

**G-19 Thematic Poster - Aging/Lifecycle**

Saturday, June 2, 2018, 9:00 AM - 11:00 AM  
Room: CC-Mezzanine M100C

3059 **Chair:** Steven K. Malin, FACSM. *University of Virginia, Charlottesville, VA.*

(No relevant relationships reported)

3060 **Board #1** June 2 9:00 AM - 11:00 AM  
**Changes In Vitamin D Status Before And After Nordic Summer In Overweight Middle-aged Participants**

Petra Lundström, Maria J. Eriksson, Kenneth Caidahl, Anette Rickenlund. *Karolinska Institutet, Stockholm, Sweden.*

(No relevant relationships reported)

**Background:** Sun exposure is the main source to synthesize vitamin D. Obesity, type II diabetes mellitus, and living at high altitude are risk factors for low vitamin D status. Seasonal variations in affected populations are unknown. **Purpose:** We investigated the effect of sun exposure during a summer season on vitamin D status in Sweden, and its association with fat mass and deranged carbohydrate metabolism. **Methods:** One hundred sixty-one subjects (91 women and 70 men), with a mean age of  $60 \pm 5$  years with body mass index  $\geq 25$  kg/m<sup>2</sup>, with or without deranged carbohydrate metabolism were studied. The participants were divided into groups based on an oral glucose tolerance test. Glucose tolerance was classified as normal (NGT)  $\leq 8.9$  mmol/L, impaired glucose tolerance  $\geq 8.9$ - $12.1$  mmol/L or T2DM  $\geq 12.2$  mmol/L. Blood samples, body composition, and food questionnaires were taken before and after a summer season with a second year follow-up.

**Results:** Eighty-five percent of participants showed low to deficient levels of vitamin D before summer ( $55.1 \pm 21.5$  nmol/L<sup>-1</sup>). After summer the level increased significantly to  $66.4$  nmol/L<sup>-1</sup> ( $P < 0.01$ ) but remained below the recommended value ( $\geq 75$  nmol/L<sup>-1</sup>) in 65% of the subjects. Similar low vitamin D levels were found in a follow-up substudy. Before summer, we did not find any interactions between vitamin D, carbohydrate metabolism, or gender. There were no significant differences in the mean value of vitamin D before and after the second summer compared with the first. Before summer, Vitamin D in women with NGT correlated with fat mass (% and kg) ( $r = -0.34$  to  $-0.43$ ,  $P = 0.01$ ). There was no correlation between vitamin D levels and the intake of fatty fish.

**Conclusion:** In most of this overweight/obese population, sun exposure at high latitudes had a beneficial but often insufficient effect on circulating vitamin D levels compared with those currently recommended.

3061 **Board #2** June 2 9:00 AM - 11:00 AM

**Continuous Glucose Monitoring in Older Adults: Impact of Aerobic Exercise and Metformin on Glucose Variability**

Oscar D. Safairad<sup>1</sup>, Hayden M. Schoenberg<sup>2</sup>, Jaime L. Laurin<sup>3</sup>, Benjamin F. Miller, FACSM<sup>2</sup>, Karyn L. Hamilton, FACSM<sup>2</sup>, Adam R. Konopka<sup>1</sup>. <sup>1</sup>University of Illinois at Urbana-Champaign, Urbana, IL. <sup>2</sup>Colorado State University, Fort Collins, CO. (Sponsor: Karyn L. Hamilton, FACSM)

(No relevant relationships reported)

A greater magnitude and frequency of glucose fluctuations within or between days is defined as impaired glucose variability (GV) and is a risk factor for Type 2 Diabetes. Glycated hemoglobin (HbA1c) is the standard approach to provide an index of long-term GV (~3 months). Continuous glucose monitoring (CGM) has emerged as a tool to measure glucose every 5 minutes to ascertain short-term GV. **PURPOSE:** Identify if GV is impaired in older, non-diabetic individuals and determine the influence of aerobic exercise with or without metformin on GV in older adults. **METHODS:** CGM was used to measure cumulative GV over 7-10 days in young ( $n=5$ , 28yr, 23kg/m<sup>2</sup>) and older ( $n=17$ , 64yr, 32kg/m<sup>2</sup>) adults. In a double blinded fashion, older adults were randomized to consume placebo ( $n=9$ ) or Metformin ( $n=8$ ) during 12-weeks of aerobic exercise training (AET). Participants were provided a standardized beverage (300 kcal) after each exercise. CGM was also implemented during and after the 12-week intervention. Cumulative mean glucose, indices of intra-day (continuous overall net glycemic action (CONGA<sub>4h</sub>)) and inter-day (mean of daily differences (MODD)), average daily risk range (ADRR)) GV were calculated by EasyGV software. Mean glucose was also determined every 24-hr after AET. **RESULTS:** Older adults have greater ( $P < 0.05$ ) mean glucose ( $6.3 \pm 0.7$  vs.  $5.3 \pm 0.3$ ), CONGA<sub>4h</sub> ( $5.2 \pm 0.4$  vs.  $4.4 \pm 0.3$ ), MODD ( $1.2 \pm 0.4$  vs.  $0.9 \pm 0.1$ ), and ADRR ( $7.4 \pm 4.8$  vs.  $2.6 \pm 1.2$ ) versus young. Compared to baseline, cumulative mean glucose and ADRR were lower ( $P < 0.05$ ) during AET in older adults on placebo (Mean,  $6.2 \pm 0.6$  vs.  $5.5 \pm 1.0$ ; ADRR,  $6.9 \pm 3.3$  vs.  $4.8 \pm 1.7$ ) or metformin (Mean,  $6.3 \pm 0.7$  vs.  $5.5 \pm 0.7$ ; ADRR,  $8.2 \pm 6.3$  vs.  $5.5 \pm 2.0$ ). When taking metformin, CONGA<sub>4h</sub> was also lower during AET ( $5.2 \pm 0.4$  vs.  $4.9 \pm 0.3$ ). Cumulative GV was not different after AET in either group. However, in

the metformin group, 24-hr mean glucose was decreased ( $P < 0.05$ ) 1 day after AET and gradually increased the next 7 days ( $P \leq 0.06$  Days 5-7 vs. Day 1) back to baseline. **CONCLUSION:** In older adults, cumulative mean glucose and GV were decreased toward young values during AET. While improvements in cumulative GV dissipated after AET, the addition of metformin to exercise may delay the return of 24-hr glucose to baseline values. These data highlight the need for regular exercise to sustain improvements in GV in older adults.

3062 **Board #3** June 2 9:00 AM - 11:00 AM

**Effect of Moderate Intensity Exercise Dose on Lipoprotein Concentrations and Particle Size in Older Women**

Ryan R. Porter, J. Larry Durstine, FACSM, Charity B. Breneman, Xuewen Wang. *University of South Carolina, Columbia, SC.* (Sponsor: J. Larry Durstine, FACSM)

(No relevant relationships reported)

Lipoprotein concentrations are well established biological markers associated with cardiovascular disease (CVD) risk. Recent research has placed great importance on the function of different lipoprotein subfractions (medium and small VLDL; small and large LDL; small, medium and large HDL). Current literature supports exercise as being protective by affecting lipoprotein particle size and concentration, whereas little research has been conducted to determine the effects of exercise dose on these outcomes.

**PURPOSE:** To determine if exercise dose has an effect on VLDL, LDL, and HDL particle size and concentrations in older sedentary women after 16 weeks of moderate-intensity aerobic exercise.

**METHODS:** Sixty-five women (age =  $64.7 \pm 4.2$  years) were randomized into higher-dose ( $n = 30$ ) and lower-dose ( $n = 35$ ) exercise groups. Supervised treadmill walking sessions lasted approximately 35 or 55 minutes, 3 times per week, for lower-dose and higher-dose groups, respectively. All exercise was completed at an intensity of 50-55% of heart rate reserve. Fasting plasma samples were collected before and after exercise intervention. Plasma lipoprotein particle concentrations and average sizes were determined by nuclear magnetic resonance spectroscopy.

**RESULTS:** Exercise, in the entire sample, lowered total HDL and small VLDL particle concentration ( $1.5 \pm 3.6$   $\mu$ mol/L and  $4.2 \pm 16.4$  nmol/L;  $p < 0.01$  and  $p < 0.05$ , respectively), and increased mean HDL particle size ( $0.1 \pm 0.3$  nm;  $p < 0.01$ ). When analyzed by exercise groups, the lower-dose group displayed a decrease in total HDL particle concentration ( $1.9 \pm 3.1$   $\mu$ mol/L;  $p = 0.001$ ), while the higher-dose group displayed an increase in mean LDL particle size ( $0.3 \pm 0.5$  nm;  $p < 0.05$ ). Both exercise higher-dose and lower-dose treatments were found to significantly increase mean HDL particle size ( $0.1 \pm 0.2$  nm and  $0.1 \pm 0.3$  nm, respectively;  $p < 0.05$ ) with no significant difference between groups.

**CONCLUSIONS:** The results from this study support that exercise in sedentary older women decreased CVD risk. Though the HDL particle concentration decreased in the lower-dose group, maintenance of HDL particle concentration in the higher-dose group along with the increase in mean HDL and LDL size are characteristics associated with lower CVD risk. Supported by NIH Grant R00AG031297

3063 **Board #4** June 2 9:00 AM - 11:00 AM

**Resistance Exercise and Low Dose Protein Ingestion Augments Anabolic Signaling Mechanisms In Older Women**

Susannah E. Scaroni<sup>1</sup>, Sarah K. Skinner, 61801<sup>1</sup>, Joseph W. Beals<sup>1</sup>, Stephan van Vliet<sup>1</sup>, Elizabeth Poozhikunnel<sup>1</sup>, Ralf Jager<sup>2</sup>, Martin Purpura<sup>2</sup>, Jonathan Oliver<sup>3</sup>, Scott Paluska, FACSM<sup>1</sup>, Nicholas A. Burd<sup>1</sup>. <sup>1</sup>University of Illinois at Urbana-Champaign, Urbana, IL. <sup>2</sup>Increnovo LLC, Milwaukee, WI. <sup>3</sup>Texas Christian University, Fort Worth, TX. (Sponsor: Scott Paluska, FACSM)

(No relevant relationships reported)

Resistance exercise enhances skeletal muscle anabolic signaling responses to the ingestion of sub-optimal amounts of protein in young men. However, the effectiveness of resistance exercise to potentiate the phosphorylation of the mechanistic target of rapamycin (mTORC1) to the ingestion of minimal amount of protein in aging women has not been well characterized. **PURPOSE:** We compared the phosphorylated-state of mTORC1 before and after ingestion of ~14 g whey protein or water at rest and after resistance exercise in middle-aged and older women. **METHODS:** 10 women ( $59 \pm 2$  y; BMI:  $25 \pm 1$  kg/m<sup>2</sup>; LBM:  $46 \pm 2$  kg) performed a bout of unilateral leg extension exercise (3 sets  $\times$  12 repetitions at 60% estimated 1RM) prior to ingesting whey protein (0.3g/kg LBM; WHEY,  $n=5$ ) or water (WATER  $n=5$ ). Blood and skeletal muscle biopsies were used to measure plasma amino acids and insulin concentrations and phosphorylation of mTORC1 at Ser2448 at 2 and 4 h of the postprandial phase in both exercise (EX) and non-exercised (CON) legs. **RESULTS:** Plasma branched chain amino acid concentrations were increased from basal (2.5-fold) in WHEY ( $P < 0.05$ ), but not in WATER condition ( $P > 0.05$ ). Plasma insulin concentrations increased after WHEY (2.3 $\pm$ 0.8 fold change from basal,  $P = 0.02$ ), but not after WATER ingestion (1.0

$\pm 0.1$  fold-change,  $P=0.45$ ). WHEY ingestion increased mTORC1 phosphorylation at 2 h ( $3.4\pm 0.6$  and  $1.7\pm 0.3$  fold-change in EX and CON, respectively  $P<0.05$ ). There were no changes in mTORC1 phosphorylation after WATER ingestion at any time point ( $P>0.05$ ). **CONCLUSION:** Our data demonstrated that consuming a minimal amount of protein immediately after resistance exercise resulted in a greater, but transient, phosphorylation of anabolic signaling mechanisms involved in protein translation over that induced by feeding or resistance exercise alone.

3064 Board #5 June 2 9:00 AM - 11:00 AM

### Calorie Restriction Promotes Constant Physical Activity Levels Throughout Total Lifetime of Female Mice

Jorge Z. Granados<sup>1</sup>, Ayland C. Letsinger<sup>1</sup>, Heather L. Vellers<sup>1</sup>, Victor A. Garcia<sup>1</sup>, Jeremiah D. Velasco<sup>1</sup>, Edward C. Nagle<sup>1</sup>, Layla C. Perez<sup>1</sup>, Madison Spier<sup>2</sup>, Isabel Lambert<sup>2</sup>, Robin Fuchs-Young<sup>2</sup>, J. Timothy Lightfoot, FACSM<sup>1</sup>. <sup>1</sup>Texas A&M University, College Station, TX. <sup>2</sup>Texas A&M University Health Science Center, College Station, TX. (Sponsor: J. Timothy Lightfoot, FACSM)

(No relevant relationships reported)

**BACKGROUND:** Physical inactivity contributes to incidence of diseases and decreased life expectancy. Previous data has shown that chronic overfeeding via high fat high sugar diet (HFHS) reduces voluntary wheel running (WR) activity in mice. **PURPOSE:** Determine the effects of a 12% calorie restriction diet (DR) vs. an *ad-lib* HFHS diet on physical activity (PA) levels (distance, duration, speed) throughout total lifetime in female SENCAR mice. **METHODS:** SENCAR mice were bred and offspring were weaned at 3 weeks of age onto a HFHS (20% protein, 45% fat, 24% sucrose + 10% fructose water), an *ad-lib* standard chow (CONT; 20% protein, 10% fat, 57% cornstarch), or a DR (12% kcal restriction, 20% protein, 10% fat, 57% cornstarch). At 4 weeks of age, female mice were housed in pairs and two plastic running wheels were mounted inside each cage. WR distance (km/day) and duration (min/day) were recorded and used to calculate average speed (m/min) via a mounted computer system. Repeated measures ANOVA determined the effect of diet on WR activity relative to varying percentages of total lifetime (15%, 25%, 50%, 75%, and 100%). **RESULTS:** 116 female mice [HFHS (n=42), DR (n=55), CNTL (n=19)] were analyzed. Both *ad lib* HFHS and *ad lib* CONT diets significantly decreased distance, duration, and speed after 25% of the total lifespan. All PA variables remained unchanged for the DR mice with the only significant reduction occurring in duration between 75% ( $221 \pm 98$ min/day) to 100% ( $188 \pm 79$ min/day) of total lifetime. Additionally, correlations of determination were observed for body weight vs HFHS (.44), DR (.04), and CONT (.34) diets. **CONCLUSIONS:** DR mice maintained activity levels across their lifespans as compared to *ad lib* CONT and *ad lib* HFHS mice whose activities decreased over their lifespan. These findings substantiate our previous data and propose that minimal calorie restriction may serve a novel intervention to prevent physical inactivity across the lifespan.

3065 Board #6 June 2 9:00 AM - 11:00 AM

### Leucine-Enriched Protein Supplementation Does Not Augment Muscle Mass and Strength Gains During Resistance-Type Exercise Training in Older Males

Andrew M. Holwerda, Maarten Overkamp, Kevin J.M. Paulussen, Joey S.J. Smeets, Annemie P. Gijzen, Joy P.B. Goessens, Lex B. Verdijk, Luc J.C. van Loon. Maastricht University Medical Centre+, Maastricht, Netherlands. (Sponsor: Professor Janice L. Thompson, PhD, FACSM)

(No relevant relationships reported)

**Purpose:** The proposed benefits of protein supplementation on the skeletal muscle adaptive response to resistance-type exercise training remain unclear. Protein ingestion after exercise and prior to sleep have been shown to augment muscle protein synthesis during recovery from exercise. However, it remains to be established whether dietary protein ingestion after exercise and before sleep augments muscle mass and strength gains during resistance-type exercise training in older individuals. **Methods:** Forty-one healthy older males ( $70\pm 1$  y) completed 12 weeks of whole-body resistance-type exercise training (3 sessions·week<sup>-1</sup>) and were randomly assigned to ingest either protein (20 g whey plus 1 g leucine;  $n=21$ ) or an energy-matched placebo ( $n=20$ ) after exercise and each night prior to sleep. Maximal strength was assessed by one-repetition maximum (1RM) testing before and after training. Muscle hypertrophy was assessed at the whole-body (dual-energy X-ray absorptiometry), upper leg (computed tomography scan), and muscle fiber (biopsy) levels. Muscle protein synthesis during week 12 of training was assessed by providing deuterated water (<sup>2</sup>H<sub>2</sub>O) and collecting muscle biopsies. **Results:** Leg extension 1RM increased in both groups (placebo:  $88\pm 3$  to  $104\pm 4$  kg, protein:  $85\pm 3$  to  $102\pm 4$  kg;  $P<0.001$ ), with no differences detected between groups ( $P>0.05$ ). Appendicular lean mass (placebo:  $26.7\pm 0.7$  to  $27.7\pm 0.7$  kg, protein:  $26.0\pm 0.5$  to  $26.6\pm 0.5$  kg;  $P<0.001$ ) and quadriceps cross sectional area

(placebo:  $67.8\pm 1.7$  to  $73.5\pm 2.0$  cm<sup>2</sup>, protein:  $68.3\pm 1.4$  to  $72.3\pm 1.4$  cm<sup>2</sup>;  $P<0.001$ ) increased in both groups, with no differences detected between groups ( $P>0.05$ ). Muscle fiber hypertrophy occurred in type II (placebo:  $5486\pm 418$  to  $6492\pm 429$  μm<sup>2</sup>, protein:  $5367\pm 301$  to  $6259\pm 391$  μm<sup>2</sup>;  $P<0.001$ ), but not in type I fibers (placebo:  $6059\pm 364$  to  $6600\pm 269$  μm<sup>2</sup>, protein:  $5935\pm 246$  to  $6171\pm 305$  μm<sup>2</sup>;  $P>0.05$ ), with no differences detected between groups ( $P>0.05$ ). Muscle protein synthesis rates were  $1.62\pm 0.06$  and  $1.57\pm 0.05$  %·d<sup>-1</sup> in the placebo and protein groups, respectively, with no differences detected between groups ( $P>0.05$ ). **Conclusion:** Leucine-enriched protein supplementation after exercise and before sleep does not augment skeletal muscle mass or strength gains after resistance-type exercise training in older males.

3066 Board #7 June 2 9:00 AM - 11:00 AM

### Muscle Protein Synthetic Responses After Low-dose Protein Ingestion and Resistance Exercise In Older Women

Sarah K. Skinner<sup>1</sup>, Joseph W. Beals<sup>1</sup>, Stephan van Vliet<sup>1</sup>, Justin T. Parel<sup>1</sup>, Elizabeth Poozhikunnel<sup>1</sup>, Alexander V. Ulanov<sup>1</sup>, Lucas Li<sup>1</sup>, Ralf Jager<sup>2</sup>, Martin Purpura<sup>2</sup>, Scott A. Paluska, FACSM<sup>1</sup>, Jonathan Oliver<sup>3</sup>, Nicholas A. Burd<sup>1</sup>. <sup>1</sup>University of Illinois at Urbana-Champaign, Urbana, IL. <sup>2</sup>Increnova LLC, Milwaukee, WI. <sup>3</sup>Texas Christian University, Fort Worth, TX. (Sponsor: Scott Paluska, FACSM)

(No relevant relationships reported)

Resistance exercise enhances the anabolic sensitivity of myofibrillar protein synthesis rates (MPS) to the ingestion of a moderate amount of protein in young and older men. However, the effectiveness of resistance exercise to potentiate postprandial MPS after the ingestion of minimal dose of protein in aging women has not been well characterized. **PURPOSE:** We compared changes in MPS to ingestion of ~14 g whey protein or water at rest and after resistance exercise in middle-aged and older women. **METHODS:** 10 women ( $59\pm 2$  y; BMI:  $25\pm 1$  kg/m<sup>2</sup>; LBM:  $46\pm 2$  kg) performed a bout of unilateral leg extension exercise (3 sets × 12 repetitions at 60% estimated 1RM) prior to ingesting whey protein (0.3g/kg LBM; WHEY,  $n=5$ ) or water (WATER  $n=5$ ). Primed continuous infusions of L-[ring-<sup>13</sup>C<sub>6</sub>]phenylalanine, blood, and skeletal muscle biopsies were used to measure MPS over 4 h postprandial phase in both exercise (EX) and non-exercised (CON) legs. **RESULTS:** Plasma essential amino acid concentrations were increased from basal (2.5-fold) in WHEY group ( $P<0.05$ ), but not in WATER group ( $P>0.05$ ). EX significantly increased MPS above basal in both WHEY (5-fold) and WATER (2.3-fold) groups over the 4-hour postprandial period ( $P<0.05$ ). MPS were not significantly increased above basal rates in the CON leg throughout the postprandial period in either condition ( $P=0.104$ ). No group differences in MPS were observed between the WHEY or WATER groups in either the EX or CON legs ( $P>0.05$ ). **CONCLUSION:** A moderate volume of resistance exercise significantly increased MPS in aging women. However, the ingestion of a low dose of whey protein immediately after resistance exercise did not potentiate the MPS response when compared to ingesting water. Therefore, more targeted anabolic strategies are warranted to maximize the MPS response to feeding and exercise in older women.

## G-20 Thematic Poster - Altitude/Hypoxia: Training and Performance

Saturday, June 2, 2018, 9:00 AM - 11:00 AM  
Room: CC-Lower level L100C

3067 Chair: Roy Salgado. USARIEM, Natick, MA.

(No relevant relationships reported)

3068 Board #1 June 2 9:00 AM - 11:00 AM

### Impact Of Altitude On Sample Size Estimations For Exercise Performance: Implications For Research

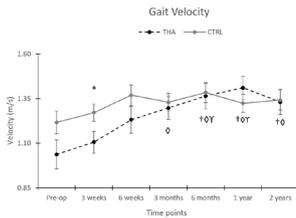
Roy Salgado, Samuel Chevront, FACSM, Upendra Bhattarai, Robert Kenefick, FACSM. US Army Research Institute of Environmental Medicine, Natick, MA.

(No relevant relationships reported)

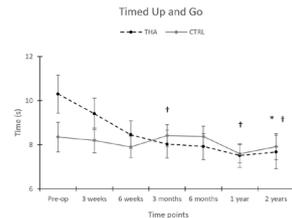
Adequate sample size is needed to detect a meaningful change in an outcome variable in response to an experimental intervention (e.g. dietary supplements). **Purpose:** To calculate and compare the sample size needed to detect a significant and meaningful improvement (5 - 20%) in exercise performance using different modes (i.e. cycling and running) of exercise at 3500 and 4300 m altitude for test selection. **Methods:** A total of 62 sea level (SL) residents (58 men and 4 women; mean  $\pm$  SD;  $24 \pm 5$  yrs,  $176.0 \pm 7.6$  cm,  $78.4 \pm 11.4$  kg;  $49.3 \pm 6.4$  ml·kg<sup>-1</sup>·min<sup>-1</sup> VO<sub>2</sub>peak) completed either a) 1) 720kj cycle time trial (TT) at 3500 m ( $n=6$ ), or at 4300 m ( $n=17$ ); 2) a 5000/6000W cycle TT at 4300 m ( $n=13$ ); 3) a 11.2 km treadmill TT at 3500 m ( $n=11$ ); or 4) a 3.2 km TT at 4300 m ( $n=15$ ) at SL and within two days upon arrival to altitude. Sample size

(n) was calculated as:  $n = 16 * CV (\%) / \Delta perf (\%)$ , where CV (%) = typical error (sec) / mean TT perf (sec) and  $\Delta perf (\%) = 5, 10, \text{ and } 20\%$  improvement in performance to be detected. **Results:** Table 1 provides sample size estimations needed to detect a change in cycling and running performance of 5, 10, and 20% at 3500 and 4300 m of altitude. **Conclusion:** The findings indicate that performance measured using running as a mode of exercise when compared to cycling requires a smaller sample size to detect a significant and meaningful change.

**Disclaimer:** The opinions or assertions contained herein are the private views of the author(s) and are not to be construed as official or reflecting the views of the Army or the Department of Defense.



**Figure 1a.** Average self-selected gait velocities for total hip arthroplasty patients (THA) and healthy control (CTRL) groups across data collection time-points. \*  $p < 0.05$  for difference between THA and CTRL groups, †  $p < 0.05$  for difference compared to pre-surgery, ‡  $p < 0.05$  for difference compared to 3 weeks post-surgery, §  $p < 0.05$  for difference compared to 6 weeks post-surgery.



**Figure 1b.** Average Timed Up and Go completion times for total hip arthroplasty patients (THA) and healthy control (CTRL) groups across data collection time-points. For THA group only, \*  $p < 0.05$  for difference compared to pre-surgery, †  $p < 0.05$  for difference compared to 3 weeks post-surgery.

3069 Board #2 Jun. 2 9:00 AM - 11:00 AM

### Ischemic Preconditioning and Cycling Time Trial Performance in Hypoxia

Chad C. Wiggins, Keren Constantini, Timothy D. Mickleborough, Robert F. Chapman, FACSM. *Indiana University, Bloomington, IN.* (Sponsor: Robert F. Chapman, FACSM)

(No relevant relationships reported)

Ischemic preconditioning (IPC) of the legs prior to exercise has been shown as a novel approach to improve performance in a number of different exercise modes in normoxia. Very little has been done potential mechanisms behind the performance improvements in well-trained subjects, and less has been done examining the influence of these mechanisms during exercise in hypoxia. **PURPOSE:** To determine if IPC is an effective intervention for improving 5km cycle time trial (TT) performance in both normoxia and hypoxia. **METHODS:** Thirteen men (age =  $24 \pm 4$  years,  $\dot{V}O_{2max} = 63.1 \pm 5.1 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) completed four randomized trials of each combination of hypoxia ( $F_{I,O_2} = 0.16$ ) or normoxia with a resting pre-exercise IPC protocol ( $4 \times 5 \text{ min}$  at  $220 \text{ mmHg}$ ) or SHAM ( $4 \times 5 \text{ min}$  at  $20 \text{ mmHg}$ ) procedure. Following the IPC/SHAM protocol subjects completed two constant load bouts and a 5km time trial on a cycling ergometer. Breath-by-breath  $\dot{V}O_2$ , oxyhemoglobin saturation, and skeletal muscle oxygenation/extraction (measured via near-infrared spectroscopy) were continuously monitored throughout the trials. **RESULTS:** IPC significantly improved 5km TT time in normoxia by  $0.9 \pm 1.7\%$  compared to SHAM (IPC:  $491.2 \pm 33.7 \text{ s}$  vs. SHAM:  $495.9 \pm 34.5 \text{ s}$ ,  $P < 0.05$ ). IPC did not alter 5km TT performance times in hypoxia. Muscle oxygenation, extraction, and tissue saturation did not differ between treatments or inspirates ( $P > 0.05$ ). **CONCLUSION:** IPC improves 5km cycling TT performance in normoxia only. Muscle oxygenation was unchanged suggesting that highly trained subjects choose power output based on a set level of muscular oxygenation regardless of the fraction of inspired oxygen or treatment with IPC.

3070 Board #3 June 2 9:00 AM - 11:00 AM

### Muscle Oxygenation & Systemic Metabolic Responses during Maximal Sprint Exercise in Hypoxia among Athletes

Nobukazu Kasai, Yuka Motomura, Akiho Ikutomo, Kazushige Goto. *Ritsumeikan University, Kusatsu, Japan.* (Sponsor: Robert Kraemer, FACSM)

(No relevant relationships reported)

The influence of maximal sprint exercise in moderate hypoxia on muscle oxygenation and systemic metabolic responses has not been fully elucidated.

**PURPOSE:** The purpose of the present study was to determine the effects of maximal sprint exercise in moderate hypoxia on muscle oxygenation, systemic oxygen uptake and power output among competitive athletes.

**METHODS:** Seven sprinters (height;  $176.1 \pm 2.2 \text{ cm}$ , body weight;  $67.8 \pm 3.4 \text{ kg}$ , BMI;  $22.6 \pm 0.7 \text{ kg/m}^2$ ) participated. They performed two trials under either hypoxic (HYP,  $F_{I,O_2}$ : 14.5%, a simulated altitude of 3000m) or normoxic (NOR,  $F_{I,O_2}$ : 20.9%) conditions in a randomized, with a single-blind and crossover design. The exercise in each trial consisted of three consecutive sets of 20-s maximal sprints with a 5 min rest period between sets. Time-course changes in percutaneous oxygen saturation ( $SpO_2$ ),

power output during exercise, blood lactate, glucose concentrations, and muscle oxygenation [oxy-hemoglobin (Hb), deoxy-Hb, total-Hb], and respiratory variables were evaluated.

**RESULTS:** A significant main effect of number of set was observed for mean power output during exercise ( $P < 0.01$ ). However, no significant interaction (trial  $\times$  number of set,  $P = 0.76$ ) or main effect of trial ( $P = 0.66$ ) for mean power output was observed. There were significant main effects of trial ( $P < 0.01$ ) and time ( $P < 0.01$ ) for blood lactate concentration, and post-exercise blood lactate concentrations were significantly higher in the HYP ( $22.8 \pm 0.6 \text{ mmol/L}$ ) than in the NOR ( $20.0 \pm 0.7 \text{ mmol/L}$ ,  $P < 0.05$ ). Both trials showed significant increases in deoxy-Hb and total-Hb during the exercise (main effect of time,  $P < 0.01$ ). However, deoxy-Hb and total-Hb tended to be higher in the HYP during the latter sets of sprint. Accumulated  $\dot{V}O_2$  during exercise was significantly lower in the HYP ( $1419 \pm 76 \text{ ml}$ ) than in the NOR ( $1973 \pm 120 \text{ ml}$ ,  $P < 0.01$ ), whereas accumulated  $\dot{V}CO_2$  was not significantly different between the trials (main effect of trial,  $P = 0.65$ ).

**CONCLUSION:** No apparent difference in muscle oxygenation kinetics during maximal sprint exercise was found between hypoxic and normoxic conditions. However, exercise-induced elevations of muscle deoxygenation (deoxy-Hb) tended to be augmented under hypoxic condition.

3071 Board #4 June 2 9:00 AM - 11:00 AM

### Cardiac Function and SMO<sub>2</sub> During HIIT at Altitude and Sea Level with Oxygen Contrast Training

Frank Wojan<sup>1</sup>, Craig Broeder, FACSM<sup>1</sup>, Peter Chomentowski<sup>1</sup>, Anthony Deldin<sup>2</sup>. <sup>1</sup>Northern Illinois University, DeKalb, IL. <sup>2</sup>Loyola University, Chicago, IL. (Sponsor: Craig Broeder, Ph.D., FNAASO, FACSM)

(No relevant relationships reported)

**PURPOSE:** This study investigated how high-intensity interval training (HIIT) at altitude (ALT) versus sea level (SL) with and without supplemental oxygen recovery (SRO2) affected cardiac function and skeletal muscle %O<sub>2</sub> saturation (SMO<sub>2</sub>). **METHODS:** Eight cyclists aged  $42.4 \pm 7.7$  (HT:  $68.9 \pm 4.6$ ; WT:  $177.9 \pm 26.6$ ; Body Fat:  $19.3\% \pm 7.5\%$ ;  $\dot{V}O_2 \text{ max}$   $4.38 \pm 1.01$ ) performed a baseline cycling  $\dot{V}O_{2max}$  test and four treatment trials (TRA - ALTHIIT/SRO2; TRB - SLHIIT/SLO2recovery; TRC - ALTHIIT/SLO2recovery; TRD - steady-state (SS) cycling). Each HIIT work period ( $n=3$ ) was 75s with 120s recovery at 75% and 50% of  $\dot{V}O_{2max}$ , respectively. For TRD, subjects cycled at a workload equal to the mean O<sub>2</sub> uptake equal of TRB (Control-Trial). O<sub>2</sub> uptake was measured using a breath X breath metabolic cart for  $\dot{V}O_2 \text{ max}$  and TRB. Cardiac function (HR, Cardiac Output (Q), Stroke Volume (SV)) was assessed using impedance cardiography. SMO<sub>2</sub> was measured in the vastus-intermedius quadriceps muscles using Moxy NIR devices. Data was analyzed using a w/in repeated measures design (Treatment (4)  $\times$  3 HIIT/Recovery Periods). **RESULTS:** Despite identical workloads, HR was significantly lower during SS cycling compared to the HIIT trials by 7.6% (SS:  $118.0 \pm 3.4$ ; Mean HIIT TR HRs:  $127.0 \pm 3.7$ ,  $p=0.002$ ). ALTHIIT/SRO2 (TRA:  $141.8 \pm 9.2$ ) showed a lower SV by 8.4% compared to the ALTHIIT/SLO2recovery trial (TRC:  $154.3 \pm 9.2$ ). Q was significantly lower during the HIITw/SRO2 (TRA:  $17.7 \pm 1.1$ ) compared to SLHIIT/SLO2recovery & ALTHIIT/SLO2recovery (TRB:  $19.8 \pm 1.1$ ; TRC:  $19.8 \pm 1.1$ ) by 12% ( $P=0.04$ ). SMO<sub>2</sub> data showed a trend for ALTHIIT/SRO2 & SS cycling to have higher SMO<sub>2</sub> values compared to the both HIIT trials without SRO2 ( $p=0.09$ ). During recovery, ALTHIIT/SRO2 showed improved HR recovery 5.2% ( $p=0.01$ ), increased SMO<sub>2</sub> re-saturation rate 12.6% ( $p=0.01$ ), and lowered Q 11.9% ( $p=0.01$ ) compared to the altitude-sea level recovery trial. **CONCLUSION:** These results suggested that supplemental O<sub>2</sub> recovery lowered cardiac demand (Q) at the same HIIT workload by maintaining HIIT SMO<sub>2</sub> better by enhancing the overall recovery process. Supported by a grant from LiveO2 and Exercising Nutritionally, LLC

3072 Board #5 June 2 9:00 AM - 11:00 AM

### Effects Of HIIT Training While Using A Breathing-restrictive Mask Compared To Increased Environmental Altitude

Bryanne N. Bellovary<sup>1</sup>, Kelli E. King<sup>1</sup>, Tony P. Nuñez<sup>2</sup>, James J. McCormick<sup>1</sup>, Andrew D. Wells<sup>1</sup>, Kelsey C. Bourbeau<sup>1</sup>, Zachary J. Fennell<sup>1</sup>, Zidong Li<sup>1</sup>, Kelly E. Johnson<sup>3</sup>, Terence Moriarty<sup>1</sup>, Christine Mermier<sup>1</sup>. <sup>1</sup>University of New Mexico, Albuquerque, NM. <sup>2</sup>Metropolitan State University of Denver, Denver, CO. <sup>3</sup>University of Saint Mary, Leavenworth, KS. (Sponsor: Dr. Ann L. Gibson, FACSM)

(No relevant relationships reported)

**Purpose:** To determine whether six weeks of high intensity interval training (HIIT) while wearing a breathing-restrictive mask (mask) (model 2.0, Training Mask LLC, Cadillac, MI) set to simulate 2550 m improves  $\dot{V}O_{2max}$  and submaximal  $\dot{V}O_2$  compared with training in hypobaric hypoxia (2550 m) and control conditions (1550 m). **Methods:** Thirty participants volunteered and were consented and randomized into a mask (M) ( $n = 10$ ; 5 men), altitude (A) ( $n = 10$ ; 6 men), or control (C) ( $n =$

10; 4 men) group. Participants maintained their normal routine. Pre- and post-testing included a  $\dot{V}O_2$ max on a cycle ergometer with continuous metabolic gas analysis allowing submaximal power outputs (PO) measures of economy. All participants completed POs of 100, 125, and 150W as they exercised to  $\dot{V}O_2$ max. Ventilatory threshold 2 (VT2) was determined graphically using metabolic equivalents. Participants cycled on an ergometer 2x/week for 30 min/session for six weeks. Sessions included a 5-min warm-up and cool-down with 20 min of HIIT (30s at 100% peak power output (PPO) of pre $\dot{V}O_2$ max, 90s active recovery at 25W, 10 bouts). Repeated measures ANOVA and one-way ANOVA determined statistical significance for training changes and percent change, respectively ( $p < 0.05$ ). **Results:** All groups significantly improved PPO by 8.3-13.0% (M:  $F_{(1,9)} = 17.28$ , A:  $F_{(1,9)} = 7.45$ , C:  $F_{(1,9)} = 11.96$ ,  $p < 0.05$ ). The M group improved PO at VT2 by 13.8% ( $p = 0.009$ ). There was a nonsignificant improvement (8.3%) in PO at VT2 for the A group ( $p = 0.054$ ). However, no significant differences occurred between groups for PPO and PO at VT2 ( $p = 0.481$  and  $0.250$ , respectively). The M group was significantly less economical (higher  $\dot{V}O_2$ ) at 125W before and after training compared with the C group ( $p = 0.003$ ). However, percent change in submaximal  $\dot{V}O_2$  at 100, 125, and 150W were not different between groups ( $p = 0.907$ ,  $0.743$ , and  $0.985$ , respectively). Percent improvements in  $\dot{V}O_2$ max were not different between groups (C = 3.6%; M = 2.6%; A = 6.5%;  $p = 0.623$ ). **Conclusion:** Since all groups demonstrated similar HIIT adaptations, using the mask or training in hypobaric hypoxia may not be needed for training adaptations. The protocol followed a live low, train high altitude model which typically lacks training improvements compared with a live high, train low altitude model.

3073 Board #6 June 2 9:00 AM - 11:00 AM  
**Muscle Oxygenation During Repeated Double-poling Sprint Exercise Under Hypoxic Condition**  
 Keiichi Yamaguchi, Nobukazu Kasai, Daichi Sumi, Haruka Yatsutani, Kazushige Goto. *Ritsumeikan University, Kusatsu, Japan.* (Sponsor: Robert R Kraemer, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** To compare acute physiological responses to repeated double-poling sprint exercise between normoxic condition and hypoxic condition.  
**METHODS:** Eight male athletes (19.8 ± 1.0 yrs, 174.9 ± 6.5 cm, 71.1 ± 5.8 kg) completed repeated exercise (double-poling exercise) under either hypoxic (HYP,  $FiO_2$ : 14.5%) or normoxic condition (NOR,  $FiO_2$ : 20.9%). The exercise consisted of 9 × 20 s maximal sprint exercise (40 s or 5 min rest periods between sprints). Power output, muscle oxygenation of triceps brachii muscles (evaluated by near infrared spectroscopy; NIRS), arterial oxygen saturation ( $SpO_2$ ) and respiratory variables were continuously monitored throughout exercise. Changes in blood lactate and glucose concentrations were also determined.  
**RESULTS:**  $SpO_2$  during exercise remained significantly lower in HYP ( $P < 0.05$ ). Mean power output during exercise did not differ significantly between HYP and NOR. No significant difference between the trials was observed for blood lactate and glucose concentrations. Both trials showed significant increases in deoxygenated hemoglobin (deoxy-Hb) (241.7 ± 46.9% in HYP vs. 175.8 ± 27.2% in NOR) and total hemoglobin (total-Hb) (138.0 ± 18.1% in HYP vs. 112.1 ± 6.7% in NOR) for triceps brachii muscle, but the exercise-induced elevations of these variables were significantly greater in HYP ( $P < 0.05$ ). During exercise, systemic oxygen uptake was significantly lower in HYP (2126 ± 108 ml/kg/min) than in NOR (2531 ± 74 ml/kg/min) ( $P < 0.05$ ).  
**CONCLUSIONS:** Exercise-induced elevation of total-Hb was profound during repeated double-poling sprint exercise in hypoxia, suggesting augmented blood volume (blood perfusion) in working muscles. In addition, power output during exercise was not affected by hypoxia, although systemic oxygen uptake was significantly lower.

3074 Board #7 June 2 9:00 AM - 11:00 AM  
**High-intensity Interval Training In Hypoxic Condition Accelerate The Anaerobic Glycolytic System**  
 Marie Oriishi<sup>1</sup>, Hayato Ohnuma<sup>2</sup>, Masahiro Hagiwara<sup>3</sup>, Ryo Yamanaka<sup>4</sup>, Toshiyuki Ohya<sup>5</sup>, Kazunori Asaba<sup>6</sup>, Takashi Kawahara<sup>2</sup>, Yasuhiro Suzuki<sup>2</sup>. <sup>1</sup>Tsukuba University, Ibaraki, Japan. <sup>2</sup>Japan Institute of Sports Sciences, Tokyo, Japan. <sup>3</sup>Japan Olympic Committee, Tokyo, Japan. <sup>4</sup>Teikyoheisei University, Chiba, Japan. <sup>5</sup>Chukyo University, Aichi, Japan. <sup>6</sup>Yamanashi Gakuin University, Yamanashi, Japan.  
 (No relevant relationships reported)

We previously demonstrated that 7 days of intermittent hypoxic training improved performance in the maximal anaerobic running test (MART) (ACSM 2015). It is expected that the high-intensity interval training (HIT) in hypoxic condition is one of the key of performance enhancement method. However, the differences of physiological response during HIT between in hypoxia and in normoxia is not clear. **PURPOSE:** The purpose of the present study was to compare the physiological response during HIT in hypoxic condition with normoxic condition in well-trained 400m or 800m runners. **METHODS:** Thirty-five well-trained university female 400m

or 800m runners were assigned to either hypoxic group (n=18) or normoxic group (n=17). The hypoxic group completed 5 sets of 30 seconds maximal effort pedaling in a normobaric hypoxic room ( $FiO_2=14.4\%$ ; 3000m). The rest periods between each sets were 4 minutes. The normoxic group completed the same exercise in ambient normobaric normoxia (60m). Mean power and peak power of each sets were recorded. Blood lactate concentration (La) was measured 1 minute after each sets of pedaling. **RESULTS:** No significant differences with hypoxic and normoxic group were found in mean power of each sets (hypoxic group: 464.7 ± 56.2, 396.4 ± 39.0, 324.7 ± 31.6, 286.2 ± 28.2, 245.7 ± 24.5, normoxic group: 455.5 ± 61.5, 396.9 ± 43.0, 339.0 ± 31.6, 293.2 ± 29.8, 249.1 ± 25.6 W). No significant differences between hypoxic and normoxic group were found in peak power of each sets (hypoxic group: 577.0 ± 77.2, 509.7 ± 55.1, 407.0 ± 46.6, 345.8 ± 41.9, 287.6 ± 30.6, normoxic group: 553.3 ± 85.4, 493.2 ± 61.6, 412.1 ± 45.3, 344.9 ± 41.0, 287.5 ± 34.0 W). La values from hypoxic group were significantly higher than normoxic group after every sets of pedaling ( $p < 0.01$ , 1st set: 16.5 ± 2.5 vs. 13.3 ± 2.1, 2nd set: 19.9 ± 2.5 vs. 16.7 ± 2.0, 3rd set: 21.7 ± 2.5 vs. 17.5 ± 1.9, 4th set: 21.1 ± 2.4 vs. 17.6 ± 1.9, 5th set: 21.2 ± 2.2 vs. 17.9 ± 1.7 mmol/l). **CONCLUSIONS:** The power produced during high-intensity interval training is not affected by hypoxic condition. However, energy production through anaerobic glycolytic system seems to accelerate in hypoxic condition.

## G-21 Thematic Poster - Bone Quality in Athletes and Special Populations

Saturday, June 2, 2018, 9:00 AM - 11:00 AM  
 Room: CC-Lower level L100E

3075 **Chair:** George A. Kelley, FACSM. *West Virginia University, Morgantown, WV.*  
 (No relevant relationships reported)

3076 Board #1 June 2 9:00 AM - 11:00 AM  
**Changes in Bone Mineral Density of Middle and Long Distance Runners Across an Indoor Season**  
 Ronald Otterstetter, FACSM<sup>1</sup>, Jordan T. Olson<sup>1</sup>, Marissa N. Baranaukas<sup>2</sup>, Brian Miller<sup>1</sup>, Michelle M. Boltz<sup>1</sup>, Laura Richardson<sup>1</sup>, Matthew Juravich<sup>1</sup>. <sup>1</sup>The University of Akron, Akron, OH. <sup>2</sup>Indiana University, Bloomington, IN.  
 (No relevant relationships reported)

**INTRODUCTION:** Bone mineral density (BMD) is an important aspect of bone health in endurance runners. Musculoskeletal overuse injuries to the bone, such as stress reactions and stress fractures, are of major concern to endurance runners and coaches because of the debilitating nature they have on training and performance. A greater understanding of BMD in these athletes can lead to a reduction in stress injuries to bone. **PURPOSE:** To determine changes in total and segmental BMD over the course of an indoor track season between sexes and between middle and long distance event groups. **METHODS:** Volunteers from a collegiate track team (N=21; men=13/women=8; Age= 20.3 ± 1.1 yrs.) were recruited. Dual x-ray absorptiometry (DEXA) was used to measure BMD before and after the 8-week indoor track and field season. Runners were classified as long or middle distance based on their current and past training history. Total and segmental BMD data were collected from DEXA output. A 2x2 factorial design using an ANCOVA procedure, adjusting for the pre-season BMD, was used to identify differences by sex and distance. **RESULTS:** Significant differences ( $p < 0.001$ ) were observed in leg BMD by sex (Men= 1.54 ± 0.12 g/cm<sup>2</sup>; Women= 1.34 ± 0.04 g/cm<sup>2</sup>) with an adjusted mean difference of 0.176 g/cm<sup>2</sup>. The men had an increase in their leg BMD, while women did not change over the length of the season. No other significant differences were found in total body BMD or any segmental BMD measures when comparing event classification or sex. **CONCLUSION:** The findings provide support for BMD awareness with runners to facilitate mechanisms for reduced injuries. For the current study, the stress placed on the bones of the runners over the span of an indoor track and field season was enough to maintain and even elicit favorable changes in leg segmental BMD. Training volume and intensity were not factors in BMD changes across a track season. Additional investigation on differences among sex is warranted for healthy endurance athletes.

