESULTS: There was no difference in soreness between groups (p>0.05) over the post exercise 48 hr period. All three analgesic groups increased soreness with movement (+515%, p<0.05) and palpation (+258%, p<0.05). After 24 hours of treatment (6 applications), soreness with palpation was significantly reduced (21-22%, p<0.05) for the GC and GCM groups but not the control (increased 2%). Additionally, soreness with movement was alleviated with GC and GCM (36-43%, p<0.05) but not the control (decreased 24%, p=0.29).

CONCLUSIONS: Delayed onset muscle soreness can be alleviated over a 24 hour period by a topical analgesic containing chondroitin and glucosamine. The inclusion of menthol does not provide any additional benefits.

3467 **Board #111** May 31, 8:00 AM - 9:30 AM

Physical Activity and Heart Rate Following an Ankle Sprain in Active Aging Mice

Michael J. Turner, Sophie Guderian, Tricia Hubbard-Turner, FACSM, Erik A. Wikstrom, FACSM. *UNC Charlotte, Charlotte, NC.*

(No relationships reported)

Cardiovascular changes with aging are commonly associated with declines in physical activity. Additionally, ankle sprains are the most common orthopedic pathology throughout the lifespan.

PURPOSE: To determine if an ankle sprain early in life will negatively influence physical activity and resting heart rate throughout the lifespan.

METHODS: Thirty, seven-week old male CBA/J mice were randomly placed into one of three groups: the transected CFL group (10 mice), the transected ATFL/CFL group (10 mice), and a SHAM group (10 mice). Three days after surgery all mice were individually housed with a running wheel and provided water and standard chow ad libitum. Daily physical activity, as assessed by voluntary running wheel activity, was measured with a sensor and digital odometer. Resting heart rate was measured during echocardiographic assessments with 2.5% Isoflurane anesthesia.

RESULTS: Daily distance run was significantly lower in the ATFL/CFL group compared to the CFL and SHAM groups ($p=0.018$) through 18 months of age. Daily distance decreased significantly across the lifespan ($p<0.0001$). Resting heart rate was not different between the groups through 18 months of age ($p=0.25$) but increased throughout the lifespan ($p=0.0007$). A significant interaction was observed suggesting a greater increase in resting heart rate in the ATFL/CFL mice with age ($p=0.01$).

Age	ATFL/CFL Group	CFL Group	SHAM Group
3 months*	3.6 ± 2.3	4.2 ± 2.3	5.0 ± 3.5
6 months*	2.1 ± 1.1	2.7 ± 1.2	3.8 ± 1.5
12 months*	2.2 ± 0.8	2.4 ± 0.9	2.6 ± 0.8
18 months*	1.1 ± 0.6	1.6 ± 0.6	1.8 ± 1.0

(*Significantly different between ATFL/CFL group and SHAM group; $p < .05$)

CONCLUSIONS: Our findings suggest ankle sprains involving the transection of the CFL and ATFL in young CBA/J mice will result in a reduced physical activity level and elevated resting heart rate throughout the remainder of the lifespan.

Supported by the UNC Charlotte Faculty Grant Program

G-38 Free Communication/Poster - Occupational and Environmental Physiology

Saturday, May 31, 2014, 7:30 AM - 11:00 AM

Room: WB1

3468 **Board #112** May 31, 9:30 AM - 11:00 AM

North Carolina Police Officer Physical Ability Test Validation: Comparing Actual and Perception of Qualifying Times

David B. Wolff¹, Glenn R. Jones², Robert W. Boyce, FACSM¹. ¹University of North Carolina at Wilmington, Wilmington, NC. ²Work Physiology Associates Inc., Charlotte, NC.
(No relationships reported)

The most recent job analysis showed a need to make changes to the police officer physical ability test (POPAT). It assesses recruits at the end of Basic Law Enforcement Training (BLET) and must be passed.

PURPOSE: To compare actual and perception of qualifying (cut off score) times between genders and age groups (<40 yrs vs. ≥40 years) to validate the test.

METHODS: The new POPAT was composed of two Scenarios: Scenario 1 - Chase and Apprehension and Scenario 2 - Rescue. After participating in each scenario the incumbent officers gave their perception of a qualifying time.

RESULTS: participants were 136 male and 48 female police officer (60% <40 yrs and 40% ≥40 yrs). ANOVA comparison between genders indicated that males and the <40 yrs group completed scenarios 1 and 2 in significantly, $p \leq 0.001$, less time than their gender or age counterparts. The females and ≥40 yrs officers' actual times were significantly, $p \leq 0.001$, closer to their suggestions for a maximum qualifying time than their gender or age group counterparts. However, there was no significant difference between genders and age groups as to the suggested maximum qualifying time. Overall, the mean scenario 1 and scenario 2 suggested qualifying times (366±72 sec; 173±49 sec, respectively) were similar among the groups with only 14 sec difference between any of the sub groups for scenario 1 and only 10 sec difference for scenario 2.

CONCLUSION: The qualifying physical ability time is strongly supported by both genders and age groups. Thus, the recruit impact and reliability trials can proceed.

3469 **Board #113** May 31, 9:30 AM - 11:00 AM

Fear And Anxiety Increase During Fire Suppression

Deena S. Rosalky¹, Robert J. Robertson, FACSM², Jon C. Rittenberger², David Hostler, FACSM¹. ¹University at Buffalo, Buffalo, NY. ²University of Pittsburgh, Pittsburgh, PA.
(No relationships reported)

Fire suppression is inherently stressful work that increases stress and negative affect in firefighters. Two affective components of the stress response are fear and anxiety which are associated with different physiological responses. Little is known about how workload duration influences psychological stress responses in firefighters.

PURPOSE: The aim of this study is to investigate the effect of workload duration on self-reported fear and anxiety responses in firefighters.

METHODS: Healthy firefighters (N=42, 30.3±8.3 yrs) participating in a live fire evolution were randomized into either 2 bouts (n=19, 20.1±1.9 min total work) or 3 bouts (n=23, 27.3±5.0 min total work) of fire suppression, with 10 minutes rest between bouts. Next, subjects participated in forearm immersion cooling for 20 minutes. Self-reported fear and anxiety data were collected at 2 time points prior to entering the burn building, immediately on exiting the burn building, and at the commencement of recovery. The fear and anxiety scales used were developed from the revised Reinforcement Sensitivity Theory literature, and comprise 17 and 6 items respectively. Data were analyzed using a 2 (affect) x 2 (group) RMANOVA model and t-tests.

RESULTS: Significant main effects for time $F(1,30) = 552.40$, $p < .01$ and affect $F(3,28) = 7.22$, $p = .01$ were found. Independent t-tests indicated no difference between fear and anxiety at baseline. Fear and anxiety rose during fire suppression and t-tests showed that the increase in fear was greater than that of anxiety during both fire suppression and recovery. A decline in anxiety during recovery was demonstrated that was not present in fear responses, which continued to rise in recovery. No main effect or interaction effect was found for group.

CONCLUSIONS: Firefighters experience an increase in anxiety and fear during fire suppression with a greater and more prolonged increase in fear than anxiety. Longer work duration did not result in a more pronounced experience of fear or of anxiety.