3077 Board #2 June 2 9:00 AM - 11:00 AM  
**Bone Mineral Density in Master Olympic Weightlifters**  
 Kayleigh Erickson<sup>1</sup>, Mara Mercado<sup>1</sup>, Kailey Goins<sup>1</sup>, Monica R. Lininger<sup>2</sup>, Bryan Riemann<sup>1</sup>. <sup>1</sup>Armstrong State University, Savannah, GA. <sup>2</sup>Northern Arizona University, Flagstaff, AZ.  
 (No relevant relationships reported)

Research has demonstrated the effects of resistance training on bone mineral density (BMD). Olympic style weightlifting, unlike traditional resistance training, uses

the entire body to conduct higher load lifts at higher velocities and lower training volumes. Little research has been done in looking at the Olympic style weightlifting and the impact it can impose on the body. Whether this mode of training results in similar BMD adaptations is unknown, particularly in middle and older age adults. **PURPOSE:** To determine the influence of age and sex on BMD in Masters Olympic Weightlifters when body mass index, weightlifting experience and strength were controlled. **METHODS:** Men (n = 27) and women (n = 24) competitors from the 2017 National Masters Championship (age: 35 to 76 years) volunteered for BMD (g/cm<sup>2</sup>) measurement using a dual energy X-ray absorptiometry (DXA) for the following sites: spine (L1-L4), femoral neck, radius and total body. For each site, separate regression models were developed using age, sex, body mass index (BMI), experience level (years of competitive lifting), and strength (meet clean and jerk performance to body mass ratio). **RESULTS:** The set of independent variables were statistically significant predictors of BMD for the radius ( $P < .001$ ,  $R^2_{\text{adj}} = .50$ ), femoral neck ( $P = .009$ ,  $R^2_{\text{adj}} = .25$ ) and total body ( $P = .001$ ,  $R^2_{\text{adj}} = .36$ ). The model for the spine was not statistically significant ( $P = .056$ ,  $R^2_{\text{adj}} = .15$ ). BMI and strength, individually, were significant predictors of radial BMD while BMI was a significant predictor for total body BMD. Neither sex nor age were significant predictors of BMD for any of the four sites. **CONCLUSIONS:** Previous studies have noted that with aging, BMD declines, especially in women post-menopause. Our study revealed that there were no sex differences, nor was age or weight lifting experience significant predictors for BMD at the four sites considered. One interpretation of these results is that the Olympic style weight training may reduce age and sex related declines in BMD. Future research will compare BMD between age and sex matched runners and sedentary individuals to determine the accuracy of this interpretation.

3078 Board #3 June 2 9:00 AM - 11:00 AM  
**Effect Of Symmetric Weight Training On Imbalanced Humerus Bone Mineral Density Of Arms In Baseball Pitchers**

Maryam Rahmani<sup>1</sup>, Chen-Wei Chung<sup>2</sup>, Chia-Hua Kuo, FACSM<sup>3</sup>.  
<sup>1</sup>Islamic Azad University Science and Branch, Tehran, Iran,  
<sup>2</sup>Islamic Republic of Shih Hsin University, Taipei, Taiwan.  
<sup>3</sup>University of Taipei, Taipei, Taiwan. (Sponsor: Chia-Hua Kuo, FACSM)  
 (No relevant relationships reported)

**Background:** Mechanical stress is known as a strong stimulus for bone growth. **Purpose:** To examine effect of bilateral balanced weight training on the disparity in bone mineral density (BMD) between dominant and non-dominant arm of baseball players. **Methods:** Baseball players (N = 25, aged 18-22 y) participated in this study after baseline measurement under overnight fasted condition. Participants received either high protein (36% protein, 6.8 kcal per kg) or low protein (12% protein, 6.8 kcal per kg) supplementations immediately after each resistance workout, 3 days a week, for 12 weeks. Three days after the last exercise-training bout, BMD were assessed by dual-energy x-ray absorptiometry (DEXA). **Results:** The baseline data show an unequivocal greater humerus bone mineral density in the dominant arm compared to contralateral non-dominant arm (~20% greater) for all baseball players without exception. However, none other locations had significant asymmetry in BMD between limbs. Weight training significantly increased humerus bone BMD (main effect), but mildly decreased total body BMD. Resistance training increased BMD in humerus bone of dominant arm and decreased whole-body BMD. No interactive effect of training and diet on BMD was found. **Conclusion:** Weight training leads to bone mineral redistribution between arm and leg, but the difference of humerus bone between both arms cannot be altered.

Keyword: BMD, resistance exercise, weight training

3079 Board #4 June 2 9:00 AM - 11:00 AM  
**A 9-month Jumping Intervention to Improve Bone Acquisition in Adolescent Male Athletes: The PRO-BONE Study**

Dimitris Vlachopoulos, Alan R. Barker, Esther Ubago-Guisado, Craig A. Williams, FACSM, Luis Gracia-Marco. *University of Exeter, Exeter, United Kingdom.*  
 (No relevant relationships reported)

Participation in different loading sports during growth can have different effects on bone status and development. However, there is no evidence how to improve bone acquisition in adolescent athletes involved in weight-bearing and non-weight bearing sports. **PURPOSE:** To investigate for first time the effect of a 9-month jumping intervention programme on bone mass, geometry and microarchitecture in adolescent males participating in weight-bearing (soccer, SOC) and non-weight bearing (swimming, SWI & cycling, CYC) sports. **METHODS:** 93 adolescent males (13-15 years) were included. Sport groups were randomised to intervention and sport (INT-SWI=19, INT-SOC=15, INT-CYC=14) or sport only (CON-SWI=18, CON-SOC=15, CON-CYC=12). The intervention comprised a progressive jumping programme of 3 levels (3 months each) using weighted vests (Level 1= 20 jumps, 0 kg, 3 sets/day, 3

times/week; Level 2= 20 jumps, 2 kg, 4 sets/day, 3 times/week; Level 3= 20 jumps, 5 kg, 4 sets/day, 4 times/week). Dual-energy x-ray absorptiometry (DXA) assessed bone mineral content (BMC), hip structural analysis (HSA) assessed cross-sectional area (CSA), cross-sectional moment of inertia (CSMI) and section modulus, trabecular bone score (TBS) assessed bone microarchitecture and quantitative ultrasound assessed bone stiffness before and after the intervention. One-way analysis of covariance compared the bone gains after controlling for pre-intervention bone, change in lean mass and post maturity status. Significance was set at  $p < 0.05$ . **RESULTS:** INT-CYC gained significantly ( $p < 0.05$ ) higher total body less head BMC (5.0 %), lumbar spine BMC (4.6 %), femoral neck BMC (9.8 %) and bone stiffness (12.3 %) than CON-CYC. INT-CYC gained significantly higher CSA (11.0 %), CSMI (10.1 %) and TBS (4.4 %) outcomes than CON-CYC. INT-SWI gained significantly ( $p < 0.05$ ) higher femoral neck BMC (6.0 %), legs BMC (4.2 %) and bone stiffness (12.7 %) than CON-SWI. INT-SWI gained significantly ( $p < 0.05$ ) higher CSMI outcomes (10.9 %) than CON-SWI. There were no significant ( $p > 0.05$ ) differences between INT-SOC and CON-SOC for any bone outcomes (0.9-3.9 %). **CONCLUSIONS:** The present 9-month jumping intervention improved bone outcomes in non-weight bearing sports, such as swimming and cycling, but not in a weight-bearing sport, such as soccer.

3080 Board #5 June 2 9:00 AM - 11:00 AM  
**Calcium, PTH, And CTX Responses to Treadmill Walking During Different Thermal Environments in Older Adults**

Sarah J. Wherry, Christine M. Swanson, Pamela Wolfe, Rebecca S. Boxer, Rpbert S. Schwartz, Wendy M. Kohrt, FACSM.  
*University of Colorado Anschutz Medical Campus, Aurora, CO.*  
 (Sponsor: Wendy Kohrt, FACSM)  
 (No relevant relationships reported)

Serum ionized calcium (iCa) decreases and parathyroid hormone (PTH) and c-terminal telopeptides of type I collagen (CTX; marker of bone resorption) increase during endurance exercise in younger and older adults. Evidence from equine models suggests this may be due to dermal calcium loss. **PURPOSE:** To determine if exercise in a warm environment exaggerates the decrease in iCa and increases in PTH and CTX compared to a cool environment. **METHODS:** Women (n=5) and men (n=7) aged 61-78 years performed two identical 1-hour treadmill walking bouts under warm (~28°C) and cool (~21°C) conditions at ~75% of maximal heart rate iCa, PTH, and CTX were measured every 15 minutes starting 15 minutes before and continuing for 60 minutes after exercise. Sweat calcium loss was estimated from sweat volume and sweat calcium concentration. Changes in iCa, PTH, and CTX were adjusted for plasma volume shifts. Between and within group differences were evaluated using maximum likelihood estimation in a repeated measures model. **RESULTS:** There was no difference in sweat calcium loss between thermal conditions. iCa decreased similarly during exercise in both conditions (W: -0.16, 95% CI: -0.28, -0.08 mg/dL; C: -0.16, 95% CI: -0.24, -0.04 mg/dL). After adjusting for plasma volume shifts, change in iCa<sub>ADJ</sub> was significant only for the warm condition (-0.24, 95% CI: -0.44, -0.04 mg/dL), but there was no difference between conditions. PTH increased similarly during exercise in both conditions (W: 16.4, 95% CI: 6.2, 26.5 pg/mL; C: 17.3, 95% CI: 8.1, 26.4 pg/mL). Adjusting for plasma volume shifts did not change the results. CTX increased similarly in both conditions (W: 0.08, 95% CI: 0.05, 0.11 ng/mL; C: 0.08, 95% CI: 0.01, 0.16 ng/mL), and adjusting for plasma volume shifts did not change the results. There were no differences between conditions for any outcome, even after adjusting for plasma volume shifts. **CONCLUSION:** Differing thermal conditions do not appear to be a major factor in the decrease in iCa and the increases in PTH and CTX observed during exercise in older adults. This may be due to the low sweat calcium loss during both conditions or small temperature difference. Future studies should determine if there are sex- or age-related differences that modify the relationship between sweat calcium loss and the activation of bone resorption during exercise.

3081 Board #6 June 2 9:00 AM - 11:00 AM  
**Bone Density Measurements in an Elite Population of Older Weightlifters**

Kevin R.m. Coyle<sup>1</sup>, Bryan L. Riemann<sup>2</sup>, Robert LeFavi<sup>2</sup>, Kailey Goins<sup>2</sup>, Kayleigh Erickson<sup>2</sup>, Mara Mercado<sup>2</sup>, Jody Stone<sup>2</sup>, Jeremy Ford<sup>2</sup>, David R. Hooper<sup>1</sup>.  
<sup>1</sup>Jacksonville University, Jacksonville, FL. <sup>2</sup>Armstrong State University, Savannah, GA.  
 (No relevant relationships reported)

In the aging population, low bone mineral density (BMD) is a prevalent health concern, ranging from the milder condition of osteopenia, to the more severe osteoporosis. Resistance training, particularly with heavy resistance that loads the axial skeleton is often prescribed as an intervention to increase BMD. Training for the sport of Olympic Weightlifting requires consistently exposing the axial skeleton to high loads and thus should lead to elevated BMD. **PURPOSE:** The purpose of this study was to measure total body and lumbar spine BMD in Olympic Weightlifters competing in the Masters National Championships. **METHODS:** 26 men (age: 49.8 ± 11.6 years; height: 172.9 ± 7.3 cm; weight: 85.0 ± 13.1 kg) and 21 women (age: 47.1 ± 9.3 years;

height: 158.9 ± 29.6 cm; weight: 67.8 ± 13.7 kg) competing in the 2016 Masters National Championships for Olympic Weightlifting were invited to the laboratory to undertake dual-energy x-ray absorptiometry (DXA) scans, including total body (TB) and posterior-anterior (PA) spine. A median split for age was performed, separating younger men (YM) (age: 41.2 ± 5.2 years) from older men (OM) (age: 60.4 ± 6.8 years) and younger women (YW) (age: 39.4 years) from older women (OW) (age: 53.7 ± 6.6 years). Independent T-tests were performed to compare age group within sex differences and also to compare sex within age group. **RESULTS:** Overall mean Z-score was not different between men and women for TB (men: 1.5 ± 1.5 vs. women: 2.1 ± 1.1) or PA spine (men: 1.2 ± 1.9 vs. women: 2.0 ± 1.5). Furthermore there were no significant differences between YM and OM for TB (YM: 1.6 ± 1.4 vs. OM: 1.4 ± 1.7) or PA spine (YM: 1.4 ± 2.0 vs. OM: 1.0 ± 1.8), or YW and OW for TB (YW: 2.3 ± 1.1 vs. OW: 1.7 ± 1.2) or PA spine (YW: 2.4 ± 1.1 vs. OW: 1.4 ± 1.8). Comparably, there were no significant differences between YM and YW, nor OM and OW in either TB or PA spine Z-scores. **CONCLUSIONS:** These data demonstrate that both men and women, including younger and older populations, all equally benefit from long-term, heavy resistance exercise that loads the axial spine when performed at the elite level. Based on these high Z-scores, it appears that this benefit is substantial and could be an effective intervention at developing bone density in populations with osteopenia or osteoporosis.

3082 Board #7 June 2 9:00 AM - 11:00 AM

### Relationships between Circulating MicroRNAs, Bone Mineral Density and Muscle Function in Postmenopausal Women

Zhaojing Chen<sup>1</sup>, Breanne Baker<sup>2</sup>, Michael Bembem, FACSM<sup>2</sup>, Debra Bembem, FACSM<sup>2</sup>. <sup>1</sup>California State University, San Bernardino, San Bernardino, CA. <sup>2</sup>University of Oklahoma, Norman, OK. (Sponsor: Debra Bembem, FACSM)  
(No relevant relationships reported)

MicroRNAs (miRNAs, miRs) are short, non-coding RNA molecules that regulate gene expression at posttranscriptional level. Recent research has indicated that some miRNAs, such as miR-21 and miR-23a, target on genes of osteogenesis (Lian et al. 2012) and/or muscle atrophy (Wada et al. 2011). In the process of aging, there are progressive declines in bone mineral density (BMD) and muscle function, which potentially may be regulated by these miRNAs. **PURPOSE:** To examine the relationships between specific circulating miRNAs and bone density and muscle function in older postmenopausal women. **METHODS:** Seventy-five postmenopausal women aged 60 to 85 years old participated in this study. Body composition and areal BMD (aBMD) were measured by DXA. Volumetric BMD (vBMD) and bone strength were measured by pQCT. Grip strength was assessed by the digital grip strength dynamometer, whereas gait speed was assessed using the 4-meter path. Muscle power was assessed through countermovement jumps on the jump mat. Serum levels of miRNAs (miR-21, -23a, -24, -100, -125b) were analyzed using real-time PCR. **RESULTS:** MiR-21 was significantly negatively correlated with left trochanter BMC ( $r = -0.252, p = 0.048$ ), right trochanter BMC ( $r = -0.294, p = 0.020$ ), and cortical vBMD at tibia 38% site ( $r = -0.253, p = 0.047$ ). There also was a trend for a significant correlation between miR-21 and lumbar spine aBMD ( $r = -0.249, p = 0.051$ ). MiR-125b was significantly positively correlated with jump velocity ( $r = 0.263, p = 0.05$ ) and relative jump power ( $r = 0.294, p = 0.028$ ). **CONCLUSION:** Our results suggest that a higher expression level of circulating miR-21 is associated with decreased BMD in relatively healthy postmenopausal women, whereas a higher expression level of circulating miR-125b is associated with a greater jump power. Future investigations are needed to further explore circulating miRNAs in osteoporotic or fragile older adults.

3083 Board #8 June 2 9:00 AM - 11:00 AM

### Bone Mineral Density In Older Adults With T2DM After Exercise Training: Results From Hart-D

Matthew C. Scott<sup>1</sup>, Neil M. Johannsen<sup>1</sup>, Damon L. Swift<sup>2</sup>, Conrad P. Earnest, FACSM<sup>3</sup>, Timothy S. Church<sup>4</sup>. <sup>1</sup>Louisiana State University, Baton Rouge, LA. <sup>2</sup>Eastern Carolina University, Greenville, NC. <sup>3</sup>Texas A&M, College Station, TX. <sup>4</sup>Pennington Biomedical Research Center, Baton Rouge, LA. (Sponsor: Conrad P. Earnest, FACSM)  
(No relevant relationships reported)

**PURPOSE:** To examine the effects of 9-months of exercise training on whole body and regional bone mineral density (BMD) in individuals with type II diabetes mellitus (T2DM). **METHODS:** Participants (N=191, men=71; age =57±8 y; BMI=34.4±5.8 kg/m<sup>2</sup>; whole body BMD=1.19±0.13 g/cm<sup>2</sup>; VO<sub>2peak</sub>=19.5±4.4 ml/kg/min; mean±SD) from the HART-D study (NCT00458133) were randomized to aerobic (AER), resistance (RES), combined training (COMB) or a non-exercise control (CON). Compliant participants (>70% of sessions) with complete baseline and follow-up data for BMD (lumbar, thoracic, pelvis, and leg derived from whole body scans by DXA), peak oxygen uptake (VO<sub>2peak</sub>), isokinetic leg strength (peak torque at 60 deg/s), and anthropometry were included in this ancillary analysis. Associations between baseline

BMD values (lumbar, thoracic, pelvis, leg and whole body BMD) were compared with age, sex, and baseline measures for VO<sub>2peak</sub>, isometric strength, and T2DM duration. Changes over 9-months were analyzed for group effects after adjusting for baseline. Changes in BMD were compared with age, sex, and changes in VO<sub>2peak</sub> and muscle strength. **RESULTS:** Baseline associations showed that age was inversely related to pelvis BMD ( $p=0.006, r=-0.20$ ) and females had significantly lower thoracic, lumbar, and whole body BMD ( $p<0.001$ ). VO<sub>2peak</sub> was correlated to leg ( $p<0.001, r=0.31$ ) and whole body ( $p=0.02, r=0.17$ ) BMD, and isokinetic leg strength was correlated to thoracic ( $p<0.001, r=0.26$ ), pelvic ( $p<0.001, r=0.28$ ), leg ( $p<0.001, r=0.46$ ), and whole body ( $p<0.01, r=0.34$ ) BMD. All groups increased whole body BMD with exercise training ( $P<0.05$ ); however, no group effects were found for BMD changes after 9-months ( $p>0.10$ ). Changes in pelvic BMD were found to be higher in females ( $p=0.04$ ) than males and changes in VO<sub>2peak</sub> were inversely correlated with changes in thoracic BMD ( $p=.04, r=-.15$ ). No significant effects were observed. **CONCLUSION:** Sex, aerobic fitness, and muscle strength had similar relationships with BMD in individuals with T2DM as typically found in the normal adult population. However, group changes after 9-months of exercise training, while increased, were not different from the changes in CON. *Funding provided by the National Institutes of Health, R01-DK068298.*

## G-22 Thematic Poster - Exercise and Sport Psychology- Applications of Technology

Saturday, June 2, 2018, 9:00 AM - 11:00 AM  
Room: CC-Lower level L100F

3084 **Chair:** Chris Pitsikoulis. *Aurora University, Aurora, IL.*  
(No relevant relationships reported)

3085 Board #1 June 2 9:00 AM - 11:00 AM

### The Effect of Treadmill Walking, Smartphone Use and School Work on Positive and Negative Affective States in College Students

Jacob E. Barkley, Andrew Lepp, Ashlyn Grose. *Kent State University, Kent, OH.* (Sponsor: Ellen Glickman, FACSM)  
(No relevant relationships reported)

Excessive internet-connected, cellular telephone (smartphone) use is associated with greater anxiety and lower quality of life in college students. However, the acute effect of a bout of smartphone use on positive and negative affect and how this may differ from other, common activities (i.e., low-intensity exercise, school work) in college students, has not been studied.

**PURPOSE:** To compare the effects of separate bouts of smartphone use, treadmill walking, and school work on positive and negative affect in college students. **METHODS:** Forty one college students ( $n = 25$  female, 21.7 ± 2.0 years old) completed four, 30-minute conditions (control, treadmill walking, smartphone, school work), on separate days, in a controlled, laboratory environment: 1) Control, participants were seated on a chair in a quiet room. 2) Walking, participants walked at 3.1 mph on a treadmill. 3) Smartphone, participants utilized their smartphones to interact with their personal social-media accounts (e.g., Facebook, Twitter). 4) School work, participants completed self-selected school work (e.g., studying). Participants completed the positive and negative affect scale pre- and post-condition. **RESULTS:** Analyses of variance revealed a significant ( $F = 22.3, p < 0.001$ ) condition by time interaction for positive affect which significantly increased ( $t = 4.2, p < 0.001$ ) from pre- to post-condition during walking (21.8 ± 8.4 pre, 27.4 ± 9.9 post), did not change ( $t = 1.2, p = 0.24$ ) during school work (21.8 ± 7.7 pre, 23.0 ± 8.2 post) and significantly ( $t \geq 3.7, p \leq 0.001$ ) decreased during both the smartphone (21.5 ± 8.1 pre, 17.2 ± 6.7 post) and control (19.8 ± 7.8 pre, 14.9 ± 5.8 post) conditions. There was also a significant ( $F = 15.6, p = 0.05$ ) condition by time interaction for negative affect which significantly decreased ( $t = 2.3, p = 0.03$ ) from pre- to post-condition during school work (13.4 ± 4.4 pre, 12.4 ± 4.1 post) and did not significantly change ( $t \leq 1.6, p \geq 0.11$ ) for the remaining conditions (control: 12.5 ± 3.5 pre, 13.7 ± 4.1 post; walking: 12.3 ± 3.7 pre, 11.8 ± 2.7 post; smartphone: 12.5 ± 3.3 pre, 12.4 ± 2.6 post). **CONCLUSION:** Walking on a treadmill increased positive affect and school work decreased negative affect in college students. Conversely, a bout of smartphone use significantly decreased positive affect and did not reduce negative affect.

3086 Board #2 June 2 9:00 AM - 11:00 AM  
**Physical Activity And Tablet-based Stem Learning: Effects On Children'S Executive Function In Low-income Childcare**

April Bowling, Chris Marcella, Sarah Boucher, Katherine Donnelly, Samantha Durand, Jacqueline Ochoa, Kevin Finn, FACSM. Merrimack College, North Andover, MA. (Sponsor: Kevin Finn, FACSM)

(No relevant relationships reported)

Low-income children are at disproportionate risk of low physical activity (PA) and school achievement. Exercise has been shown to positively affect executive function (EF) in children, and may act to prime the brain for learning. Likewise, tablet-based learning applications are an engaging educational modality that can be employed in diverse settings. However, little research exists in real world settings, particularly regarding the robustness of EF improvements after engagement with electronic learning technologies. **PURPOSE:** To investigate changes in children's EF pre-/post-PA, versus pre-/post-PA incorporating a tablet-based STEM learning platform in a real-world low-income childcare setting. **METHODS:** Children (n=19, ages 7-10) attending a YMCA summer childcare program serving low-income families participated in a control condition (40 minutes of quiet reading), and two, 40 minute PA sessions, one immediately followed by 5-10 minutes of a tablet-based science, technology, engineering, and math (STEM) lesson (PA+tablet). PA sessions utilized aerobically-oriented games led by trained staff. Pedometers were used to measure children's total steps during PA. EF was measured and pre- and post- all three conditions. Children were randomly assigned to condition order. Relationships between condition and Stroop score changes were assessed using multi-level mixed effects linear regression, controlling for condition order, test administrator, child age and gender. **RESULTS:** Children averaged 954.5 steps per PA session (SD±751.8). Relative to the control condition, participation in PA was associated with a 0.73 point improvement in Stroop score; that improvement was not significant (p=0.71). However, participation in PA+tablet resulted in a 3.5 point deterioration in Stroop score relative to the control condition (p=0.08). **CONCLUSION:** In a real world setting serving children at risk of low-physical activity and scholastic achievement, PA may prime children for learning by improving EF, but improvements do not appear to be sustained after engagement in tablet-based STEM learning.

3087 Board #3 June 2 9:00 AM - 11:00 AM  
**Chronic Systemic Inflammation Moderates the Relationship Between Adiposity and Behavioral and Neuroelectric Indices of Attention**

Grace M. Niemi<sup>1</sup>, Anne M. Walk<sup>1</sup>, Caitlyn G. Edwards<sup>1</sup>, Melisa A. Bailey<sup>1</sup>, Sarah K. Skinner<sup>1</sup>, Michael De Lisio<sup>2</sup>, Nicholas A. Burd<sup>1</sup>, Hannah D. Holscher<sup>1</sup>, Naiman Khan<sup>1</sup>.

<sup>1</sup>University Of Illinois at Urbana - Champaign, Urbana, IL.

<sup>2</sup>University Of Ottawa, Ottawa, ON, Canada.

(No relevant relationships reported)

**PURPOSE:** Two-thirds of the US population today is living with overweight or obesity, signifying a serious public health concern. One co-morbidity of obesity is chronic inflammation, which contributes to cardiovascular and metabolic disease, and is often indicated by elevated plasma C-reactive protein (CRP) concentrations. Further, adiposity has been linked to decrements in selective aspects of cognitive function. However, the potential interactive effects of adiposity and inflammation on cognitive function are limited. This study aimed to examine the relationships among plasma CRP concentrations, cognitive function, and adiposity.

**METHODS:** 36 adults (25-45 years) underwent a fasted venous blood draw for measurement of CRP and a dual x-ray absorptiometry (DXA) scan for quantification of whole body adiposity. Cognitive function was assessed using a two-stimulus visual oddball paradigm while underlying event-related brain potentials were recorded. Specifically, the latency of the P3 waveform in a central-parietal region of interest (ROI) was used to index attentional resource allocation and information processing speed, respectively.

**RESULTS:** According to bivariate correlations, plasma CRP was positively associated with whole body percent fat (r=0.55, p<0.001). Whole body percent fat and CRP were negatively correlated with target accuracy (r=-0.28, p=0.048; r=-0.44, p=0.003; respectively). Whole body percent fat was correlated with lower peak latency difference (target peak latency - non-target peak latency) in the ROI (r=-0.38, p=0.01), signifying poorer modulation in cognitive processing speed. Yet, adjustment of plasma CRP using partial correlations revealed that the relationship between adiposity and target accuracy (r=-0.13, p=0.23), and P3 peak latency difference (r=-0.24, p=0.09) was mitigated (All, P > 0.05).

**CONCLUSIONS:** The cross-sectional relationship between adiposity and cognitive function was moderated by the extent of systemic inflammation in overweight and obese adults. Future studies are needed to determine whether reducing chronic systemic inflammation via exercise and nutritional manipulations prevents the negative implications of adiposity for cognitive function.

3088 Board #4 June 2 9:00 AM - 11:00 AM  
**Adults' Smartphone Use Predicts Being an Active Couch Potato**

Andrew Lepp<sup>1</sup>, Jacob E. Barkley<sup>1</sup>, Curtis Fennell<sup>2</sup>. <sup>1</sup>Kent State University, Kent, OH. <sup>2</sup>University of Montevallo, Monteballo, AL. (Sponsor: Ellen Glickman, FACSM)

(No relevant relationships reported)

Physical activity is typically negatively associated with sedentary behavior. However, individuals who exercise regularly but allocate large amounts of time to sedentary behavior are an exception to this relationship and known as "active couch potatoes" (ACP). The ACP is of concern as the negative health effects of sedentary behavior appear to be independent of the benefits of physical activity. Previously published research found a positive relationship between smartphone use and sedentary behavior but no relationship between smartphone use and physical activity. Therefore, being a high smartphone user may predict being an ACP (i.e., being highly sedentary yet sufficiently physically active). This idea was previously explored with a correlational study using a sample of college students. In that study, smartphone use was associated with being an ACP. However, this relationship has not been tested in adults beyond college age. Furthermore, previous research did not include the most commonly studied predictor of sedentary behavior - TV viewing. **PURPOSE:** To test whether adults' smartphone use, TV viewing, sex and age predicts being an ACP.

**METHODS:** A sample of 423 adults (n = 277 female, 40 ± 16 years old) completed surveys assessing physical activity and sedentary behavior. Daily smartphone use and TV viewing were also assessed. Participants were coded as an ACP (or not) based off scores from the physical activity and sedentary behavior surveys. A binary logistic regression was used to test whether smartphone use, TV viewing, sex and age were predictors of being an ACP.

**RESULTS:** The binary logistic regression model was statistically significant,  $\chi^2 = 50.96, p < 0.001 (df = 4)$ . Sex and TV watching were not significant predictors of being an ACP (Wald ≤ 1.148, p ≥ 0.284). Age and smartphone use were significant predictors of being an ACP (Wald ≥ 6.545, p ≤ 0.011). Results revealed an inverse relationship between age and the likelihood of being an ACP, and a positive relationship between smartphone use and the likelihood of being an ACP.

**CONCLUSIONS:** Similar to college students, increased smartphone use predicted being an ACP in adults beyond college age. Because TV viewing was not a predictor, greater attention should be given to understanding the relationship between smartphone use and the health compromising ACP lifestyle.

3089 Board #5 June 2 9:00 AM - 11:00 AM  
**Factors Related to Accelerometer-determined Patterns of Physical Activity in Adults: The Houston Train Study**

Erin E. Dooley<sup>1</sup>, Deborah Salvo<sup>1</sup>, Kelley Pettee Gabriel, FACSM<sup>1</sup>, Ashleigh M. Johnson<sup>1</sup>, Casey P. Durand<sup>2</sup>, Gregory Knell<sup>2</sup>, Samantha J. Kreis<sup>1</sup>, Ipek N. Sener<sup>3</sup>, Harold W. Kohl, III, FACSM<sup>1</sup>. <sup>1</sup>The University of Texas Health Science Center at Houston (UTHealth) School of Public Health in Austin, Austin, TX. <sup>2</sup>The University of Texas Health Science Center at Houston (UTHealth) School of Public Health in Houston, Houston, TX. <sup>3</sup>Texas A&M Transportation Institute, Texas A&M University System, Austin, TX.

(No relevant relationships reported)

Meeting U.S. Physical Activity (PA) Guidelines has health benefits. Yet, little is known about factors related to changes in PA over time, particularly among minority populations.

**PURPOSE:** To examine sociodemographic, PA preferences (for walk and bike), and health factors related to accelerometer-derived patterns of 1-year PA change in the Houston Travel Related Activity in Neighborhoods (TRAIN) Study, a majority-minority cohort.

**METHODS:** Participants wore an ActiGraph wGT3X-BT monitor and completed self-report surveys at baseline and follow-up. Valid wear time was defined as ≥ 4 days, ≥ 10 hrs/day. PA was stratified by meeting Guidelines using total MVPA defined by Freedson. Four PA patterns were defined: (i) maintain high activity above Guidelines, (ii) increased to meet Guidelines, (iii) decreased from meet to not meet Guidelines, and (iv) maintained low activity. Multinomial logistic regression was used to examine associations between studied factors and each PA pattern, with the 'maintain high' group as referent.

**RESULTS:** Complete data were available for 153 adults (19% maintained high activity, 8.5% increased, 13% decreased, 59.5% maintained low activity). Controlling for all variables, males (OR = 0.3, 95% CI = 0.1, 0.9) had lower odds of being in the 'maintain low' group. Blacks (vs. whites, OR = 18.8, 95% CI = 2.6, 275.0), those liking biking (vs. strongly liking, OR = 4.6, 95% CI = 1.3, 15.6), and older participants (vs. younger, on continuous scale, OR = 1.1, 95% CI = 1.0, 1.1) had higher odds of being in the 'maintain low' group. Factors directly associated with being in the 'increased' group were being black (vs. white, OR = 17.9, 95% CI = 1.3, 120.9), strong dislike for biking (vs. strongly liking OR = 25.2, 95% CI = 1.6, 401.3), and having

more chronic diseases (vs. less, on continuous scale, 95% CI = 1.5, 11.7). Having low educational attainment (vs. high, OR = 0.04, 95% CI = 0.0, 0.9) was inversely associated with being in the 'increased' group. No studied factors were significantly associated with being in the 'decreased' group.

**CONCLUSION:** PA patterns are dynamic and suggest that sociodemographic, PA preferences, and health factors relate to change patterns over time. Future studies should examine the role of these factors over longer follow-up periods, and consider these factors when designing interventions.

3090 Board #6 June 2 9:00 AM - 11:00 AM  
**Computerized Forecast Modeling to Predict Energy Intake: Perceptions of Adopting New Technology**  
 Marissa Baranauskas, Judith A. Juvancic-Heltzel, Laura Richardson, Shiva Sastry. *The University of Akron, Akron, OH.* (Sponsor: Ronald Otterstetter, FACSM)  
*(No relevant relationships reported)*

Alarming trends in obesity precipitate the examination of current weight-management strategies used by exercise professionals (EPs). Unaddressed energy balances negatively affect the efficacy of weight-management interventions. However, the scope of practice of EPs limits their ability to address energy imbalances through observation of trends in dietary intake. Common methods, such as the 24-hr dietary recall, tend to underestimate energy intake (EI) especially in overweight and obese populations, and are associated with poor adherence. Furthermore, traditional dietary recall methods assess past EI without considering how future EI patterns change over time. Therefore, the development of new technologies to accurately facilitate EPs in addressing EI imbalances, and improve the effectiveness of weight-management interventions is warranted.

**PURPOSE:** To investigate perceptions of a new technology designed to track EI via computerized forecast modeling. **METHODS:** Evaluating perspectives towards technology can be difficult using traditional Likert scale surveys. Q Methodology provides an avenue to systematically study subjectivity by using factor analysis and correlation to assess agreement and variances of views. Participants (N = 11, 2 males, 9 females; 47 ± 17 yrs.; BMI 26 ± 5 kg·m<sup>-1</sup>) sorted 44 statements from "most like my view" to "most unlike my view." The Q sort consisted of statements associated with the Transtheoretical Model of behavior change, barriers, and the adoption of a new technology to track EI. **RESULTS:** Factor analysis revealed two factors of participants' views: compliant dieters and dedicated exercisers. **CONCLUSION:** Two converging views emerged surrounding the adoption of a new technology designed to track nutritional intake. Consensus between factors provides tangible evidence of technology apprehension. Overall, the analysis identifies how facets of a diverse population will perceive a novel technology designed to track EI, and provides insight into how distinct barriers can be overcome to enhance adoption. Conducting preliminary research regarding perceptions of technology adoption can enhance the development and marketability of an EI forecasting system.

3091 Board #7 June 2 9:00 AM - 11:00 AM  
**Effects of Physical Activity Trackers and Motivational Interviewing on Mood in Chronic Low Back Pain**  
 Maria Perez, Laura D. Ellingson, Jeni E. Lansing, Kathryn J. Southard, Jacob D. Meyer, Gregory J. Welk, FACSM. *Iowa State University, Ames, IA.* (Sponsor: Gregory J. Welk, FACSM)  
*(No relevant relationships reported)*

Annually, ~23% of individuals suffer from chronic low back pain (CLBP). Physical activity (PA) is a recommended treatment and increasing PA also improves mood-related symptoms, which are prevalent in those with CLBP. However, effective strategies to increase PA and their effects on mood in CLBP are unknown.

**PURPOSE:** We examined the effects of using an activity tracker (AT) alone or in combination with motivational interviewing (MI) on PA and mood in CLBP. **METHODS:** Fifty-one adults with CLBP (51% women; mean age 44 ± 10.6) were randomized to receive either: an AT (AT, n = 18), an AT with three sessions of MI (MI, n = 17) or were placed in a wait-list control group (WL, n = 16) for 12 weeks. Changes steps/day (activPAL) and mood (Profile of Mood States [POMS]) over the intervention were evaluated with Group X Time repeated measures ANOVA and effect sizes (Cohen's *d*). Correlation coefficients (Pearson's *r*) assessed relationships between changes in PA and changes in mood.

**RESULTS:** There were non-significant (*p* > 0.05) increases in steps/day for intervention groups (MI: 1,019 ± 2,665; AT: 897 ± 2,468) and a small decrease for WL (-182 ± 2,434). POMS Total Mood Disturbance (TMD) improved across all groups (*p* = 0.001). Groups were not significantly different for either outcome (*p* > 0.05); however, larger effect sizes were observed for intervention groups for PA (MI *d* = 0.30; AT: *d* = 0.28; WL: *d* = 0.06) and TMD (MI: *d* = 0.42; AT: *d* = 0.48; WL: *d* = 0.28). When examining POMS subscales, significant improvements were observed across groups for Depression (*p* = 0.023) and Fatigue (*p* < 0.020). For Vigor, there was a significant Group X Time interaction (*p* = 0.011). Vigor improved for AT (*d* = 1.02) and MI (*d* = 0.52) and decreased for WL (*d* = 0.46). Across groups, change in PA

was significantly and positively associated with change in Vigor (*r* = 0.32; *p* = 0.022). When examining groups individually, the association remained significant for the MI group only (*r* = 0.62; *p* = 0.006).

**CONCLUSION:** Results suggest that AT alone and with MI may be effective for improving PA and vigor in CLBP. Future research is needed to determine the intervention components that are most effective for increasing PA and to elucidate possible mechanisms underlying the beneficial effects of changes in PA for patients with CLBP.

3092 Board #8 June 2 9:00 AM - 11:00 AM  
**Behavior Change Theory Taxonomy Analysis of Smartphone Apps for Fitness, Nutrition, and Weight Loss**  
 Joy Furlipa, Kimberly Reich. *High Point University, High Point, NC.*  
*(No relevant relationships reported)*

A majority of Americans do not meet physical activity or nutrition guidelines for health. Convenient interventions to support healthy behaviors may be beneficial. Smartphone use has become ubiquitous, with apps that are an integral part of life for many. The health and fitness category of apps is robust and growing, but the potential for these apps to affect health behavior change is poorly understood.

**PURPOSE:** To evaluate top-ranked fitness, nutrition, and weight-loss smartphone apps for incorporation of evidence-based behavior change strategies. **METHODS:** Two investigators coded descriptions of the 150 top-ranked "free" apps in the health and fitness category of the US iOS app store for evidence of health behavior change strategies using the Behavior Change Technique (BCT) Taxonomy (v1). Prevalence of taxonomy items were calculated and Pearson correlations were estimated for the relationship between BCTs per app and customer ranking, as well as for the relationship between BCTs per app and app store ranking. Significance was set at *p* < 0.05. **RESULTS:** 71 app descriptions were identified as fitness, nutrition, and/or weight-loss focused. Of those, 45.1% incorporated goals and planning; 57.7% incorporated feedback and monitoring; 56.8% incorporated social support; 29.6% incorporated comparison of behavior; 29.6% incorporated shaping knowledge; 22.5% incorporated associations; 11.6% incorporated reward and threat; 9.9% incorporated antecedents; and 5.6% incorporated natural consequence. Only 17 of the 93 techniques in the BCT taxonomy were utilized across all coded apps. There was a trend towards a weak negative correlation between number of BCTs per app and app store ranking (*r* = -0.22, *p* = 0.06) and no significant correlation between number of BCTs and customer rating (*r* = -0.02, *p* = 0.87). 45.1% of the "free" apps offered a premium version, in addition, and 11.3% required a paid subscription after download. **CONCLUSIONS:** Goal planning, monitoring, feedback, and social support were the most common strategies found in the popular fitness, weight-loss, and nutrition apps, though more must be learned about their effectiveness. Furthermore, there is potential to incorporate a greater variety of health behavior change techniques.

**G-23 Thematic Poster - Jumping and Landing**  
 Saturday, June 2, 2018, 9:00 AM - 11:00 AM  
 Room: CC-Lower level L100H

3093 **Chair:** Robin Queen, FACSM. *Virginia Tech, Blacksburg, VA.*  
*(No relevant relationships reported)*

3094 Board #1 June 2 9:00 AM - 11:00 AM  
**Association Of Flexibility And Jump Landing Kinematics On The Recovery Of Lower Body Power And Strength Following Exhaustive Exercise**  
 Thomas Kopec<sup>1</sup>, Mark Richardson<sup>2</sup>, Phillip Bishop<sup>3</sup>, Lizzie Hibberd<sup>2</sup>, James Leeper<sup>2</sup>, Bailey Welborn<sup>2</sup>, Mike Esco, FACSM<sup>2</sup>.  
<sup>1</sup>Samford University, Birmingham, AL. <sup>2</sup>University of Alabama, Tuscaloosa, AL. <sup>3</sup>Liberty University, Lynchburg, VA. (Sponsor: Mike Esco, FACSM)  
*(No relevant relationships reported)*

**PURPOSE:** The purpose of this study was to determine the relationship between knee flexion range of motion (ROM) and jump landing kinematics evaluated via the landing error scoring system (LESS) and the change in performance variables following an exhaustive bout of exercise. **METHODS:** Participants were measured for ROM and LESS, and then completed performance tests consisting of vertical jump (VJ), and isometric quadriceps strength assessment (ISO). Next, participants completed an exhaustive bout of exercise, and upon termination, performance variables were reassessed. Participants returned for follow-up testing at 24-, 48-, and 72-hours.

**RESULTS:** ROM was significantly correlated with the changes in VJ ( $\Delta VJ_{24}$ ,  $r = .65$ ) and the changes in ISO ( $\Delta ISO_{24}$ ,  $r = .75$ ) at 24-hours after baseline, and ROM was also significantly correlated with the change in VJ ( $\Delta VJ_{48}$ ,  $r = .66$ ) and the change in ISO ( $\Delta ISO_{48}$ ,  $r = .79$ ) at 48-hours follow-up, but not at 72. LESS scores were significantly correlated with  $\Delta ISO_{24}$  ( $r = .67$ ), as well as  $\Delta ISO_{48}$  ( $r = .62$ ), respectively, but not at 72. **CONCLUSIONS:** These findings indicate that higher levels of flexibility resulted in better mitigation of the decreases to VJ and ISO following the exhaustive bout of exercise at both 24- and 48-hours post-exhaustive exercise, but not at 72. A possible explanation for the association between higher LESS scores (poorer mechanics) and faster return of ISO towards baseline may be that those with poorer LESS scores exerted less effort during the exhaustive exercise bout and therefore did not manifest a high level of muscle damage. However, this was not supported by the non-significant relationships between LESS and the number of repetitions participants completed ( $r = .27$ ), or LESS and RPE following exercise ( $r = -.27$ ). The reason for these findings remains unclear. Clinicians can use ROM before training to predict the recovery of lower extremity power and strength following intense physical activity.

Pearson partial correlation coefficients		
	ROM (control LESS)	LESS (control ROM)
VJ	.27	.57
ISO	-.38	-.03
$\Delta VJ_{ip}$	.31	.37
$\Delta ISO_{ip}$	.50	.41
$\Delta VJ_{24}$	.65*	.44
$\Delta ISO_{24}$	.75*	.62*
$\Delta VJ_{48}$	.66*	.37
$\Delta ISO_{48}$	.79*	.62*
$\Delta VJ_{72}$	.43	.18
$\Delta ISO_{72}$	.45	.44

3095 Board #2 June 2 9:00 AM - 11:00 AM  
**Countermovement Jump Kinetics and Performance Changes from 1st to 4th year in Division I Collegiate Athletes**

Demitra R. Philosophos, Jennifer L. Sanfilippo, Mikel R. Stiffler-Joachim, Bryan C. Heiderscheid, Daniel G. Cobian.  
*University of Wisconsin-Madison, Madison, WI.*  
 (No relevant relationships reported)

The countermovement jump (CMJ) is a common test of athletic ability. Kinetic analysis indicates phase-specific CMJ ground reaction rate of force development (RFD) and rate of force unloading (RFU) are associated with jump performance. Collegiate athletes complete strength and conditioning regimens to maximize athletic ability and sports performance, but it is unclear what elements of the CMJ moderate these performance improvements.

**PURPOSE:** To evaluate the changes in CMJ ground reaction force-time curve eccentric (ECC) and concentric (CONC) phase variables between the 1st and 4th year of participation in Division I collegiate athletics, and determine if and how these adaptations relate to changes in jump height.

**METHODS:** 79 healthy NCAA Division I athletes (60 males) participating in football, soccer, basketball, hockey, and wrestling performed maximal CMJs on force plates (800 Hz) as part of standard yearly preseason evaluations. ECC and CONC phase force-time curve variables were computed, and Wilcoxon Signed-Ranks tests were used to evaluate changes in variables of interest between 1st and 4th year CMJ performance. Spearman's correlation was used to evaluate associations between CMJ height and force-time curve variable differences.

**RESULTS:** Jump height increased significantly ( $p < .001$ ) from 1st to 4th year ( $38.3 \pm 9.5$  cm to  $40.1 \pm 9.1$  cm), along with early phase (0-50%) ECC RFD ( $44.1 \pm 37.6$  N/s/kg to  $55.1 \pm 35.1$  N/s/kg). Improved jump height was significantly associated with increased peak ECC RFD ( $rs = .274$ ,  $p = .015$ ), late phase (50-100%) ECC RFD ( $rs = .308$ ,  $p = .006$ ), and peak CONC RFU ( $rs = -.383$ ,  $p < .001$ ). Across the cohort, the force-time curve variable most strongly associated with CMJ height was peak CONC RFU ( $rs = -.560$ ,  $p < .001$ ).

**CONCLUSIONS:** Improved CMJ performance is associated with increased ground reaction force ECC RFD and CONC RFU from 1st to 4th year of participation in Division I collegiate athletics. Our results suggest that CMJ height may be maximized by training to enhance the rate of unloading through rapid generation of hip, knee, and ankle extensor torque in combination with utilization of stored elastic energy.

3096 Board #3 June 2 9:00 AM - 11:00 AM  
**Reliability And Between-limb Symmetry Of Joint Kinetics And Kinematics During A Countermovement Jump**

Bryan C. Heiderscheid, Mikel R. Stiffler-Joachim, Jennifer L. Sanfilippo, Daniel G. Cobian.  
*University of Wisconsin-Madison, Madison, WI.*  
 (No relevant relationships reported)

Investigations of lower extremity movement biomechanics in injured populations are often designed with the assumption that limb symmetry and reliability across measurement intervals are inherent. However, the between-limb variation and long term reliability of lower extremity kinetics and kinematics in healthy comparison groups is unknown.

**PURPOSE:** To evaluate the test-retest reliability and between-limb symmetry of hip, knee, and ankle joint kinetics and kinematics of the countermovement jump (CMJ) in healthy Division I collegiate athletes.

**METHODS:** 22 Division I collegiate cross country athletes (13 females, age  $19.7 \pm 1.1$ , BMI  $20.8 \pm 2.2$ ) performed maximal CMJs as part of preseason evaluations in 2 consecutive years. Whole body kinematics and ground reaction forces were recorded bilaterally. Eccentric (ECC), concentric (CONC), and landing (LAND) phase sagittal plane hip, knee, and ankle joint angles, moments, and powers were computed. Between session reliability was assessed with intraclass correlation coefficients (ICC). To evaluate limb symmetry, median between-limb differences were expressed as a percentage of the median absolute values of each variable.

**RESULTS:** Most variables demonstrated fair to good reliability ( $.4 < ICC < .75$ ). CONC phase hip, knee, and ankle joint moment impulses (ICCs 0.69 - 0.73), peak powers (ICCs 0.75 - 0.82), and LAND phase peak angles (ICCs 0.70 - 0.71), excursions (ICCs 0.70 - 0.82), and peak powers (ICCs 0.66 - 0.72) demonstrated the greatest consistency. Rate of hip, knee, and ankle joint moments during the ECC (ICCs 0.37 - 0.56) and CONC phases (ICCs 0.37 - 0.58) were less reliable. Between-limb variation in hip and knee joint peak angles throughout all CMJ phases was  $< 5\%$  of absolute values. LAND moments, impulses, powers, and work demonstrated substantially greater between-limb asymmetry (14 - 46% of absolute values) than CONC phase variables (6 - 12%).

**CONCLUSIONS:** CMJ CONC phase hip, knee, and ankle joint impulses and powers have the greatest limb symmetry and reliability across intervals in healthy collegiate athletes. Sports medicine clinicians and scientists should be aware of the expected between-limb asymmetry and variation across testing intervals when assessing CMJ biomechanics in injured populations or attempting to evaluate the effects of intervention.

3097 Board #4 June 2 9:00 AM - 11:00 AM  
**Biomechanical Risk Factors For Recurrent Ankle Sprains During Landing/Cutting In Ankle Instability Patients: 6-month Follow-up**

S. Jun Son, Dustin Bruening, Brent Feland, Matthew Seeley, Ty Hopkins, FACSM.  
*Brigham Young University, Provo, UT.*  
 (Sponsor: J. Ty Hopkins, FACSM)  
 (No relevant relationships reported)

Altered movement patterns have consistently been observed in chronic ankle instability (CAI) patients during landing and cutting tasks. Altered foot placement along with changes in joint moments have been identified as risk factors for ankle sprains.

However, to examine a causal effect between biomechanical factors and risk of ankle injury, research should be conducted in a prospective design.

**PURPOSE:** To identify biomechanical risk factors related to recurrent ankle sprains during jump landing/cutting in CAI patients at a 6-month follow-up.

**METHODS:** 91 of 100 CAI patients completed a 6-month follow-up survey, and 13 CAI patients (7M, 6F,  $22 \pm 2$  yrs,  $174 \pm 11$  cm,  $75 \pm 15$  kg,  $84 \pm 5\%$  FAAM-ADL,  $65 \pm 12\%$  FAAM-Sports,  $5.8 \pm 3$  sprains) reported recurrent sprains within 6 months, and 78 CAI patients (39M, 39F,  $22 \pm 2$  yrs,  $174 \pm 11$  cm,  $74 \pm 14$  kg,  $85 \pm 6\%$  FAAM-ADL,  $69 \pm 10\%$  FAAM-Sports,  $3.3 \pm 2$  sprains) did not have recurrent injury after the initial data collection where subjects performed 10 jumps consisting of a maximal vertical jump-landing and cutting at  $90^\circ$ . Functional linear models were used to detect between-group differences. If 95% confidence intervals did not cross zero, differences were significant.

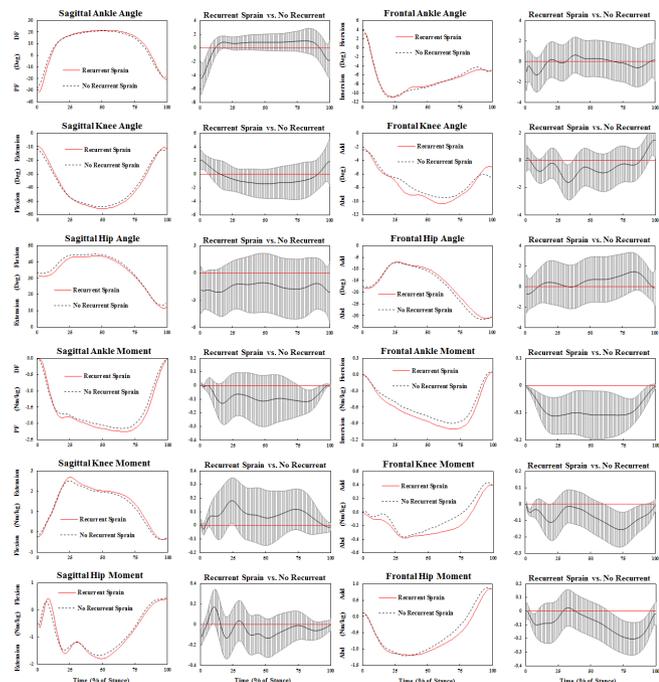
**RESULTS:** Figure 1 shows that CAI patients who suffered ankle sprains within 6 months showed several biomechanical differences including (i) more plantarflexion, less knee flexion and more knee abduction angles, and (ii) increases in plantarflexion, inversion, knee extension, knee abduction and hip abduction moments over various portions of stance relative to those who did not have recurrent injury.

**CONCLUSIONS:** CAI patients who suffered recurrent sprains within 6 months demonstrated altered foot placement ( $4^\circ$  more plantarflexion) along with more inversion moment and altered frontal knee and hip biomechanics. Moreover, these patients reported a greater number of previous ankle sprains (5.8 sprains) relative to those who did not have reinjury at a 6-month follow-up (3.3 sprains).

3099 Board #6 June 2 9:00 AM - 11:00 AM  
**The Relationship Between Vertical Ground Reaction Force And Audio Characteristics During A Single-Leg Landing**

Caroline Lisee, Thomas Birchmeier, Arthur Yan, Brent Geers, Kaitlin O'Hagan, Caitlin Davis, Christopher Kuenze. *Michigan State University, East Lansing, MI.*  
 (No relevant relationships reported)

Landing kinetic are associated with injury risk and altered after injury, but are difficult to assess clinically. Relationships between soundwave characteristics and kinetics have only been reported during bilateral tasks. Preliminary evidence may support the use of sound as a clinically feasible technique of landing kinetic evaluation. **Purpose:** To assess the relationship between kinetics (peak vertical ground reaction force (vGRF), linear loading rate (LR), instantaneous LR) and soundwave characteristics (peak audio amplitude, audio frequency) during a single leg landing task. **Methods:** Physically active participants (15 males/11 females, age=24.81±3.6 years, height=176±9.05 cm, mass=74.86±14.4 kg) with no injuries in the past 3 months completed 5 single leg landings per limb onto a force plate while soundwave characteristics were recorded with a microphone. Means and standard deviations were calculated for all landings of each limb and considered independent outcomes for a total of 52 landings. Loading time was defined from initial contact to peak vGRF. Linear and instantaneous LR were defined as the slope during loading time and peak slope during the middle 60% of loading time respectively. Audio frequency was calculated from the onset of sound to peak audio amplitude defined as the largest peak to peak amplitude of sound. Outliers were detected through the Grubb's Outlier Test and 1 data point was removed from each of the peak amplitude and audio frequency datasets for a final sample of 51 limbs. Spearman's rho correlations were used to assess relationships between soundwave and kinetics due to non-normally distributed data. **Results:** Peak audio amplitude was moderately correlated with non-normalized vGRF ( $\rho=0.356, p=0.010$ ), normalized vGRF ( $\rho=0.486, p=0.001$ ), linear LR ( $\rho=0.500, p=0.001$ ), and instantaneous LR ( $\rho=0.368, p=0.009$ ). Audio frequency was moderately correlated with instantaneous LR ( $\rho=-0.394, p=0.005$ ). **Conclusion:** Peak audio amplitude may be more useful for assessing normalized vGRF and linear LR, but audio frequency may be more useful for instantaneous LR assessment. Evidence of soundwave and kinetic relationships support continued refinement of soundwave measurement techniques especially in feedback based interventions and for use in previously injured populations.



**Figure 1.** Grand ensembles for lower extremity joint angles and internal moments in the sagittal and frontal planes during a jump landing/cutting task between CAI patients who experienced recurrent ankle sprains within 6 months and CAI patients who did not have recurrent sprain injury at a 6-month follow-up. 0% of stance indicates initial foot contact, 50% of stance indicates peak ankle dorsiflexion and knee flexion, and 100% of stance indicates toe-off during the task. When 95% confidence intervals (shaded area) did not cross the zero (horizontal red line), between-group differences were significant. Abbreviations: DF, dorsiflexion; PF, plantarflexion; Add, adduction; Abd, abduction.

3098 Board #5 June 2 9:00 AM - 11:00 AM  
**The Biomechanical Pattern Of Multidirectional Single-leg Landing In Professional Dancers And Non-dancers**

Ana M. Azevedo<sup>1</sup>, Raul Oliveira<sup>1</sup>, Joao R. Vaz<sup>2</sup>, Nelson Cortes<sup>3</sup>.  
<sup>1</sup>University of Lisbon, Lisbon, Portugal. <sup>2</sup>University of Nebraska at Omaha, Omaha, NE. <sup>3</sup>George Mason University, Manassas, VA.  
 (No relevant relationships reported)

Professional dancers (PD) have a high injury rate (42% to 97%) with more than 50% occurring in the lower extremity (LE). PD are required to perform repetitive multidirectional single-leg landings. Therefore, it is important to investigate the landing biomechanical strategies in various jump directions between PD and non-dancers (ND). **PURPOSE:** To compare LE biomechanics during multidirectional single-leg landings between PD and ND. **METHODS:** 15 PD (27±7 years, 1.69±0.1m, 57.8±9.3kg), and 15 ND (25±5 years, 1.69±0.1m, 66±10.2kg) conducted single-leg jumps in three directions (diagonal-DJ, frontal-FJ, and lateral-LJ) followed by a vertical jump. The second landing was used for analysis. Dominant LE biomechanical data was collected using a motion capture system (200Hz) and a force plate (1000Hz). Visual3D was used for data processing. LE joint angles (°) of the hip (HF), knee (KF), ankle, and foot; internal joint moments (Nm/Kgm); and ground reaction force (BW) were calculated at: initial contact (IC), peak knee flexion (PKF), and peak vertical ground reaction force (vGRF). Repeated measures ANOVAs were conducted ( $p<0.05$ ). **RESULTS:** A main effect was found for direction ( $p<0.05$ ). LJ (2.9±0.5) had the lowest vGRF compared to FJ (3.1±0.6) and DJ (3.3±0.7). HF at PKF was lower in the FJ direction (32±12), compared to LJ (39±11) and to DJ (39±10). A main effect for group was attained ( $p<0.05$ ). Particularly, PD (2.9±0.5) had lower vGRF than ND (3.3±0.7). At IC, PD had lower HF (19.3±4.7), KF (-3.1±3.5), and 1<sup>st</sup> metatarsophalangeal extension (MTPE: -9.9±7.0), and higher hindfoot-tibia (-32.7±4.5), and forefoot-tibia (-49.1±6.1) plantarflexion (PF) than ND (HF: 25.2±6.6, KF: -13.6±4.1, MTPE: -4.8±7.5, hindfoot-tibia: -23.8±6.8, forefoot-tibia: -30±12.5). Lastly, at IC, PD had a lower knee abductor moment (12±16) than ND (-0.1±14). Yet, at vGRF, PD had a higher knee adductor moment (-51±3) than ND (-41±2). No other difference was found ( $p>0.05$ ). **CONCLUSION:** This study demonstrated that PD had an extended landing pattern compared with ND. Despite the extended landing posture at IC, PD showed a lower vGRF, suggesting that a higher PF angle of the ankle may improve energy absorption and dissipate landing forces. Further research should investigate the role of PDs' ankle range of motion and shock absorption in landings.

3100 Board #7 June 2 9:00 AM - 11:00 AM  
**Limited Dorsiflexion Range of Motion Alters Joint Kinematics during Landing/Cutting in Chronic Ankle Instability Patients**

Kaitland Garner, S. Jun Son, Dustin Bruening, Brent Feland, Matthew Seeley, Ty Hopkins, FACSM. *Brigham Young University, Provo, UT.* (Sponsor: J. Ty Hopkins, FACSM)  
 (No relevant relationships reported)

Limited dorsiflexion range of motion (DFROM) has consistently been demonstrated in chronic ankle instability (CAI) patients. Further, reduced DFROM appears to increase the risk factor for ankle sprains. However, DFROM seems to vary between CAI patients, which could result in altered movement patterns and risk of injury. **PURPOSE:** To examine lower extremity joint angles during a jump landing/cutting task within a CAI population categorized by DFROM. **METHODS:** 100 CAI subjects were classified into 3 subgroups based on DFROM, measured by the weight-bearing lunge test: a Hypo (14M, 10F;  $\leq 39^\circ$ ; 35±2.5°, 23±2 yrs, 176±13 cm, 80±13 kg), Normal (25M, 32F; 40-50°; 46±2.6°, 21±2 yrs, 174±7 cm, 72±14 kg), or Hyper DFROM group (11M, 8F;  $\geq 51^\circ$ ; 54±3°, 22±2 yrs, 175±11 cm, 74±14 kg). Subjects performed 5 jumps consisting of a maximal vertical forward jump-landing plus a side-cut at 90°. Functional linear models were used to detect between-group differences. If 95% confidence intervals did not cross zero, differences were significant. **RESULTS:** Figure 1 shows that CAI subjects with Hypo DFROM had up to 4° less DFROM and 2.5° less knee flexion, relative to Normal and Hyper DFROM groups, during the jump landing/cutting task, and increased hip flexion (2.5°) during initial landing compared to the Normal DFROM group. **CONCLUSIONS:** Static DFROM on the weight-bearing lunge test influences sagittal-plane joint kinematics in the lower extremity during jump landing/cutting. CAI subjects with Hypo DFROM show decreases in DFROM and knee flexion, but these limitations did not increase hip flexion during most of stance (a small increase during initial landing relative to the Normal DFROM group). This stiffer landing/cutting movement pattern could increase impact loading of the lower extremity and may increase the risk of ankle reinjury.

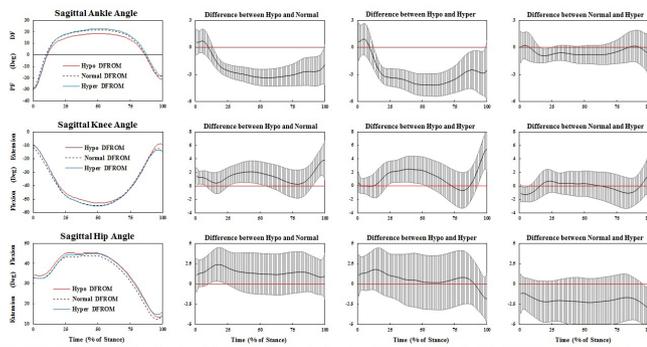


Figure 1. Grand ensembles for sagittal plane joint angles in the lower extremity during a jump landing/cutting task between the Hypo, Normal, and Hyper DFROM groups. 0% of stance indicates initial foot contact, 50% of stance indicates peak ankle dorsiflexion and knee flexion, and 100% of stance indicates toe-off during the task. When 95% confidence intervals (shaded area) did not cross the zero (horizontal red line), between-group differences were significant.

## G-24 Free Communication/Slide - New Strategies to Increase Physical Activity in Youth

Saturday, June 2, 2018, 9:00 AM - 11:00 AM  
Room: CC-Mezzanine M100D

3101 **Chair:** John R. Sirard, FACSM. *University of Massachusetts Amherst, Amherst, MA.*

(No relevant relationships reported)

3102 June 2 9:00 AM - 9:15 AM

### Effects of a School-Based Physical Activity Intervention on Cardiometabolic Health Five Years After Cessation

Geir K. Resaland<sup>1</sup>, John Bartholomew, FACSM<sup>2</sup>, Lars Bo Andersen<sup>1</sup>, Sigmund A. Anderssen<sup>3</sup>, Eivind Aadland<sup>1</sup>. <sup>1</sup>Western Norway University of Applied Sciences, Sogndal, Norway. <sup>2</sup>The University of Texas at Austin, Austin, TX. <sup>3</sup>Norwegian School of Sport Sciences, Oslo, Norway. (Sponsor: John Bartholomew, FACSM)

(No relevant relationships reported)

While there have been several school-based physical activity (PA) interventions targeting improvement in cardiovascular disease (CVD) risk factors, including cardiorespiratory fitness (CRF), few have assessed the long-term effect on a cardiometabolic health composite score. **PURPOSE:** To determine the effect of a two-year school-based PA intervention on CVD risk five years after cessation. **Methods:** We recruited two elementary schools, assigned to intervention (n=125 children) or control (n=134 children). The intervention school offered 210 min/week more PA than the control school over two consecutive years (4th and 5th grades) during 2004-2007. A follow-up assessment was conducted 5-y post intervention (10th grade) during 2011-2012 where 180-210 (73-85%) children provided valid data. Primary outcomes were several CVD risk factors: triglyceride (TG), total to high-density lipoprotein cholesterol ratio (TC:HDL ratio), insulin resistance (HOMA), systolic blood pressure (SBP), waist circumference (WC), and (CRF measured as) peak oxygen uptake (VO<sub>2</sub>peak). These variables were analyzed individually and as a composite score through linear mixed models, including random intercepts for children. **Results:** Analyses revealed significant effects of the intervention five years after cessation for HDL (ES=.22), diastolic BP (ES=.48), VO<sub>2</sub>peak (ml/kg/min) (ES=.29), and the composite risk score (ES=.38). These effects were similar to the immediate results following the intervention. In contrast, while TC:HDL ratio initially decreased post intervention (ES=.27), this decrease was not maintained at 5-y follow-up (ES=.09), whereas WC was initially unchanged post intervention (ES=.02), but decreased at 5-y follow-up (ES=.44). **Conclusion:** These data reveal that the significant effects of a two-year school-based PA intervention remained in effect for CVD risk factors five years after cessation of the intervention. As cardiometabolic health can be maintained long-term after school-based PA, this paper demonstrates the sustainability and potential of schools in the primary prevention of future CVD risk in children.

3103 June 2 9:15 AM - 9:30 AM

### Effects of Integrating Physical Activity into Early Education Learning Standards on Preschoolers' Physical Activity Levels

Sofiya Alhassan, FACSM, Christine St. Laurent, Sarah Burkart, Cory J. Greever, Matthew Ahmadi. *University of Massachusetts, Amherst, Amherst, MA.*

(No relevant relationships reported)

Preschool centers are ideally situated to intervene on preschoolers' health behaviors such as physical activity (PA), diet, and sleep (PADS). In order for health behavior interventions to be sustainable within the preschool center, the intervention needs to be implemented by classroom teachers. Unfortunately, teachers are constrained by demands such as meeting early childhood education learning standards (state mandated policies). It is possible that integrating health behavior lessons and activities into learning standard could improve teachers' compliance with health behavior interventions. **PURPOSE:** To examine the impact of integrating health behavior interventions into learning standards on preschoolers' PA, diet and sleep behavior. **METHODS:** This was a parallel group pilot randomized control study. Data were collected in Spring 2016 and analyzed in Fall 2016. Two preschool centers were randomized to either the PADS (children, n = 60) or the control (CON; children, n = 54) group. The PADS intervention consisted of a PA, diet, and sleep curriculum and activities embedded into Massachusetts early education learning standards and was implemented for four days/week for 12 weeks. PADS also had a parent component, which was delivered online. CON preschool participated in their usual activity. PA was assessed using accelerometers for seven days per week. Diet and sleep variables were assessed using a parent report surveys. Outcome variables were assessed at baseline, 6-weeks, and 12-weeks. **RESULTS:** After adjusting for baseline differences, significant group by visit interaction were observed for during preschool-day percent of time spent in moderate-to-vigorous PA (PADS; baseline = 7.7% ± 3.6, 12-week = 11.7 ± 3.8; CON, baseline = 10.7% ± 3.7, 12-week = 10.9% ± 3.5; p = 0.03) and sedentary time (PADS; baseline = 83.6% ± 5.8, 12-week = 77.2% ± 6.4; CON; baseline = 79.1% ± 5.4, 12-week = 78.4% ± 5.5; p = 0.05). At 6-week, significant improvement (p = 0.02) was observed in percent of time spent in total daily vigorous activity for the PADS compared to the CON group. **CONCLUSION:** This pilot study provides preliminary evidence that integrating health behaviors into learning standards are feasible and potentially an effective way for increasing preschoolers PA level but not effective in changing either diet or sleep behaviors.

3104 June 2 9:30 AM - 9:45 AM

### Fueling Learning Through Exercise (FLEX) - Long-term Impact Of School-based Programs On Children's Moderate-to-Vigorous Physical Activity

Jennifer M. Sacheck, FACSM<sup>1</sup>, Sarah Amin<sup>1</sup>, Stephanie Anzman-Frasca<sup>2</sup>, Virginia Chomitz<sup>1</sup>, Kenneth Chui<sup>1</sup>, Paula Duquesnay<sup>1</sup>, Miriam Nelson, FACSM<sup>3</sup>, Catherine Wright<sup>1</sup>, Christina Economos<sup>1</sup>. <sup>1</sup>Tufts University, Boston, MA. <sup>2</sup>University of Buffalo, Buffalo, NY. <sup>3</sup>University of New Hampshire, Durham, NH.

(No relevant relationships reported)

**Purpose:** Schoolchildren do not meet current recommendations for school-time and daily moderate-to-vigorous physical activity (MVPA), which is further exacerbated by a steady decline in MVPA over the elementary school years. Our objective was to evaluate the impact of two innovative school-based PA programs, *100 Mile Club*® and *Just Move/NYP*™, on school-time (sMVPA) and total daily MVPA among lower-income schoolchildren.

**Methods:** Elementary schools (n=18) were randomized to *100 Mile Club* (walk/run program), *Just Move* (active classroom breaks), or control. Teachers/champions were trained to implement programming for 3rd and 4th grade students. Consented children were measured at baseline (pre-intervention), mid-point (6 months), and end-point (18 months). MVPA was measured via 7-day accelerometry (Actigraph GTX3+). Height/weight were measured to assess weight status. Demographics were collected by parent report. Mixed effects linear regression models were used to examine the impact of program on sMVPA and total daily MVPA adjusting for school-level clustering, sex, grade, BMI status, free/reduced-price lunch eligibility (FRPL), wear-time, and average daily temperature.

**Results:** 982 children (8.7 ± 0.7 years; 44% male; 64% non-white; 40% overweight/obese; 55% FRPL; 38% *100 Mile Club*, 32% *Just Move*, 31% control) had valid accelerometer wear-time (≥3 days, ≥10 hr/day) over the three time points. At baseline, 8.4% (18.3 ± 8.6 min/day) and 19.8% (44.9 ± 20.1 min/day) fulfilled the 30-min sMVPA and 60-min total daily MVPA recommendations, respectively. There was a significant program effect on sMVPA (p = 0.002), but not for daily MVPA (p = 0.47). Pair-wise comparisons suggest that this difference was driven by a decrease in sMVPA in control schools from mid- to end-point (Bonferroni p = 0.004; -2.3 min, 95%CI -4.3,

-0.4); while sMVPA in both intervention groups remained stable over the 18-month intervention period (*100 Mile Club*: 18.1, 18.9, 18.4 min/day; *Just Move*: 17.6, 16.8, 17.5 min/day).

**Conclusion:** Two very different school-based PA programs appeared to be effective in preventing the decline in sMVPA that is typically seen with increasing grade level. Multiple opportunities for PA during school hours are needed to move the needle on children meeting sMVPA recommendations. Funding provided by NIH-NICHD.

3105 June 2 9:45 AM - 10:00 AM

### Effect of the Kiddie Cats on the Move Intervention On Preschoolers' Physical Activity

Connie Tompkins, Lori E. Meyer, Erin K. Shoulberg, Caroline Martin, Marissa Dennis, Allison Krasner, Betsy Hoza. *University of Vermont, Burlington, VT.*  
(No relevant relationships reported)

Young children spend a significant amount of time in structured preschool settings; however, the majority of this time is spent in sedentary behaviors. Given that obesity, physical activity (PA), and sedentary behaviors track throughout development, interventions aimed at increasing PA opportunities for young children in the preschool setting may be critical in establishing healthy trajectories for young children. **PURPOSE:** To examine PA in preschool-aged children during school days when a PA curriculum was administered as compared to non-intervention days. **METHODS:** A pilot PA curriculum, *Kiddie CATs on the Move*, was implemented in local preschools over 23-weeks, 2-3 times per week by classroom teachers and college students enrolled in a service-learning course. Physical activity was objectively measured by accelerometry during the preschool day at 3 intervention timepoints. A total of 32 children ( $M_{age} = 3.91 \pm 0.6$ , 12 males, 20 females) who had at least 2 days of valid data on both intervention days and non-intervention days were included in the analyses. Minutes per hour (min/hr) of moderate-to-vigorous (MVPA), total PA (light + MVPA), and sedentary as well as percentage of time spent in each were calculated. Paired-samples t-test was used to compare intervention vs. non-intervention days. **RESULTS:** Children engaged in significantly more total PA (min/hr) on days when the PA curriculum was administered vs. non-intervention days ( $17.2 \pm 3.5$  vs.  $16.0 \pm 3.5$ ,  $p < 0.001$ ) and significantly more min/hr in MVPA ( $9.5 \pm 2.7$  vs.  $8.5 \pm 2.9$ ,  $p < 0.001$ ). On intervention days, children spent significantly less time in sedentary behavior compared to days without the intervention ( $71.3\%$  vs.  $73.4\%$ ,  $p < 0.001$ ). **CONCLUSIONS:** The current findings suggest the *Kiddie CATs on the Move* curriculum significantly increased the amount of time preschoolers engaged in PA (total and MVPA) throughout their school day. This teacher- and student-led intervention in the preschool setting may represent a viable approach to increase PA and aid in the establishment of healthy behaviors in young children.

3106 June 2 10:00 AM - 10:15 AM

### Physical Fitness Changes are Independent of Adiposity in an Afterschool Translational Health Program

Carolina Velasquez, Emily W. Flanagan, Kara Bolon, Arlette C. Perry, FACSM. *University of Miami, Coral Gables, FL.*  
(No relevant relationships reported)

**Background:** As obesity rates continue to rise in children and adolescents, physical fitness (PF) levels are reported to decrease. Given the fact that low PF levels are associated with adverse medical conditions and fewer schools require physical education, improving PF levels has been the target of many afterschool programs. However, not all afterschool programs have been successful in improving PF levels in minority children. In adults, improvements in aerobic fitness (AF) are observed concomitantly with decreases in adiposity. However, less is known about this relationship in children, particularly minority children. **Purpose:** The present study was done to determine whether a translational health in nutrition and kinesiology (THINK) program focusing on education, clinical activities, and free play can improve PF independent of adiposity. **Methods:** A total of 73 participants (35 Latino, 31 Black, and 7 White) 8-12-years enrolled in a YMCA afterschool program. All participants were randomly assigned to THINK or control (CON) programs. Muscular strength (MS) was assessed using grip dynamometer and AF was assessed using the NIH two-minute walk test as part of their PF evaluation. Adiposity was measured using skinfold thickness of the triceps (TRI) and subscapular (SS). Means and standard errors were evaluated for all dependent variables in both THINK and CON groups. An analysis of covariance was performed to determine differences between groups over time after adjustment for pretest scores. **Results:** Significant differences were found in MS between THINK and CON even after controlling for SS (THINK  $\bar{x} = 14.641 \pm 1.724$ ; CON  $\bar{x} = 6.554 \pm 2.391$ ;  $p = .010$ ) and TRI (THINK  $\bar{x} = 14.771 \pm 1.767$ ; CON  $\bar{x} = 6.425 \pm 2.496$ ;  $p = .013$ ). Significant differences were also observed between THINK and CON in AF after controlling for SS (THINK  $\bar{x} = 39.952 \pm 10.738$ , CON  $\bar{x} = 7.125 \pm 14.681$ ;  $p = .016$ ) and TRI (THINK  $\bar{x} = 41.352 \pm 11.130$ , CON  $\bar{x} = 9.630 \pm 15.60$ ;  $p = .016$ ). **Conclusion:** A translational health program such as the THINK which

targets exercise physiology knowledge, clinical experiences, and structured free play can improve PF measures independent of adiposity levels in predominantly minority children participating in an afterschool setting.

3107 June 2 10:15 AM - 10:30 AM

### Impact of Social Support on Changes in Physical Activity among Children Participating in School-based Programs

Sarah A. Amin, Kenneth Chui, Paula J. Duquesnay, Catherine M. Wright, Virginia R. Chomitz, Christina D. Economos, Jennifer M. Sackeck, FACSM. *Tufts University, Boston, MA.*  
(No relevant relationships reported)

**PURPOSE:** Teacher and peer social support (SS) enhances children's physical activity (PA) engagement and represents an important consideration for implementing school-based PA interventions. We aimed to assess changes in school PA social support (S-SS) among children participating in school-based PA programming and examine if changes in moderate-to-vigorous PA (MVPA) differed by S-SS level.

**METHODS:** Eighteen MA schools from lower-income districts were enrolled in the *FLEX* study and randomized to control, *100 Mile Club*<sup>®</sup> (walking/running club), or *Just Move/NYP*<sup>™</sup> (active classroom breaks). Demographic data were collected by parent report. Third and fourth grade children were recruited and measured for height/weight and 7-day accelerometry (Actigraph GT3X+). SS for PA was self-reported and a S-SS score (6 items) was median split into low and high categories. For each program group, the association between low vs. high S-SS and changes in MVPA from baseline (pre-intervention) to 6 months were examined using mixed effects models adjusting for sex, grade, race, BMI category, free/reduced price lunch eligibility (FRPL), mean temperature, and school-level clustering.

**RESULTS:** 747 children ( $8.7 \pm 0.7$  years, 43% male, 64% non-white, 56% FRPL, 40% overweight/obese) had valid accelerometer wear-time ( $\geq 3$  days,  $\geq 10$  hrs/day) and 20% ( $45.6 \pm 19.3$  min/day) met the 60-min total daily MVPA recommendations at baseline. There were modest changes in high S-SS from baseline to 6 months for children participating in *Just Move* (4% increase), *100 Mile Club* (7% increase), and control (7% decrease) ( $p > 0.05$ ). The interaction between S-SS and time point was not significant for the control or *100 Mile Club* group ( $p > 0.05$ ). In *Just Move*, there was an interaction between time point and S-SS ( $p = 0.02$ ). Pairwise comparisons indicated no difference in MVPA for children reporting low vs. high S-SS at baseline ( $p > 0.05$ ). However, at 6 months, *Just Move* children with high S-SS had 3.8 min (95% CI: 0.69-6.91) more MVPA than those with low S-SS ( $p = 0.016$ ; Bonferroni adjusted  $p = 0.09$ ). **CONCLUSIONS:** Children participating in active classroom breaks who reported high S-SS had increased MVPA compared to those reporting lower support. Future work should consider how to effectively support and sustain S-SS to encourage school-wide improvements in PA behaviors.

3108 June 2 10:30 AM - 10:45 AM

### Changes In Ability, Confidence, And Motivation Among Children In A Novel School-based Physical Literacy Intervention

Erin Hennessy<sup>1</sup>, Daniel P. Hatfield<sup>1</sup>, Kenneth Chui<sup>2</sup>, Stephanie Herrick<sup>3</sup>, Christine Odalen<sup>3</sup>, Teri West<sup>3</sup>, Rachel Pratt<sup>3</sup>, Catherine Wright<sup>1</sup>, Jennifer Sackeck, FACSM<sup>1</sup>. <sup>1</sup>Tufts University Friedman School of Nutrition and Policy, Boston, MA. <sup>2</sup>Tufts University School of Medicine, Boston, MA. <sup>3</sup>New York Road Runners, New York, NY. (Sponsor: Jennifer Sackeck, FACSM)  
(No relevant relationships reported)

Programs that increase children's physical literacy (PL), defined as the *ability*, *confidence*, and *motivation* to be physically active for life, hold promise for helping children achieve physical activity recommendations, yet few studies have tested PL interventions. **PURPOSE:** To fill this gap, we conducted a pilot evaluation of a PL-based intervention in the school setting. **METHODS:** Three New York City elementary schools were recruited. The intervention included twice-weekly lessons during regularly scheduled 3<sup>rd</sup>/4<sup>th</sup> grade PE classes over 10 weeks between Feb-Jun 2017. Twenty lessons were selected from a bank of 400 activities designed to build running, locomotion, and balance skills through age-appropriate play and games. Lessons were linked to SHAPE America PE standards and involved a warm up activity, skill-based activity, games focused on the skill, and a cool down activity. *Ability* was measured by direct observation (eight tasks from the PL Assessment for Youth (PLAY<sup>fun</sup>) tools). Each task was graded on a four-point rubric (0-100), categorized as: Initial (0-25), Emerging (26-50), Competent (51-75) and Proficient (76-100). *Confidence* and *motivation* were measured by child-reported surveys; demographics were collected via parent-reported surveys. Height/weight were measured; body-mass index z-scores computed. Paired sample t-tests tested change in PLAY<sup>fun</sup> scores, reported as mean (SD). **RESULTS:** Baseline (T1) and post-intervention (T2) data were collected on n=45 children. Most children were 9.4 (0.5) years old (n=28), female (n=24), either Non-Hispanic Black or Hispanic (n=40), and of a healthy weight (n=30). Children improved in two running tasks: run there/back (T2:

50.4, T1: 45.2,  $\Delta$ 5.1 (11.7, p lt 0.01) and run/jump/land (T2: 42.8, T1:37.5,  $\Delta$ 5.3 (16.3), p=0.03); one locomotor task: crossovers (T2:27.0 T1:22.3  $\Delta$ 4.8 (13.4), p=0.02); and the balance task: backward balance walk (T2:32.9 T1:29.2,  $\Delta$ 3.7 (10.8), p=0.02). Self-reported confidence and motivation were high (>4 on 5-point scales) at baseline with no change observed at post. **CONCLUSION:** Children participating in a PL-based program focused on running, locomotion, and balance may demonstrate improvements in PL domains, particularly motor skills. This study was funded by NYRR.

3109 June 2 10:45 AM - 11:00 AM

### Physical Activity and Screen Time Recommendation Compliance in Preschoolers

Sarah Burkart, Christine W. St. Laurent, Sofiya Alhassan, FACSM. *University of Massachusetts Amherst, Amherst, MA.* (Sponsor: Sofiya Alhassan, FACSM)  
(No relevant relationships reported)

Low physical activity (PA) and increased screen time (ST) is problematic for preschool-age children (2.9-5 years), and is attributed to childhood overweight/obesity. Due to this, several organizations have provided recommendations surrounding these behaviors. However, few studies have examined the compliance rates of preschoolers based on the recently released PA and ST recommendations ( $\geq 15$  minutes of PA/hour and  $\leq 60$  min/day). **PURPOSE:** To assess preschool-age children's compliance with PA and screen time recommendations and identify variables contributing to compliance. **METHODS:** Baseline data from preschoolers (n=52, 50% male, age =  $3.7 \pm 0.8$  years, BMI % =  $50.2 \pm 26.5$ ) in two preschool centers participating in the Preschool Activity, Diet, and Sleep pilot study was utilized for this analysis. PA was measured with an Actigraph GT3X accelerometer worn on the lower back of children for seven consecutive days. PA data were reduced using Pate et al. cut points, and compliance was assessed for school-day ( $\geq 15$  min/hour) and total day ( $\geq 180$  min) recommendations. ST and parent variables were assessed with self-report validated questionnaires. Appropriate descriptive statistics were calculated for all variables. Logistic regression was used to determine differences in compliance based on gender, ST, school-day PA, parent PA, and parent PA knowledge. **RESULTS:** Children engaged in  $11.3 \pm 3.6$  min/hour of PA and  $102.6 \pm 79.6$  min/day of ST. The percentage of preschoolers meeting school-day recommendations and total day recommendations were 17.1% and 26.5%, respectively. Approximately 35.9% of preschoolers met ST recommendations. There were no gender differences in PA (p=0.052) or ST (p=0.91) compliance. Additionally, only school-day PA significantly contributed to the likelihood of meeting total day recommendations (OR=1.05, 95% CI=1.002, 1.104). **CONCLUSION:** Preschoolers' compliance with PA and ST recommendations was low in this sample. Additionally, only school-day PA was a significant predictor of meeting daily PA recommendations. No significant predictors were identified for ST compliance. Practical intervention strategies are needed to increase PA and reduce ST in preschoolers, specifically in the preschool environment.

## G-25 Clinical Case Slide - Arm

Saturday, June 2, 2018, 9:00 AM - 10:40 AM  
Room: CC-200E

3110 **Chair:** Jim Macintyre, FACSM. *Center for Orthopedic and Rehabilitation Excellence, West Jordan, UT.*  
(No relevant relationships reported)

3111 **Discussant:** William J. Moreau, FACSM. *US Olympic Committee, Colorado Springs, CO.*  
(No relevant relationships reported)

3112 **Discussant:** Wayne Elton Derman. *Stellenbosch University, Cape Town, South Africa.*  
(No relevant relationships reported)

3113 June 2 9:00 AM - 9:20 AM

### Left Anterior Arm Pain in a 79 year old Female Pilates Method Strength Trainer

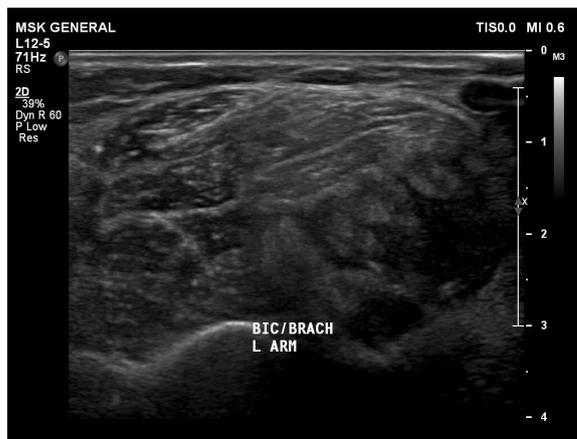
Brittany J. Moore<sup>1</sup>, Elena J. Jelsing<sup>2</sup>, Jonathon T. Finnoff, FACSM<sup>3</sup>. <sup>1</sup>Mayo Clinic, Rochester, MN. <sup>2</sup>Mayo Clinic, Minneapolis, MN. <sup>3</sup>Mayo Clinic College of Medicine and Science, Rochester, MN. (Sponsor: Jonathan T. Finnoff, FACSM)  
(No relevant relationships reported)

**HISTORY:** A 79 year old female presented to sports clinic with 2 weeks left anterior elbow pain that developed following a Pilates class. She described a pulling type of discomfort in the left antecubital region worse with elbow extension and improved with rest. She noted associated swelling in the region over the same period. She denied history of bruising, trauma, or obvious injury to the arm during the class. She exercised regularly with Pilates method and denied engaging in any novel activities prior to pain onset. She denied changes in strength or sensation. She had cochlear implants which were not MRI compatible.

**PHYSICAL EXAMINATION:** There was fullness about the left anterior distal arm to antecubital fossa which was tender and hard on palpation. The left biceps tendon was palpable in the antecubital fossa but less prominent than the contralateral side. She had a left elbow extension lag of 15 degrees; elbow flexion and forearm pronation-supination range and strength were symmetric. She was neurovascularly intact.

**DIFFERENTIAL DIAGNOSIS:** 1. Distal biceps tendon tear 2. Distal biceps muscle tear 3. Brachialis muscle tear 4. Deep venous thrombosis 5. Sarcoma

**TEST AND RESULTS:** Elbow anterior-posterior & lateral radiographs: Normal. Elbow anterior musculoskeletal ultrasound: Lateral portion of brachialis muscle had heterogeneous echogenicity, large areas of hypoechogenicity in between fibers and discontinuity of proximal fibers with the distal insertion. Medial half of brachialis muscle had intact fibers. Remainder of exam was normal including brachialis tendon insertion, biceps muscle and tendon, vasculature, and nerves.



**FINAL WORKING DIAGNOSIS:** High grade partial thickness tear of the distal lateral brachialis muscle

**TREATMENT AND OUTCOMES:** She was managed with compression sleeve and initiation of physical therapy for range of motion with later progression to elbow flexor strengthening. Three months post injury she was at normal baseline for motion and activity.

3114 June 2 9:20 AM - 9:40 AM

**Left Arm Pain and Numbness-Recreational Athlete**

Paul A. Krebs, Clinton Hartz. *The Ohio State University, Columbus, OH.* (Sponsor: James Borchers, MD, MPH, FACSM)  
(No relevant relationships reported)

**History:** A 41 year old right hand dominant female presented with left arm pain and numbness of 6 months duration with progressive worsening. Symptoms started in the distal posterior medial aspect of her arm and radiated to the 4<sup>th</sup> and 5<sup>th</sup> fingers of the hand. The pain was worse with lifting, swimming, biking, and tennis, forcing her to stop her normal athletic activities. She also noticed swelling in the distal aspect of the arm where the pain originated and a palpable bump. She denied history of trauma, clicking, locking, or instability.

**Physical Exam:** Neck exam showed full painless range of motion, no tenderness, and a negative Spurling test. Shoulder exam showed full strength and range of motion. Her left elbow had full range of motion with pain, no instability or crepitus. She had soft tissue tenderness and swelling in the distal arm medially with palpable nodules just proximal to the medial epicondyle. Cozen's, Speed's, and Yergason's tests were negative. She had 5/5 strength and full range of motion of her left hand. Neurologic exam showed decreased sensation in the ulnar nerve distribution. Capillary refill and radial pulses were intact.

**Differential Diagnosis:**

1. Cubital Tunnel Syndrome
2. Ulnar Neuropathy Secondary to Mass Effect
3. Fracture/Stress Fracture
4. Cervical Radiculopathy
5. Thoracic Outlet Syndrome

**Tests and Results:**

XR Humerus: No soft tissue swelling or acute osseous abnormality  
Limited Diagnostic Ultrasound: 4 hypervascular nodules adjacent to ulnar nerve, likely lymph nodes

**Final Working Diagnosis:**

Ulnar neuropathy secondary to mass effect, lymphadenopathy, need to rule out malignancy.

**Treatment and Outcomes:**

1. MRI Left Humerus: abnormal enlarged lymph nodes. Mass effect evident along the ulnar nerve.
2. Referred to Hematology Oncology.
3. Biopsy: grade 1 follicular lymphoma.
4. PET scan: hypermetabolic lymphadenopathy above and below the diaphragm, uptake in the spleen and liver, consistent with a Stage III lymphoma.
5. Bendamustine/Rituximab (BR) was started because of its response rate and lower side effect profile compared to other chemotherapies.
6. Patient has undergone 2 cycles of BR with good response, including near resolution of her humeral disease.
7. She is restarting activities as tolerated. The expectation is that her ulnar neuropathy will improve with remission of her lymphoma.

3115 June 2 9:40 AM - 10:00 AM

**Bilateral Wings**

Nina Yaftali. *Rush, Chicago, IL.*  
(No relevant relationships reported)

**HPI:**

19 year-old right hand dominant male high school recreational basketball player who presents with chief complaint of bilateral shoulder pain for one year. About one and half years ago patient was training in the gym when he did a heavy overhead press and heard an audible pop in his shoulders. He complained of a dull, achy posterior shoulder pain and mild winging of both his scapula. He stopped exercising, and went to see an orthopedist who recommended physical therapy. He was diagnosed with weak shoulders and rotator cuff tendonitis with a prescription of rotator cuff and scapular strengthening exercises. After one year of physical therapy, he notes no improvement.

**PHYSICAL EXAM:**

Alert, oriented Caucasian male. Bilateral scapular winging more prominent on right compared to left. Atrophy of periscapular region more prominent on left.

Full active range of motion bilaterally.

4+/5 strength in abduction, forward flexion, and external rotation bilaterally. Negative

belly press or lift off sign bilaterally

Neck flexion and bilateral deltoids 4+/5 strength bilaterally

Rhomboids 2/5 strength bilaterally

5/5 biceps and triceps strength bilaterally

Positive O'Brien's and Hawkins on right.

Normal reflexes and sensation bilaterally.

Increased lumbar lordosis with ambulation

**DIFFERENTIAL DIAGNOSIS:**

1. Long thoracic nerve neuropathy
2. Axillary nerve neuropathy
3. Myotonic Dystrophy

**4. Limb Girdle Muscle Dystrophy****TEST AND RESULTS:**

MRI right shoulder: Minimal tendinosis of the supraspinatus and subscapularis tendon.

MRI left shoulder: Mild tendinosis of subscapularis tendon.

EMG: Myopathic process with chronic features affecting the right upper extremity and periscapular region.

Genetic test: FSHD1 confirmed

**FINAL WORKING DIAGNOSIS:**

Facioscapulohumeral muscle dystrophy

**TREATMENT AND OUTCOMES:**

Patient was prescribed physical and occupational therapy for stretching, and range-of-motion exercise. It is recommended he no longer do heavy weightlifting, just low intensity aerobic exercise. His pain is controlled with NSAIDS currently, as no other drug shows any clear benefit. He received a baseline pulmonary function test, and dilated retinal exam. Patient is doing well overall. The shoulder surgeon is evaluating him for possible scapular fixation if his range of motion worsens.

3116 June 2 10:00 AM - 10:20 AM

**Shoulder Weakness- Football**

Daniel Sisk, Mindy Loveless. *University of Washington, Seattle, WA.*

(No relevant relationships reported)

**HISTORY:** A 17-year-old high school football player sustained a left shoulder injury while tackling an opposing player to the ground. He had pain in the left shoulder that increased the following day with radiation into the neck. He was evaluated by orthopedics 5 days post-injury. Initial X-rays of the cervical spine and left shoulder were unremarkable and subsequent left shoulder MRI 12 days post-injury was also unremarkable. Over the next few weeks the pain resolved but weakness in the shoulder persisted. He was then referred to our clinic for further evaluation approximately 3 months post-injury with ongoing shoulder weakness. He denied paresthesias.

**PHYSICAL EXAMINATION:**

Weakness was isolated to left shoulder external rotation and abduction. Shoulder flexion, extension and internal rotation were intact. Inspection showed atrophy of left supraspinatus and infraspinatus. Full pain free ROM of neck. Sensation and reflexes were intact in upper extremities.

**DIFFERENTIAL DIAGNOSIS:**

1. Suprascapular nerve injury
2. Rotator cuff tear
3. Cervical radiculopathy
4. Brachial plexus injury

**TEST AND RESULTS:** Diagnostic US of left shoulder: Increased echogenicity of left supraspinatus and infraspinatus

EMG/NCS: Increased insertional activity, 1+ fibs, 2+ sharps, increased phasicity and decreased recruitment in supraspinatus and infraspinatus. Membrane instability in deltoid and teres minor. No other abnormalities.

Repeat MRI of left shoulder: Atrophy of supraspinatus and infraspinatus. No mass or anatomic abnormality

**FINAL WORKING DIAGNOSIS:**

Left suprascapular nerve injury

**TREATMENT AND OUTCOMES:**

1. Referral to surgery resulted in nerve transfer surgery from spinal accessory nerve to suprascapular nerve
2. One month post-op little to no return of external rotation with mild weakness in left shoulder shrug as expected course post-operatively
3. Returned to football one month after surgery with recommendation to avoid positions requiring tackling



3117 June 2 10:20 AM - 10:40 AM

**Forearm Pain- Diving**Dorcas Copa, Jaime Aparicio. *Memorial Hermann Ironman, Houston, TX.**(No relevant relationships reported)***Forearm Pain-Diving**

D. Copa, Jaime Aparicio, Memorial Hermann Ironman, Houston, TX

E-mail: [Dorcas.copa@memorialhermann.org](mailto:Dorcas.copa@memorialhermann.org)

**HISTORY:** A 22 year old International and NCAA Division I female diver developed medial forearm pain during the Spring of 2017 experienced only during the pike position of her dive. The pain initially was during the activity only but progressed to pain after the activity had ended.

**PHYSICAL EXAM:**

The examination of the athlete was done in the athletic training room by a physical therapist. Subjectively, questions about female athlete triad indicated inconsistent menstrual cycle. However, she did consume adequate calories including foods with calcium and protein. Further questioning about hormone levels and nutrition indicated she had been found to have low levels of vitamin D in previous blood tests as well as very low estrogen. The athlete reported having to take estrogen supplements in the past.

The physical exam revealed normal active range of motion bilaterally, normal sensation, reflexes, and strength. Vascular system was noted to be intact. Upper limb nerve tension was tested, resulting in negative findings. Pin point pain with palpation along the ulna in two places, one approximately middle of the ulna and the other approximately 2 inches from the proximal radioulnar joint, reproduced her pain. Applied manual force at each end of the ulna over a fulcrum also reproduced her pain suggesting an osseous pathology so imaging was suggested by the physical therapist and ordered by the orthopedic surgical fellow.

**DIFFERENTIAL DIAGNOSIS:**

1. Ulnar Stress Reaction
2. Periostitis
3. Bone Contusion

**TESTS AND RESULTS:** Plain Radiographs demonstrate bowing of the ulna

**WORKING DIAGNOSIS:**

The final diagnosis was bowing of the ulna with a stress reaction.

**TREATMENT AND OUTCOMES:**

1. Increase core strength in pike position in create a "tighter" pike throughout the pike position during dive.
2. Scapulothoracic strengthening to offload the forearm during the dive.
3. Diving Technique
4. Vitamin D supplements and nutrition counseling.

**G-34 Free Communication/Poster - High Intensity Interval Training**

Saturday, June 2, 2018, 7:30 AM - 11:00 AM

Room: CC-Hall B

3132 Board #1 June 2 8:00 AM - 9:30 AM

**Sports Related Fitness Evaluation and High Intensity Interval Training in Table Tennis Players**Pei-Fan Wang, Mei-Hua Tu, Li-Lan Fu. *National Taiwan Sport University, Taoyuan, Taiwan.**(No relevant relationships reported)*

**PURPOSE:** To investigate the effect of 8 weeks high intensity interval training (HIIT) in elite table tennis players.

**METHODS:** Twenty four elite table tennis player (age:  $19.52 \pm 1.21$  yrs; playing experience:  $11.17 \pm 1.56$  yrs) participated in this study and were allocated into HIIT exercise group ( $n = 12$ , TG) and control group ( $n = 12$ , CG). All subjects were assessed by graded exercise test (GXT), sub-maximal exercise test (SBT), and table tennis specific fitness test (TTSFT) before and after the intervention. The TG group received HIIT protocol 3 times/week for 8 weeks period. Control group maintained the regular training programs. Participants were asked to perform a running test to fatigue before and after the experiment intervention to measure  $\dot{V}O_{2max}$ , exercise duration, VT, HRmax and RPE. All subjects completed two 6-min bouts of moderate-intensity (MIE) and severe-intensity (SIE) running incremental exercise test. TTSFT was executed using a mechanical table tennis ball thrower to control the exercise intensity. Each participant forehand topspin three position rally table tennis trials at frequency of 60 balls/min till exhaustion. The Polar heart rate monitor was used to record HR and exercise duration.

**RESULTS:** After HIIT, TG significantly improve  $\dot{V}O_{2max}$  ( $53.19 \pm 6.11$  vs.  $56.73 \pm 4.39$  ml/kg/min,  $p < .05$ ), time to voluntary exhaust ( $14.14 \pm 1.17$  vs.  $14.93 \pm 0.73$  min,  $p < .05$ ), and LACpost (pre  $9.99 \pm 2.35$  vs. post  $11.07 \pm 2.02$  mmol/L,  $p < .05$ ) of GXT

test, and better than CG (post  $50.04 \pm 6.40$  ml/kg/min;  $13.70 \pm 1.64$  min; LACpost  $8.96 \pm 1.23$  mmol/L) ( $p < .05$ ). The variables of CG showed no significant difference. TG significantly increase SIE velocity,  $\dot{V}O_{2max}$  ( $55.01 \pm 4.76$  vs.  $58.05 \pm 4.88$  ml/kg/min,  $p < .05$ ) and LACpost (pre  $11.72 \pm 1.89$  vs. post  $12.50 \pm 1.51$  mmol/L,  $p < .05$ ) of SBT, and better than CG ( $p < .05$ ). However, there were no significant difference in MIE test between TG and CG ( $p > .05$ ). TG (pre  $371.36 \pm 112.97$  vs. post  $475.71 \pm 165.62$  sec,  $p < .05$ ) showed significantly improvement in TTSFT compare to CG (pre  $361.20 \pm 79.18$  vs. post  $334.80 \pm 128.00$  sec,  $p > .05$ ).

**CONCLUSIONS:** Eight weeks HIIT could effectively improve aerobic capacity, specific fitness and exercise performance of table tennis players. Incorporation of a suitable training program into the training routine might be important to improve the exercise performance.

3133 Board #2 June 2 8:00 AM - 9:30 AM

**Biomarkers of Inflammation and Angiogenesis Following Short Vs. Long Bouts of High-Intensity Training**Chad D. Markert<sup>1</sup>, Khala N. Clemons<sup>1</sup>, Emily E. Bechke<sup>2</sup>, Cassie M. Williamson<sup>2</sup>, Michael J. McKenzie, FACSM<sup>1</sup>, Brian M. Kliszczewicz<sup>2</sup>. <sup>1</sup>Winston Salem State University, Winston Salem, NC. <sup>2</sup>Kennesaw State University, Kennesaw, GA.*(No relevant relationships reported)*

Effects of varying types of high-intensity training (HIT) on the appearance and time course of circulating biomarkers have not been adequately characterized. **Purpose:** The purpose of this study was to examine the effects of HIT on biomarkers of inflammation and angiogenesis, over time, in HIT bouts of varying duration (short bout, 5 min, and long bout, 15 min). **Methods:** Ten males, 18-45 years old, who had participated in CrossFit for at least 6 months, were recruited from local affiliates. The participants completed a total of 3 lab visits [Visit 1: collection of descriptive data; the next 2 visits were randomized between the short bout and long bout]. All subjects completed the same exercises. Blood was drawn pre and post-exercise, and 1 hour, 3 hours, and 6 hours post-exercise, centrifuged, and plasma frozen for analysis. A multiplex assay (Millipore MagPix) was used to determine concentrations of the biomarkers of interest [interleukin 6 (IL-6), interleukin 10 (IL-10), tumor necrosis factor alpha (TNF-alpha), and vascular endothelial growth factor (VEGF)]. **Results:** The short bout produced results similar to those of the long bout. Repeated measures ANOVA revealed no trial-dependent differences ( $p \leq 0.05$ ) in any of the biomarkers. Both temporal responses and concentrations were similar in the short and long bout. **Conclusions:** The biomarkers IL-6, IL-10, TNF-alpha, and VEGF all follow a similar pattern of peaking post-exercise, and returning to baseline within 6 hours, regardless of the duration of the HIT. A practical implication is that a 5 min bout of HIT may be just as effective as a 15 min bout in terms of eliciting certain specific physiologic responses. Supported by WSSU Office of Student Research, Honors Student Research Grant (K.N.C.).

3134 Board #3 June 2 8:00 AM - 9:30 AM

**Effect of Reducing Sprint Duration in A REHIT Protocol on Changes in  $\dot{V}O_{2max}$  and Mood**Preeyaphorn Songsorn<sup>1</sup>, Gulbin Nalçakan<sup>2</sup>, Richard Metcalfe<sup>3</sup>, Niels Vollaard<sup>1</sup>. <sup>1</sup>University of Stirling, Stirling, United Kingdom. <sup>2</sup>University of Ege, Izmir, Turkey. <sup>3</sup>Ulster University, Belfast, United Kingdom.*(No relevant relationships reported)*

Sprint interval training (SIT) is associated with health benefits, but 'classic' SIT (6x30-s 'all-out' cycle sprints) requires high motivation and is associated with negative affective responses and high levels of perceived exertion. In order to make SIT more suitable for sedentary individuals, the number of sprints and sprint duration have previously been reduced to develop a reduced-exertion high-intensity interval training (REHIT) protocol consisting of 2x20-s 'all-out' cycle sprints within a 10-min session. This genuinely time-efficient protocol remains effective at improving aerobic capacity ( $\dot{V}O_{2max}$ ). It is unknown if further reducing the sprint duration in the REHIT protocol affects improvements in  $\dot{V}O_{2max}$  or changes in mood. **PURPOSE:** To examine the effect of reducing sprint duration from 20-s to 10-s in a REHIT protocol on changes in  $\dot{V}O_{2max}$  and psychological perceptions. **METHODS:** Thirty-five healthy untrained subjects (mean±SD age:  $22 \pm 3$  y; BMI:  $25 \pm 5$  kg·m<sup>-2</sup>;  $\dot{V}O_{2max}$ :  $37 \pm 8$  mL·kg<sup>-1</sup>·min<sup>-1</sup>) were randomised into groups performing two 10-s sprints (REHIT10; n=18) or 2x20-s sprints (REHIT20; n=17), within a 10-min session performed 3 times a week for 6 weeks.  $\dot{V}O_{2max}$  was examined before and after training. Rating of perceived exertion (RPE), psychological perceptions (BRUMS, PANAS and acceptability of HIT) were evaluated during training sessions. **RESULTS:** The increase in  $\dot{V}O_{2max}$  was significantly greater in REHIT20 ( $2.77 \pm 0.75$  vs.  $3.04 \pm 0.75$  L·min<sup>-1</sup>, +10%) compared to REHIT10 ( $2.58 \pm 0.57$  vs.  $2.67 \pm 0.61$  L·min<sup>-1</sup>, +4%; time x group interaction effect:  $p < 0.05$ ). There were no significant differences between REHIT10 and REHIT20 in mean RPE (REHIT10:  $13.6 \pm 0.4$ , REHIT20:  $14.5 \pm 0.4$ ), changes in mood status, or affective responses. **CONCLUSIONS:** Reducing REHIT sprint duration from 20-s to

10-s attenuates improvements in  $\dot{V}O_{2\max}$ , and does not result in more desired affective responses. Our findings support the use of the original REHIT protocol consisting of 2x20-s sprints.

3135 Board #4 June 2 8:00 AM - 9:30 AM

### Chlorella Intake Further Enhances Anaerobic And Aerobic Capacities Increased By High Intensity Intermittent Training

Shumpei Fujie<sup>1</sup>, Natsuki Hasegawa<sup>1</sup>, Naoki Horii<sup>1</sup>, Moe Oshiden<sup>1</sup>, Katsunori Tsuji<sup>1</sup>, YuZhong Xu<sup>1</sup>, Toru Mizoguchi<sup>2</sup>, Eri Okumura<sup>2</sup>, Izumi Tabata, FACSM<sup>1</sup>, Motoyuki Iemitsu<sup>1</sup>.  
<sup>1</sup>Ritsumeikan University, Kusatsu, Japan. <sup>2</sup>Sun Chlorella Corp., Kyoto, Japan. (Sponsor: Izumi Tabata, FACSM)  
(No relevant relationships reported)

High intensity intermittent training (HIIT) enhances anaerobic and aerobic capacities. Our recent study have demonstrated in animal study that the 6-week combination of chlorella intake and HIIT further elevated glycolytic and oxidative phosphorylation as ATP supply in skeletal muscle as compared with chlorella alone and HIIT alone, resulting in enhancement of anaerobic and aerobic exercise capacities. However, the combined effects of chlorella intake and HIIT on anaerobic and aerobic capacities in human remain unclear. **PURPOSE:** The aim of this study was to investigate whether the combination of chlorella intake and HIIT further enhanced anaerobic and aerobic capacities as compared with HIIT alone in human.

**METHODS:** Twelve healthy young male subjects ( $21 \pm 1$  years) were participated in this study. Subjects completed 3-week of exhaustive HIIT, consisting of 6-7 bouts of 20-second cycling on a leg ergometer at an intensity of 170% maximal oxygen uptake ( $\dot{V}O_{2\max}$ ) with a 10-second rest between each bout, 3 days/week. They orally took chlorella or placebo (10 tablets) after the breakfast and dinner between the 3-week in a double-blind, randomized, crossover design with 4 weeks between each intervention. We measured  $\dot{V}O_{2\max}$  as an indicator of aerobic capacity and maximal oxygen deficit (MOD) as an indicator of anaerobic capacity.

**RESULTS:** After each HIIT intervention,  $\dot{V}O_{2\max}$  was significantly increased in both chlorella and placebo groups ( $P < 0.05$ ). However, the amount of change in  $\dot{V}O_{2\max}$  after the intervention was significantly higher in chlorella intake than placebo intake ( $P < 0.05$ ). After each HIIT intervention, MOD was significantly increased in both chlorella and placebo groups ( $P < 0.05$ ). However, the amount of change in MOD after the intervention was significantly higher in chlorella intake than placebo intake ( $P < 0.05$ ).

**CONCLUSIONS:** These results suggest that the combination of chlorella intake and HIIT may further enhance anaerobic and aerobic capacities in human.

Supported by Grants-in-Aid for Scientific Research (#17H02183, #16K13059, M. Iemitsu)

3136 Board #5 June 2 8:00 AM - 9:30 AM

### Effect Of A Short-term Hiit Program On Systemic Brain-derived Neurotrophic Factor In Healthy Males

Iván Rentería<sup>1</sup>, Patricia C. García-Suárez<sup>1</sup>, David O. Martínez-Corona<sup>1</sup>, Luis M. Gómez-Miranda<sup>2</sup>, Alberto Jiménez-Maldonado<sup>1</sup>.  
<sup>1</sup>Universidad Autónoma de Baja California, Ensenada, Baja California, Mexico. <sup>2</sup>Universidad Autónoma de Baja California, Tijuana, Baja California, Mexico.  
(No relevant relationships reported)

#### Effect of a Short-Term HIIT Program on Systemic Brain-Derived Neurotrophic Factor in Healthy Males

Iván Rentería<sup>1</sup>, Patricia C. García-Suárez<sup>1</sup>, David O. Martínez-Corona<sup>2</sup>, Luis M. Gómez-Miranda<sup>1</sup>, Alberto Jiménez-Maldonado<sup>1</sup>

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The brain-derived neurotrophic factor (BDNF) is a member of the neurotrophin family of growth factors. Several stimuli, such as physical exercise have the potential to increase BDNF production. Ambiguous findings regarding the exercise intensity that elicits changes in systemic BDNF levels have been reported in the literature.

**PURPOSE:** To determine the effects of short-term high intensity-interval training (HIIT) on systemic BDNF levels in healthy males. **METHODS:** Eleven healthy young males (Age =  $22.8 \pm 2.3$  yr.; body weight (BW) =  $77.8 \pm 11.9$  kg; height =  $173.4 \pm 5.2$  cm; BMI =  $25.8 \pm 3.3$  kg/m<sup>2</sup>) participated in the study. A graded maximal exercise test (GXT) was used to determine the maximal aerobic power (MAP) required to design the exercise intensities. The short-term HIIT protocol consisted of cycle ergometer exercise 3 times/week for 4-weeks. Paired t-test was used to compare anthropometrics and cardiovascular variables, MAP and systemic BDNF levels before and after short-term HIIT. **RESULTS:** Short-term HIIT did not change significantly the systemic BDNF levels (Pre-HIIT =  $18.8 \pm 1.6$  ng/mL vs. Post-HIIT =  $19.2 \pm 2.2$  ng/mL,  $p = 0.6495$ ). Similarly, the BW and BMI were not modify by HIIT. Contrary, the heart rate recovery was improved after the HIIT program (Pre-HIIT =  $159.5 \pm 11.9$  vs Post-

HIIT =  $148.1 \pm 13.6$ ,  $p = 0.04$ ). **CONCLUSION:** The short-term HIIT protocol used in this study was unable to elicit significant changes on systemic BDNF levels in healthy males. The physiological mechanisms explaining this finding are currently under scrutiny. On the other hand, the same protocol improved the heart rate recovery in healthy men. These data suggest different response of the Central Nerve System and Peripheral Nerve System to the same exercise modality.

3137 Board #6 June 2 8:00 AM - 9:30 AM

### Effects of High Intensity Interval Training on Anaerobic Performance & Aerobic Power on Male Basketball Players

Seyed reza Seyedi. Wuhan sport university, Wuhan, China.  
(No relevant relationships reported)

**PURPOSE:** High Intensity interval training (HIIT) has become an increasingly popular form of exercise due to its greater effects on exercise capacity and short time requirement. The purpose of this study was to compare two models of HIIT 15s and 30s training on anaerobic peak power, anaerobic average power, anaerobic power drop, time to peak power and aerobic power.

**METHODS:** Fourteen male basketball players (age:  $22.4 \pm 2.1$  years, weight:  $74.5 \pm 6.7$ kg and height:  $182 \pm 7.3$ cm) participated in the study. Participants were healthy and active players of a collegiate varsity team, who were randomly assigned to 15s HIIT group and 30s HIIT group. After baseline metabolic, anthropometric, and fitness measurements, both groups performed HIIT three times a week for a period of six weeks. The training of the 30s HIIT group consisted of a total of 18 sessions of 4 to 8 repeats of 30-second sprint cycling at 95% of heart rate with 1-minute active rest between each repetition on an electromagnetically controlled cycle ergometer. The 15s HIIT group trained using the same frequency of workouts per week with 4 to 8 repetition, and applied 15s sprint cycling at 95% of heart rate with 1-minute interval between each repetition on the electromagnetically controlled cycle ergometer. For both groups, before and after the six-week long training anaerobic performance was measured by means of 30 second Wingate cycling ergometer test and aerobic power was measured by means of cycling. Peak power, average power, time to peak, drop of power and aerobic power data were collected and analyzed. Independent t test and paired t test were employed to examine the differences ( $p < .05$ ) between groups, respectively.

**RESULTS:** The 15s HIIT group had significantly greater improvements on peak power ( $0.704 \pm 0.601$ ), and average power ( $0.748 \pm 0.347$ ) than the 30s HIIT group did on peak power ( $-0.260 \pm 1.06$ ), and average power ( $-0.395 \pm 0.831$ ). Meanwhile, the 30s HIIT group had significantly greater values on drop power ( $3.394 \pm 2.318$ ), time to peak ( $1.66 \pm 1.10$ ), and aerobic power ( $3.142 \pm 2.544$ ) than the 15s HIIT group did on drop power ( $-0.484 \pm 1.621$ ), time to peak ( $1.110 \pm 0.981$ ), and aerobic power ( $4.142 \pm 3.132$ ).

**CONCLUSIONS:** It is concluded that the 15s HIIT model may result in greater effects on anaerobic power (peak and average powers) and the 30s HIIT model may yield great aerobic power.

3138 Board #7 June 2 8:00 AM - 9:30 AM

### The Effects Of A Three-week Hiit Program On Physiological And Physical Performance Parameters

Linghao Kong<sup>1</sup>, Qingwei Jin<sup>2</sup>, Susan Sotir<sup>1</sup>, Vincent Paolone, FACSM<sup>1</sup>, Jeff Gagnon<sup>1</sup>, Samuel Headley, FACSM<sup>1</sup>.  
<sup>1</sup>Springfield College, Springfield, MA. <sup>2</sup>Tianjin University of Sports, Tianjin, China. (Sponsor: Samuel Headley, FACSM)  
(No relevant relationships reported)

High Intensity Interval Training (HIIT) has been demonstrated to have a positive effect on a number of physiological variables in several clinical populations. However, little work has been done on this topic in China. **PURPOSE:** To investigate the effects of a 3-week HIIT program on physiological and physical performance parameters (blood pressure, time to exhaustion, peak heart rate, lactate threshold, and  $O_{2peak}$ ) among three different Chinese groups. **METHODS:** Thirty males were categorized by current health status (blood pressure,  $O_{2peak}$ , and frequency of exercise per week): to healthy active group ( $n = 10$ ; age =  $21.9 \pm 2.8$ , height =  $176.5 \pm 4.8$ , weight =  $71.8 \pm 9.3$ , percentage of body fat =  $13.0 \pm 6.12$ ), healthy inactive group ( $n = 10$ ; age =  $20.9 \pm 1.85$ , height =  $172.8 \pm 4.4$ , weight =  $69.1 \pm 10.5$ , percentage of body fat =  $18.35 \pm 7.0$ ), or prehypertensive group ( $n = 10$ ; age =  $22.1 \pm 2.0$ , height =  $176.3 \pm 7.4$ , weight =  $71.8 \pm 12.8$ , percentage of body fat =  $20.47$ ). Baseline testing included body fat estimation, blood pressure measurement, and a  $O_{2peak}$  test conducted on a treadmill. Subjects completed a 3-week, 3 sessions per week intervention. Each session included a warm-up (5 min), 10 HIIT cycles (60 sec high intensity at 90%  $O_{2peak}$  and 60 sec active recovery at 45%  $O_{2peak}$  20 min), and a cool-down (5 min). Post intervention assessments repeated the baseline measures. Six 2 (Time) x 3 (Group) mixed factorial ANOVAs were performed to determine if differences existed in the dependent variables. **RESULTS:** No significant interaction was found for any dependent variables. Significant main effects were identified for systolic blood pressure ( $120.1 \pm 8.3$  to  $116.8 \pm 7.2$  mmHg,  $p < 0.001$ ) diastolic blood pressure ( $72.3 \pm 6.7$  to  $69.5 \pm 5.5$  mmHg,  $p < 0.001$ ), time to exhaustion ( $16.0 \pm 3.2$  to  $18.0 \pm 2.5$

min,  $p < 0.001$ ),  $O_{2peak}$  ( $42.2 \pm 6.8$  to  $45.5 \pm 6.2$  ml·kg<sup>-1</sup>·min<sup>-1</sup>,  $p < 0.001$ ), and lactate threshold ( $67.1 \pm 12.8$  to  $79.6 \pm 11.0$  %,  $p < 0.001$ ) over time. Systolic blood pressure and diastolic blood pressure decreased, time to exhaustion,  $O_{2peak}$ , and lactate threshold increased, regardless of groups. No significant main effect was found for peak heart rate ( $183.7 \pm 8.8$  vs.  $184.3 \pm 8.8$ ,  $p > 0.05$ ). **CONCLUSION:** A 3-week HIIT program lowered resting systolic and diastolic blood pressure, while increasing time to exhaustion, lactate threshold, and  $O_{2peak}$  for all three groups included.

3139 Board #8 June 2 8:00 AM - 9:30 AM  
**Acute Physiological Responses During Steady State and High Intensity Interval Training in Inactive Men**  
 Toni LaSala, Jordan L. Cola, Racine R. Emmons, Michael A. Figueroa, Francis Frabasile. *William Paterson University, Wayne, NJ.* (Sponsor: Gordon Schmidt, FACSM)  
 (No relevant relationships reported)

#### Abstract

High Intensity Interval Training (HIIT) has become an increasingly popular mode of exercise, especially with those with the perception of a lack of time. These intervals have been shown to decrease the time spent being active while simultaneously providing similar results to steady-state training to elicit the cardiovascular adaptations. **Purpose:** To investigate the changes between steady-state training and HIIT training on respiratory exchange ratio (RER), peak oxygen consumption ( $VO_{2peak}$ ), heart rate (HR) and rate of perceived exertion (RPE) in recreationally trained, college-aged participants. **Methods:** Thirteen men 21 to 27 years old ( $M = 23.31$ ,  $SD \pm .07$ ) were recruited for the study. Subjects participated two sessions and were randomly assigned to two groups: Steady-State (SS) or High Intensity Interval Training (HIIT) training on a treadmill. SS training consisted of a 3-minute warm-up at 2.0 mph with a 0% grade followed by the Balke Protocol. HIIT protocol consisting a 5-minute warm-up at 3 mph at 0% grade, followed by maximum effort sprints for 30 seconds followed by a 30 second active recovery with sprint intervals beginning at 4.5mph increasing by .5mph after recovery interval. **Results:** There was a significant difference in RER between groups ( $t(12) = 2.30$ ,  $p < .05$ ,  $d = .55$ ). However, no significant differences in  $VO_2$  ( $t(12) = -1.06$ ,  $p = .31$ ,  $d = .36$ ) and HR ( $t(12) = -.812$ ,  $p = .43$ ,  $d = .26$ ) were identified using a paired samples  $t$ -test, between treadmill conditions (SS, HIIT). Furthermore, there were no significant differences ( $z = -1.51$ ,  $p = .13$ ,  $r = .54$ ) in RPE after conducting a Wilcoxon matched pairs signed-rank test. The results suggest that training at higher intensities for a shorter period of time yielded similar results to training at lower intensities for a longer duration. **Conclusion:** HIIT training allows for increased cardiovascular health in a time efficient manner, which can accommodate various schedules.

3140 Board #9 June 2 8:00 AM - 9:30 AM  
**Testosterone and Cortisol Responses after Short-term High-intensity Interval Exercise Training in Healthy Humans**  
 Giorgos Paradisis, Anastassios Philippou, Popi Stavrinou, Gregory Bogdanis, Maria Maridaki. *National and Kapodistrian University of Athens, Athens, Greece.*  
 (No relevant relationships reported)

High intensity interval training (HIIT) has recently gained popularity as an effective stimulus for eliciting adaptations in various aspects of physical fitness. Those adaptations may also involve complex hormonal changes, however less is known about the hormonal responses to this type of exercise training. **Purpose:** This study investigated the changes in serum levels of the competitive (anabolic vs catabolic) hormones testosterone (TESTO) and cortisol (CORT) caused by a 3-week HIIT regimen in healthy humans. **Methods:** Eight physically active males (age:  $24.3 \pm 1.4$  y, body mass:  $77.9 \pm 2.9$  kg, height:  $179 \pm 1$  cm, body fat:  $9.7 \pm 1.3$ %) performed three HIIT sessions/week over 3 weeks. Each session included four to six 30-s bouts of high-intensity cycling separated by 4 min of recovery. Blood samples were withdrawn before and at 0.5, 24 and 48 hrs post-exercise. Serum levels of TESTO and CORT were measured by ELISA using commercially available kits. Two-way ANOVA was used for statistics. **Results:** Before training, acute exercise significantly elevated CORT levels by 120.5% ( $p < 0.05$ ) at 0.5 hrs post exercise ( $357.3 \pm 54.7$  ng/ml,  $137.4 \pm 16.8$  ng/ml and  $179.9 \pm 28.5$  ng/ml, at 0.5, 24 and 48 hrs after exercise, respectively, compared to  $194.9 \pm 29.0$  ng/ml at baseline; mean $\pm$ SE). Training reduced the CORT levels both at baseline ( $122.1$  ng/ml) and post exercise ( $231.9 \pm 35.0$  ng/ml,  $78.7 \pm 6.3$  ng/ml and  $78.7 \pm 8.2$  ng/ml, at 0.5, 24 and 48 hrs after exercise, respectively) compared to the pre-training levels ( $p < 0.05-0.01$ ); however post-training CORT levels remained significantly elevated at 0.5 hrs post exercise ( $p < 0.01$ ). Circulating levels of TESTO did not change significantly over time, neither before nor after the 3-week HIIT regimen ( $p > 0.05$ ). Interestingly, however, after training the TESTO/CORT ratio increased at 48 hrs post exercise ( $p < 0.05$ ) and was significantly higher at 24 and 48 hrs post exercise compared to the corresponding pre-training time points ( $65.0\%$  vs  $35.9\%$  and  $85.3\%$  vs  $67.1\%$ , at 24 and 48 hrs, respectively;  $p < 0.05$ ). **Conclusion:** Our findings suggest that HIIT triggers beneficial responses of CORT and TESTO/

CORT ratio, which may reflect a specific drive towards anti-catabolic and/or regulatory adaptations to exercise-induced stress. More studies are needed to further characterize the hormonal responses to HIIT in humans.

3141 Board #10 June 2 8:00 AM - 9:30 AM  
**Physiological Effects of Increasing Battling Rope Weight During 6 weeks of High Intensity Interval Training**  
 Derek PD Bornath, Kevin J. Milne, Kenji A. Kenno. *University of Windsor, Windsor, ON, Canada.*  
 (No relevant relationships reported)

Acute battling rope (BR) high intensity interval training (HIIT) increases oxygen consumption, and 4 weeks of BR HIIT has reported significant increases in female upper body maximal oxygen consumption (MVO<sub>2</sub>), and skeletal muscle endurance. **Purpose:** To determine if increasing BR weight during 6 wks of HIIT increases upper body MVO<sub>2</sub> and upper body skeletal muscle strength, endurance and power. **Methods:** 18 recreationally active men and 15 women ( $23 \pm 2$  y) performed 10 BR HIIT sets, 30s work: 60s rest, 3x/week, for 6 wks. For the first 3 weeks, women used 40 ft, 1.5", 20lb BR and men used 50 ft, 1.5", 25lb BR, after which BR weight was increased by 10lb using a heavier rope for another 3 wks in both groups. Upper body MVO<sub>2</sub> (arm ergometer) and skeletal muscle performance (isometric shoulder [shld] flexion/extension, dynamic shoulder power, maximum sit-ups and push-ups) was assessed at baseline, and after 3 and 6 wks. **Results:** During BR HIIT male and female heart rates were  $>85\%$  of predicted maximums, and peak HIIT blood lactates (BLA) reached 10.79 and 8.33 mmol/L, respectively. See table below for MVO<sub>2</sub> and skeletal muscle performance adaptations after 3 and 6 wks of BR HIIT.

		baseline	3 wks	6 wks
upper body MVO <sub>2</sub> (ml/kg/min)	male	36.5 $\pm$ 5	39.9 $\pm$ 7 <sup>a</sup>	43.9 $\pm$ 7 <sup>bc</sup>
	fe-male	31.5 $\pm$ 5	34.3 $\pm$ 5 <sup>a</sup>	38.8 $\pm$ 5 <sup>bc</sup>
isometric shld flexion (lb)	male	93 $\pm$ 18	96 $\pm$ 16 <sup>a</sup>	99 $\pm$ 18 <sup>bc</sup>
	fe-male	45 $\pm$ 9	50 $\pm$ 9 <sup>a</sup>	53 $\pm$ 10 <sup>bc</sup>
isometric shld extension (lb)	male	47.1 $\pm$ 7	48.8 $\pm$ 7	49.6 $\pm$ 6 <sup>c</sup>
	fe-male	23.2 $\pm$ 5	25.4 $\pm$ 4 <sup>a</sup>	25.3 $\pm$ 4.7 <sup>c</sup>
dynamic shld power (N)	male	3904 $\pm$ 528	4274 $\pm$ 523 <sup>a</sup>	4597 $\pm$ 536
	fe-male	2883 $\pm$ 372	3264 $\pm$ 465 <sup>a</sup>	3425 $\pm$ 451 <sup>bc</sup>
situps (#)	male	44.9 $\pm$ 15	50.4 $\pm$ 15 <sup>a</sup>	55 $\pm$ 15 <sup>bc</sup>
	fe-male	43.7 $\pm$ 17	50.3 $\pm$ 20 <sup>a</sup>	55.7 $\pm$ 24 <sup>bc</sup>
pushups (#)	male	41.6 $\pm$ 17	45.9 $\pm$ 16 <sup>a</sup>	48.8 $\pm$ 18 <sup>bc</sup>
	fe-male	27.4 $\pm$ 9	32.3 $\pm$ 10 <sup>a</sup>	37.1 $\pm$ 11 <sup>bc</sup>

a=baseline vs. 3 wks  $p < .05$ , b=3 vs 6 wk  $p < .05$ , c=baseline vs 6 wks  $p < .05$

**CONCLUSION:** 3 wks of BR HIIT can significantly increase upper body MVO<sub>2</sub> and skeletal muscle strength, endurance and power in male and female university students. Increasing BR weight plus 3 more wks of BR HIIT produced additional significant improvements in MVO<sub>2</sub> and skeletal muscle performance, suggesting progressive overload training principles can be applied to BR training.

3142 Board #11 June 2 8:00 AM - 9:30 AM  
**Hormonal Responses after Short-term High-intensity Interval Exercise Training in Healthy Humans**  
 Maria Maridaki<sup>1</sup>, Roxane Tenta<sup>2</sup>, Popi Stavrinou<sup>1</sup>, Gregory Bogdanis<sup>1</sup>, Anastassios Philippou<sup>1</sup>. <sup>1</sup>*National and Kapodistrian University of Athens, Athens, Greece.* <sup>2</sup>*School of Health Science and Education, Harokopio University, Greece, Athens, Greece.*  
 (No relevant relationships reported)

High intensity interval training (HIIT) elicits multiple physiological adaptations which may involve complex hormonal changes, as HIIT is characterized by high physiological demands and stress, and might disturb the levels of hormones associated with energy expenditure and exercise-induced stress. **Purpose:** This study investigated the changes in serum levels of thyrotropin (TSH), free thyroxine (fT4) and prolactin (PRL) caused by a 3-week HIIT regimen in healthy humans. **Methods:** Eight physically active males (age:  $24.3 \pm 1.4$  yrs, body mass:  $77.9 \pm 2.9$  kg, height:  $179 \pm 1$  cm, body fat:  $9.7 \pm 1.3\%$ ) performed three HIIT sessions/week over 3 weeks. Each session included four to six 30-s bouts of high-intensity cycling separated by 4 min of recovery. Blood samples were withdrawn before and at 0.5,

24 and 48 hrs post-exercise. Serum levels of TSH, fT4 and PRL were measured by ELISA using commercially available kits. Two-way ANOVA was used for statistics and data are presented as mean±SE. RESULTS: TSH levels peaked at 0.5 hr post exercise, both before (3.41±0.44, 4.85±1.54, 3.14±0.283, and 2.91±0.31 µIU/ml, at baseline, 0.5, 24 and 48 hrs post-exercise, respectively) and after the 3-week HIIT regimen (2.55±0.34, 4.14±0.70, 2.44±0.22, and 2.37±0.49 µIU/ml, at baseline, 0.5, 24 and 48 hrs post-exercise, respectively). FT4 levels peaked 24 hrs post exercise, both before (2.66±0.17, 2.71±0.09, 2.99±0.22, and 2.61±0.04 ng/dl, at baseline, 0.5, 24 and 48 hrs post-exercise, respectively) and after the 3-week HIIT regimen (2.70±0.17, 2.90±0.17, 3.16±0.12, and 2.77±0.07 ng/dl, at baseline, 0.5, 24 and 48 hrs post-exercise, respectively). PRL levels peaked at 0.5 hrs post exercise, both before (38.80±9.90, 66.0±16.32, 27.86±4.40, and 20.14±7.90 ng/ml, at baseline, 0.5, 24 and 48 hrs post-exercise, respectively) and after the 3-week HIIT regimen (25.32±4.81, 55.0±9.39, 24.03±2.50, and 20.76±4.76 ng/ml, at baseline, 0.5, 24 and 48 hrs post-exercise, respectively), reaching statistical significance compared to baseline only after the 3-week regimen ( $p < 0.01$ ). CONCLUSION: Our findings suggest that HIIT triggers mild acute hormonal changes, particularly of PRL, which may reflect regulatory responses to exercise-induced stress; however more studies are needed to further characterize the hormonal responses to HIIT in humans.

**3143 Board #12 June 2 8:00 AM - 9:30 AM**  
**The Physical and Psychological Effects of Tactical High-Intensity and Jiu-Jitsu Training on Law Enforcement Officers**

Charlie Shervheim, Nick Powell, Maxwell Rasmussen, Jennifer Dysterheft. *Hamline University, St. Paul, MN.* (Sponsor: Robert Pettitt, FACSM)  
*(No relevant relationships reported)*

Law enforcement officers (LEO) require speed, strength, agility, and endurance for their job; however, the training requirements for many LEO departments are minimal. Tactical-specific high-intensity interval training (TS-HIIT) and jiu-jitsu martial arts practices are theoretically effective in improving performance in tactical fields, however no research exists this. **Purpose:** To examine whether TS-HIIT and jiu-jitsu training is more effective than current training practices to improve physical and psychological variables of experienced LEO. **Methods:** 10 experienced LEO were recruited from local departments. Baseline testing included the Perceived Stress Scale (PSS), WHO Quality of Life (WQ), General Self-Efficacy Scale (GSES), and skills-test. The skills-test examined upper-body maneuverability, heavy-object manipulation, lower-body power output, shooting accuracy, ground grappling/gun retention, memory recall, and decision-making. LEO then completed a six-week TS-HIIT and jiu-jitsu program for three hours per week. LEO repeated baseline measures after completion and will again at three months post-completion. **Results:** Despite previous experience, 65% of LEO failed baseline tests. Preliminary t-test analysis revealed significant improvements in grappling technique, timing, and score ( $p = 0.02$ ) as well as time to complete the skills-test ( $M = -6.65$  s;  $p = 0.01$ ) post-intervention. Improvements on the grappling test were noted by less time gain control of the situation, prolonged time to failure, or improving from failed baseline tests to passing post-intervention. Two of the 10 LEO did not improve on the grappling test. LEO recalled 30% more phrases during the memory retention test post-intervention ( $p = 0.01$ ). Post-intervention, there was no significant change in shooting accuracy ( $p = 0.37$ ), perceived stress levels, (PSS;  $p = 0.58$ ), or perceived quality of life (WQ;  $p = 0.30$ ). The decision-making task was removed due to a number of participants having already viewed the specific scenarios used during data collection. **Conclusion:** Preliminarily, results indicate that a TS-HIIT and jiu-jitsu program may be critical for improving LEO fitness levels, memory retention, and gun retention skills. Three-month follow-up testing will be completed January 2018 to examine skill retention.

**G-35 Free Communication/Poster - Running**

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
 Room: CC-Hall B

**3144 Board #13 June 2 8:00 AM - 9:30 AM**  
**Longitudinal Comparison Of Polarized Vs. High Intensity Multimodal Training In Recreational Runners**

Andrew Carnes. *Bellarmine University, Louisville, KY.* (Sponsor: Sara E. Mahoney, FACSM)  
*(No relevant relationships reported)*

Empirical endurance training studies support a polarized distribution, i.e., a high volume of low intensity training combined with less at high intensity. Few studies include recreational runners, who typically train with low volume. CrossFit Endurance® (CFE) targets these runners, emphasizing low volume, high intensity

intervals and multimodal circuit training. Anecdotally, CFE enhances performance to a similar extent as higher volume run training, but empirical data have not been available.

**PURPOSE**  
 Longitudinally compare changes in performance and fitness after 12 weeks of CrossFit Endurance® or polarized training in recreational runners.

**METHODS**  
 Twenty-one ( $N=21$ ) participants completed 12 weeks of CrossFit Endurance (CFE),  $n=12$ , or polarized endurance training (PET),  $n=9$ . Both groups trained 5 d · wk<sup>-1</sup>. PET ran 5 d · wk<sup>-1</sup> while CFE ran 3 d · wk<sup>-1</sup> and performed CrossFit 3 d · wk<sup>-1</sup> (run + CF 1 d · wk<sup>-1</sup>). Duration, intensity, and distance were recorded via GPS and HR monitoring. Intensity was classified as low, moderate, or high (Zone 1, 2, or 3) according to ventilatory thresholds. PET was prescribed greater volume (295 ± 67 min · wk<sup>-1</sup>), predominantly in Z1 (86/14% in Z1≥Z2). CFE emphasized lower volume (110 ± 18 min · wk<sup>-1</sup>) Z3 running (48/52% Z1≥Z2). Performance (5-km TT) was assessed at baseline (BL) and at 6 (MID) and 12 weeks (POST). VO<sub>2</sub> max and body composition (BC) were assessed at BL and POST.

**RESULTS**  
 Two-way ANOVA showed a significant main effect of time on TT ( $F = 40.1, p < .001, \eta_p^2 = 0.74$ ), VO<sub>2</sub> max ( $F = 24.0, p < .001, \eta_p^2 = 0.56$ ), and BC ( $F = 20.2, p < .001, \eta_p^2 = 0.51$ ), and a significant group\*time interaction on VO<sub>2</sub> max ( $F = 4.13, p = .05, \eta_p^2 = .18$ ). Both groups ( $p \leq .001$ ) improved TT from BL-POST (-88 ± 55 s), BL-MID (-57 ± 40 s), and MID-POST (-31 ± 37 s). VO<sub>2</sub> max (46.2 ± 6.8 to 49.1 ± 7.4 ml · kg<sup>-1</sup> · min<sup>-1</sup>) and BC (15.5 ± 6.7 to 13.0 ± 6.9 %BF) improved BL - POST ( $p < .001$  for both). However, the VO<sub>2</sub> max increase was larger in PET (4.3 ± 3.6 vs. 1.78 ± 1.9 ml · kg<sup>-1</sup> · min<sup>-1</sup>). No interaction occurred for TT ( $F = 0.23, p = .79$ ) or BC ( $F = 0.02, p = .88$ ).

**CONCLUSION**  
 Recreational runners achieved similar improvement in 5-km performance and body composition through polarized training or CFE, but PET yielded a greater increase in VO<sub>2</sub> max. Both programs appear efficacious for recreational athletes. Extrapolation to longer distances requires additional research.

**3145 Board #14 June 2 8:00 AM - 9:30 AM**  
**Optimal Inspiratory Muscle Training Dose(s) to Enhance Respiratory Function Characteristics and Running Performance**

Kyle R. Barnes, Sara M. Dansforth, Katie G. Smyth. *Grand Valley State University, Allendale, MI.* (Sponsor: Stephen Glass, FACSM)  
*(No relevant relationships reported)*

**PURPOSE** Inspiratory muscle training (IMT) is a form of resistance training for the muscles primarily involved in the processes of breathing using a resisted breathing trainer. However, the optimal IMT loading parameters to elicit specific physiological adaptations are unknown. The authors adopted a dose-response design to determine the IMT load most effective for enhancing various inspiratory muscle function characteristics and performance. **METHODS:** 29 trained runners performed a 1-mile (1609-m) time trial and a series of breathing tests using an inspiratory breathing trainer and software. Runners were then randomly assigned to 1 of 5, six week IMT programs ranging in resistance from 30-70% of peak strength index (S<sub>IND</sub>) in 10% increments. Maximal and submaximal inspiratory breathing tests were repeated each week and 1-mile performance was repeated after six weeks. To identify the optimal IMT group (resistance) for each measure, each runner's percentage change was modeled as a quadratic function of the rank order of the intensity of IMT. Uncertainty in the optimal IMT and in the corresponding effect on the given measure was estimated as 90% confidence limits (CL) using bootstrapping. **RESULTS:** There was a clear optimum for performance at Group 3.2 (52% of S<sub>IND</sub>) with a possibly beneficial effect of 3.2% (CL = 2.8-3.5%). There was a strong trend toward Groups 2 to 3 (40-50% of S<sub>IND</sub>) having the optimal IMT resistance to improve S<sub>IND</sub> (mean improvement of 36.5%, CL = 29.2-45.7%), peak inspiratory flow (19.5%, 13.3-24.4%), training load (37.8%, 27.4-46.3%), flow (40.3%, 28.6-54.1%), power (52.3%, 43.5-65.1%), and energy (45.6%, 29.4-60.9%) with very-likely beneficial effects on all measures. Improvements in inspiratory volume (15.3%, 10.7-17.4%) were optimal at Group 4.0 (60% S<sub>IND</sub>). Correlations between changes in performance and changes in inspiratory muscle function characteristics were trivial-small. IMT training at 2-wk was unlikely or possibly beneficial with the magnitude of effects trivial-small. At 4- and 6-wk, effects were greater and more beneficial than the previous 2-wk with no visual plateau in improvements. **CONCLUSION:** IMT between 40-50% of S<sub>IND</sub> appears to be optimal for most inspiratory muscle characteristics, while IMT at slightly higher resistances (~52% S<sub>IND</sub>) is optimal for 1-mile performance.

3146 Board #15 June 2 8:00 AM - 9:30 AM  
**Feasibility of Predicting Bone Mineral Density in Distance Runners with an Artificial Neural Network**  
 Alec C. Miller, Kevin S. Ryan, Toni D. Uhrich, Kristof Kipp.  
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*(No relevant relationships reported)*

Bone mineral density (BMD) is used to assess the risk of stress fractures in distance runners. Given that the standard assessment of BMD with Dual X-ray Absorptiometry (DXA) is very expensive, a possible solution would be to establish models that can predict BMD from data that is easier and cheaper to acquire. Artificial Neural Networks (ANN) are able to model non-linear and complex associations between biomechanical and physiological variables, and could pose a solution to the aforementioned problem. **PURPOSE:** Determine the feasibility of predicting BMD in distance runners with an ANN. **METHODS:** BMD of the femoral neck was assessed in twenty-three collegiate distance runners (16 male) using DXA. They also ran on an instrumented treadmill at their long-slow distance pace. Ground reaction forces (GRF) were collected and Rate of Loading (RoL) was derived. Average peak values were calculated for the right and left leg, and were pooled for all analyses. Simple and multiple linear regression models were used to assess associations between input (body mass, GRF, RoL) and output variables (BMD). In addition, a three-layer feedforward ANN with 20 hidden neurons was trained fifteen separate times to also model the same associations. The prediction ability of all models was compared based on their associated correlation coefficients. Further, the root mean squared error (RMSE) of the multilinear regression model and ANN were also compared. **RESULTS:** Significant simple linear correlations were found between BMD and body mass ( $r = 0.645$ ,  $p = 0.008$ ), BMD and GRF ( $r = 0.534$ ,  $p = 0.038$ ), and BMD and RoL ( $r = 0.567$ ,  $p = 0.025$ ). In addition, the multiple linear regression model (adjusted  $r = 0.630$ ,  $p = 0.001$ , RMSE = 0.161) and ANN (training  $r = 0.865$ ,  $p = 0.001$ ; test  $r = 0.697$ ,  $p = 0.003$ ; RMSE = 0.161) were also able to fit predict the association between input and output variables. **CONCLUSIONS:** An ANN can feasibly predict BMD in distance runners, and is able to do so better than standard regression models. While the developed ANN performed well with the inputs of body mass, GRF, and RoL, there are other variables (e.g., stride parameters or caloric balance) that should be included in future studies, as they are easier to assess and would provide a more holistic model of known risk factors for stress fractures in distance runners.

3147 Board #16 June 2 8:00 AM - 9:30 AM  
**The Effect of Physiological Performance Variables on 3000m Times in Collegiate Mid-Distance and Distance Runners**  
 Matthew Miltenberger, Alexander Zubko, Shala Davis, FACSM, Chad Witmer. *East Stroudsburg University, East Stroudsburg, PA.* (Sponsor: Dr. Shala Davis, FACSM)  
*(No relevant relationships reported)*

Collegiate mid-distance (MD) runners and distance (D) runners compete in the 3000m. Previous research has identified  $\text{VO}_2\text{max}$ , velocity at lactate threshold (vLT),  $\% \text{VO}_2\text{max}$  at lactate threshold, and running economy (RE) to correlate with 3000m performance. Research is lacking on if differences in these variables, and pacing strategy, affects 3000m performance between groups. **PURPOSE:** To identify how physiological performance variables relate to 3000m time, and if differences in these variables, and pacing strategies, occurs between groups. **METHODS:** 11 male NCAA Division II runners (5 MD, 6 D) were used. Subjects completed a 3000m time trial on a synthetic 200m indoor track, where 3000m time and split times were recorded using a single-beam timing gate. A discontinuous 3-minute stage lactate threshold protocol was used to measure vLT, lactate threshold (LT), and running economy at 14.5km/h, 16km/h, and 17.5 km/h ( $\text{RE}_{14.5}$ ,  $\text{RE}_{16}$ ,  $\text{RE}_{17.5}$ ). A modified Astrand  $\text{VO}_2\text{max}$  test was used to assess  $\text{VO}_2\text{max}$ , with the speed set at 16.1km/h and grade increasing 2% every two minutes. **RESULTS:**  $\text{VO}_2\text{max}$  ( $r = -.629$ ),  $\text{RE}_{14.5}$  ( $r = .632$ ),  $\text{RE}_{16}$  ( $r = .756$ ),  $\% \text{VO}_2\text{max}$  at LT ( $r = 0.675$ ), 600-1200m time ( $r = .784$ ), 1200-1800m time ( $r = .962$ ), and 1800-2400m time ( $r = .719$ ) significantly correlated to 3000m time ( $p < 0.05$ ), when merging subjects. In the D group,  $\% \text{VO}_2\text{max}$  at LT ( $r = .875$ ),  $\text{RE}_{16}$  ( $r = .853$ ), 600-1200m time ( $r = .882$ ), and 1200-1800m time ( $r = .965$ ) significantly correlated to 3000m time ( $p < 0.05$ ). In the MD group, 1200-1800m time ( $r = .932$ ) significantly correlated to 3000m time ( $p < 0.05$ ), and  $\text{VO}_2\text{max}$  had a trend towards significance with 3000m time ( $r = -.829$ ,  $p = .083$ ). Statistically different mean differences in  $\text{VO}_2\text{max}$  (D =  $67.00 \pm 2.64$  vs MD =  $63.56 \pm 1.52$  ml/kg/min), and vLT (D =  $15.10 \pm 0.19$  vs MD =  $14.33 \pm 0.35$  km/h) was observed between groups ( $p < 0.05$ ). A graphical difference in pacing strategy was observed between groups. **CONCLUSION:** 1200-1800m time is the most important split time for 3000m performance.  $\text{VO}_2\text{max}$  was the best physiological performance indicator in MD runners, and  $\text{RE}_{16}$  was the best physiological performance indicator in D runners. Runners should be trained differently according to their training status, to improve 3000m performance.

3148 Board #17 June 2 8:00 AM - 9:30 AM  
**Long Ground Contact Time Enhances Running Economy at High-Intensity Running**  
 Fumiya TANJI, Hayato OHNUMA, Ryosuke ANDO, Tatsuaki IKEDA, Yasuhiro SUZUKI. *Japan Institute of Sport Sciences, Tokyo, Japan.*  
*(No relevant relationships reported)*

Running economy (RE) determines the difference in distance running performance in highly-trained runners. Studies have highlighted RE importance during high-intensity running. Although RE is related to ground contact time (Tc), the relationship between RE at high-intensity running and Tc is not elucidated. It is also unclear whether the hamstrings muscle, which contribute to high-intensity running, affect RE and Tc. **PURPOSE:** We aimed to clarify the relationships among RE, Tc at intensity below and above the lactate threshold (LT) run, and hamstring muscle's cross-sectional area in highly-trained long-distance runners. **METHODS:** We enrolled 11 highly trained male distance runners (IAAF score:  $1038 \pm 48$ ). They underwent treadmill running test to assess the LT, and RE. RE was evaluated at 270 (RE270) and 360 m/min (RE360) as the intensity below and above the LT, respectively. Tc was also evaluated at the same velocity (Tc270; Tc360). Both medial and lateral hamstring muscles' cross-sectional areas (MHA and LHA, respectively) were calculated using MRI at 50% position of the right thigh. **RESULTS:** The subjects' LT, RE270 and RE360 were  $337 \pm 17$  m/min,  $0.90 \pm 0.08$  kcal/kg/km, and  $1.00 \pm 0.07$  kcal/kg/km, respectively. The Tc270, Tc360, MHA and LHA values were  $195 \pm 17$  ms,  $164 \pm 9$  ms,  $1.24 \pm 0.18$  cm<sup>2</sup>/kg<sup>0.67</sup>, and  $0.99 \pm 0.11$  cm<sup>2</sup>/kg<sup>0.67</sup>, respectively. RE270 showed a significant relationship with Tc270, MHA, and LHA ( $r = -0.81$ ,  $0.75$ , and  $0.60$ , respectively;  $P < 0.05$ ), but no relationship was noted with IAAF score ( $r = -0.55$ ;  $P = 0.08$ ). Tc270 was related to MHA and LHA ( $r = -0.63$  and  $-0.67$ ;  $P < 0.05$ ). Although RE360 showed a significant relationship with IAAF score, Tc360, and MHA ( $r = -0.73$ ,  $-0.65$ , and  $0.69$ , respectively;  $P < 0.05$ ), no relationship was noted with LHA ( $r = 0.35$ ;  $P = 0.30$ ). Tc360 did not exhibit any significant relationship with MHA ( $r = -0.55$ ;  $P = 0.08$ ) and LHA ( $r = -0.52$ ;  $P = 0.10$ ). **CONCLUSION:** The findings of this study are as follows: (a) RE at high rather than low intensity is related to running performance; (b) longer Tc enhances RE; (c) superior RE and long Tc at low intensity are related to small hamstring muscles, but these associations disappear, except between RE and MHA, at high intensity. These results suggest that long Tc at high-intensity contributes to superior RE, but not to hamstring muscles, and leads to higher running performance.

3149 Board #18 June 2 8:00 AM - 9:30 AM  
**Relationship Between Running Economy and Achilles Tendon Length.**  
 Jacquelyn Crow, Eric Sobolewski, Randolph Hutchison, Scott Murr. *Furman University, Greenville, SC.* (Sponsor: Tony CATERISANO, FACSM)  
*(No relevant relationships reported)*

Longer tendon length has been shown to be related to better running economy because longer tendons can store more energy to produce more force during concentric contraction. Running economy is traditionally defined as having a lower  $\text{VO}_2$  at the same submaximal speed. However, studies have not tested if this relationship also occurs in male and female elite distance runners at faster speeds. **PURPOSE:** To determine if Achilles tendon length influences running economy. **METHODS:** The researchers used ultra sound technology to measure the right Achilles Tendon length of twenty-two varsity collegiate runners (20.09  $\pm$  1.63 yrs), 12 males (178.44  $\pm$  6.74 cm, 65.21  $\pm$  6.62 kg) and 10 females (167.22  $\pm$  7.73 cm, 54.45  $\pm$  4.80 kg). After the researchers measured Achilles Tendon length, participant completed a  $\text{VO}_2$  max test and running economy was determined by assessing  $\text{VO}_2$  at submaximal speeds. The men ran at speeds of 10.0, 10.4 and 10.8 mph, and the females ran at speeds of 8.4, 8.8, and 9.2 mph. The relationship between tendon length and running economy was assessed using Pearson correlation coefficients. **RESULTS:** For collegiate male runners, there was a significant negative relationship between Achilles Tendon length and running economy ( $r = -0.76$  -  $-0.71$ ,  $p \leq .01$ ). When tendon length was normalized to height (tendon length/height) the relationship between tendon length and running economy was no longer significant ( $r = -0.32$  -  $-0.24$ ,  $p = 0.32$ - $0.45$ ). For collegiate female runners, there was no significant relationship between Achilles Tendon length and running economy alone ( $r = 0.24$ - $0.39$ ,  $p = 0.06$ - $0.51$ ) or when normalizing to height ( $r = 0.35$ - $0.44$ ,  $p = 0.23$ - $0.40$ ). **CONCLUSION:** These findings indicate that longer Achilles Tendons in collegiate male runners are related to improved running economy. In collegiate female runners, tendon length is not significantly associated with running economy. However, there was a negative correlation between Achilles Tendon length and running economy for the males and a positive correlation for the females indicating that longer tendon length might be more beneficial for male runners and shorter tendon might be slightly more economical for females. Other factors besides tendon length attribute to running economy, but this study indicates that for male's tendon length plays a role in running economy.

3150 Board #19 June 2 8:00 AM - 9:30 AM  
**Impact of Wearing Compression Pants on HR, RPE, Lactic Acid During a Submaximal Run**  
 Jacob Whitmore, Mike Ryan, Shinichi Asano, Paul Reneau.  
*Fairmont State University, Fairmont, WV.*  
*(No relevant relationships reported)*

Compression pants, waist to ankle, have grown in popularity among recreational and athletic populations for improving performance, however, minimal is known about the effects of compression pants on submaximal exercise. **PURPOSE:** The purpose of this study was to investigate the impact of wearing compression pants on physiological responses to a 12 min run. **METHODS:** College aged males (n=8) participated in three separate running sessions. Subjects initially performed a graded exercise test to anchor the RPE scale. Thereafter subjects were assigned to run on a treadmill at a set speed of 8 mph for 12 minutes either while wearing or not wearing compression pants, order of tests was randomized. Lactic acid, HR, and RPE were recorded every 3 minutes during the test, and every 3 minutes after the test for 6 minutes. Subjects were instructed to wear the pants for no longer than 30 minutes prior to the running tests. Dependent T-tests were performed on LA, HR, and RPE at each 3 min measurement of the test and recovery, with an alpha set at p<.05. **RESULTS:** Lactic acid levels were significantly lower (p<.05) with compression pants on at the 12 and 18 minute marks. RPE was significantly higher (p<.05) with the compression pants on at the 3 and 6 minute marks. No other significant differences (p>.05) were found in RPE and no significant differences (p>.05) were found in HR.

Test	With/Without Compression	3 min	6 min	9 min	12 min	15 min	18 min
LA (mmol/l)	With Compression	9.78 (5.95)	8.04 (2.10)	9.15 (4.55)	8.85* (4.24)	9.28 (5.85)	5.3* (2.05)
	Without Compression	11.18 (6.56)	9.45 (4.94)	10.65 (6.0)	12.25* (4.12)	11.74 (6.25)	9.25* (3.06)
HR (bpm)	With Compression	135 (18.85)	150 (22.93)	160 (19.83)	162.5 (21.37)	112 (9.8)	106 (15.3)
	Without Compression	138.5 (17.1)	146 (21.17)	162 (16.42)	168 (18.27)	121.6 (20.65)	110.5 (11.7)
RPE	With Compression	10.63* (1.4)	11.88* (1.73)	12.5 (2.14)	13.88 (1.73)	9.38 (1.69)	8.25 (0.89)
	Without Compression	9.5* (1.93)	10.88* (1.96)	12.25 (1.83)	13.38 (2.26)	9.86 (1.64)	8.75 (1.16)

(\*p<.05)  
**CONCLUSION:** Wearing compression pants was shown to lower your lactic acid levels at the 12 min point and 6 min after completion of submaximal exercise. RPE was shown to be higher initially but then the differences became non-significant. Compression pants were shown to not make any significant changes in HR.

3151 Board #20 June 2 8:00 AM - 9:30 AM  
**Modeling Critical Speed and D' in Elite Track & Field Athletes**  
 Timothy J. Fulton, Robert F. Chapman, FACSM. *Indiana University, Bloomington, IN.*  
*(No relevant relationships reported)*

**PURPOSE:** 1) To determine if there are sex differences in critical speed (CS) and D' , 2) to develop a model to predict CS, and 3) to determine the percent of CS various races are run at in elite track and field athletes. **METHODS:** Inclusion criteria were athletes with personal best times in each of the 1500m, 3000m, and 5000m events faster than 4:10, 8:55, and 15:20 (women) or 3:38, 7:45, and 13:30 (men) since January 1, 1997. CS and for each athlete were calculated using the linear method [D = CS \* t + D', where D is the distance ran and t is the time it took (in seconds) to cover that distance]. A second data set was compiled which included all those who met the above criteria and had a 10,000m time faster than 32:15 (women) or 28:00 (men). **RESULTS:** 115 women and 127 men met the initial inclusion criteria. A subset of athletes, 51 women and 48 men, also met the 10000m inclusion criteria. The average Pearson correlation coefficient for the regression line used to calculate CS and D' was > 0.9999. As expected, men had a significantly faster CS (m/s) than women (6.10 ± 0.13 vs. 5.39 ± 0.13; p < 0.001), however D' (m) was not significantly different (204.0 ± 35.8 vs. 197.5 ± 39.6; p = 0.18). For both men and women, 5000m time was the best predictor of CS. The men's prediction model was CS = -0.0105 \* 5000m time (s) + 14.347 (R<sup>2</sup> = 0.9522; p < 0.001) and the women's was CS = -0.00761 \* 5000m time (s) + 142.180 (R<sup>2</sup> = 0.9313; p < 0.001). 1500m race pace was 112.8 ± 2.8% (women) and 113.2 ± 2.8% (men) of CS. 3000m race pace was 106.7 ± 1.5% (women) and 107.1 ± 1.7% (men) of CS. 5000m race pace was 103.6 ± 0.7% (women) and 103.7 ± 0.7% (men) of CS. 10000m race pace was 98.7 ± 1.5% (women) and 98.6 ± 1.5% (men) of CS. There were no significant differences between men's and women's race pace as a percent of CS for any race distance (p = 0.24 - 0.55).

**CONCLUSIONS:** As CS represents the greatest wholly oxidative metabolic rate, men's faster CS is likely due to their known ability for greater oxygen delivery and consumption compared to women. The lack of difference in D' may be due to similar phosphocreatine stores (per kg dry muscle mass) between sexes. Additionally, coaches and athletes that want to know CS for training design or race pacing applications may be able to utilize the prediction equations if data on a full range of performances is not available.

3152 Board #21 June 2 8:00 AM - 9:30 AM  
**Heart Rate Variability in middle-aged Sprinters and Endurance Runners**  
 Lysleine Alves de Deus, Thiago dos Santos Rosa, Caio Victor de Sousa, Samuel da Silva Aguiar, José Morais Souto Filho, Patrick Anderson dos Santos, Lucas Duarte Barbosa, Herbert Gustavo Simões. *Universidade Católica de Brasília, Brasília, Brazil.*  
*(No relevant relationships reported)*

Aging is associated with decreased autonomic balance which could be assessed by Heart Rate Variability (HRV). Exercise training improves autonomic balance, but there is a lack in the literature regarding the HRV profile of middle-aged sprinters and endurance runners. **PURPOSE:** The effects of lifelong endurance and sprint training on cardiac autonomic balance were assessed in middle-aged master athletes, and compared with age-matched controls and young untrained individuals. **METHODS:** Participants (n=81) were 8 master sprinters (MS; 51.75±11.08yrs), 8 endurance runners (EN, n=8, 51.14±5.36yrs), 17 age-matched untrained (CON, 47.47±6.00yrs) and 48 young controls (YC, 25.40±3.87 yrs). For the acquisition of RR intervals (iRR) (Polar RS800X Heart Rate Monitor®) the participants remained seated for 15-min, with the final 10-min being considered for analysis. HRV was measured using Kubios software. A two-way ANOVA with repeated measures was applied. **RESULTS:** All studied parameters did not differ between MS and EN {Time Domain [HR (bpm) 59.00±6.13 vs. 58.94±12.75], [R-R (ms) 1030.45±107.45 vs. 1068.77±206.17], [SDNN (ms) 57.35±20.07 vs. 80.66±71.07], [RMSSD (ms) 40.88±20.07 vs. 38.93±20.44]; Non-linear domain [SD1 (ms) 28.93±14.20 vs. 27.56±14.46]}, whose demonstrated a reduced HR and elevated mean R-R intervals in comparison to both YC [(HR (bpm) 69.64±9.81) and (R-R 883.93±124.11)] and age-matched individuals [(HR (bpm) 70.06±6.63) and (R-R (ms) 865.11±78.39)]. It was observed a lower HRV for middle-aged CON {[RMSSD (ms) 20.23±5.87], [SDNN (ms) 37.79±10.15] and [SD1 (ms) 14.31±4.15]} compared to YC {[RMSSD (ms) 43.33±26.41], [SDNN (ms) 67.07±28.77] and [SD1 (ms) 30.66±18.69; p<0.05]}. These last age-related changes were not observed for MS and EN. **CONCLUSION:** For the master athlete, regardless of being endurance runner or a sprinter, both training modes are similarly beneficial, attenuating the effects of aging on the autonomic balance.

3153 Board #22 June 2 8:00 AM - 9:30 AM  
**A Comparison of Two VO<sub>2max</sub> Treadmill CPETs in Highly Trained Distance Runners**  
 Ryan A. Vanhoy<sup>1</sup>, Stephanie A. Sullivan<sup>2</sup>, Claudio L. Battaglini, FACSM<sup>2</sup>. <sup>1</sup>University of Mississippi, University, MS. <sup>2</sup>University of North Carolina at Chapel Hill, Chapel Hill, NC. (Sponsor: Claudio Battaglini, FACSM)  
*(No relevant relationships reported)*

Measuring maximal oxygen consumption (VO<sub>2max</sub>) via treadmill testing is a popular procedure for testing aerobic power and subsequently developing exercise prescriptions. Previous studies have produced conflicting results when comparing horizontal and incline graded treadmill protocols designed to assess VO<sub>2max</sub> and the variability may be due to the heterogeneity of subjects, having different fitness levels and backgrounds. **PURPOSE:** To prospectively compare the VO<sub>2max</sub> value attained during a horizontal (increment in speed only) (SOVO<sub>2max</sub>) and an inclined (constant speed with increment in grade only) (GOVO<sub>2max</sub>) cardiorespiratory exercise tests (CPETs) in highly trained distance runners. A secondary purpose examined if the ventilatory threshold (VT) determined from the SOVO<sub>2max</sub> and GOVO<sub>2max</sub> CPETs occurred at the same percent of VO<sub>2max</sub> (% VO<sub>2max</sub> @ VT). **METHODS:** After a familiarization session performing the Bruce Protocol, VO<sub>2max</sub> and % VO<sub>2max</sub> @ VT were evaluated in 16 male distance runners, some who preferred hilly terrain and some who preferred flat or track running, using the SOVO<sub>2max</sub> and GOVO<sub>2max</sub> CPETs. Dependent samples t-tests were used to compare the VO<sub>2max</sub> and % VO<sub>2max</sub> @ VT results between the SOVO<sub>2max</sub> and GOVO<sub>2max</sub> CPETs. **RESULTS:** VO<sub>2max</sub> values were significantly higher from the GOVO<sub>2max</sub> in comparison to the SOVO<sub>2max</sub> protocol (76.1 and 71.2 mL O<sub>2</sub>/kg/min, p= .005); however, the % VO<sub>2max</sub> @ VT was not significantly different between the GOVO<sub>2max</sub> and SOVO<sub>2max</sub> protocols (77.5% and 77.2%, p=.825). **CONCLUSION:** Higher VO<sub>2max</sub> values were attained on the GOVO<sub>2max</sub> CPET, even on those who reported they were track athletes and favored running on the flat surfaces. These results agree with previous research that found athletes who train and compete on an exclusively flat surface or hilly terrain both tend to produce higher VO<sub>2max</sub> values on CPETs that include changes in treadmill grade. However, due to the non-significant difference in % VO<sub>2max</sub> @ VT observed between the SOVO<sub>2max</sub> or GOVO<sub>2max</sub> CPETs,

for the determination of training thresholds, runner specialty (flat versus hill runners) should therefore be considered when selecting the most appropriate CPET in this athletic population.

3154 Board #23 June 2 8:00 AM - 9:30 AM  
**Effects of Hip Strengthening on Running Mechanics and Chronic Leg Pain in Recreational Athletes**

Jennifer Bossi<sup>1</sup>, Samantha Everett<sup>2</sup>, Vanessa Rettinger<sup>1</sup>, Adam Keath<sup>1</sup>. <sup>1</sup>Anderson University, Anderson, SC. <sup>2</sup>Elon University, Elon, NC.

(No relevant relationships reported)

**PURPOSE:** The effects of a hip strengthening protocol on posterior hip running mechanics and Functional Movement Screen scores were examined in recreational athletes with chronic leg pain.

**METHODS:** Subjects ( $n = 12$ ) were instructed to run at a self-selected pace on a treadmill, while a two-dimensional video was recorded to assess posterior hip drop. Posterior hip drop angle was defined as the alignment of the PSIS during the stance phase as indicated by reflective markers. Subjects were also assessed using the Functional Movement Screen. A treatment group ( $n = 7$ ) was then instructed to complete an 8 week hip abductor strengthening protocol in addition to their normal training routine, while a control group ( $n = 5$ ) resumed normal training without a hip abductor strengthening protocol. Both groups were reassessed after 8 weeks to determine changes in posterior hip drop angles and FMS scores. Chronic leg pain was assessed using a 10 point visual analogue scale pre and post treatment.

**RESULTS:** A two-way mixed ANOVA revealed a significant interaction between the treatment group and time on hip drop measurement,  $F(1, 10) = 6.383, p = .03$ , partial  $\eta^2 = .390$ . Hip drop showed a statistically significant improvement in the treatment group ( $M = 0.43, SE = 0.17, p = .03$ ) compared to the control group. No statistically significant interaction effects were observed for pain ( $F(1, 10) = .278, p = .60$ , partial  $\eta^2 = .027$ ) or FMS ( $F(1, 10) = .310, p = .59$ , partial  $\eta^2 = .03$ ). Follow-up within subjects univariate analysis showed significant mean improvements for the treatment group in pre and post ratings for hip drop ( $m = -.89, p = .04$ ) and FMS ( $m = -1.28, p = .03$ ) and no significant differences in pain.

**CONCLUSIONS:** Hip abductor strength training was observed to reduce hip drop angles and increase FMS scores which may lead to better posterior hip mechanics. These improvements alone however, will not reduce pain in recreational runners with chronic leg pain. Given the limited sample size, further research is warranted to identify what factors contribute to chronic pain reduction in recreational runners.

3155 Board #24 June 2 8:00 AM - 9:30 AM  
**Relationship between Daily Mileage and Upper Respiratory Illnesses in Collegiate Cross Country Runners**

Joshua S. Hogg, Keith D. Randazzo, Suzanne L. McDonough, Michael C. Washam. Mississippi College, Clinton, MS.

(No relevant relationships reported)

The incidence of upper respiratory illnesses (URI) within endurance sports is commonplace and often results in decreased athletic performance. For this reason, avoidance of these illnesses is of utmost importance to the athlete. Previous research has identified a positive relationship between running mileage and frequency of URI; however, defining this threshold in terms of intensity and duration of exercise has not been well established. Little is known about underlying factors influencing this relationship. Greater insight into the relationship between mileage and URI will allow for better training and can help establish best practices for creating programs that can reduce the occurrence of URIs. **PURPOSE:** The purpose of this study was to investigate the relationship between endurance training and immune function. **METHODS:** Participants ( $N = 25$ , 13 females, 12 males; mean age  $19 \pm 3$  years) were college undergraduate students. A survey consisting of the Wisconsin upper respiratory system measure (WURSS-21), Daily mileage, sleep, and diet logs were kept by each of the cross country athletes throughout the duration of this study. **RESULTS:** Correlations revealed a significant relationship between daily mileage and frequency of URI ( $r = .10, p = .05$ ). Additionally, sleep and diet were significantly correlated with both mileage and URI frequency, which fulfilled prerequisites to test for moderation (Aiken & West, 1991). However, when sleep and diet were added to the model, neither was found to moderate the relationship between mileage and URI. **CONCLUSION:** Results suggest that as daily mileage increases there is a greater likelihood of URI. It was also revealed that vitamin C intake and hours of sleep did not affect this relationship. Future research on this should explore other factors that could potentially influence the relationship between miles run per day and URI.

3156 Board #25 June 2 8:00 AM - 9:30 AM

**The Effect of Workload on Exercise Volume during Exhaustive Anaerobic Treadmill Running**

Taylor Kennon, Taylor Bloedon, Boe Burrus, Young Sub Kwon. Humboldt State University, Arcata, CA.

(No relevant relationships reported)

Anaerobic capacity has implications in health and sport performance. Sprint interval training improves anaerobic capacity, aerobic factors as well as performance. Optimal durations for taxing anaerobic capacity have been shown to be 60 seconds, and have been elicited using Anaerobic Speed Test (AST). In order to maintain this optimal duration for multiple sets, a decreasing workloads method must be used as fatigue increases following each set. These workloading methods must be compared to determine which protocol allows for the maximum exercise volume to be achieved. **PURPOSE:** The purpose of this study was to compare the effects of three different workload protocols on exercise volume completed during multiple sets of exhaustive anaerobic running on a treadmill. **METHODS:** Twelve male subjects (mean  $\pm$  SD; age =  $22.7 \pm 4$  yr, height:  $172.9 \pm 6.9$  cm, weight:  $75.9 \pm 10.3$  kg,  $VO_2$  max:  $57.3 \pm 6$  ml/kg/min) completed three sessions of high intensity running on a graded treadmill with three different protocols using parameters adopted from the AST (20% grade, 8 mph to exhaustion). Four sets were completed during each protocol. Protocols included: 1) constant sets (CS): no descending workload in all four sets, 2) descending speed (DS): the speed is decreased by 10% for each subsequent set, 3) descending grade (DG): the grade is decreased by 10% for each subsequent set. **RESULTS:** Total exercise volume achieved during the four sets of the DS protocol was significantly higher than both the CS ( $p < 0.01$ ) and DG ( $p < 0.01$ ) protocols. Time to exhaustion achieved during the 2nd, 3rd and 4th sets of the DS protocol were significantly higher than the 2nd, 3rd and 4th sets of the CS protocol, all under  $p < 0.01$ . Cadence during the 3rd set of the DS protocol was significantly lower than the 3rd set of the CS protocol ( $p < 0.01$ ). Additionally, cadence during the 4th set of the DS protocol was significantly higher than the 4th sets of the CS and DG protocols ( $p < 0.01$ ). **CONCLUSIONS:** The longer times per set and greater volume achieved during the DS protocol, in comparison to the DG and CS protocols, suggests the potential for a greater training effect. Differences in cadence values among the protocols could help explain differences in performance implicating muscle fiber type recruitment and fatigue.

3157 Board #26 June 2 8:00 AM - 9:30 AM

**The Acute and Chronic Effects of Highly Cushioned Shoes on Loading Characteristics in Recreational Runners**

Jessica L. Corkin<sup>1</sup>, Sarah Clarke<sup>1</sup>, Michael J. Bohne<sup>2</sup>, Michael Stoolmiller<sup>3</sup>, Scott N. Drum, FACSM<sup>1</sup>. <sup>1</sup>Northern Michigan University, Marquette, MI. <sup>2</sup>Utah Valley University, Orem, UT. <sup>3</sup>Michigan State University, East Lansing, MI. (Sponsor: Scott Drum, FACSM)

(No relevant relationships reported)

Highly cushioned shoes (HCS) are a popular choice for road and trail runners. Manufacturers suggested extra cushioning potentially reduces injury rates through superior shock absorption, implying less impact upon foot strike versus standard cushioned shoes (SCS). **PURPOSE:** To examine the effects of a 4-week HCS intervention on running-related impact forces in adult recreational runners. **METHODS:** Twenty-nine healthy runners (18-60 yrs of age) who had never worn HCS were randomized to either HCS intervention (INV) or SCS control (CON) groups, and wore HCS or SCS a majority of each training week. During pre and post-tests in a lab, all participants wore SCS first, followed by HCS, while running overground at a self-selected, monitored pace and striking embedded force plates in up to 30 total trials/session, at least 10 trials/shoe, to obtain impact peak (PK1) and active peak (PK2) forces, instantaneous loading rate (ILR), average loading rate (ALR), and contact time (CT). Runners recorded daily training data for 4-weeks. A repeated measures, mixed ANOVA was utilized to detect differences between shoes and groups. **RESULTS:** At pretesting, when comparing pooled data in SCS to HCS, no significant differences were found and all effect sizes were small. The acute (i.e., at baseline testing) response to the shoes yielded no statistically significant difference between shoe types. Additionally, there was no statistically significant difference between shoes over time ( $p > 0.05$ ) or between the groups over time ( $p > 0.05$ ). ILR was the variable closest to significance ( $p = 0.066$ ) with a small effect size (0.120). **CONCLUSION:** HCS do not cause alterations in ground reaction forces over a short-term (4-week) habituation period in recreational runners. Interestingly, there was a high drop-out rate in the HCS group of 18% due to self-reported adverse reactions (e.g., numbness, bruising, pain), but results indicated no differences in loading characteristics between shoe types. Still, transitioning to HCS should be a gradual process; however, more research is warranted in long-term HCS usage.

3158 Board #27 June 2 8:00 AM - 9:30 AM  
**Association Between Race Time, Body Mass, and Total Body Water in Ultramarathon Runners**

Julie M. Cousins, Heather H. Betz. *Albion College, Albion, MI.*  
 (Sponsor: Helaine Alessio, FACSM)  
 (No relevant relationships reported)

Acute bouts of prolonged endurance exercise have been found to significantly decrease body mass. Some researchers suggest that a decrease in body mass may improve performance in weight-bearing exercise. Yet, other researchers suggest the decrease in body mass may impair exercise performance. **PURPOSE:** The purpose of this study was to investigate the association between race time with changes in body mass (BM) and total body water (TBW) in ultramarathon runners. **METHOD:** 10 ultramarathon runners (age = 36.4 (10.0) years, race time = 5.7 (1.5) hours) were assessed with the InBody 270 bioelectrical impedance analysis (BIA) before and after a 50k race. The InBody 270 BIA measured BM, skeletal muscle mass (SMM), fat mass (FM), and total body water (TBW). Race time was recorded as the runners crossed the finish line. Statistical analysis was performed using paired t-test, multiple linear regression, and Pearson product-moment correlations. Significance was set to  $p < 0.05$ . **RESULTS:** BM significantly decreased by 2.15 (1.44) kg ( $p = 0.001$ ) while TBW showed a nonsignificant increase of 0.93 (1.79) kg ( $p = 0.134$ ). SMM decreased by 1.1 (1.24) kg ( $p = 0.023$ ) and FM decreased by 3.67 (1.83) kg ( $p < 0.001$ ). There was a positive correlation between race time and age ( $r = 0.676$ ,  $p = 0.032$ ). Multiple linear regression suggested that change in BM and TBW predicted 10% of the variance in race time. **CONCLUSIONS:** Change in BM and TBW were not significantly associated with race time. BM was significantly decreased following the ultramarathon race. A limitation of the study is the small sample size. Therefore, additional research is needed to examine the relationship between performance and changes in BM in a larger sample size of ultramarathon runners.

3159 Board #28 June 2 8:00 AM - 9:30 AM  
**Does Stance Time Predict Running Economy at Relative Speeds in Highly Trained Distance Runners?**

Stephen T. Hammond, Timothy R. Lindsay, Stephen J. McGregor. *Eastern Michigan University, Ypsilanti, MI.*  
 (Sponsor: Andrew Coggan, FACSM)  
 (No relevant relationships reported)

Running economy (RE) is an important component of distance running performance. Recent evidence suggests shorter stance times (ST) are related to superior RE and practitioners often recommend shorter ST for this benefit. However, overall, reports are equivocal, perhaps because comparisons are usually made at absolute running speeds, which fails to account for differences in relative fitness. To date, this relationship has not been explored at relative intensities. **PURPOSE:** To determine the relationship of ST and RE at absolute and relative running speeds. **METHODS:** 20 highly trained distance runners (13 M, 7 F;  $VO_{2max} = 67.6$  vs  $53.5$  ml/kg/min) consented to procedures approved by EMU-HSRC. Session 1 included a critical speed (CS) field test to determine relative fitness and establish relative testing speeds. Session 2 included two treadmill tests for kinematic and metabolic measurements. For both tests, subjects ran at 10, 12, 14, and 16 km/h (absolute speeds) and at 75, 85, and 95% CS (relative speeds). Kinematic data were collected for 60 sec using lower-body optical motion capture (Plug-In-Gait; Vicon, Centennial, CO). Metabolic data were collected using open circuit spirometry (TrueOne 2400, ParvoMedics, Sandy, UT) during three-minute trials, where the last 60 sec of each stage was used to calculate RE. Linear regressions were used to determine the relationship between ST and RE expressed as mL/kg/km, % $VO_{2max}$ , and kcal/kg/km, done separately for absolute and relative speeds.  $\alpha$  was set at .05. **RESULTS:** For absolute speeds, significant negative relationships were found between ST and RE expressed as mL/kg/km ( $\beta = -.374$ ), % $VO_{2max}$  ( $\beta = -.461$ ), and kcal/kg/km ( $\beta = -.459$ ) (all  $p < .01$ ). For relative speeds, a significant negative relationship was found for RE expressed as % $VO_{2max}$  ( $\beta = -.318$ ) ( $p < .05$ ) but not mL/kg/km or kcal/kg/km ( $p > .05$ ). **CONCLUSION:** Contrary to some reports and recommendations, for comparisons using absolute speeds, shorter ST was related to inferior RE. Comparisons using relative speeds showed weaker or non-significant relationships. Therefore, changes in RE mediated by ST may depend more on individual exercise strain than absolute speed. Future investigations should consider using relative intensities for a more appropriate comparison between individuals.

3160 Board #29 June 2 8:00 AM - 9:30 AM  
**Run Performance is the Primary Factor in Determining Olympic Distance Triathlon Performance**

Tyler J. Noble, Robert F. Chapman, FACSM. *Indiana University-Bloomington, Bloomington, IN.*  
 (No relevant relationships reported)

**Introduction:** Triathlon is a unique athletic event, given that it requires athletes to be proficient in three distinct disciplines: swimming, cycling, and running. Often,

high achieving athletes in one of these disciplines are recruited to the triathlon event, but it is unknown as to which event proficiency is most important to triathlon performance. As a result, National Governing Bodies (NGBs) tasked with maximizing performance on the international stage may stand to benefit from the optimization of talent identification procedures. **Purpose:** To assess the relationship between discipline specific performance and overall triathlon performance. **Methods:** Performance data from all three disciplines (swim, cycle, run) were collected on each athlete ( $n = 430$ ) for Olympic distance races (1.5k swim, 40k cycle, 10k run) contested during both the 2016 and 2017 World Triathlon Series (WTS,  $n = 12$ ). Performance in each discipline was ranked versus other competitors in the same race, based on time. Spearman rank-order correlations were then used to explore the relationship between discipline performance rank and overall performance rank. **Results:** Run rank was shown to have a strong, linear correlation with overall rank ( $r_s = 0.90$ ,  $p < 0.01$ ) while both swim ( $r_s = 0.37$ ,  $p < 0.01$ ) and cycle ( $r_s = 0.43$ ,  $p < 0.01$ ) ranks were shown to have mild linear relationships with overall rank. **Conclusion:** The strong linear relationship experienced between run rank and overall rank suggests that NGBs interested in maximizing triathlon performance at the Olympic distance may be best suited to engage in talent identification processes that place an emphasis on running ability.

3161 Board #30 June 2 8:00 AM - 9:30 AM  
**Acute:Chronic Workload Ratio is a Better Predictor of Running Injury than Average Weekly Running Volume**

Allison H. Gruber, Emily G. Wagoner, Jacob E. Vollmar, Ashley B. Nguyen, Andrea K. Chomistek. *Indiana University, Bloomington, IN.* (Sponsor: Joseph Hamill, FACSM)  
 (No relevant relationships reported)

An acute:chronic workload (AC) ratio between 0.8-1.3 was shown to be protective against injury among athletes in rugby, cricket, and other sports but has yet to be applied to runners. **PURPOSE:** To assess AC ratio as a predictor of running-related overuse injury (RROI). **METHODS:** To date, 36 runners have been enrolled in a prospective injury for a minimum of 6 months. An average of  $1.2 \pm 0.8$  injuries have been sustained by 19 runners. Weekly running volume (Rvol), running time, non-running exercise time, and RROI were recorded in a weekly online survey. RROI was defined as pain resulting in any reduction or stoppage of planned running. For each week of enrollment, AC ratio was calculated for running mileage (AC-vol), running time (AC-RT), and all-type exercise time (AC-ET) as the current week value divided by the mean of the previous four weeks. The average AC ratio was calculated across weeks from enrollment to date of injury for members of the injured group. AC ratio was calculated for all weeks of enrollment for members of the uninjured group. Univariate tests were used to assess the differences between injured and uninjured groups ( $\alpha = 0.05$ ). All variables were entered into a stepwise logistic regression model to determine the explanatory variables related to RROI incidence ( $\alpha = 0.15$ ). **RESULTS:** Significant differences between injured (I) and uninjured (U) groups were found for Rvol ( $I = 12.9 \pm 8.9$ ; uninjured  $19.7 \pm 14.4$ ,  $P = 0.011$ ), AC-vol ( $I = 0.86 \pm 0.26$ ;  $U = 1.01 \pm 0.09$ ,  $P < 0.001$ ) and AC-RT ( $I = 0.94 \pm 0.46$ ;  $U = 1.06 \pm 0.13$ ,  $P = 0.036$ ). No other variables were significant between groups ( $P > 0.05$ ). Stepwise logistic regression identified that number of RROI, age, and mass were significant predictors of AC-vol ( $P < 0.131$ ) and that years running, height, and BMI were significant predictors of AC-RT ( $P < 0.030$ ). No significant predictors were identified for AC-ET ( $P > 0.15$ ). **CONCLUSIONS:** AC ratio using running time was a better predictor of RROI incidence than average miles/week, years running, and other common training variables. Reducing mileage or infrequent running training may increase the risk of RROI. AC ratio should be above 0.86 to prevent RROI, which is similar to the minimum threshold value for other sports reported in previous studies. Further study is needed to assess a maximum and minimum AC ratio that is considered 'safe' to prevent RROI.

**G-36 Free Communication/Poster - Soccer**

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
Room: CC-Hall B

**3162 Board #31 June 2 8:00 AM - 9:30 AM  
Generalized Assessments of Mobility in Professional Soccer Athletes: Should Other Physiologic Characteristics Be Considered?**

Bradley Lambert<sup>1</sup>, Tyler Heimdal<sup>1</sup>, Justin Vickery<sup>1</sup>, Corbin Hedt<sup>1</sup>, Joshua Harris<sup>1</sup>, Michael Moreno<sup>2</sup>, Stephen Crouse, FACSM<sup>2</sup>, Patrick McCulloch<sup>1</sup>. <sup>1</sup>Houston Methodist Hospital, Houston, TX. <sup>2</sup>Texas A&M University, College Station, TX. (Sponsor: Stephen Crouse, FACSM)  
(No relevant relationships reported)

The influence of body composition (Bcomp), and skeletal dimensions (SkD) on mobility screening conclusions is unknown. **PURPOSE:** Determine if each are correlated with balance, range of motion (ROM), and Functional Movement Screen (FMS) scores in professional soccer athletes (M&F). **METHODS:** Athletes provided informed consent to participate ( $\sigma$ 18, 27±5 y, 79±9 kg | ♀16, 25±3 y, 63±4 kg). Bcomp and SkD were assessed using DXA. Balance and ROM were assessed via Y-balance (Y-bal) testing. FMS was used for movements listed in table. A two-tailed t-test and Chi-square were used for gender comparison of Y-bal and FMS respectively. Correlational analysis and Spearman's Rank Order were used to determine if Bcomp and/or SkD correlated with Y-bal or FMS measures. Correlations were defined as weak ( $r > 0.4$ ), moderate ( $r = 0.4-0.7$ ), and strong ( $r > 0.7$ ). Type I error;  $\alpha = 0.05$ . **RESULTS:**

MEAN Y-BALANCE SCORE (reach / limb length)					
		Anterior	Posteromedial	Posterolateral	-
Men		0.65 ± 0.05	1.13 ± 0.08	1.06 ± 0.09	
Women		0.69 ± 0.07	1.20 ± 0.19	1.10 ± 0.08	
Sig.		NS	NS	NS	
FUNCTIONAL MOVEMENT SCREEN (1-3 Scale, % of Athletes Scored In Each Category)					
	FMS SCORE	Deep Squat	Hurdle Step	Inline Lunge	Shoulder Mobility
Men	1	33%	8%	0%	14%
	2	67%	75%	100%	50%
	3	0%	17%	0%	36%
Women	1	0%	0%	0%	0%
	2	94%	63%	28%	44%
	3	6%	38%	72%	56%
Sig.	Gender Diff.	$p < 0.05$	NS	$p < 0.05$	NS
	FMS SCORE	Straight Leg Raise	Trunk Stability Pushup	Rotary Stability	
Men	1	6%	6%	6%	
	2	47%	56%	94%	
	3	47%	39%	0%	
Women	1	0%	22%	11%	
	2	16%	44%	79%	
	3	84%	22%	0%	
Sig.	Gender Diff.	$p < 0.05$	NS	NS	

Table 1. Values are presented as means ± SD for Y-balance scores. Y-balance scores represent averaged means of left and right limbs. For FMS scores, the proportion of each gender that scored 1 (worst), 2, or 3 (best) for each test was calculated based on range of motion. Type I error set at  $\alpha = 0.05$

**Y-balance:** Weak correlations were found between anterior reach and height ( $r = -0.36$ ), total lean mass (TLM) ( $r = -0.39$ ), leg LM ( $r = -0.39$ ), and trunk LM ( $r = -0.39$ ) ( $p < 0.05$ ). Moderate correlations were found between posterolateral reach and pelvic width below the femoral head ( $r = 0.42$ ), femur length ( $r = 0.44$ ), and tibia length ( $r = 0.51$ ). **FMS:** Moderate correlations were found between height and both; deep

squat ( $r = -0.400$ ) and inline lunge ( $r = -0.63$ ). Weak correlations were found between deep squat and both; TLM ( $r = -0.43$ ) and trunk LM ( $r = -0.40$ ). Strong correlations were found between inline lunge and TLM ( $r = -0.77$ ), trunk LM ( $r = -0.73$ ), and leg LM ( $r = -0.70$ ). Pelvic width below the femoral head was found to be moderately correlated with deep squat ( $r = 0.40$ ), straight leg raise ( $r = 0.45$ ), and inline lunge ( $r = 0.60$ ). **CONCLUSION:** Factors such as Bcomp and SkD likely influence diagnostic conclusions of commonly generalized mobility assessments in men and women soccer athletes. Further study is needed to determine if these variables could be used to improve testing value for improving performance and assessing injury risk.

**3163 Board #32 June 2 8:00 AM - 9:30 AM  
Profiles And Correlation Between Sprint And Agility K-test Of Elite Young Soccer Players As A Function Of Age**

Lee Cabell<sup>1</sup>, Frantisek Zahalka<sup>2</sup>, Tomas Maly<sup>2</sup>, Lucia Mala<sup>2</sup>, Michal Dragusky<sup>2</sup>, Arnold Baca<sup>3</sup>. <sup>1</sup>Arkansas Tech University, Russellville, AR. <sup>2</sup>Charles University, Prague, Czech Republic. <sup>3</sup>University of Vienna, Vienna, Austria. (Sponsor: Kevin Ford, FACSM)  
(No relevant relationships reported)

Agility, acceleration, change of direction, deceleration, and sprinting are critical technical skills in soccer. Sprint performance relative to a new Agility K-test (KT) required testing among four age groups. **PURPOSE:** To determine the profiles and relationship between linear running speed and agility KT of elite young soccer players. **METHODS:** Elite Czech national level young male soccer players volunteered for his study and were divided into four age groups (16 yr,  $n_1 = 22$ ; 17 yr,  $n_2 = 18$ ; 18 yr,  $n_3 = 26$ ; 19 yr,  $n_4 = 20$ ). The KT consisted of the participants running at maximum speed between cones positioned in a "K" pattern on a field with artificial grass. The participants started and ended running at the intersection of the "K" pattern. A contact switch for time measurement was placed on the top of each cone which participants touched with the hand. The participants performed two trials and the time of test execution was measured in seconds. Times were measured in a 5-m (S5) and 10-m (S10) dash from a static position. Two-way (4x2) ANOVA and post-hoc Tukey HSD were used for statistical assessment. Pearson correlation coefficient test was used to correlate two dependent variables.  $P < .05$ . **RESULTS:** Factorial ANOVA indicated no significant interaction between sprint distance and age,  $F_{3,164} = 0.15$ ,  $p = .93$ , but significant main effect for sprint distance,  $F_{1,164} = 2142.61$ ,  $p < .01$ , and age,  $F_{3,164} = 3.06$ ,  $p < .05$ . The 19-year old group significantly improved both sprint times compared to the other age groups. The correlation between sprint times and KT for individual age groups primarily showed weak to moderate non-significant correlations: 16 yr:  $r_{S5} = -0.24$ , NS;  $r_{S10} = 0.24$ , NS; 17 yr:  $r_{S5} = 0.46$ , NS;  $r_{S10} = 0.39$ , NS; 18 yr:  $r_{S5} = 0.22$ , NS;  $r_{S10} = 0.46$ ,  $p < .05$ ; 19 yr:  $r_{S5} = 0.36$ , NS;  $r_{S10} = 0.36$ , NS. The correlation between sprint times for S5 and S10 for the individual age groups: 16 yr:  $r = 0.64$ ,  $p < .01$ ; 17 yr:  $r = 0.76$ ,  $p < .01$ ; 18 yr:  $r = -0.06$ , NS; 19 yr:  $r = 0.97$ ,  $p < .01$ . **CONCLUSION:** The sprint distance main effect indicated that sprint times improve with participants' ages. The weak correlation between sprint and KT may suggest a different training program for young soccer athletes or individual training program for different ages. The significant correlation between the linear sprint distances shows a good choice for speed training.

**3164 Board #33 June 2 8:00 AM - 9:30 AM  
Changes in Lower Extremity Musculoskeletal Characteristics Associated with Ankle Sprain History in Intercollegiate Soccer Athletes**

Mallory Faherty<sup>1</sup>, Jennifer Csonka<sup>2</sup>, Karl Salesi<sup>2</sup>, Tara Moore<sup>1</sup>, Robert Zarzour<sup>1</sup>, Timothy Sell, FACSM<sup>1</sup>. <sup>1</sup>Duke University, Durham, NC. <sup>2</sup>University of Pittsburgh, Pittsburgh, PA. (Sponsor: Timothy Sell, FACSM)  
(No relevant relationships reported)

Ankle sprains (AS) result in persistent neuromuscular deficits and increased risk of re-injury. Examining the effect of AS on lower extremity (LE) flexibility, strength, static balance (SB), and dynamic postural stability (DPS) may aid in the development of injury prevention and rehabilitation programs. **PURPOSE:** Determine side-to-side differences in LE flexibility, strength, SB, and DPS in intercollegiate soccer athletes with a history of ankle sprain (HAS). **METHODS:** Fifteen intercollegiate male and female soccer athletes with a HAS participated (Age: 20.2±1.3 years, Height: 175.3±9.9cm, Weight: 68.7±10.2kg). LE flexibility tests included weight-bearing and active ankle dorsiflexion, active knee extension, and straight leg raise. LE strength tests included ankle dorsiflexion/plantarflexion, ankle inversion/eversion, hip abduction/adduction, hip internal/external rotation, and knee flexion/extension. LE SB and DPS were assessed with a force plate collecting ground reaction forces (GRF). Single-leg SB was assessed under eyes-open and eyes-closed conditions. DPS was assessed during a single-leg landing task. Side-to-side differences were assessed using T-tests, Wilcoxon Signed-Ranks or Mann-Whitney U tests, as appropriate. Significance for all tests was set at  $p < 0.05$ , a priori. **RESULTS:** Athletes with a HAS demonstrated significant side-to-side differences for weight-bearing ankle dorsiflexion

( $p=0.044$ ), ankle dorsiflexion strength ( $p=0.006$ ), and knee flexion strength ( $p=0.023$ ). No other significant differences were observed. **CONCLUSION:** Athletes with a HAS demonstrated persistent side-to-side differences despite returning to competition. These differences, including weight-bearing ankle dorsiflexion flexibility, ankle dorsiflexion strength, and knee flexion strength may predispose these athletes to re-injury. The results of this study should guide AS rehabilitation programs in an effort to mitigate these persistent changes in an attempt to prevent re-injury.

3165 Board #34 June 2 8:00 AM - 9:30 AM  
**Knee Alignment And Muscle Strength Ratios In Division III Female Soccer Players With Reconstructed Anterior Cruciate Ligament**

Nina M. Robinson, Ana B. Freire Ribeiro. *Augsburg University, Minneapolis, MN.* (Sponsor: Dr. Mark Blegen, FACSM)  
*(No relevant relationships reported)*

**Intro:** Anterior cruciate ligament tears are very common in sports that require contact, hard landing from jumps, or cutting, like soccer. Analyzing an athlete's knee valgus and muscle strength ratios may help reduce their risk for injury.

**Objective:** To compare knee valgus angles and the hamstring to quadriceps femoris strength ratio between healthy female Division III soccer athletes and athletes with ACL reconstruction, as surrogates for knee (re)injury risk.

**Methods:** Thirteen non-injured and three injured athletes completed a vertical drop jump (VDJ) from a 31 cm box and 1 Repetition Maximum tests (1RM) using seated knee curl and seated knee extension machines. Baseline and landing knee valgus angles (KVA) were measured using Dartfish software.

**Results:** There was a significant difference in quadriceps to hamstring ratio between injured and non-injured athletes ( $p=0.03$ ), with injured individuals having an average ratio of 0.89 and non-injured 0.71. No significant difference was found in KVA from VDJ between injured and non-injured subjects ( $p=0.87$ ). No significant relationship was found between KVA and quadriceps to hamstring ratios.

**Conclusion:** There are significant differences in hamstring to quadriceps strength ratios in injured female DIII soccer players compared to non-injured, suggesting it is a better screening than VDJ. KVA cannot be predicted by quadriceps to hamstring ratio and injury history.

3166 Board #35 June 2 8:00 AM - 9:30 AM  
**Knee Biomechanics in Division III Female Soccer Players with Reconstructed Anterior Cruciate Ligament (ACL)**

Marissa Guillou, Ana B. Freire Ribeiro. *Augsburg University, Minneapolis, MN.* (Sponsor: Dr. Mark Blegen, FACSM)  
*(No relevant relationships reported)*

**PURPOSE:** To compare knee valgus angles (KVA) between healthy athletes and athletes with reconstructed ACLs in vertical drop jump and soccer specific drills.

**METHODS:** Sixteen NCAA Division III (DIII) female soccer players, ages 20.94 ( $\pm 1.29$ ), thirteen athletes with healthy ACL and three with an ACL reconstruction (ACLR). Knee Valgus Angles (KVA) were measured during vertical drop jump, ladder drill, dribbling drill and shooting drill using Dartfish. Paired t-tests compared the groups.

**RESULTS:** There were no differences in KVA between groups in any of the drills. Drop Jump KVA mean was  $12.9 \pm (SD \pm 11.8)$  ( $p=0.87$ ). Mean right leg KVA on ladder drill was  $19.1 \pm (SD \pm 9.6)$  ( $p=0.95$ ) and  $17.2 \pm (SD \pm 8.3)$  ( $p=0.3$ ) for left leg. Mean right leg dribbling drill average KVA was  $15.8 \pm (SD \pm 8.5)$  ( $p=0.11$ ) and  $12.7 \pm (SD \pm 7.5)$  ( $p=0.16$ ) for left leg. Mean right leg shooting drill average KVA was  $19.9 \pm (SD \pm 7.3)$  ( $p=0.08$ ) and  $15.2 \pm (SD \pm 7.2)$  ( $p=0.29$ ) for left leg.

**CONCLUSIONS:** Although there were no significant differences, between the injured and non-injured athletes for any drills, KVA in the injured athletes tended to be larger in game-like drills, suggesting they could be more meaningful in injury prevention assessment.

3167 Board #36 June 2 8:00 AM - 9:30 AM  
**Sweat Loss in Association With Measures of External Load in Adolescent Soccer Players**

Timothy J. Roberts, Melissa L. Anderson, Tina L. Bonsignore, Kortney J. Dalrymple, Khalil A. Lee, Lindsay B. Baker, FACSM. *Gatorade Sports Science Institute, Bradenton, FL.* (Sponsor: Lindsay Baker, FACSM)

**Reported Relationships:** T.J. Roberts: Salary; This study was funded by the Gatorade Sports Science Institute. The views expressed in this abstract are those of the authors and do not necessarily reflect the

position or policy of PepsiCo, Inc.

**BACKGROUND:** The use of technology to track workload and measurements of sweat loss to prescribe hydration strategies are now common practice. No study has explored the association of load variables to sweat loss in soccer athletes.

**PURPOSE:** To determine the association of load measures (total distance (TD), energy expenditure (EE)), body mass (BM), and sweat loss in adolescent soccer athletes during organized practice.

**METHODS:** Thirty-two adolescent soccer athletes (Male:  $n=16$ ,  $17 \pm 1$  y,  $71.4 \pm 6.7$  kg; Female:  $n=16$ ,  $18 \pm 1$  y,  $64.0 \pm 8.4$  kg) had workload measured during 3 in-season practices ( $21.9$ - $25.4^\circ\text{C}$  WBGT) using GPS/accelerometer technology. Total sweat loss was calculated from pre- to post-exercise change in BM, corrected for fluid/food intake (ad libitum), urine output, metabolic mass loss, and respiratory water loss. Practice type was assessed subjectively and categorized as small or large-sided games/drills based on the activities athletes engaged in during the majority (>50%) of the practice time. Girls practice 1 and 2 and boys practice 2 were small-sided. Girls practice 3 and boys practice 1 and 3 were large-sided. Multiple linear regression analyses were used to model the effects of independent variables (BM, EE, and TD) on total sweat losses. Data are shown as mean  $\pm$  SD.

**RESULTS:** Boys covered  $4.7 \pm 1.4$  km and expended  $1595 \pm 481$  KJ ( $381 \pm 115$  kcal) in  $81 \pm 13$  min practices. Girls covered  $4.4 \pm 0.9$  km and expended  $1310 \pm 299$  KJ ( $313 \pm 72$  kcal) in  $81 \pm 7$  min practices. Total sweat loss was  $1.3 \pm 0.3$  L in boys and  $0.8 \pm 0.2$  L in girls. Models to predict sweat loss included: 1) BM and EE; and 2) BM and TD. Model 1 was significant in boys during practice 1 ( $r^2=0.73$ ,  $p<0.001$ ) and 3 ( $r^2=0.60$ ,  $p<0.01$ ), but not practice 2 ( $r^2=0.38$ ,  $p=0.06$ ). Model 1 was significant in girls during practice 3 ( $r^2=0.57$ ,  $p<0.01$ ), but not practice 1 ( $r^2=0.36$ ,  $p=0.11$ ) or 2 ( $r^2=0.32$ ,  $p=0.12$ ). Model 2 (not reported) was largely identical. **CONCLUSION:** The association between total sweat loss, BM, and workload was inconsistent among practices, which may be explained in part by practice type. Significant prediction models were found during practices that consisted of predominantly large-sided game/drill scenarios. This work provides a literature base for the exploration of associations between workload measures and physiological/metabolic variables.

3168 Board #37 June 2 8:00 AM - 9:30 AM  
**Effect of Maturation on Heart Rate During a Six-Week Plyometric Training in Female Soccer Players**

Christina M. Mullen, Jeffrey B. Taylor, Michelle A. Aube, Audrey E. Westbrook, Anh-Dung Nguyen, James M. Smoliga, FACSM, Kevin R. Ford, FACSM. *High Point University, High Point, NC.* (Sponsor: Kevin R. Ford, FACSM)  
*(No relevant relationships reported)*

Implementation of an anterior cruciate ligament (ACL) injury prevention program (IPP) has been recommended to coincide with the adolescent growth spurt as risk factors increase during and following this phase of maturation. Physiological responses to load during this stage of growth may result in a differing maximum heart rate ( $HR_{max}$ ) during intense exercise. Understanding the relationship between physiological responses to load and maturation stage may result in more effective IPP in youth athletes. **PURPOSE:** To examine the effects of maturation on  $HR_{max}$  in adolescent soccer players over a six-week training program. **METHODS:** 34 female soccer players participated in a 6-week training study (age  $13.3 \pm 1.5$  yrs; height  $158.7 \pm 6.9$  cm; mass  $50.0 \pm 9.6$  kg). Maturation groups were determined based on percent of adult stature (PAS) with 88-94% representing pubertal ( $n=9$ , PAS  $91.6 \pm 2.0\%$ ) and 95-100% representing post-pubertal ( $n=25$ , PAS  $97.7 \pm 1.7\%$ ). Three 30 minute sessions, separated into plyometric, resistance, and core strength training, were completed each visit for a total training time of 90 minutes three times per week. Participants wore HR monitors during each plyometric session. The initial exercises were adapted from ACL IPP, and intensity of each exercise was progressed weekly following the second week of training (5 total phases).  $HR_{max}$  was calculated for each participant during each session and averaged weekly. A linear mixed model ( $p<0.05$ ) was used to determine the effects of  $HR_{max}$  over the six-week intervention in pubertal and post-pubertal female soccer players. Average HR during the first week of training was used as a covariate.

**RESULTS:** A significant interaction of maturational group and training week was found ( $p<0.04$ ) with  $HR_{max}$ . A main effect of training week was found in both pubertal ( $p<0.001$ ) and post-pubertal ( $p<0.01$ ) groups.  $HR_{max}$  was significantly increased in both groups (week 1 to week 3,  $p<0.05$ ) following the first two technique focused weeks of plyometric program with the pubertal group ( $184.3 \pm 4.7$  BPM) having greater  $HR_{max}$  compared to the post-pubertal group ( $172.7 \pm 2.2$  BPM) during week 3.

**CONCLUSIONS:** Physiologic responses to load was dependent on maturation stage and should be further examined in relation to reduced risk of injury following IPP. Funding supported by NIAMS/NIH R21AR069873

3169 Board #38 June 2 8:00 AM - 9:30 AM  
**Comparison of Pre And Postseason FMS Individual Test Scores In DIII Male Soccer Players**  
 Ana B. Freire Ribeiro<sup>1</sup>, Darby R. Lindgren<sup>2</sup>, Jide Ifonlaja<sup>1</sup>, Stuart Borne<sup>3</sup>. <sup>1</sup>Augsburg University, Minneapolis, MN. <sup>2</sup>North Dakota State University, Fargo, ND. <sup>3</sup>University of Saint Thomas, Saint Paul, MN. (Sponsor: Mark Blegen, FACSM)  
 (No relevant relationships reported)

The Functional Movement Screen (FMS) is a battery of seven tests scored on a 0-3 scale that aims to identify imbalances and asymmetries in the body (Cook, 2014). Within the FMS, the deep squat (DS) and active straight leg raise (ASLR) are good predictors of injury (Hotta et al, 2015, Hammes et al, 2016, and Zalai et al, 2014); therefore they were tracked pre and postseason, along with shoulder mobility (SM). Given that most soccer injuries occur during preseason (Hootman et al., 2007, NCAA 2017), it is hypothesized that athletes would have lower scores at preseason. **PURPOSE:** To compare pre and postseason DS, ASLR, and SM scores in NCAA DIII male soccer players. **METHODS:** Sixteen collegiate players were assessed in mid-August and late March. They completed the DS, ASLR, and SM tests and were rated by one athletic trainer certified in FMS. A paired t-test compared the pre and postseason scores. **RESULTS:** The mean preseason total score was 6.62 (SD=0.89), while the postseason mean was 6.88 (SD=1.15). Scores between the two seasons were not different ( $p=0.21$ ). From pre to postseason, DS scores increased by 21% ( $p=0.059$ ), ASLR scores increased by 5.8% ( $p=0.054$ ), but SM scores decreased by 7% ( $p=0.18$ ). **CONCLUSIONS:** DS, ASLR, and SM scores did not significantly change from pre to post-season. Sport-specific tests and a more sensitive rating scale could have yielded different results and should be further investigated.

3170 Board #39 June 2 8:00 AM - 9:30 AM  
**Differences Between the Bilateral and Ipsilateral Strength Asymmetries With Respect to Age, Contraction Velocity and Limb Preferences in Female Soccer Players.**  
 Lucia Mala, Tomas Maly, Frantisek Zahalka, David Bujnovsky, Mikulas Hank, Michal Dragijsky. Charles University, FPES, Prague, Czech Republic.  
 (No relevant relationships reported)

During the soccer match, strength and power movements are accumulated on both lower extremities. This occurs in an asymmetrical manner and may gradually leads to higher shifts of myodynamic characteristics and strength asymmetries (SA). There are limited investigations of a combination of muscle SA and different age groups in female soccer players.

**PURPOSE:** To investigate of differences bilateral and ipsilateral SA in female soccer players of four age categories.

**METHODS:** Elite female players ( $n=67$ ) of 4 age categories (U17=13, U19=18, U18=20 and U19=15) performed isokinetic strength testing (Cybex NORM®, Humac, USA) for knee extensors (KE) and flexors (KF) at three angular velocities (AV: 60, 180, 300 °·s<sup>-1</sup>). Bilateral strength ratios (Q:Q, H:H) and ipsilateral strength ratios (H:Q) were evaluated. Three-way Mixed-design ANOVA with two between subject effect (Age, Limb) and one within subject effect (AV) were used for evaluation. Bonferonni's *post-hoc* test and partial eta square ( $\eta_p^2$ ) were also used for data analysis.

**RESULTS:** We found a statistically significant effect of AV on bilateral ( $F_{2,123} = 5.52; p < .01$ ; Wilk's  $\Lambda = 0.92$ ;  $\eta_p^2 = .08$ ) and ipsilateral ( $F_{2,123} = 4.87; p < .01$ ; Wilk's  $\Lambda = 0.93$ ;  $\eta_p^2 = .07$ ) SA in four age groups. We found a significant higher SA between KF compare to KE ( $F_{1,124} = 23.89, p < 0.00, \eta_p^2 = 0.16$ ). With increasing AV from 60 to 180°·s<sup>-1</sup>, significant changes in H:H appeared (H:H<sub>60} = 7.81±0.60 % vs. H:H<sub>180} = 11.03±0.73 %,  $p < 0.01$ ). The factor "Age" did not significantly affected SA in players (Bilateral:  $F_{3,124} = 1.10, p > 0.05, \eta_p^2 = 0.03$ ; Ipsilateral:  $F_{3,124} = 1.85, p > 0.05, \eta_p^2 = 0.04$ ). The interaction between "Age" and "Leg" had not significant effect ( $p > 0.05$ ) on SA for groups. Post-hoc analysis showed in dominant leg a significant difference in H:Q<sub>60} = 54.73±0.92 % vs. H:Q<sub>180} = 57.61±1.17 ( $p < 0.01$ ). Totally, 17 (~25%) risk results (>20%) of H:H was found in players in comparison to 3 (~5%) risk results in Q:Q.</sub></sub></sub></sub>

#### CONCLUSION

The KF demonstrated a higher degree of the bilateral ratio in comparison to KE. Seventeen players (25%) had SA in KF higher than 20% at least at one AV. More attention should be paid to KF, where a higher percentage of SA was observed. Higher percentage of SA was seen at higher AV. The results may be beneficial for fitness coaches, physiotherapists, doctors and other clinical staff of female soccer players.

3171 Board #40 June 2 8:00 AM - 9:30 AM  
**High Intensity Interval Training Does Not Improve Cardiorespiratory Parameters In Trained Young Soccer Players**  
 Stelios Poulos, Ilias Zacharogiannis, Giorgos Paradisis, Fotini Dagli, Maria Maridakis. National and Kapodistrian University of Athens, Athens, Greece.  
 (No relevant relationships reported)

Soccer performance is the result of technical, tactical, physiological and psychological attributes of the players. **PURPOSE:** The present study investigated the effect of high-intensity interval training (HIIT) and continuous moderate intensity training (CONT) on selected parameters of the cardiorespiratory function in young trained soccer players. **METHODS:** Thirty Greek amateur soccer players (mean ± sd, age 19 ± 2.21y, Body mass 71.19 ± 2.5 kg) were randomized into a high-intensity interval training group (HIIT,  $n = 10$ ), a continuous moderate intensity training group (CONT,  $n = 10$ ) and a control group (Control,  $n = 10$ ). The intervention for HIIT and CONT groups was 16 more training sessions, 2 per week while CONTROL group continued regular soccer training routine. The HIIT group training sessions consisted either of 15s sprints interspersed by 15s of recovery at 120%VO<sub>2max</sub> with 8 min total exercise time or they played 4x4 min (16 min total time) small-sided games (4v4) followed by 2 min recovery interval. The CONT group training sessions consisted either of 40 min continuous running at 70% VO<sub>2max</sub> or 10v10 full field soccer game for 40min. **RESULTS:** Mean values ± sd pre and post-training for Body weight, (HIIT: 69.49 ± 8.39 v 69.0 ± 8.8; CONT: 71.2 ± 10.93 v 70.2 ± 11.01 kg), %fat, (HIIT: 13.02 ± 2.41 v 12.12 ± 2.49, CONT: 13.75 ± 2.19 v 13.82 ± 2.21), VO<sub>2max</sub>, (HIIT: 55.08 ± 4.43 v 57.75 ± 5.63, CONT: 56.46 ± 4.61 v 58.41 ± 5.24 ml·kg<sup>-1</sup>·min<sup>-1</sup>), vVO<sub>2max</sub> (velocity at VO<sub>2max</sub>, HIIT: 15.9 ± 0.70 v 16.5 ± 0.52, CONT: 16.5 ± 1.51 v 16.7 ± 1.19 km·h<sup>-1</sup>) and vVT (velocity at ventilatory threshold, HIIT: 11.8 ± 0.87 v 12.5 ± 0.69, CONT: 12.4 ± 1.03 v 12.5 ± 1.13 km·h<sup>-1</sup>). VO<sub>2max</sub>, vVO<sub>2max</sub> and vVT improved 4.6, 3.6 and 5.6% only after HIIT training but the difference didn't pass statistical significance due to large sd of the sample. **CONCLUSIONS:** In conclusion, the combination of the training regimens of this study did not improve cardiorespiratory parameters of endurance performance in already trained young soccer players. There was, though, a tendency for better adaptations favors the time efficient HIIT training.

3172 Board #41 June 2 8:00 AM - 9:30 AM  
**Performance Differences Between Home And Away Fixtures And Halves In NCAA DI Women'S Soccer**  
 Mikaela C. Gabler<sup>1</sup>, Gavin Connolly<sup>1</sup>, Shane F. O'Riordan<sup>2</sup>, Tomas Barrett<sup>1</sup>, Naveen Sharma<sup>1</sup>, Paul L. O'Connor<sup>1</sup>. <sup>1</sup>Central Michigan University, Mount Pleasant, MI. <sup>2</sup>Australian Sports Commission, Canberra, Australia.  
**Reported Relationships:** M.C. Gabler: Consulting Fee; CMU women's soccer.

**PURPOSE:** It is well documented that there is an advantage when playing games at home. The influence of home advantage on performance measures are not fully understood. The current study compared performance variables between wins and losses, home and away fixtures and also first and second halves to explore potential performance differences.

**METHODS:** 12 Division I female soccer players (19.5 ± 1.5 yrs, 166 ± 3.5 cm, 61.4 ± 4.8 kg) were included based on playing time criteria (≥ 60% total game time). Global positioning system (GPS) data was collected for conference games for one season (11 total games). Total distance (TD), distance covered (m·min<sup>-1</sup>), high speed distance (HSD: 15.5 - 19.9 km·h<sup>-1</sup>), and average player passes were recorded. Data was analyzed using Two-Way ANOVAs in Sigma Plot.

**RESULTS:** There were no differences in any measured variable between games won and games lost. TD was significantly greater for the first half compared to the second half (4632.5 ± 368.8m vs 4045.2 ± 364.6m;  $P = 0.002$ ). TD was also significantly greater for the first half compared to the second half for both home (H) and away (A) games ( $P < 0.05$ ). M·min<sup>-1</sup> was significantly greater for the first half compared to the second half (119.9 ± 5.8m vs 113.1 ± 5.5m;  $P = 0.015$ ). M·min<sup>-1</sup> was also significantly greater for the first half compared to the second half for H games ( $P = 0.037$ ). HSD was significantly greater in the first half compared to the second half (585.16 ± 75.3m vs 499.9 ± 71.9m;  $P = 0.016$ ). There was no difference in HSD between home and away games. Average passes were significantly greater for the H compared to A games (11.7 ± 2.6 v 9.3 ± 1.7;  $P = 0.015$ ). They were also significantly greater for the first half compared to the second half ( $P = 0.049$ ). Additionally, average passes were significantly greater for the first half for H compared to A games ( $P = 0.036$ ).

**CONCLUSIONS:** Game result had no effect on the measured variables. TD, m·min<sup>-1</sup>, and HSD were greater for the first half compared to the second half regardless of location. Average passes were greater for the first half compared to the second half and for H compared to A games. This information could influence coaches' decision making.

3173 Board #42 June 2 8:00 AM - 9:30 AM  
**Match-Play Analysis Of Physiological And Movement Variables In Men's And Women's Division I Soccer Players**

Ashley N. Triplett, Michael Vorkapich, James M. Pivarnik, FACSM. *Michigan State University, East Lansing, MI.*  
 (No relevant relationships reported)

HR monitoring, accelerometers, and GPS tracking have become popular tools to quantify activity intensity during soccer matches. Limited research has examined differences between men and women collegiate players using these tracking modalities. **PURPOSE:** To quantify the activity profile of Division I collegiate soccer players during games using HR response and GPS and to examine differences based on gender and position. **METHODS:** A team HR monitoring system was used to evaluate in-game HR response and quantify match-play movement patterns of 21 men and 21 women NCAA Division I soccer players who played >70 min in each of 3 games. Players were divided into 3 groups based on position (defender, midfielder, forward). Percentage of playing time spent above 80% of HR max and average %HRmax was calculated. Total distance/playing time and number of sprints above sprint threshold (men: accelerations >2.8m/s<sup>2</sup>, women: accelerations >2.4m/s<sup>2</sup>) were also calculated. ANOVA and student's t-test were used to determine differences. **RESULTS:** Forwards and midfielders had significantly greater distance/playing time and sprints/playing time than defenders (F: 115.2m/min, M: 115.7m/min, D: 103.0m/min) (F: 0.38sprints/min, M: 0.33sprints/min, D: 0.26sprints/min) ( $p < 0.05$ ). No positional differences were observed in average %HRmax or % of game time >80% of HRmax. Men had a greater average distance/playing time than women (113.0m/min vs 105.6m/min) ( $p < 0.05$ ). Men had significantly fewer average sprints/min above threshold than women (0.18/min vs 0.42/min) ( $p < 0.05$ ). No differences were observed in average %HRmax (M: 85.6%HRmax, W: 87.7%HRmax) or % of game >80% of HRmax (M: 80.6%, W: 88.3%) between genders. **CONCLUSIONS:** HR data illustrate that elite level soccer is a highly aerobic sport. Differences in distance/playing time and sprints based on position may be explained by positional requirements, with more constant movement required for midfielders and explosiveness for forwards. Men's soccer moves at a faster pace, explaining the difference in distance/playing time by gender; however, relative activity intensity (%HRmax) was similar between positions and gender. The gender difference in number of game sprints may be at least partially related to the threshold differences determined by the GPS system.

3174 Board #43 June 2 8:00 AM - 9:30 AM  
**The Effect of High Intensity Interval Training on Planned Agility Performance in Soccer Players**

Tal Amasay, Sofia Jakobsson, Constance M. Mier, FACSM. *Barry University, Miami Shores, FL.* (Sponsor: Constance M. Mier, FACSM)  
 (No relevant relationships reported)

Inducing fatigue prior to agility training through high intensity interval training (HIIT) has shown to yield greater agility improvements compared to agility training alone. However, high levels of neuromuscular fatigue can impair the ability to implement proper technique and may increase injury risk associated with the explosive neuromuscular demand of agility performance. **PURPOSE:** To investigate the fatiguing effects of HIIT on agility performance, and determine if performance can be fully recovered following a short rest period. **METHODS:** Nineteen collegiate level soccer players participated in the study, nine men (22 ± 2 yrs) and ten women (20 ± 2 yrs). Agility T-test were performed before (PRE), and twice following (POST 1 and POST 2) the completion of four 4-seconds cycle ergometer sprints. The four sprint intervals were separated by 25 s active recovery. POST 1 was performed immediately following the final cycle sprint whereas, POST 2 began two minutes after completion of POST 1. Repeated measures ANOVA and Bonferroni post hoc tests were used to determine significant differences in the time to complete the T-tests. **RESULTS:** During HIIT, average power from the first sprint to the last declined by 30.7 ± 9%. Time to complete the agility T-test significantly differed among the three tests (PRE: 10.46 ± .17 s; POST 1: 11.67 ± .33 s; POST 2: 10.96 ± .19 s;  $F(2, 54) = 6.174$ ,  $p = .003$ ). Post hoc test revealed an increase in time from PRE to POST 1 ( $p = .002$ ), but no difference between PRE and POST 2 ( $p = .473$ ). **CONCLUSION:** These results show that acute fatigue from HIIT impairs planned agility, but performance can be recovered within a few minutes. Coaches can safely combine fatigue-inducing drills and planned agility training into same sessions with rest interval.

3175 Board #44 June 2 8:00 AM - 9:30 AM  
**Acute Hypoxic Exposures On Submaximum And Maximum Physical Performance In Soccer Players**

runghchai C. chaunchaiyakul. *mahidol university, Nakhonpathom, Thailand.* (Sponsor: Professor Chia-Hua Kuo, FACSM)  
 (No relevant relationships reported)

Acute hypoxic exposures on submaximum and maximum physical performance in Soccer Players.

Runghchai Chaunchaiyakul<sup>1</sup>, Panik Avirutakan<sup>2</sup>, Chusak Pattanamontri<sup>2</sup>, Somporn Wannasiri<sup>2</sup> and Salinee Chaikyakul<sup>3</sup>

<sup>1</sup> College of Sports Science and Technology, Mahidol University, Thailand.

<sup>2</sup> Sports Authority of Thailand,

<sup>3</sup> Faculty of Allied Health Science, Walailak University, Thailand.

**Purpose:** This study was aimed to investigate cardiorespiratory and metabolic changes during acute hypoxic exposures on physical performance in soccer players. **Materials and method:** Male football players, who currently trained, participated. This study was approved by the Human Research Committee of Ethical Reinforcement for Human Research, Mahidol University, Thailand (MU-CIRB 2015/075 1905). A hypoxic chamber was used to simulate normobaric-normoxic (NOR,  $F_{iO_2} = 0.21$ ) and hypoxic (HYP,  $F_{iO_2} = 0.15$ ) condition. Cardiorespiratory and metabolic functions at rest and during exercise were monitored using an impedance cardiography (PhysioFlow<sup>®</sup>) and telemetry gas analyser (Oxycon Mobile<sup>®</sup>). Variables including heart rate (HR) stroke volume (SV), cardiac output (CO), respiratory rate (RR), tidal volume ( $V_T$ ), ventilation ( $\dot{V}_E$ ), oxygen consumption ( $\dot{V}O_2$ ), carbon dioxide production ( $\dot{V}CO_2$ ) and respiratory exchange ratio (RER), were monitored. Two separated progressive exercise tests were conducted on a cycle ergometer. **Results:** At submaximum exercise, no significant difference of all resting variables between two groups were detected. HR, SV, VT, RR, VE, SaO<sub>2</sub> and VO<sub>2</sub> remarkably increased in the stepwise pattern ( $p < 0.05$ ) in parallel with all workloads. EDV, ESV, CO and VCO<sub>2</sub> in both groups progressively increased ( $p < 0.05$ ) at the moderate to high workloads (90, 120 and 150 W). HYP showed the significantly higher HR ( $p < 0.05$ ) for all workloads, and significantly lower EDV and ESV at 150 W. At maximum exercise, HYP showed significant reductions in maximum values of HR, SV, EDV, ESV, CO, WR and VO<sub>2</sub> ( $p < 0.05$ ), with increasing in RR, VE, VCO<sub>2</sub>, and RER ( $p < 0.05$ ). **Conclusion:** Hypoxic condition declines performance, VO<sub>2</sub> and cardiac function at maximum exercise. Physiologic responses are mostly derived from respiratory compensation for all workloads. Thus, respiratory adjustment plays major role in acute normobaric-hypoxic condition.

3176 Board #45 June 2 8:00 AM - 9:30 AM  
**Unstable Surface Training Effects on Balance and Lower Limb Power in Adolescent Female Soccer Players**

Ieng Si Chan, Li-Lan Fu. *National Taiwan Sport University, Taoyuan City, Taiwan.*  
 (No relevant relationships reported)

Soccer is a moderate contact sport and has a higher injury rate in female adolescent. Previous researches demonstrate the unstable surface training (UST) could improve the body's stability and movement control, thereby reducing the risk of injury during exercise. **PURPOSE:** The purpose of this study was to determine the effect of a 6-week unstable surface training program on dynamic balance and lower limb power in adolescent female soccer players. **METHODS:** Twenty female soccer players (age: 14.9 ± 0.75 yrs, height: 160 ± 6.02 cm, weight: 50.6 ± 6.5 kg) from a local Junior School were randomly divided into control group (n = 10) and exercise group (n = 10). All players underwent a regular soccer training 5 times per week. Participants in the exercise group received extra UST program (6 weeks, 3 times per week, 20 min per session). The training program included core muscle, lower limb strength and balance training by using the BOSU ball as a training tool. Vertical jump, 30 meters dash and the dynamic balance (Star Excursion Balance Test, SEBT) before and after the training program were assessed for all players. Paired sample t-test was used to analyze the difference between pre and post-tests in two groups. The significant level was set at  $\alpha = .05$ .

**RESULTS:** In the exercise group, the SEBT scores significantly increased after UST ( $p = .000$ , pre 294 ± 23 % vs. post 332 ± 30 %). No significant difference was found in the control group ( $p = .823$ , pre 301 ± 17 % vs. post 299 ± 16 %). The time of 30 meters dash in exercise group was significantly improved after UST ( $p = .047$ , pre 5.38 ± 0.3 s vs. post 5.27 ± 0.27 s). No significant differences were found in control group ( $p = 0.17$ , pre 5.45 ± 0.21 s vs. post 5.61 ± 0.38 s). The vertical jump height in exercise group was significant increased after UST ( $p = .008$ , pre 30.88 ± 3.82 cm vs. post 32.1 ± 4.2 cm), but no significant difference in control group ( $p = 0.405$ , pre 31.08 ± 2.12 cm vs. post 30.36 ± 3.19 cm).

**CONCLUSIONS:** Six weeks UST could improve the dynamic balance, vertical jump and 30 meters dash performance in adolescent female soccer players. Incorporation of UST into the routine training of female adolescent soccer players is important for the development of sports fitness and possibly exercise performance.

3177 Board #46 June 2 8:00 AM - 9:30 AM  
**Heart rate Variability, Stress Tolerance and Performance Outcomes to Intensification and Tapering in Soccer Players**  
 Luiz Claudio Reeberg Stanganelli, Diego H. Figueiredo, Diogo H. Figueiredo, Helcio R. Goncalves. *State University of Londrina, Londrina-Parana, Brazil.*  
*(No relevant relationships reported)*

**PURPOSE:** The aim of this study was to examine the effect of intensification weeks (IT) followed by a 1-week tapering (TP) phase leading up to a major competition, on heart rate variability (HRV), stress tolerance (ST) measures, and physical performance in sixteen male U19 soccer players.

**METHODS:** The study comprised 1 baseline week, 2 weeks of intensified training followed by a 1-week taper. Daily measures of HRV, ST (DALDA questionnaire) and internal training load (ITL) were collected through the training phases. Mean values of  $\ln\text{RMSSD}$  ( $\ln\text{RMSSD}_{\text{mean}}$ ) and the coefficient of variation ( $\ln\text{RMSSD}_{\text{cv}}$ ) were determined on a weekly basis for each training phase. At the end of each training phase, the athletes performed the Yo-Yo Intermittent Recovery level 1 (Yo-Yo IR1) test, Counter movement jump, Squat jump, speed tests and a running anaerobic sprint test (Rast test).

**RESULTS:** A decrease in  $\ln\text{RMSSD}_{\text{mean}}$  with an increase in  $\ln\text{RMSSD}_{\text{cv}}$  were observed during the IT with an opposite response observed during TP. No difference was found for the Rast test among training phases ( $p>0.05$ ). During IT all remaining performance variables decline ( $p>0.001$ ) with a supercompensation during TP ( $p>0.001$ ). A decrease in stress tolerance were found during IT ( $p>0.001$ ) with a reduction during TP ( $p>0.001$ ).

**CONCLUSIONS:** The present results suggest that decreases in vagal-related HRV with greater daily fluctuations during peak volume-based training loads may be a sign that the athletes are not 'coping' with the applied training load and may reflect the initial stage of physiological stress.

### G-37 Free Communication/Poster - Training

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
 Room: CC-Hall B

3178 Board #47 June 2 8:00 AM - 9:30 AM  
**Training Strategies Maintain Performance Characteristics in Marines Selected for Marine Corps Special Operations Individualized Training Course**  
 Scott D. Royer<sup>1</sup>, Joshua D. Winters, FACSM<sup>1</sup>, Kathleen Poploski<sup>1</sup>, John Abt, FACSM<sup>1</sup>, Andrejs Zalaiskalns<sup>2</sup>, Scott Lephart, FACSM<sup>1</sup>. <sup>1</sup>*University of Kentucky, Lexington, KY.* <sup>2</sup>*United States Marine Corps Forces Special Operations Command, Camp Lejeune, NC.* (Sponsor: John Abt, FACSM)  
*(No relevant relationships reported)*

Marines must complete an intensive Assessment and Selection (A&S) course prior to becoming a United States Marine Corps Forces Special Operations Command (MARSOC) Raider. Following selection, Marines are given training recommendations designed to maintain performance characteristics deemed relevant to successfully complete a rigorous nine-month Individualized Training Course (ITC). However, the time between the two courses is highly variable and training strategies are individually implemented by the Marine. **PURPOSE:** To evaluate the effectiveness of current training strategies following A&S and prior to ITC. **METHODS:** Fat free mass (FFM), fat mass (FM), anaerobic power (AP), anaerobic capacity (AC), aerobic capacity ( $\text{VO}_{2\text{max}}$ ), knee flexion (KF), knee extension (KE), shoulder internal rotation (SIR), shoulder external rotation (SER), trunk extension (TE) and trunk flexion (TF) isokinetic strength were collected on 27 Marines (Age:  $25.6 \pm 2.9$  years, Height:  $1.78 \pm 0.05$  meters, Mass:  $83.0 \pm 8.4$  kg, Post A&S to ITC Start:  $183.8 \pm 68.2$  days) following A&S and directly prior to ITC. **RESULTS:** No significant changes were found in Marines between A&S and the start of ITC in FFM ( $p=0.852$ ), FM ( $p=0.119$ ), AP ( $p=0.569$ ), AC ( $p=0.388$ ),  $\text{VO}_{2\text{max}}$  ( $p=0.594$ ), KF ( $p=0.855$ ), KE ( $p=0.843$ ), SIR ( $p=0.868$ ), SER ( $p=0.710$ ), TE ( $p=0.590$ ), and TF ( $p=0.971$ ). **CONCLUSION:** Performance characteristics were similar following selection and prior to the start of ITC, suggesting the current training strategies, as implemented and adopted for the varying time gaps post A&S, were effective at maintaining performance between courses. Although effective at sustaining performance levels, Marines still demonstrated deficits in AP ( $13.0$  W/kg vs  $12.65$  W/kg respectively) compared to previous studies on MARSOC Raiders. Future training strategies may further benefit from an increased emphasis on AP in conjunction with current recommendations. Additionally, further research is needed to determine how performance characteristics are affected by variance in time between courses.

3179 Board #48 June 2 8:00 AM - 9:30 AM  
**The Influence Of Four-week Of Endurance Training With Periodic CO Inhalation On Aerobic Capacity**  
 Jun WANG, Yang HU. *Beijing Sport University, Beijing, China.*  
*(No relevant relationships reported)*

**PURPOSE:** Altitude training is commonly used to enhance aerobic capacity in competitive athletes. The rationale is hypoxic stimulation of EPO to raise blood Hb mass and concentration and therefore also  $\text{O}_2$  transport capacity. We hypothesized that periodic inhalation of low levels of CO at sea level might be an easier method to achieve the same outcome. **METHODS:** 12 non-smoking male well trained football players volunteered to participate in this study. In a preliminary experiment in resting subjects, the concentrations of CO in exhaled gas and of CO and EPO in venous blood were measured before and then at 1h, 2h, 4h, 6h, 8h after inhaling a bolus of CO (1ml/kg BW) through a spirometer. For the main experiment, the subjects were divided into two groups (one group given inhaled CO (INCO) and a control group not given CO (NOCO)). All subjects participated in a four-week treadmill training program, running for 50 minutes at a speed of 90% of that producing each individual ventilation threshold, 3 times a week for 4 weeks. Prior to each training session, INCO inhaled a mix of CO (1ml/kg BW) and  $\text{O}_2$  (4L) over two minutes, while NOCO inhaled a bolus of  $\text{O}_2$  (4L) over two minutes. Before and after 4 weeks of training, total hemoglobin mass (tHb), blood parameters (RBC, Hct, [Hb], MCV), and  $\text{VO}_{2\text{max}}$  were measured.

**RESULTS:** In the first experiment, HbCO% increased from 0.7% to 5.81% ( $p<0.05$ ) 1 hr after CO inhalation, decreasing gradually to 1.48% after 8 hours; EPO increased significantly 2 hours ( $p<0.05$ ) after CO inhalation, peaking ( $42.3\%$  higher than pre  $1.912$  mIU/mL) at 4 hours, and then decreasing gradually at 6 ( $2.465$  mIU/mL) and 8 hours ( $1.759$  mIU/mL); (2) tHb and  $\text{VO}_{2\text{max}}$  in INCO increased significantly after training (5.9% higher and 6.7% respectively, each  $p<0.05$ ). However there were no such changes in NOCO; Oxygen uptake at a given submaximal intensity declined slightly both in INCO and NOCO, with the changes being more obvious in INCO. At 8, 10, 12km/h,  $\text{VO}_2$  decreased by 7.08%, 2.13% and 3.43% respectively in INCO and by 1.56% ( $p=0.057$ ), 5.74% ( $p=0.081$ ) and 0.66% ( $p=0.059$ ) in NOCO. **CONCLUSIONS:** Circulating EPO increases sharply after a bolus of CO (1ml/kg BW), peaking at 4 hours after inhalation; Endurance training with CO inhalation increases tHb and  $\text{VO}_{2\text{max}}$  and slightly reduced the energy cost of submaximal running.

3180 Board #49 June 2 8:00 AM - 9:30 AM  
**Prescription of Dry-land Resistance Training by Elite Swimming Strength and Conditioning Coaches.**  
 Emmet Crowley, Andrew J. Harrison, Mark Lyons. *University of Limerick, Ireland, Limerick, Ireland.* (Sponsor: Giles Warrington, FACSM)  
*(No relevant relationships reported)*

**Purpose:** No research to date has investigated the current practice of prescription of dry-land resistance training by elite swimming strength and conditioning (S&C) coaches. The aims of this study were to examine the prescription of dry-land resistance training modalities and exercises among elite swimming S&C coaches and explore coach's rationale and justification for prescribing dry-land resistance training modalities and dry-land exercises. **Methods:** Twenty-three ( $n = 21$  males,  $n = 2$  females) elite swimming strength and conditioning coaches from Ireland ( $n = 7$ ), Great Britain ( $n = 5$ ), Australia ( $n = 6$ ) and the United States ( $n = 5$ ) were recruited through their specific national governing bodies. Coaches completed an online questionnaire consisting of seven sections; participant information, informed consent, coach's biography, coach education, current training commitments, dry-land resistance training modalities exercises and additional information. **Results:** Results showed that coaches had varying levels of experience, education and worked with swimmers at regional (4.6%), national (59.1%) and international (36.4%) levels. The most popular S&C accreditations were; National S&C Association (29.2%), United Kingdom S&C Association (22%) and Australian S&C Association (7.3%). S&C coaches reported that their primary sources of information were their own experience (52.4%), S&C coaches (14.3%) and academic journals (9.5%). In total four different resistance training modalities were reported and these included 95 dry-land resistance training exercises. **Conclusion:** Traditional resistance training was the most commonly practiced dry-land training modality with the pull up and squat reported as the most popular exercises prescribed by elite swimming S&C coaches. Future research should focus on exploring the specificity and transfer of specific exercises to swimming performance. This study highlighted that coaches need to have a clear understanding of the mechanisms that occur during sport specific movements such as swimming. Furthermore, there is a need for coaches to perform detailed needs analysis before prescribing dry-land resistance training programs as aquatic sports provide a unique challenge to the S&C coach.

3181 Board #50 June 2 8:00 AM - 9:30 AM  
**Changes in Muscular Strength and Endurance Following Various Resistance Training Frequencies and Protocols in Untrained Females**  
 Murat Karabulut<sup>1</sup>, P. Gage Murphy<sup>1</sup>, Ulku Karabulut<sup>1</sup>, Michael G. Bemben, FACSM<sup>2</sup>. <sup>1</sup>University of Texas Rio Grande Valley, Brownsville, TX. <sup>2</sup>University of Oklahoma, Norman, OK.  
 (Sponsor: Michael G. Bemben, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** To determine the impact of various resistance training protocols and frequencies on isometric and isokinetic strength and endurance in sedentary and recreationally active females.

**METHODS:** Forty-six female subjects (age= 22.7±4.1) were randomly assigned to one of four groups that trained the knee flexors and extensors for 6 weeks. Training groups included a traditional group (TRAD) [3 sets (10, 10, 10 reps), 3x/wk at 70-80% of one repetition maximum (1RM)], two blood flow restriction groups [(BFR-1) 4 sets (30, 15, 15, failure), 1x/wk at 20-50% 1RM; and (BFR-2) 4 sets (30, 15, 15, failure), 2x/wk at 20-50% 1RM], and a one set to failure group (FAIL) [1x/wk at 75-80% 1RM]. Subjects fasted (for at least 8 hours) and were hydrated for pre and post testing sessions that included assessing isometric maximum voluntary contraction (MVC) of the knee extensors (60° of knee joint flexion), 10 repetitions of isokinetic knee extensions at 60°/s (ISO-60), and 10 reps at 180°/s (ISO-180), and 50 maximal knee extensions (50 REP) at 180°/s.

**RESULTS:** One-way ANOVA found no between-group differences in any of the outcome measures of interest at baseline. Repeated measures ANOVA found a significant time main effect for MVC ( $p < 0.01$ ). There was also a significant time main effect ( $p < 0.01$ ) and time\*condition interaction ( $p < 0.05$ ) for ISO-60 as well as a significant time main effect ( $p < 0.01$ ) for ISO-180, with post torque values being greater than baseline. There was a significant time\*condition interaction ( $p < 0.04$ ) for percent decline in torque for the 50 REP test. All training groups had increases in strength (peak torque) following each training program, but the TRAD group had greater percent declines in torque from the average of first 3 reps to last 3 reps of the 50 contraction test on the posttest compared to the pretest (58% pre-training vs. 60% post-training) while the BFR-1 groups improved their ability to maintain torque over the 50 reps (63% pre-training vs. 59% post-training).

**CONCLUSIONS:** Findings indicate that the FAIL, BFR-1, and BFR-2 training programs can be as effective as the TRAD training program to improve isometric and isokinetic strength, but the BFR-1 group appeared to be able to maintain muscular endurance better than the TRAD group.

3182 Board #51 June 2 8:00 AM - 9:30 AM  
**The Relationship Between Macronutrient Consumption and an Off-Season Training Program in Female Athletes**  
 Yvette Figueroa<sup>1</sup>, Arlette Perry, FACSM<sup>2</sup>. <sup>1</sup>Augusta University, Augusta, GA. <sup>2</sup>University of Miami, Coral Gables, FL.  
 (No relevant relationships reported)

Sports performance and training are impacted by energy provisions. Adequate caloric and carbohydrate intakes are necessary for positive adaptations to exercise training, yet there is limited research examining dietary intake in relation to strength and power in female athletes. **PURPOSE:** To determine whether there are significant changes in weekly total caloric and macronutrient consumption, strength, and power and to determine whether changes in caloric and macronutrient consumption are significantly and positively related to changes in strength and power across a controlled eight-week, off-season resistance training program. **METHODS:** Eleven female volleyball players were examined on macronutrient consumption, strength, and power every two weeks over a period of eight weeks. A total of 5 assessments were conducted per subject. Anthropometric measures were taken to evaluate pre- and post-test measures of body mass index (BMI), lean body mass (LBM), and body fat (BF) percentage. Macronutrient consumption was measured using a three-day food log. Strength was assessed using a 3-repetition maximum (RM) bench press for upper body strength and a 3-RM back squat for lower body strength. A vertical jump was used to assess lower body power. Repeated-measures ANOVA and weighted regression analysis was used to compare assessments across time. **RESULTS:** Back squat and vertical jump significantly increased across the training program ( $p < 0.05$ ). Changes in caloric and carbohydrate intake were significantly related to the changes in vertical jump ( $p < 0.05$ ). Significant improvements were seen in BMI, LBM, and BF percentage ( $p < 0.05$ ). Bivariate correlations showed significant inverse relationships between pre-test BMI and pre-test caloric intake ( $p < 0.05$ ), as well as between post-test LBM and post-test carbohydrate intake ( $p < 0.05$ ). **CONCLUSION:** Changes in caloric and carbohydrate intake positively contribute to lower body strength and power in female athletes.

3183 Board #52 June 2 8:00 AM - 9:30 AM  
**Cardiometabolic Responses Of Body-weight Exercises With And Without Vibration**  
 Jie Kang, FACSM, Nicholas A. Ratamess, Jeremy Kuper, Elizabeth O'Grady, Nicole Ellis, Ira Vought, Jill A. Bush, FACSM, Avery D. Faigenbaum, FACSM. *The College of New Jersey, Ewing, NJ.*  
 (No relevant relationships reported)

**Purpose:** This investigation examined cardiometabolic responses of body-weight (BW) exercises with and without concurrent vibration. **Methods:** Eight men and six women performed a BW exercise protocol either on the floor (BW-V) or with a vibration platform (BW+V) in a randomized order. The BW exercise protocol consisted of three circuits of eight calisthenics-based exercises performed using Tabata intervals. Vibratory frequency and amplitude were set at 40 Hz and 4 mm, respectively. Oxygen uptake ( $\dot{V}O_2$ ), heart rate (HR), expired ventilation ( $\dot{V}_E$ ), and respiratory exchange ratio (RER) were measured throughout the protocol and during 30 min recovery. Blood lactate concentrations ([La]) were determined at rest and at the end of BW-V and BW+V. **Results:** The mean ( $\pm$ SE)  $\dot{V}O_2$  reached 22.11 ( $\pm 0.51$ ) and 23.28 ( $\pm 0.82$ ) ml·kg<sup>-1</sup>·min<sup>-1</sup> or 48% and 50% of  $\dot{V}O_{2max}$  in BW-V and BW+V, respectively. The mean HR reached 156.63 ( $\pm 4.15$ ) and 162.22 ( $\pm 4.40$ ) beats·min<sup>-1</sup> or 80% and 83% of HRmax in BW-V and BW+V, respectively. During the protocol, while the mean  $\dot{V}_E$  was greater ( $p = 0.031$ ) in BW+V than BW-V, no differences were seen for  $\dot{V}O_2$ , RER, and HR between the two conditions. During recovery, while mean  $\dot{V}O_2$  was greater ( $p = 0.002$ ), and RER was lower ( $p = 0.033$ ) in BW+V than BW-V, no differences were seen for  $\dot{V}_E$  and HR between the two conditions. [La] were significantly elevated, but remain similar between the two conditions. **Conclusion:** Performing three circuits of eight BW exercises using Tabata intervals produces a sufficient increase in cardiometabolic responses. Metabolic potentiation associated with combining vibration with BW exercises seems to be influenced by how the exercises were carried out on a vibration platform.

3184 Board #53 June 2 8:00 AM - 9:30 AM  
**Single-joint Eccentric Knee Extension Training Induces Selective Hypertrophy: A Potential Preventive Measure Against Strain Injuries**  
 Sumiaki Maeo<sup>1</sup>, Xiyao Shan<sup>1</sup>, Shun Otsuka<sup>1</sup>, Hiroaki Kanehisa<sup>2</sup>, Yasuo Kawakami<sup>1</sup>. <sup>1</sup>Waseda University, Tokorozawa, Japan. <sup>2</sup>National Institute of Fitness and Sports in Kanoya, Kanoya, Japan.  
 (No relevant relationships reported)

It is known that eccentric muscle action-induced strain injuries during sports activities (e.g. American football, soccer, etc.) often occur in the rectus femoris (RF). By using magnetic resonance imaging (MRI)-based transverse relaxation time ( $T_2$ ) as an index of exercise-induced muscle edema, we recently reported that acute (unaccustomed) single-joint eccentric knee extension exercise specifically induced muscle damage in RF. **PURPOSE:** To test hypotheses that 1) single-joint eccentric knee extension training would induce greater hypertrophy in RF than its synergists, and 2) training-induced changes in muscle activity [i.e. increased electromyogram (EMG) amplitude] would be also greater for RF. **METHODS:** Twelve young males conducted single-joint isokinetic (180°/s) maximal eccentric contractions of the knee extensors 5-10 repetitions/set, 6 sets/session (3-5 sets in the initial 1-3 sessions), 2 sessions/week for 10 weeks. MRI-based anatomical cross-sectional area (ACSA) and  $T_2$  of the quadriceps muscles [RF, vastus lateralis (VL), vastus medialis (VM) vastus intermedius (VI)] and EMG of the superficial muscles (RF, VL, VM) were measured weekly throughout the training period and pre- and post-training. Whole muscle volume of each muscle was also assessed pre- and post-training. **RESULTS:** ACSA significantly ( $P < 0.05$ ) increased after week (W)4 or W9 in RF, VL, and VI but not in VM, without significant  $T_2$  changes in all muscles throughout. Percentage change (% $\Delta$ ) in muscle volume was significantly ( $P = 0.01-0.02$ ) greater for RF (7.3  $\pm$  4.5%) than VM (3.7  $\pm$  2.9%) and VL (2.9  $\pm$  3.0%). Agonist EMG amplitude significantly ( $P < 0.05$ ) increased after W4 or W7 in all muscles, without significant differences in % $\Delta$  among muscles ( $P = 0.292$ , RF: 58.8  $\pm$  35.0%, VL: 64.4  $\pm$  62.0%, VM: 91.9  $\pm$  97.3% at post). **CONCLUSIONS:** These results suggest that single-joint eccentric knee extension training induces greater hypertrophy in RF, while increases in muscle activity (i.e. neural adaptations) are similar among the synergists. Single-joint eccentric knee extension training would be a strong preventive measure against strain injuries in RF. Supported by JSPS KAKENHI (JP15J03228).

- 3185 Board #54 June 2 8:00 AM - 9:30 AM  
**Evaluation Of The LaxPrep ACL Injury Prevention Program**  
 Kelly Comolli<sup>1</sup>, Andrew E. Lincoln<sup>2</sup>, Lisa Hepburn<sup>2</sup>, Justin Cooper<sup>2</sup>, Carissa Colangelo<sup>2</sup>, Bruce Griffin<sup>3</sup>. <sup>1</sup>Georgetown University School of Medicine, Washington DC, DC. <sup>2</sup>MedStar Health, Baltimore, MD. <sup>3</sup>US Lacrosse, Sparks, MD.  
 (No relevant relationships reported)

**Title:** Evaluation of the LaxPrep ACL Injury Prevention Program  
 Neuromuscular-based warm-up programs are effective at reducing risk of lower extremity injury, but more research is needed on the perspective of the program instructor. LaxPrep is a lacrosse-specific, progressive 3-phase program that combines neuromuscular control, core strength, and balance training. Each phase features a series of 9-10 exercises that are to be practiced 2-3 times per week for a period of 3-6 weeks. Resistance bands are implemented in advanced phases of the program. The online training is based on the US Lacrosse website and takes 45-60 minutes to complete.

**PURPOSE:** To characterize respondents who completed and implemented the LaxPrep training, which program phase was reached, and common barriers to implementation.

**METHODS:** A web-based survey (Tonic Health) was created and sent to 390 trainees who completed the online education course and intended to implement the LaxPrep program with their team.

**RESULTS:** 64 trainees (16%) responded to the survey. They included coaches, athletic trainers, and others for youth, high school, and college athletes across 27 states. 28% of respondents completed Phase 1, 28% completed Phase 2, 25% completed Phase 3, and 19% did not implement the program. Program instructors for youth teams cited 2 barriers to full implementation: the inability of young athletes to perform some of the exercises in advanced phases, suggesting the need for age-specific programs; and the accessibility and expense of resistance bands. High school and collegiate players were not as willing as youth players to participate and implement the program.

**CONCLUSION:** Challenges to program implementation were associated with the team's age group and included finding practice time, athlete willingness, and resistance band expense. These observations support the implementation of age-specific neuromuscular-based warm-up programs, starting at the youth level.

**FUNDING:** This research was supported by the US Lacrosse Center for Sport Science and the Georgetown University School of Medicine's MedStar Health Research Scholarship.

- 3186 Board #55 June 2 8:00 AM - 9:30 AM  
**The Effects Of A Shoulder Stretching And Strengthening Intervention On Shoulder Benchmarks And Disability In Collegiate Softball Players**  
 Alicia M. Montalvo<sup>1</sup>, Brianne Kimura<sup>2</sup>. <sup>1</sup>Florida International University, Miami, FL. <sup>2</sup>Wake Forest University, Winston-Salem, NC. (Sponsor: Greg Myer, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** To investigate the effects of a shoulder strengthening and stretching program on shoulder internal rotation (IR) and shoulder external rotation (ER) range of motion, throwing speed, and disability in collegiate softball players. **METHODS:** Eighteen Division I softball players (age=19.5±1.3 yrs, height=65.3±2.6 in, weight=148.4±20.8 lbs) completed a four week arm care intervention two to three days per week before practice during the pre-season. The intervention consisted of two sets of eight repetitions of five resistance band exercises (shoulder horizontal abduction, shoulder scaption-flexion, shoulder extension, and shoulder IR and ER in abduction) and three sets of a 30 second shoulder IR stretch (sleeper stretch). Bilateral shoulder IR and ER were measured by cell phone inclinometer app, throwing speed was measured by radar gun, and shoulder disability was measured by the Disability of Arm, Shoulder, and Hand form. All outcomes were measured at pretest and posttest. Paired t-tests were used to compare athletes at pretest and posttest and significance was established at p<0.05. **RESULTS:** The mean overall compliance rate was 95.3%±12.4. The maximum compliance rate was 100% (n=14). The minimum compliance rate was 50% (n=1). Dominant shoulder IR increased significantly (54.7±13.6° vs 60.7±12.3°, p=0.011) and throwing speed decreased significantly (53.4±4.4 mph vs 51.8±4.3 mph, p=0.005) from pretest to posttest. There were no changes in non-dominant shoulder IR (67.6±12.8° vs 74.9±15.1°, p=0.052), dominant shoulder ER (90.9±14.8° vs 86.9±16.2°, p=0.481), non-dominant shoulder ER (83.9±12.7° vs 86.1±11.6°, p=0.413), or shoulder disability (9.1±5.7 vs 12.7±10.4, p=0.871) from pretest to posttest. **CONCLUSION:** The sleeper stretch increased shoulder IR without changing shoulder ER. Four weeks' time may have been insufficient to increase strength in the newly acquired shoulder range of motion, which may have resulted in a decrease in throwing speed. Disability did not change following the intervention, though disability may have been low at the start of the pre-season.

- 3187 Board #56 June 2 8:00 AM - 9:30 AM  
**Salivary Testosterone-to-Cortisol Ratio in Collegiate Gymnasts over a Competitive Season**  
 Scott K. Crawford, Jessica L. Calvi, Jack W. Ransone, FACSM.  
 University of Nebraska-Lincoln, Lincoln, NE.  
 (No relevant relationships reported)

Scant empirical literature can be found regarding female gymnasts' physiological hormonal responses to training and competition, especially at the collegiate level. **PURPOSE:** To understand the long-term physiological effects of a full competitive season of NCAA Division-I female gymnasts on hormonal responses. **METHODS:** Participants were 8 female athletes (ages 18-22) on the active roster of a university women's gymnastics team. Saliva samples were taken approximately 24 hours pre-competition at approximately the same time of day as schedules permitted. Saliva samples were collected via unstimulated passive drool. Salivary cortisol (C) and testosterone (T) concentration levels were determined using an enzyme immunoassay kit (Salimetrics, State College, PA, USA). Given the nested nature of the data, hierarchical linear regression models examining individual-level and team-level variables on testosterone:cortisol ratio (T:C) were conducted. **RESULTS:** The initial, simplified model indicated that T:C decreased over a competitive season ( $p = 0.003$ ). Specifically, it was observed that T did not change over the competitive season, but C significantly increased. To examine alternative predictors over the season, other variables were examined in a second model, namely the number of events in which an athlete competed and whether the competition was a conference or non-conference competition. Conference competitions predicted significantly higher T:C than non-conference competitions ( $p < 0.001$ ), and the number of events in which individuals competed predicted significantly higher T:C ( $p = 0.001$ ). Surprisingly, the interaction between time and conference showed a significant decrease in T:C ( $p < 0.001$ ), and the main effect of time became non-significant ( $p = 0.186$ ). **CONCLUSION:** This is the first study of its kind to examine hormonal changes over a competitive season in female gymnasts. These findings indicate that the athletes had significant increases in cortisol without a corresponding increase in testosterone throughout the season, resulting in a decreased anabolic-catabolic balance. This perhaps contributed to an overtrained state as the season progressed. Further research should be conducted with this athlete population to optimize training and competition stress and recovery periods.

- 3188 Board #57 June 2 8:00 AM - 9:30 AM  
**The Effects Of The Alchemy Philosophy On Cardiovascular Health, Flexibility, And Strength**  
 Chloe Tuma, Lana Prokop, Mark Blegen, FACSM, Joshua Guggenheimer. St. Catherine University, St. Paul, MN.  
 (No relevant relationships reported)

Various styles of fitness training target different aspects of health. By utilizing different modalities of fitness, overall health can be improved. Alchemy is a relatively new type of exercise class that offers a blend of flexibility, strength, and cardiovascular training in a group fitness setting. Little research has been done to examine the effectiveness of the Alchemy approach on fitness outcomes. **PURPOSE:** To examine the effects of eight weeks of Alchemy training on flexibility, strength, and cardiovascular performance in healthy adults. **METHODS:** 12 men and 20 women were recruited to participate in this study. The pre-intervention protocol included testing peak torque of the knee joint and examining the strength of the hamstrings and quadriceps. A Vo2max test was completed to examine cardiovascular health. Flexibility was tested by examining ROM of hip flexion, ankle arc flexion, knee hyperextension, and closed dorsiflexion. Participants height and weight were also recorded. The eight-week intervention instructed participants to attend at least two Alchemy classes per week. All classes include disciplines of yoga, strength and cardiovascular training. After the intervention, participants return for post-intervention testing to examine changes in fitness areas. **RESULTS:** 32 participants (age 31.7 ± 8.9 yrs, weight 67.9 ± 13.4 kg, height 168.2 ± 7.5 cm) completed a battery of fitness tests, which included average peak torque (APT) of the quadriceps and hamstrings of both legs (APT right extension 106.7 ± 26.6, APT left extension 105.4 ± 24.3, APT right flexion 53.8 ± 14.8, APT left extension 50.9 ± 13.3). Mean Vo2max was 50.1 ± 10.5. Flexibility as measured by right and left hip flexion, right and left ankle arc, right and left closed dorsiflexion, and right and left knee hyperextension, was 106.1 ± 13.12, 106.5 ± 13.9, 74.8 ± 10.8, 78.5 ± 10.8, 35.2 ± 5.4, 34.1 ± 6.2, 7.9 ± 2.6, 8.3 ± 3.0, respectively. **CONCLUSIONS:** These results suggest that the participants are in good physical health, which may lead to small changes from an Alchemy-based training intervention. However, there did appear to be a bilateral discrepancy in quadricep and hamstring torque production which may be worth further examination in the future.

3189 Board #58 June 2 8:00 AM - 9:30 AM  
**Muscle Activation of Palmaris Longus and Flexor Carpi Radialis Muscles in Different Rock Climbing Holds**  
 Kacey Savage, Kade Worton, Nathan Stevenson, Austin Jensen, Devin Ashby, Ellis Jensen. *Utah Valley University, Orem, UT.*  
*(No relevant relationships reported)*

Rock climbing is a popular sport with very dedicated athletes and fan base. Climbing performance, especially for new climbers, should increase when climbers develop the appropriate muscle strength to execute a variety of different climbing holds. **PURPOSE:** This study investigated which of four popular rock-climbing holds caused the greatest recruitment of the Palmaris Longus (PL) and the Flexor Carpi Radialis muscles (FCR). **METHODS:** Muscle activation was measured in eleven experienced rock climbers: seven males and four females. Electromyography (EMG) sensors were placed on PL and FCR muscles. Participants performed four different types of rock climbing holds in random order. The PL activation, in all holds, was greater than the FCR activation. **RESULTS:** The Sloper hold caused greater PL activation than the Jug, Crimp, or Pinch holds as well as greater activation for the FCR in the Crimp and Pinch holds.

Muscle Activation While Performing Climbing Holds				
Muscle Type	Climbing Hold Type			
	SLOPER	JUG	PINCH	CRIMP
Palmaris Longus m.	108.468	69.7*	77*	82.243*
Flexor Carpi Radialis m.	26.1	19.6	13.7*	13.53*
* = p<.05 compared to SLOPER in Palmaris Longus				
+ = p<.05 compared to SLOPER in Flexor Carpi Radialis				

**CONCLUSION:** Developing rock climbers should be able to increase their physical capacity to climb more quickly if they supplement their training with exercises aimed at increasing the strength and endurance of their PL muscle as it is highly recruited when executing holds. Ability to climb more difficult routes may advance quickly by training the Sloper hold as its performance required the greatest recruitment of both the PL and FCR muscles.

3190 Board #59 June 2 8:00 AM - 9:30 AM  
**Intra-day And Inter-day Reliability Of A Combined Pre-planned And Reactive Agility Protocol**  
 Khalil A. Lee<sup>1</sup>, Justina L. Bonsignore<sup>1</sup>, Timothy J. Roberts<sup>1</sup>, Lindsay B. Baker, FACSM<sup>2</sup>, Melissa L. Anderson<sup>1</sup>. <sup>1</sup>*Gatorade Sports Science Institute, Bradenton, FL.* <sup>2</sup>*Gatorade Sports Science Institute, Barrington, IL.*  
*(No relevant relationships reported)*

**PURPOSE:** To evaluate the reliability of a novel agility protocol using a wireless light system, consisting of pre-planned and reactive agility components. **METHODS:** Seventeen male athletes (19 ± 1 yrs; 85.1 ± 9.4 kg) completed 3 sessions, each separated by 3-7 days. Each session consisted of a standardized warm-up followed by 5 trials of the protocol, assessing time to complete each trial. Subjects reported to the laboratory at the same time of day for all 3 sessions to avoid differences in circadian rhythm. Pre-trial urine specific gravity measurements, 24-h dietary recalls (to assess macronutrient intake), and visual analogue ratings (to assess physical and mental fatigue) were measured, and results suggested no baseline differences between sessions (p>0.05, ANOVA). A two-way (day x trial) repeated measures ANOVA was used to assess differences in completion times, followed by Tukey's post hoc test where main effects were found. Reliability was determined using coefficient of variation (CV). **RESULTS:** Main effects were evident for day (p<0.0001) and trial (p<0.0001), yet no interactions were present. Post-hoc results revealed significantly slower completion times during day 1 (27.76 ± 1.33 sec), but no significant difference between day 2 (27.17 ± 1.38 sec) and day 3 (27.13 ± 1.18 sec). Completion times (intra-day) were significantly slower during trial 1 (28.07 ± 1.26 sec) and trial 2 (27.49 ± 1.37 sec), but no differences existed between trials 3, 4, and 5 (27.25 ± 1.30 sec, 26.91 ± 1.27 sec, and 27.04 ± 1.16 sec, respectively). The reliability analyses suggested a high consistency (for mean of trials 3-5) within each day (CV = 2.2%, 2.2%, and 1.3% for days 1, 2, and 3, respectively) as well as between days 1-3 (CV = 1.8%). **CONCLUSIONS:** The evaluated protocol is a reliable tool that may be used for future research investigating agility performance. An initial familiarization session is warranted, followed by a minimum of two familiarizations (or warm-up trials) prior to performing an initial test trial in each successive visit. This study was funded by the Gatorade Sports Science Institute. The authors are employed by the Gatorade Sports Science Institute, a division of PepsiCo, Inc. The views expressed in this abstract are those of the authors and do not necessarily reflect the position or policy of PepsiCo, Inc.

3191 Board #60 June 2 8:00 AM - 9:30 AM  
**Effects of Manipulating Stride Length on Ground Reaction Form and Wrist Velocity During Baseball Pitching.**  
 Kevin Ritsche, Garrison Roy, Wendt Christopher, Kurt Kornatz. *Winston-Salem State University, Winston-Salem, NC.* (Sponsor: Michael McKenzie, FACSM)  
*(No relevant relationships reported)*

**PURPOSE:** Stride-leg ground reaction forces have been used to predict wrist velocity during baseball pitching and are likely influenced by stride length. The purpose of this study is to determine the effect of stride length on peak vertical ground reaction forces (Fzpeak) of the stride leg and wrist velocity in skilled baseball throwers. **METHODS:** Ten collegiate baseball pitchers (6 right-handed, 4 left-handed) completed one laboratory testing session in which they were instructed to throw a baseball as fast and accurately as possible. After a standardized warmup, a total of 15 throws (5 Normal-stride [NS], 5 Over-stride (NS +10% [OS]), and 5 Under-stride (NS -10% [US])) were performed on a dimensionally correct pitching mound equipped with a force platform (1200 Hz). Marker trajectory data (32 reflective markers) was tracked from 10 high-speed cameras at 240 frames/sec. Fzpeak was normalized for body weight (N/BW) and wrist velocity (m/s) was measured at ball release. **RESULTS:** When all stride lengths were combined, significant correlations were found between Fzpeak and wrist velocity (r=0.47; p<0.01). However there was no effect of stride length on either Fzpeak (NS=1.63±0.20, OS=1.59±0.19, US=1.60±0.22; p>0.05) or wrist velocity (NS=18.27±1.03, OS=17.95±1.00, US=18.12±0.85; p>0.05). **CONCLUSIONS:** These results confirm the relation between Fzpeak and wrist velocity. However, the data indicate that skilled throwers are able to compensate for changes in stride length up to 10% to maintain performance.

3192 Board #61 June 2 8:00 AM - 9:30 AM  
**Six-week Pilates Program Improves Postural Stability, Balance, And Isometric Back Strength In College-aged Athletes**  
 Melinda B. Smith, Tyler Mitcheltree, H. Scott Kieffer, FACSM, Douglas K. Miller. *Messiah College, Mechanicsburg, PA.* (Sponsor: Dr. Diane Gill, FACSM)  
*(No relevant relationships reported)*

Pilates training engages core musculature and utilizes controlled repetitions of various movements to improve muscular strength and endurance, flexibility, balance, and posture. Although a growing body of research identifies the benefits of Pilates training for middle-aged and older adults, little emphasis has been placed on evaluating athletic populations. **PURPOSE:** To determine the effects of a short-term Pilates training program on postural stability, balance and core isometric back strength in NCAA DIII and competitive club sport athletes. **METHODS:** The experimental group of 16 off-season college-aged female athletes participated in a supervised Pilates training program, which took place two times each week for six weeks. The 30-minute Pilates sessions consisted of body weight training that progressed to the incorporation of dumbbells. Pre- and post-test measurements were taken in three functional tests, which included Force Plate Tandem Balance (FPTB), Limits of Postural Stability (LPS), and Biering-Sorensen Back Extension (BSBE). A control group of 10 college students, who maintained their normal physical activities, but were not involved in the Pilates training program, completed pre- and post-testing for comparison. **RESULTS:** There were no significant differences between the experimental and control groups at baseline testing. The control group did not show any significant changes between pre- and post-test measurements. The experimental group decreased path length in the FPTB assessment (39.8 inches vs. 36.5 inches, p<0.05). The experimental group also exhibited significant improvement in postural control score on the LPS assessment (37.1 vs. 47.4, p<0.001). Finally, there was a significant increase in seconds held during the BSBE assessment among the experimental group (172.4 seconds vs. 187.7 seconds, p<0.05). **CONCLUSION:** A six-week progressive Pilates program contributed to significant decreases in single-foot sway, increases in postural stability, and increases in isometric back strength in female college-aged athletes.

3193 Board #62 June 2 8:00 AM - 9:30 AM

**Effect of Suspension Training on Selected Health Related Fitness and Functional Movement**

Kelsey D. Bryan, A Tamlyn Shields, Alex T. McDaniel, Rachel E. Williams, Ryan Swiezy, Adrian Gonzalez, Andrew L. Ortiz, Brad R. Hollingsworth, Sarah A. Noland, Christa Douros, Raechel M. Santee, Phillip V. Morie, Lauren A. Ackerman, Emma C. Schmid, Tiago V. Barreira, Wayland Tseh. *University of North Carolina Wilmington, Wilmington, NC.* (Sponsor: Robert Wilkes Boyce, FACSM)

(No relevant relationships reported)

Although body weight training is included in the 2017 ACSM Top Fitness Trends, there is relatively little research quantifying the effects of suspension training on health-related fitness and functional movement. **PURPOSE:** To examine the impact of suspension training on selected health-related fitness variables and functional movement. **METHODS:** Fifteen individuals (11 females; 4 males; Age = 22.2 ± 3.2 yrs; Height = 172.0 ± 11.4 cm; Body Mass = 69.8 ± 19.2 kg) in a suspension training course completed 11 workout sessions over a 6-week period. Throughout each 30-minute exercise session, six body positions were utilized across push, pull, rotational, squat and lunge movements. Pre- and post-health-related fitness assessments included body composition, muscular endurance, flexibility, and a functional movement screen. Dependent t-tests were used to determine if there were mean changes in health-related fitness and functional movement. Due to multiple comparisons, Bonferroni correction was used, therefore, alpha level was set at .008. Cohen's Delta effect size was calculated for functional movement. **RESULTS:** There were no significant changes in mean fat mass, percent body fat, and push-ups. There were, however, positive changes in mean lean body mass (55.5 ± 18.4 kg to 56.3 ± 18.6 kg), sit and reach (42.2 ± 8.5 to 45.5 ± 8.3 cm, p = .004), and functional movement screen score (15.7 ± 2.1 to 17.7 ± 2.0). A large effect size was present for functional movement (Cohen's Delta = 0.98). **CONCLUSION:** Suspension training had a significant impact on lean body mass, flexibility and functional movement in as few as 11 thirty-minute sessions.

3194 Board #63 June 2 8:00 AM - 9:30 AM

**The Effects of Ballistic Exercise on Cognitive Function**

Allan Shook, Joshua A. Logan, Toria A. Crispin. *Slippery Rock University, Slippery Rock, PA.*

(No relevant relationships reported)

A strong connection between physical activity and cognition has been well documented in health science. Prior research suggests a strong relationship between both aerobic exercise training and slow-controlled resistance training with improvements in cognitive function (CF). Little research exists on the influence of high-force production (ballistic) strength training on CF. **PURPOSE:** To determine the effects of ballistic strength training on CF in an apparently healthy, college-aged population. **METHODS:** 21 low-risk participants (age 18-25 years) who had refrained from any ballistic strength training for at least six months were recruited to the treatment group. 19 individuals (age 18-25 years) served as controls. Treatment and control groups continued previous aerobic and traditional (slow-controlled) resistance training during the study. Both groups completed congruent (CONG) and incongruent (INCONG) sections of The Stroop Test, and the Trail Making Test, Part B (TMT-B), at baseline, and eight weeks later. The Stroop Test assessed the number of correct answers on CONG and INCONG questions and the completion time of the test. The TMT-B measured the correct completion time of the test. The treatment group met twice weekly for eight weeks and completed a ballistic training protocol. Pre- and post-test comparisons within and between subjects on CF were assessed. **RESULTS:** Completion time for both CONG and INCONG sections of The Stroop Test significantly improved from baseline to post-test for all participants (1.65 ± 3.59, p = .006; 2.17 ± 4.60, p = .005, respectively); however, there was no significant difference in between groups (F = .921, p = .847; F = 2.696, p = .450, respectively). All participants significantly improved from baseline to post-test on the TMT-B (9.74 ± 10.48, p < .001); however, there was no significant difference between the treatment and control group from baseline to post-test (1.82 ± 3.08, p = .564). **CONCLUSION:** CF improved in the treatment and control group but was not statistically different. Future research could investigate if ballistic strength training influences CF in sedentary individuals.

3195 Board #64 June 2 8:00 AM - 9:30 AM

**The Effects of Pilates Training on Functional Movement Screen and Muscle Endurance for Cheerleaders**

Yu-chen Chung, Nai-Jen Chang. *Kaohsiung Medical University, Kaohsiung City, Taiwan.*

(No relevant relationships reported)

Pilates provides a way to train core muscles. However, most researches in Pilates focus on how Pilates releases back pain. Functional movement screen (FMS) is a simple tool to assess a player's movement dysfunction. Nevertheless, there is no related research to investigate the efficacy on movement change and trunk muscular endurance after Pilates training of cheerleading dancers. **PURPOSE:** To investigate cheerleading dancers' capability of movements and muscular endurance after eight-week Pilates training. **METHODS:** Thirty cheerleading dancers were divided randomly into two groups, training (TRN: n = 15) and control (CTL: n = 15). TRN group had a regular practicing program which includes Pilates training with a licensed Pilates instructor. This training course was held three times a week, 50 minutes each course, for a total of 8 weeks. On the contrary, CTL group only maintained regular practicing. Functional movement screen (FMS) was adopted to assess capability of movements and body asymmetry, which includes seven fundamental movements (deep squat, hurdle step (HS), active straight leg raise, in-line lunge (ILL), active straight leg raise, trunk stability push up (TSPU), and rotary stability (RS). The test trunk extension, plank, and side plank were adopted to measure isometric endurance of abdominal and trunk muscles. **RESULTS:** After 8-weeks training, TRN group had significant improvements in FMS, indicating in HS (pre-test: 2.00 ± 0.53 vs post-test: 2.73 ± 0.46, p < .001), TSPU (pre-test: 1.73 ± 0.46 vs post-test: 2.2 ± 0.41, p = .004), RS (pre-test: 2 vs post-test: 2.67 ± 0.49, p < .001), totally FMS scores (pre-test: 16.40 ± 1.24 vs post-test: 19.00 ± 1.13, p < .001). Furthermore, the asymmetrical ratio on HS and ILL were improved by 67% and 100%, respectively. However, CTL group obtained few improvements. Regarding trunk endurance, TRN group had significantly increased isometric contraction time on trunk extension (p = .025), plank (p = .001), and side plank (p = .007) compared to CTL group. **CONCLUSION:** Eight-week Pilates training can significantly enhance FMS scores (movement function) and improve body asymmetrical problem. Moreover, Pilates is also helpful for increasing isometric endurance of abdominal and trunk muscles.

3196 Board #65 June 2 8:00 AM - 9:30 AM

**Assessing Changes in Absolute and Relative One-repetition Maximum Bench Press After a Six-week Blindfolded Training**

Ali Boolani<sup>1</sup>, Masoud Moghaddam<sup>2</sup>, Timothy Baghurst<sup>3</sup>, Timothy Jones<sup>3</sup>, Essameldin Hamido<sup>3</sup>, Bert Jacobson, FACSM<sup>2</sup>. <sup>1</sup>Clarkson University, Potsdam, NY. <sup>2</sup>Oklahoma State University, Stillwater, OK. <sup>3</sup>Tennessee State University, Nashville, TN.

(Sponsor: Bert Jacobson, FACSM)

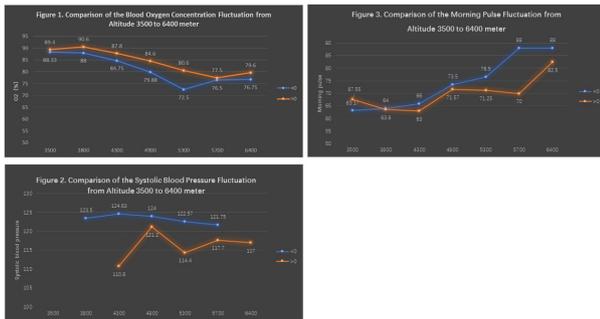
(No relevant relationships reported)

**PURPOSE:** This study investigated changes in one-repetition maximum (1-RM) strength on the bench press following 6 weeks of vision-deprived resistance training in college-aged individuals. **METHODS:** Fifty-three resistance-trained individuals (males = 40, females = 13; age = 19.67 ± 1.12; height = 174.25 ± 9.58 cm; weight = 85.89 ± 22.18 kg; body fat % = 13.98 ± 10.54) were recruited to participate in a 6-week resistance training intervention. Testing procedures were completed pre- to post-training intervention, including the 1-RM bench press and body composition using BODPOD. Participants were matched by 1-RM/lean mass relative bench press strength and randomly assigned to either the experimental (E) or control group (C). Both groups completed 3 sets of the following upper-extremity exercises: barbell bench press, lat pull-down, standing shoulder press, overhead triceps extension, and biceps curl) 2 days a week for 6-weeks. The experimental group performed the exercises blindfolded and the C group were visually unimpaired. The participants progressively increased the loads and decreased the repetitions every 2 weeks (weeks 1-2 = 12-15 reps; weeks 3-4 = 8-12 reps; weeks 5-6 = 6-8 reps). A repeated-measures ANOVA was used to assess changes in 1-RM bench press between the groups. **RESULTS:** Statistical analysis yielded a significant (p < .001) improvement in absolute (E pre = 73.9 ± 34.3 kg, post = 79.5 ± 33.8 kg, C pre = 84.2 ± 35.2 kg, post = 87.7 ± 35.93 kg), relative to body weight (E pre = 0.9 ± 0.3, post = 0.9 ± 0.3, C pre = 1.0 ± 0.4, post = 1.0 ± 0.4), and relative to lean mass (E pre = 1.1 ± 0.3, post = 1.2 ± 0.3, C pre = 1.1 ± 0.4, post = 1.2 ± 0.4) 1-RM bench press between the pre- to post-testing. However, there were no significant differences between groups (p > .05). **CONCLUSION:** Although there were no statistically significant differences between groups, there was a 7.6% change for the blindfold group compared to a 4.2% change for the blindfold group compared to the control group. The large standard deviations may explain why a statistical significance was not found. Further research needs to be conducted with better matching criteria.

3197 Board #68 June 2 8:00 AM - 9:30 AM  
**Cardiovascular Adaption From Altitude 3500-6400m Among Trekkers With Different Endurance Genotype Scores**

Yutao Du, Lei Kuang, Jun Cao, Meng Li. *Sport Genomics Institute, BGI, Shenzhen, China.*  
 (No relevant relationships reported)

**Purpose:** to explore if and how the endurance genotype score would affect the cardiovascular adaption under reduced oxygen caused by the altitude elevation.  
**Method:** All 9 trekkers who participated in a 8000 meter peak climbing is studied. Nine genes (ADRB2,AQP1,COL5A1,NRF2,HFE,KCNJ11,PPARD,UCP3,HIF1A) that reported to be associated with endurance performances were measured and the total genotype score were obtained by adding up the genotype score of each genes. The trekkers were divided into two groups according to their genotype scores as high endurance group (score>0) and low endurance group (score<0). We defined cardiovascular adaption as the changes of morning pulse, systolic blood pressure and blood oxygen concentration. These parameters for cardiovascular adaptions were measured every 300-400 elevation of the altitude from 3500 m to 6400 m. Mean changes for each of parameters were compared for the two groups during the whole course.  
**Results:** There were four trekkers in the low endurance group and five trekkers in the high endurance group (score: -2.5 vs.1.0). Due to small study sample, none of the comparison show statistical significance at 0.05 level. However, we were able to find that the high endurance score group maintained a higher blood oxygen level and smaller oxygen fluctuation as the altitude elevation. Though the systolic blood pressure showed higher fluctuation in the high endurance score group, mean systolic blood pressure were 3-13 mmHg lower at different altitudes. We also viewed that morning pulse increased as the altitude increased in both groups. However, compared to low endurance group, the mean pulses were lower for the high endurance group for each altitude from 3800m and above.  
**Conclusion:** Different genotypes scores may indicate different oxygen carrying and utilizing ability which resulted in different cardiovascular adaption manifestation among the trekkers.



3198 Board #67 June 2 8:00 AM - 9:30 AM  
**Optimal Load For High-Speed Exercise**

Ling Bai, Ema A. Selimovic, Rebecca Mueller, Samantha Beatty, Kathy A. Carter, Thorburn B. Symons, George Pantalos, John F. Caruso, 40292. *University of Louisville, Louisville, KY.*  
 (No relevant relationships reported)

**PURPOSE:** Identify an optimal load for knee extensions done on an exercise device called the Impulse (Impulse Technologies; Newnan GA).  
**METHODS:** Subjects (29 women, 15 men) made six laboratory visits. The first two visits entailed familiarization to the knee extension exercise. For their last four visits they did four 30-second knee extension sets with different loads (0, 3.4, 5.7, 8.0 kgs.) added to the Impulse weight sled per set. A Latin Squares design counterbalanced the set sequence, which limited the risk of an order effect and fatigue's impact on our results. Subjects rested 120 seconds between sets and were told to exert maximal effort. Average and peak force (AF, PF) data were each analyzed with a 2 (gender) x 4 (load) ANOVA, with repeated measures for load. Alpha = 0.05 and T-tests served as our post-hoc.  
**RESULTS:** AF and PF results (mean ± sem) appear below:

Average force (N)	0 kgs.	3.4 kgs.	5.7 kgs.	8.0 kgs.
Women	38.4 ± 1.5	70.1 ± 2.8	84.3 ± 3.5	92.8 ± 3.5
Men	44.5 ± 2.2	76.2 ± 4.4	85.9 ± 7.3	101.5 ± 6.2

Peak force (N)	0 kgs.	3.4 kgs.	5.7 kgs.	8.0 kgs.
Women	400.4 ± 21.8	708.1 ± 39.8	810.1 ± 44.9	857.3 ± 47.7
Men	529.5 ± 38.5	936.2 ± 69.3	1100.8 ± 77.2	1174.3 ± 76.7

Analysis of AF yielded a load effect, while PF produced a two-way interaction, in which men produced higher values than women for each load.  
**CONCLUSIONS:** Results show significant inter-gender PF, but not AF, values per load examined.

3199 Board #68 June 2 8:00 AM - 9:30 AM  
**A Preceding Bout of Endurance Exercise Decreases Peak Power of the Arm Extensor Muscles**

Luke Olsen<sup>1</sup>, Bjorn Hansson<sup>2</sup>, Tommy R. Lundberg<sup>3</sup>. <sup>1</sup>University of Kansas, Lawrence, KS. <sup>2</sup>The Swedish School of Sport and Health Sciences (GIH), Stockholm, Sweden. <sup>3</sup>Karolinska Institute, Stockholm, Sweden.  
 (No relevant relationships reported)

The combination of aerobic exercise (AE) and resistance exercise (RE) within a given training protocol, termed concurrent training (CT), lacks sufficient analysis concerning the upper body. In the lower body knee extensor muscles, we have previously demonstrated reduced peak power when AE precedes RE. However, postural requirements of the lower body, as compared to the upper body, may give rise to unique responses following CT. Thus, further investigation as to specific peak power alterations of the upper body muscles are warranted.  
**PURPOSE:** To investigate the effects of a preceding AE bout on muscle strength to subsequent RE of the arm extensors. **METHODS:** Healthy men (n=8) performed AE+RE (CT) for the elbow extensors in one arm, while the contralateral arm performed RE only. The AE consisted of unilateral, moderate endurance exercise (43±2 min of repeated elbow extensions) using an isokinetic dynamometer. After 15-min rest, subjects performed unilateral RE (4x7 iso-inertial RE) with a flywheel device for both arms targeting the arm extensor muscles. Work produced during AE and peak concentric power during RE were recorded. **RESULTS:** The AE bout resulted in a gradual increase in heart rate (126±12 bpm) with a parallel increase in RPE reaching the termination threshold (18±0.5 RPE). The implementation of AE prior to RE led to a 21% decrease (p=0.045) in arm extensor peak concentric power from 98W to 78W, respectively. There was no change in performance from pre- to post in the RE-only arm (94W to 89W). **CONCLUSIONS:** These results demonstrate that the implementation of AE prior to RE, as compared to RE alone, compromises peak concentric power adaptations of the arm extensors. The noticeable decrement in peak concentric power between pre- and post from the CT intervention (21%), relative to a similar study with the same testing protocol which targeted the lower body (10%), gives credence to the possibility that upper and lower body muscles respond differently to concurrent training.

3200 Board #69 June 2 8:00 AM - 9:30 AM  
**Quality of Life Improved by Adequate Physical Activity Levels Among University Employees**

Gustavo Mendoza, Kenneth R. Ecker, FACSM. *University of Wisconsin, River Falls, WI.* (Sponsor: Kenneth Ecker, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** The purpose of this study was to determine if quality of life is affected through different levels of physical activity and compare those to the national norms. This study also looked at the number of ACSM cardiovascular disease risk factors and different physical activity levels among university faculty.  
**METHODS:** An SF-36, I-PAQ, and Health Questionnaire form was handed out to the participants to complete to the best of their knowledge.  
**RESULTS:** Comparative analysis showed that there was a significant positive difference among the participants who were HEPA active in general health (p = 0.0354) and the active group in comparing emotional well-being (p = 0.0346) and physical functioning (p = 0.0498) when using one-way ANOVA. A Tukey-Kramer post hoc test was performed to prove honestly significant difference.  
**CONCLUSION:** The results indicate that the university faculty had better quality of life scores in certain parts of the SF-36 sub-scales when being active and HEPA active. The university faculty seem to be at risk for some cardiovascular disease risk factors in which the need to reduce the risks by implementing an exercise-based health and wellness program within the university workplace should be considered in university workplace policies.

3201 Board #70 June 2 8:00 AM - 9:30 AM  
**Lower VO<sub>2</sub>max In Individuals With A Family History Of Diabetes is normalized After 8-weeks Exercise**

Mario Garcia<sup>1</sup>, Manuel Amador<sup>1</sup>, Cesar Meza<sup>1</sup>, Christopher Figueroa<sup>1</sup>, Andrew McAinch<sup>2</sup>, Sudip Bajpeyi<sup>1</sup>. <sup>1</sup>University of Texas at El Paso, El Paso, TX. <sup>2</sup>Victoria University, St. Albans Campus, Melbourne, Australia.  
 (No relevant relationships reported)

A family history of type 2 diabetes (FH+) is considered a risk factor for insulin resistance and poor cardiorespiratory fitness. However, it is not known if exercise induced improvement in maximal aerobic capacity (VO<sub>2</sub>max) is impeded by a FH+. **PURPOSE:** The purpose of this study was to determine if normoglycemic, sedentary, Hispanic men with FH+ have a lower VO<sub>2</sub>max compared to those without a family history of type 2 diabetes (FH-) and if the improvement in VO<sub>2</sub>max after 8-weeks of combined exercise training is comparable between FH- and FH+. **METHODS:** 19 participants (mean ± SEM: age:23±0.56 years; BMI: 26.9±0.98 kg/m<sup>2</sup>) underwent 8 weeks of combined exercise training (35 min aerobic at 60-75% VO<sub>2</sub>max followed by 6 full-body resistance exercises (3x/week)). VO<sub>2</sub>max was measured using ParvoMedics 2400 metabolic measurement system during a standardized graded exercise test performed on a treadmill. Body composition was assessed by DXA. **RESULTS:** VO<sub>2</sub>max was significantly lower in FH+ compared to FH- at baseline (3.57 ± 1.7 vs. 4.08 ± 0.15 L/min; p=0.04). After 8 weeks of combined exercise training FH+ significantly improved VO<sub>2</sub>max (3.57 ± 0.17 to 3.82 ± 0.16 L/min; p=0.002), whereas no improvement was observed in FH- (4.08 ± 0.15 to 4.21 ± 0.17 L/min; p=0.16). There was no difference in VO<sub>2</sub>max between groups after 8 weeks of exercise training (p=0.67). Lean body mass significantly improved in both groups (FH- 56.6 ± 2.1 to 58.5 ± 2.1 kg; p=0.01; FH+ 51.8 ± 1.95 to 53.4 ± 1.79 kg; p=0.01) and fat mass remained unchanged (p=0.38). **CONCLUSIONS:** A family history of diabetes may negatively impact cardiorespiratory fitness in a normoglycemic, sedentary, Mexican American population. A combined exercise training program (8 weeks) is effective in normalizing this defect.

3202 Board #71 June 2 8:00 AM - 9:30 AM  
**Effects Of Chronic Endurance Exercise Training On Serum 25(OH)D Concentrations In Elderly Japanese Men**

Xiaomin Sun<sup>1</sup>, Zhen-Bo Cao<sup>2</sup>, Kumpei Tanisawa<sup>3</sup>, Hirokazu Taniguchi<sup>4</sup>, Takafumi Kubo<sup>5</sup>, Mitsuru Higuchi, FACSM<sup>6</sup>. <sup>1</sup>School of Public Health, Xi'an Jiaotong University Health Science Center, Xi'an, China. <sup>2</sup>School of Kinesiology, Shanghai University of Sport, Shanghai, China. <sup>3</sup>Department of Physical Activity Research, National Institutes of Biomedical Innovation, Health and Nutrition, Tokyo, Japan. <sup>4</sup>Faculty of Agriculture, Ryukoku University, Shiga, Japan. <sup>5</sup>Graduate School of Sport Sciences, Waseda University, Saitama, Japan. <sup>6</sup>Faculty of Sport Sciences, Waseda University, Saitama, Japan. (Sponsor: Mitsuru Higuchi, FACSM)  
 (No relevant relationships reported)

Effects of chronic endurance exercise training on serum 25(OH)D concentrations in elderly Japanese men

Xiaomin Sun<sup>1,2,7</sup>, Zhen-Bo Cao<sup>3,7\*</sup>, Kumpei Tanisawa<sup>4,7</sup>, Hirokazu Taniguchi<sup>5</sup>, Takafumi Kubo<sup>6</sup>, and Mitsuru Higuchi FACSM<sup>7</sup>

<sup>1</sup> School of Public Health, Xi'an Jiaotong University, <sup>2</sup> Global Health Institute, Xi'an Jiaotong University, <sup>3</sup> School of Kinesiology, Shanghai University of Sport, <sup>4</sup> National Institutes of Biomedical Innovation, Health and Nutrition, <sup>5</sup> Faculty of Agriculture, Ryukoku University, <sup>6</sup> Graduate School of Sport Sciences, Waseda University, <sup>7</sup> Faculty of Sport Sciences, Waseda University

Higher levels of physical activity and cardiorespiratory fitness are positively related to serum 25-hydroxyvitamin D [25(OH)D] concentrations; however, the response of 25(OH)D concentrations to chronic endurance exercise training is unclear.

**PURPOSE:** To elucidate whether serum 25(OH)D concentrations were directly increased by 5 weeks of endurance exercise training and influenced by changes in body fat in elderly men.

**METHODS:** Twenty elderly Japanese men were randomized to either the 5-week endurance exercise training group (ET group; N=10) or the sedentary control group (SC group; N=10). Fasting blood samples were collected to determine serum 25(OH)D and other blood

parameters. The visceral fat area and hepatic fat content were assessed by magnetic resonance imaging and proton magnetic resonance spectroscopy, respectively.

**RESULTS:** After 5 weeks of endurance exercise training, the levels of maximal oxygen uptake (VO<sub>2</sub>max) were significantly increased from 23.3 at baseline to 28.1 mL/kg/min at the endpoint for the ET group; levels were unchanged for the SC group. A significant seasonal reduction in serum 25(OH)D concentrations was observed in the SC group (P<0.05), while no change was found in the ET group. The results may be

partly attributed to the slight decrease in intrahepatic fat in the ET group. No changes were observed in percent body fat or visceral fat area. **CONCLUSIONS:** The results of our study suggest that 5 weeks of endurance training could inhibit the seasonal reduction in serum 25(OH)D concentrations without changes in body fat.

3203 Board #72 June 2 8:00 AM - 9:30 AM  
**The Effect of Hyperthermic Whole Body Heat Stimulus (Sauna) on Heat Shock Protein 70 and Skeletal Muscle Hypertrophy in Young Males**

Brandon Jones, Scott Drum, FACSM. Northern Michigan University, Marquette, MI. (Sponsor: Scott Drum, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** The aim of this study was to investigate if stimulating HSP70 by using a sauna (45 - 50°C, 80% Humidity) three times per week, for 15 minutes, could aid skeletal muscle hypertrophy during six weeks of resistance training in a young (21.38 ± 1.9 yrs.), recreationally trained male population.

**METHODS:** Thirteen subjects were randomly distributed into 3 groups [resistance Training + sauna (RT+S, n=5), RT + Relaxation (RT+R, n=5), and complete control (CON, n=3) or no training]. Primary dependent variables, observed in a pre- and post-test format, included: lean body mass (LBM), HSP70 concentration, and a 5 repetition maximum (5RM) back squat.

**RESULTS:** When comparing groups (i.e., RT+S, RT+R, and CON), no significant main effects or interactions were observed (p > 0.05) over the 6-week intervention period for LBM, HSP70, and 5RM. The hypothesis that HSP70 would be upregulated to a greater extent with concurrently larger LBM and 5RM improvements in RT+S vs. the other groups was not supported.

**CONCLUSIONS:** Although HSP70 and LBM were highest in RT+S after 6-weeks of heavy resistance training, RT+R improved the most on 5RM. Sauna use in combination with resistance training does not appear to augment muscle hypertrophy or strength. Despite this, it appears using sauna post RT does not hinder muscle growth and may be a viable strategy for maintaining muscle mass.

3204 Board #73 June 2 8:00 AM - 9:30 AM  
**Cost-Effective Personal Training Aid to Improve Leg Function Using Smart Exercise Application: Pilot Study**

Byungjoo Noh, Eric Vasey, Kevin Phillips, Derek Verbrigghe, Myoungsoon Jeon, Tejin Yoon. Michigan Technological University, Houghton, MI. (Sponsor: Sandra Hunter, FACSM)  
 (No relevant relationships reported)

As a personal training aid, a smart exercise application (SEA) has been developed to improve leg function such as balance and endurance. **PURPOSE:** The purpose of this study was to evaluate the functionality of SEA and validate the data output. **METHODS:** Thirteen healthy young adults (25.4 ± 8.3 years) attached an inertial measurement unit sensor (IMU; MetaWear C; mbientlab, Portola, San Francisco) and a research level accelerometer (ACC; Trigno wireless, Delsys Inc., Boston) on their thigh. Subjects sustained a one-leg half squat posture with 45 degrees of knee flexion as steady and accurate as possible. During the experiment, 3-axis acceleration data were collected using an IMU and ACC at 100 Hz and 1000 Hz respectively. The vertical direction acceleration was displayed as visual feedback on three different zones such as safety, warning, and failure. In addition to visual feedback, SEA created no sound, a warning sound at 1 Hz, and a high-frequency warning sound at 3 Hz on each zone respectively. As the acceleration exceeded a particular threshold value or passed the failure zone for a certain amount of time, the task was terminated and the time was logged as endurance time. The accuracy of IMU was assessed through Pearson's correlation between two data sets obtained from two systems. Bland-Altman plot was used to evaluate the discrepancy between measurements. **RESULTS:** Our application provided visual/auditory feedback as required and determined the task failure objectively. Our application was able to collect acceleration data accurately, as assessed by correlation and Bland-Altman plot. Correlations (r = 0.90 to 0.99, P < 0.001) between the output from the IMU and the reference output from the ACC were high. Bland-Altman plot also showed a low discrepancy between each of the two measures. The mean bias across all axes was -0.01 ± 0.01 m/s<sup>2</sup> with 95% LOA ranging from -0.14 to 0.13 m/s<sup>2</sup> (x-axis: 0.01 ± 0.04 m/s<sup>2</sup> (95% LOA: -0.07 to 0.09 m/s<sup>2</sup>), y-axis: -0.02 ± 0.10 m/s<sup>2</sup> (95% LOA: -0.21 to 0.18 m/s<sup>2</sup>), and z-axis: -0.01 ± 0.06 m/s<sup>2</sup> (95% LOA: -0.13 to 0.11 m/s<sup>2</sup>)). **CONCLUSIONS:** These results suggest that there is potential for the application as a cost-effective personal training aid in the future. It may be useful in long-term interventions such as home-based training aimed at increasing balance and endurance in a healthy or clinical population.

3205 Board #74 June 2 8:00 AM - 9:30 AM  
**Changes In Upper-body Strength Are Dependent On Training Mode And Independent Of Strength Level**  
 Jerry L. Mayhew<sup>1</sup>, Jensynn Kasper, 63501<sup>1</sup>, William F. Brechue, FACSM<sup>2</sup>, Jana L. Arabas<sup>1</sup>. <sup>1</sup>Truman State University, Kirksville, MO. <sup>2</sup>A. T. Still University, Kirksville, MO.  
 (No relevant relationships reported)

Previous research has shown upper-body muscular strength gains are independent of fat-free mass (FFM) in men. Further, initial strength is typically higher when evaluated with machine weights (MW) than with free weights (FW). Lacking is information comparing the training effects of FW versus MW in men with comparable initial strength levels. **PURPOSE:** To evaluate the effect of resistance training (RT) using different modes on changes in upper-body muscular strength when controlling mode-specific initial strength.

**METHODS:** College men (n = 1,331) enrolled in a RT course volunteered to participate and initially performed 1RM bench press using free-weights (FW), seated horizontal press (SHP) or supine vertical press (SVP). FW (n = 218), SHP (n = 270), and SVP (n = 208) groups were matched for mode-specific initial strength. Groups were further divided into low, average, and high strength based on the bottom, middle, and top one-third of mode-specific 1RM. Each participant performed 12 weeks of linear periodization mode-specific RT using progressively heavier loads and reduced repetitions designed to achieve maximum strength improvement. Each participant performed auxiliary upper- and lower-body supplemental exercises in 3 sets of 6-10 repetitions.

**RESULTS:** A mode x strength level ANOVA noted significantly greater improvement with SHP (12.5 ± 7.0 kg) than with SVP (10.7 ± 7.0 kg) which was greater with FW (6.8 ± 5.9 kg) but no significant difference among low (10.3 ± 7.4 kg), average (10.4 ± 6.2 kg), and high (9.8 ± 7.9 kg) strength levels. The interaction was not significant (p = 0.45). The relationships between initial strength and strength change was nonsignificant and similar in SHP (r = 0.01), FW (r = -0.05), and SVP (r = 0.06).

**CONCLUSIONS:** Men of differing strength levels gain similar amounts of upper-body strength when training with different RT modes. In participants with equal initial strength, training with one mode does not appear to offer any significant advantage over training with a different mode.

3206 Board #75 June 2 8:00 AM - 9:30 AM  
**Testosterone Response Following Five Crossfit® Open Workouts**  
 Paul Serafini<sup>1</sup>, Trisha VanDusseldorp<sup>1</sup>, Yuri Feito, FACSM<sup>1</sup>, Alyssa Holmes<sup>1</sup>, Adam Gonzales<sup>2</sup>, Gerald Mangine<sup>1</sup>. <sup>1</sup>Kennesaw State University, Kennesaw, GA. <sup>2</sup>Hofstra University, Hempstead, NY. (Sponsor: Yuri Feito, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** To determine the effect of sex and lean mass (LM) on the testosterone (T) responses to five unique CrossFit® Open (CFO) workouts. **METHODS:** LM was measured via Dual-Energy X-Ray Absorptiometry (DXA) within two weeks of the onset of the 2016 CFO in recreationally-trained adults (males-n=5, 34.4±3.8 yrs, 175.5±5.1cm, 80.31±9.7kg; females-n=5, 35.5±7.0yrs, 159.0±7.1 cm, 76.93±21.4kg). During each week of the 5-week competition, saliva samples were collected prior to (PRE) the competitors' warm-up, immediately (IP), 30- (30P), and 60 min post-exercise (60P) and analyzed for concentrations of T. All workouts were completed at the same gym; mid-day during the first four weeks (WK1-WK4) and on the night of the final challenge's release (WK5). Separate two-way (sex x time) repeated measures analyses of variance were performed to assess the percent change from PRE-values in T during each week. Pearson's correlation coefficients were calculated between all LM measures and T responses, quantified as the area under the curve, of each week. **RESULTS:** Although no (sex x time) interactions were found, significant (p<0.05) main effects for time were observed on WK2-WK4 where T was elevated from PRE at IP (162.1-191.7%, p≤0.015) and 30P (40.2-59.8%, p≤0.040). T was also elevated at 60P on WK3 (62.8%, p=0.015). Additionally, a trend (p<0.01) was noted for elevated T at IP (p=0.077) and 30P (p=0.033) on WK1. The T response was not related to any LM measure. **CONCLUSION:** The majority of the CFO events observed in this study elicited an elevation in salivary T from PRE-values. These elevations were not affected by the athlete's sex or quantity of LM.

3207 Board #76 June 2 8:00 AM - 9:30 AM  
**A Preliminary Investigation of the Relationship Between Training Volume and Body Fat in Triathletes**  
 Barbara S. McClanahan<sup>1</sup>, Michelle Stockton<sup>1</sup>, Christopher Vukadinovich<sup>2</sup>. <sup>1</sup>University of Memphis, Memphis, TN. <sup>2</sup>St. Jude Children's Research Hospital, Memphis, TN. (Sponsor: Lawrence Weiss, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** Appropriate levels of body fat are critical to optimal health and athletic performance, particularly for endurance athletes such as the triathlete. Therefore, the purpose of this study was to explore the potential relationship between body fat percent and training volume in triathletes over a competitive season while controlling for caloric intake.

**METHODS:** Participants were 12 male and 13 female triathletes. Body fat percent, determined through dual-energy x-ray absorptiometry, for male and female triathletes was 13.3% (±4.63%) and 21.4% (±6.12%) respectively. Training volume was determined by exercise duration and intensity over 24 weeks. Caloric intake was assessed through a seven-day dietary recall.

**RESULTS:** Average daily energy intake was 2,366 (±714) kcals/day for all participants, males reported consuming an average of 2,776 (±774) kcals/day and females reported consuming 1,987 (±386) kcals/day. Overall training volume (Intensity\*min) for the 25 participants over the 24-weeks was 37,661 (±16,478), with males averaging 44,948 (± 18,433) and females averaging 30,934 (± 11,377). For males, a bivariate correlation revealed that total training volume (r = -0.66) was significantly associated with body fat percent. However, total training volume was not statistically significantly related to body fat percent for females. Preliminary analyses using multiple linear regression indicated that for males the independent variable (total training volume) explained 49% of the variance in body fat percent (p < .05) while controlling for total kcals. Training volume was a significant predictor of body fat percent for males (β = -0.976; t = -2.40; p = 0.04). For females, the multiple regression indicated that there was not a significant amount of the variance explained in body fat percent by training volume while controlling for kcals.

**CONCLUSIONS:** Given its potential impact on athletic performance and overall health and wellness it is important to consider possible contributors to body fat. It was surprising to document a significant influence of training volume on body fat percent in men but not women in this study. Further studies are needed to better understand the current findings.

3208 Board #77 June 2 8:00 AM - 9:30 AM  
**The Effects of Gender and Training Status on Optimal Loads for Developing Muscular Power**  
 Ryan M. Miller, Eduardo D.S. Freitas, Aaron D. Heishman, Japneet Kaur, Karolina J. Koziol, Bianca A.R. Galletti, Michael G. Bembem, FACSM. University of Oklahoma - Department of Health & Exercise Science, Norman, OK. (Sponsor: Michael G Bembem, FACSM)  
 (No relevant relationships reported)

Muscular power is required in varying degrees for differing situations (fall prevention, sport performance, etc.) and populations (athletes, elderly, clinical populations, etc.). Generally, greater muscular power is achieved at lower percentages of maximal strength (1RM); however, these intensities have not been evaluated based on gender or training status. **PURPOSE:** To determine the optimal loading intensity for developing maximal lower and upper body muscular power for trained and untrained men and women. **METHODS:** Forty-one men and women (resistance trained or untrained) completed a 1RM test for the leg press and barbell bench press. Following at least 48 hours, subjects returned to perform single repetitions, in randomized order, at 20, 30, 40, 50, 60, 70 and 80% of their 1RM for each exercise to determine lower and upper body muscular power. Mixed-model ANOVAs were used to determine if there were any significant differences between the within-subject variable (intensity or %1RM) and between-subject factors (gender and training status). **RESULTS:** Significant main effects were observed for intensity (F=44.2, p<0.001) and gender (F=31.3, p<0.001) for the leg press with males producing more power at each intensity with maximal power output occurring at 60% 1RM (which was significantly different (p<0.001) from 20, 30, 40% 1RM but not different from 70 or 80% 1RM). The bench press analyses revealed significant main effects for intensity (F=54.7, p<0.001), gender (F=101.9, p<0.001) and training status (F=17.5, p<0.001), as well as significant interactions for %1RM X gender (F=10.2, p<0.001) and %1RM X training status (F=3.2, p<0.001). Males produced more power (p<0.001) at each intensity with maximal power output occurring at 50% 1RM compared to females who produced maximal power at 40% 1RM. Trained subjects had significantly higher power outputs (p<0.001) at each intensity with the greatest power produced between 40-60% 1RM, while untrained subjects achieved maximal power between 40-70% 1RM. **CONCLUSION:** In order to obtain maximal power outputs for large lower or upper body muscle groups, relatively low intensities ranging between 40-70% 1RM depending on gender and training status should be used.

3209 Board #78 June 2 8:00 AM - 9:30 AM  
**Influence of Psychosocial Wellness Factors on Training Duration in Triathletes**

Michelle B. Stockton<sup>1</sup>, Barbara McClanahan<sup>1</sup>, Christopher Yukadinovich<sup>2</sup>. <sup>1</sup>University of Memphis, Memphis, TN. <sup>2</sup>St. Jude Children's Research Hospital, Memphis, TN. (Sponsor: Lawrence Weiss, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** Training duration is an important factor in athletic performance, especially long endurance events such as triathlons. While the majority of attention in training duration has focused on physical factors, psychosocial wellness factors may also influence training duration. Therefore, the purpose of this study was to explore the influence of psychosocial wellness on triathlete training duration.

**METHODS:** Participants established their own training regimen and recorded training duration (minutes) for each sport. Total training duration was calculated by summing training duration for each sport across six months. Participants also completed a multi-dimensional wellness assessment during the laboratory visit. The 70-item self-report assessment consisted of seven subcategories with Likert scale responses 1-5. Total scores were calculated for each category as well as a composite wellness score.

**RESULTS:** Participants were 14 male and 9 female triathletes. Total training duration for all participants was 12,880 ( $\pm 5536$ ) minutes over 6-months with males reporting an average of 13,435 ( $\pm 5990$ ) total minutes, and females reporting 12,017 ( $\pm 4961$ ) total minutes. Preliminary analyses using multiple linear regression indicated that the multiple-dimensions of psychosocial wellness (drugs and driving, social, emotional awareness, emotional control, intellectual, occupational, and spiritual) explained 73.8% of the variance in total training duration for all the participants ( $p = .002$ ). Social ( $\beta = .804$ ), intellectual ( $\beta = -.757$ ), occupational ( $\beta = 1.091$ ), and spiritual ( $\beta = -.749$ ) were significant predictors at the univariate level. For males, the multiple-dimensions of wellness explained 94.3% of the variance in total training duration ( $p = .002$ ) with social ( $\beta = 1.226$ ), intellectual ( $\beta = -.650$ ), occupational ( $\beta = 1.332$ ), and spiritual ( $\beta = -.914$ ) being significant predictors. For females, the psychosocial wellness factors did not significantly influence training duration.

**CONCLUSIONS:** Study results illustrate the importance of understanding potential psychosocial influences on training duration for triathletes. Further research is needed to determine the multiple dimensions of psychosocial wellness on all aspects of training in order to develop ideal strategies for optimal performance.

3210 Board #79 June 2 8:00 AM - 9:30 AM  
**Effects Of High Concentration Oxygen Intervention On Physiological Recovery From High Intensity Hammer Throwing Training**

Chung-Wen Chen<sup>1</sup>, Szu-Kai Fu<sup>2</sup>, Jen-Chun Lo<sup>2</sup>, Kuo-Wei Tseng<sup>2</sup>, Chang-Chi Lai<sup>2</sup>. <sup>1</sup>National Taiwan Sport University, Taoyuan City, Taiwan. <sup>2</sup>University of Taipei, Taipei City, Taiwan.  
 (No relevant relationships reported)

**Purpose:** To investigate the effects of high-concentration oxygen inhaled on repeated hammer throwing efficiency and the recovery of physiological fatigue. **METHODS:** Five hammer players completed 10 throws with both normobaric oxygen and high-concentration oxygen interventions with a 7-day interval. Each bout consisted of 10 repeated throws with a 5-minute rest between each throw. For high-concentration oxygen intervention, each subject was given 5 minutes of highly concentrated oxygen inhalation after each throw; no specific application for normobaric oxygen intervention. Distance, blood lactate (La), rating of perceived exertion (RPE), heart rate (HR) and recovery heart rate were measured at baseline (pre-exercise) and after each throw.

**Results:** All variables were changed significantly after the 1st-10th throws ( $p < .05$ ) following high-concentration and normobaric oxygen intervention, but no significant intervention  $\times$  times was found in all dependent variables (Distance, La, RPE, HR and recovery heart rate) during the repeated throws. **Conclusion:** The results suggested that high-concentration oxygen inhalation intervention did not improve the rate of blood lactate metabolism, and the recovery of heart rate and rating of perceived exertion after high intensity throws.

**G-38 Free Communication/Poster - Performance**

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
 Room: CC-Hall B

3211 Board #80 June 2 8:00 AM - 9:30 AM  
**Effects Of A Caffeine-carbohydrate Mouth Rinsing On Sprinting Kinetics And Kinematics In Fasted Athletes**

Jad-Adrian Washif<sup>1</sup>, Christopher Martyn Beaven<sup>2</sup>. <sup>1</sup>National Sports Institute Of Malaysia, Kuala Lumpur, Malaysia. <sup>2</sup>University Of Waikato, Hamilton, New Zealand.  
 (No relevant relationships reported)

Carbohydrate mouth rinsing during an intermittent fasting has been reported to be advantageous for endurance performance; however, there appears to be no clear effect on repeated sprints. What has not been investigated previously is the effects of combined caffeine and carbohydrate (CAF-CHO) mouth rinsing on speed-endurance performance commonly performed by track and field athletes during a fasted state.

**PURPOSE:** To determine the influence of CAF-CHO mouth rinsing on sprinting kinetics and kinematics, as well as subjective exertion during a speed-endurance bout performed in a fasted state. **METHOD:** In a counterbalanced, single-blind random order design, eleven ( $n = 11$ ) well-trained National level male sprinters and middle-distance runners performed three 15-sec all-out sprints on a Woodway nonmotorized force treadmill, interspersed with 2-min active recovery between sprints. Athletes rinsed 25 ml of CAF-CHO (4g carbohydrate, 5 mg caffeine), or a similarly coloured placebo solution (PLA) prior to warm-up (30-min pre-trial), 1-min pre-trial, and the mid-way of each period of active recovery. On one occasion, no mouth rinse (NMR) was administered. The study was conducted within the second and third quarters of Ramadan, and each session separated by at least 72 hours. **RESULTS:** At the start of each trial, the rating of perceived exertions (RPE), readiness to train, blood glucose, and lactate concentrations were similar ( $p > 0.05$ ). A significant primary effect of trial ( $3 \times 15$  seconds sprint) was observed for the distance ( $p = 0.019$ ), revealing a longer average distance achieved in the CAF-CHO compared to PLA trial ( $69.80 \pm 3.57$  vs.  $68.08 \pm 3.22$ ;  $p = 0.026$ ; EF: 0.5), and NMR ( $69.69 \pm 3.82$ ;  $p = 0.680$ ; EF: 0.2). The difference between NMR and PLA also approached significance ( $p = 0.073$ ; ES: 0.5). The CAF-CHO intervention also obtained better results in all other sprint measures such as average velocity, peak acceleration, and peak horizontal force, although these differences were not significant. Post-trial RPE was higher during NMR ( $7.23 \pm 1.92$ ) as compared to CAF-CHO ( $6.54 \pm 2.15$ ) and PLA ( $6.38 \pm 1.94$ ) ( $p = 0.247$ ). **CONCLUSION:** In challenging metabolic conditions, CAF-CHO mouth rinsing might have potential to improve measures of sprint training performance with a positive ergogenic effect on speed endurance performance.

3212 Board #81 June 2 8:00 AM - 9:30 AM  
**Association of Performance Physiology Measures with Sports Performance Tests**

Therese Wichmann, Marissa Burnsed-Torres, Michael Hahn.  
 University of Oregon, Eugene, OR.  
 (No relevant relationships reported)

**PURPOSE:** Common fitness tests such as the Yo-Yo Intermittent Recovery Test and the Beep Test have previously been validated against laboratory-based assessments and shown to be accurate. The purpose of this study was to assess whether the Gauntlet, an unexplored fitness assessment, was an accurate assessment of individual fitness compared to standard laboratory-based physiological tests. The Gauntlet test requires athletes to complete a set of maximal effort runs, with a one-minute break in between each stage (Stage 1: 814.6m, Stage 2: 907.3m, Stage 3: 453.7m, Stage 4: 226.8m, Stage 5: 100m) with the goal of achieving the best overall time. **METHODS:** Subjects ( $n=18$ ) first completed a lactate threshold test and  $VO_{2max}$  test in the laboratory. After four to fourteen days, subjects then completed the Gauntlet on an outdoor track. Lactate,  $VO_{2max}$  and heart rate were recorded during the laboratory session, and heart rate, lactate, and time of completion per stage and overall time to completion were recorded during the Gauntlet test. **RESULTS:** Preliminary correlation analyses showed a positive relationship between  $VO_{2max}$  ( $ml \cdot kg^{-1} \cdot min^{-1}$ ) to Time to Completion of the Gauntlet ( $r = 0.89$ ,  $P = 1.29E-15$ ),  $VO_{2max}$  Maximum Heart Rate to Gauntlet Maximum Heart Rate ( $r = 0.80$ ,  $P = 0.0011$ ), and  $VO_{2max}$  3-min Post Lactate to Gauntlet 3-min Post Lactate ( $r = 0.66$ ,  $P = 0.0188$ ). **CONCLUSION:** These results indicate that the Gauntlet is an accurate estimate of aerobic fitness when compared to laboratory-based physiological tests. Therefore, the Gauntlet could be implemented into common exercise programs or sport specific training to assess an individual's level of fitness without the need for laboratory testing.

3213 Board #82 June 2 8:00 AM - 9:30 AM  
**Effects of Depth Jump Implementation on Sprint Performance in Collegiate and Club Sport Athletes**  
 Ryan Bean, Michael Lane, Aaron Sciascia, Matthew Sabin.  
*Eastern Kentucky University, Richmond, KY.*  
*(No relevant relationships reported)*

**Introduction;** Depth jumps (DJ) are popular high-intensity plyometric exercises typically reserved for highly-trained individuals. DJs cause an individual to undergo high amounts of stress during the eccentric and concentric phase. This extreme loading allows individuals to increase lower body strength and power output. Muscular strength and power have a transfer effect to sprint speed; however, few have examined if implementing DJs into training can increase sprint speed.

**Purpose;** The purpose of this study was to determine if the implementation of DJs into a sprint training program would increase sprint speed more so than sprinting alone.

**Methods;** 5 collegiate level and 13 club level athletes participated in this study (6 males and 13 females). Subjects performed 3 maximal 40-yard sprints with 3 to 5 minutes of rest between sprints. Subjects were randomized into either a control group, a sprint training group, or a DJ group. The DJ and sprint group performed 2 training sessions/week, with both groups performing the same sprint training protocol. The DJ group had DJs of varying intensities. Following 6 weeks of implementation, subjects were retested on the 40-yard sprints in the same manner as before.

**Results;** One-way ANOVA were conducted using paired comparisons to determine significance. Significant differences were observed after implementation for the 40-yard sprint (-.24±.43s) ( $P<.01$ ), 20-30yard split (-.13 ± .11s) ( $P<.05$ ), and a 20-40yard split (-.20 ± .18s) ( $P<.01$ ). No differences were observed between groups. The DJ group changes showed the largest effect sizes of any group in these measures; 1.12, 1.6, and 2.5 respectively.

**Discussion;** The effect sizes of the changes in sprint speed demonstrate that DJs may benefit sprint speed. It can be concluded from this study that maximal sprint speed was improved more so than acceleration due to the improvements observed from 20-30yards and 20-40yards. These indicate the maximal speed phase of sprinting. Further research is needed to determine if DJs can improve sprint performance in highly-trained athletes.

3214 Board #83 June 2 8:00 AM - 9:30 AM  
**Comparison Of The Effects Of A Novel Structured Nanotechnology Water On Physical Performance.**  
 ALI K. M. SAMI<sup>1</sup>, Gary Liguori, FACSM<sup>2</sup>. <sup>1</sup>College of Medicine/University of Sulaymany, Sulaymany, Iraq. <sup>2</sup>University of Rhode Island/College of Health Sciences, Kingston, RI.  
*(No relevant relationships reported)*

#### Purpose

A new type of water that uses nanotechnology to alter the physical and chemical properties of water molecules to enhance its bioavailability was compared to other commonly consumed beverages for the effect on physical performance.

#### Methods

Thirty male college athletes (21-23 y) were randomly divided into three groups, nanotechnology structured water (N), Gatorade (G), ordinary water (W) for a 3-month training program. Participants were blinded to their beverage and were instructed to consume their respective beverage at 500 ml/kg body weight over the course of each day during the 3-month training period, with other fluids consumed ad libitum. All participants completed the same set of pre-post physical tests: resting heart rate (RHR); sprinting; jumping, in which participants jumped 10 consecutive times with the difference in height jumped between the first and last jump recorded; obstacle course, which measured for accuracy in completing the course; and peak exercise heart rate on a 60-min steady-state treadmill run (EHR).

#### Results

Post-training test results were analyzed for differences among groups using an ANCOVA, which accounted for any baseline differences among groups. All significant results were then subjected to a post-hoc analysis to determine specific differences. For sprinting, the N group (10.0s) was faster than both G (11.5s;  $p=0.025$ ) and W (13.5s;  $p<.001$ ). The N group had lower EHR (112.6bpm) compared to G (138bpm;  $p<.001$ ) and W (157bpm;  $p<.001$ ). The N group had a lower jump differential (25cm) than G (41cm;  $p<.001$ ) and W (59cm;  $p<.001$ ). In the obstacle course, N had a mean score of 86.6, which was higher than G (70;  $p<.001$ ) and W (63;  $p<.001$ ). The only variable that was not different among groups on the post-test was RHR ( $p=0.33$ ).

#### Conclusions

This is the first known study to measure the effect of structured nanotechnology water magnalife on physical performance, and these results indicate that participants consuming nano-water performed better on a series of physical tests compared to other beverages. However, this study had used a small population of male athletes only. Future studies should be larger and include a variety of populations to gain a better understanding of the possible ergogenic effects of nano-water.

3215 Board #84 June 2 8:00 AM - 9:30 AM  
**The Effects Of A Six-week Ketogenic Diet On The Performance Of Short-duration, High-intensity Exercise: A Pilot Study**  
 Emily M. Miele<sup>1</sup>, Steven Vitti<sup>1</sup>, Laura Christoph<sup>2</sup>, Elizabeth C. O'Neill<sup>1</sup>, Tracey D. Matthews<sup>1</sup>, Richard J. Wood<sup>1</sup>. <sup>1</sup>Springfield College, Springfield, MA. <sup>2</sup>Holyoke Community College, Holyoke, MA.  
*(No relevant relationships reported)*

There is much controversy surrounding the use of very high fat, low carbohydrate ketogenic diets and athletic performance. Specifically, it has been hypothesized that anaerobic activity, which is primarily fueled by ATP that is formed through the metabolism of carbohydrate sources, may be hindered when utilizing a ketogenic dietary approach. **PURPOSE:** The current study was designed to investigate how switching from a habitual diet to a ketogenic diet for 6 weeks would affect the performance of short-duration, high-intensity exercise. **METHODS:** Eight men and seven women ( $N = 15$ ;  $30.2 \text{ yr} \pm 4.11$ ) were randomly assigned to either the ketogenic diet (KETO;  $n = 8$ ) or the control group (CON;  $n = 7$ ). All subjects were trained in CrossFit for at least 3 months prior to the study. Several measures of anaerobic performance were assessed at baseline and following 6 weeks utilizing the following series of standardized exercise tests: timed 500m row, Wingate Anaerobic Test, and 3-repetition maximum (3RM) deadlift. Aerobic capacity was also assessed by measuring  $\text{VO}_2\text{peak}$ . Subjects continued their regular CrossFit training during the 6 week period and dietary intake was recorded. **RESULTS:** A significant increase ( $p < .05$ ) in mean power output (MPO; W/kg) from baseline ( $M = 8.24 \pm 1.15$ ) to 6 weeks ( $M = 8.70 \pm .82$ ) was found the CON group. No significant interactions ( $p > .05$ ) were found between diet and test time for any of the other measured exercise variables. No significant differences ( $p > .05$ ) were found in the KETO group from baseline to 6 weeks in any of the measured exercise variables. No significant differences in body weight (lbs) were found from baseline to 6 weeks in either group (KETO;  $183.8 \pm 31.7 \text{ vs. } 181.03 \pm 30.28$ , CON;  $166.38 \pm 35.77 \text{ vs. } 166.88 \pm 37.28$ ). Attrition rate was 33% in the KETO group and 30% in the CON group. **CONCLUSION:** A 6-week ketogenic diet did not affect the performance of short-duration high-intensity exercise. Our data does not support the hypothesis that ketogenic diets induce detriments in the performance of activity that is anaerobic in nature. The current study took place over a 6 week period, allowing for keto-adaptation to occur; results may be different if a shorter time period were utilized.

3216 Board #85 June 2 8:00 AM - 9:30 AM  
**Inconsistency of Bilateral Asymmetry Between Sprinting and Jumping Performance: Rethinking Leg Dominance**  
 Nathan T. Gorman<sup>1</sup>, Jerry L. Mayhew<sup>2</sup>, William F. Brechue, FACSM<sup>3</sup>. <sup>1</sup>Rocky Vista University College of Osteopathic Medicine, Parker, CO. <sup>2</sup>Truman State University, Kirksville, MO. <sup>3</sup>A.T. Still University, Kirksville, MO. (Sponsor: William F. Brechue, Ph.D., FACSM, FACSM)  
*(No relevant relationships reported)*

The concept of leg dominance is complicated as bilateral muscular strength/power asymmetry is linked to poor performance and/or injury risk. Bilateral asymmetry during 2-leg (2L) jumping appears to define performance, rather than limit it. During 2L jumping, the leg that developed the greatest torque/velocity is defined as dominant. **PURPOSE:** to investigate the relationship between apparent leg dominance in jumping and sprinting. **METHODS:** Men ( $n=18$ ; football, basketball) and women ( $n=17$ ; basketball, soccer, volleyball) athletes competing in intercollegiate sports completed repeat trials of sprint and jump testing. Sprint: three trials of a 12-m sprint with step-by-step kinematic data collected with an infrared timing system. Jump: repeat trials of 2L and single-leg (1L- left leg; 1R-right leg) squat jump without countermovement conducted on individual force plates to determine jump impulse ( $\text{IMP}_j$ ). Jump height (JHt) was calculated from flight time ( $\Delta t$ ). Data were averaged across trials. Asymmetry index was calculated as  $(L-R)/(0.5*(L+R))$ . Bilateral facilitation/deficit was determined from jump performance as  $(1L+1R)/2L$ . Differences were tested with ANOVA;  $p<0.05$ . **RESULTS:** Men ( $1.70 \pm 0.17 \text{ s}$ ) were faster than women ( $1.82 \pm 0.11 \text{ s}$ ). Horizontal acceleration (a) decreased from the first to last stride while horizontal velocity (v) increased throughout. In contrast, step-by-step a was asymmetric while v increased linearly. a and v were always greater in men. There were no differences in 1L and 1R JHt (left & right: men:  $22.0 \pm 11.7$  &  $21.5 \pm 11.6 \text{ cm}$ ; women:  $12.4 \pm 2.7$  &  $12.7 \pm 2.9 \text{ cm}$ , respectively). 1L and 2L (men:  $39.6 \pm 3.6 \text{ cm}$ ; women:  $26.4 \pm 4.2 \text{ cm}$ ) JHt was greater in men. Bilateral asymmetry (AI range 40 to -58%) was noted in  $\text{IMP}_j$  during 2L; both groups produced a greater jump impulse in one leg (men:  $135 \pm 18$  &  $110 \pm 13.2 \text{ N}$ ; women:  $92 \pm 18 \text{ N}$  &  $74 \pm 15 \text{ N}$ ). 2L performance was associated with a bilateral deficit ( $n=12$ ) or facilitation ( $n=19$ ) and was unrelated to JHt ( $r=-0.25$ ). There was no relationship between the dominant leg during 2L jumping and sprinting. **CONCLUSION:** There is a non-linear, asymmetric acceleration pattern associated

with short distance sprinting which appears to define leg dominance in sprinting. There appears to be a dominant leg during sprinting and 2L jumping, which is not consistent across performance.

3217 Board #86 June 2 8:00 AM - 9:30 AM  
**Acute Effects of Beta-Alanine on Exercise Performance Variables.**

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(No relevant relationships reported)

Beta-Alanine (BA) is converted to carnosine which serves to lower acid levels in the muscle by acting as an intramuscular buffer to H<sup>+</sup> ions. BA supplementation may increase carnosine synthesis in muscle, leading to reduced muscle fatigue with exercise. **PURPOSE:** To determine the effects of an acute dose of BA (4 grams, 30 min before testing) on muscular power, muscular endurance and aerobic performance. **METHODS:** 21 recreationally active men (24.5±1.5yrs, 1.8±0.1m, 79.2±9.3kg) and 15 women (25.7±2.2yrs, 1.6±0.1m, 55.1±8.1kg) participated in a placebo controlled, double blind cross-over design study. Subjects were tested on 3 separate days with a 24-hour washout period between test visits. Visits consisted of 4 tests done in the following order: vertical jump on a jump mat, repetition of 70% leg press and chest press max until failure, and a 4-kilometer time trial (4km) on a cycle ergometer. The first testing visit established the 1-repetition maximum on the leg and chest press and familiarization with testing procedures. Subjects were randomized to BA or placebo on the 2<sup>nd</sup> and 3<sup>rd</sup> visit. Comparisons of the effects of BA and placebo on exercise test values were made using two-way ANOVA with repeated measures (p<0.05). **RESULTS:** BA showed a significant increase from baseline in the number of reps performed on both the leg press (15.7±5.5 vs. 22.9±7.3 repetitions, p<0.001) and chest press (12.0±5.8 vs. 17.7±5.4 repetitions, p<0.001). Placebo showed a small non-significant increase from baseline in the number of reps performed on both the leg press (15.7±5.5 vs. 17.3±5.3 repetitions, p=0.055) and chest press (12.0±5.8 vs. 12.6±5.6 repetitions, p=0.059). The increases in the BA group were statistically different from the change in the placebo group (leg press, p<0.001 and chest press p<0.001). BA showed a significant increase from baseline in aerobic power (132.0±49.1 vs 144.0±48.8 Watts, p<0.001) during the 4km. Placebo showed a small non-significant increase from baseline in aerobic power (132.0±49.1 vs 134.3±49.4 Watts, p=0.080) during 4km. The increase in aerobic power in the BA group was statistically different from the change in the placebo group (p<0.001). **CONCLUSION:** A single 4 gram dose of BA improves muscular endurance and aerobic power in recreationally active young men and women.

3218 Board #87 June 2 8:00 AM - 9:30 AM  
**The Influence of Different Walking Conditions on Walking Parameters**

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(No relevant relationships reported)

**PURPOSE:** This study investigated the relationship between characteristics of walking parameters and walking parameters of different walking conditions. **METHODS:** The participants were 54 university students who had the habit of exercising (32 men and 22 women, 19.6 ± 0.7 years). Participants were asked to walk on flat and sloped ground. On the flat ground, they were asked to walk freely with a subjective intensity of "Light (ratings of perceived exertion (RPE) 11)" and "Somewhat hard (RPE 13)." The average slope was 4% for both upward and downward conditions and participants walked freely on both. Participants wore a wearable device attached to the left wrist that measured their walking speed, cadence, stride, and heart rate. **RESULTS:** On the flat ground, in all walking parameters, RPE 13 showed significantly higher values compared to RPE 11 (walking speed: 5.35 ± 0.49 versus 4.48 ± 0.43 km/h, cadence: 121.9 ± 8.8 versus 113.0 ± 7.3 steps/min, stride: 73.2 ± 6.8 versus 65.8 ± 6.8 cm, respectively; P < 0.05). On the sloped ground, walking speed on the upward slope showed significantly lower values compared to that on the downward slope and the free-walking speed on flat ground (upward slope: 4.85 ± 0.27 km/h, downward slope: 5.27 ± 0.38 km/h, flat ground: 5.25 ± 0.30 km/h). However, heart rate was significantly higher on the upward slope than in other conditions (118.8 ± 16.9 beats/min, 103.5 ± 14.0 beats/min, 107.8 ± 18.2 beats/min, respectively). Multiple regression analysis was performed with walking speed as the dependent variable and cadence and stride as independent variables. Results showed that for walking on the flat ground, the standardized coefficient for stride was higher than that for the cadence under all conditions. Although the same trend was found for walking on downward slopes, for walking on upward slopes, the standardized coefficient for cadence was higher than that for the stride. **CONCLUSIONS:** Walking parameters tended to be similar for walking on flat ground even when conditions changed; however, it became clear that characteristics of walking parameters on upward slopes varied from those of other conditions.

3219 Board #88 June 2 8:00 AM - 9:30 AM  
**Physiological Performance Predictions Based on Simple Assessments**

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(No relevant relationships reported)

Muscular strength and cardiovascular capacity are important determinants of athletic performance. Fundamental assessments include lower body strength (e.g., squat max), upper body strength (e.g., bench press max), and aerobic capacity (VO<sub>2</sub> max). For coaches who lack equipment to measure these parameters, it is important to know if there are feasible alternatives to accurately evaluate their athletes. **PURPOSE:** To determine if simple strength and aerobic assessments can be used in the place of equipment-intensive testing to evaluate college athletes. **METHODS:** Fourteen collegiate male rugby players were recruited and tested. Independent variables were age, height, weight, vertical jump, and 10-yard dash. Dependent variables were body fat percent (BF%) via hydrostatic weighing, bench press max, squat max, and VO<sub>2</sub> max. Data were collected twice during the competitive season, one month apart. Multiple linear regression tested how well the simple assessments predicted the traditional performance measurements. **RESULTS:** On average, athletes were 19.6 years of age with a BMI of 25.2 kg/m<sup>2</sup>, 13.4% body fat, VO<sub>2</sub> max of 45.5 ml/kg/min, bench press of 186.7lb, squat max of 269.5lb, 10-yard dash of 1.7 seconds, and vertical jump of 22.2 inches. At baseline, BMI (p<0.001) and 10-yard dash (p=0.023) predicted BF% (R<sup>2</sup>=0.881; p<0.001). Significance was preserved at follow-up (R<sup>2</sup>=0.751; p<0.001). At baseline, holding age constant, 10-yard dash predicted VO<sub>2</sub> max (β=-31.4; p=0.002); the model was significant (R<sup>2</sup>=0.714; p=0.004) and was strengthened at follow-up (R<sup>2</sup>=0.780; p<0.001). Holding age and BMI constant, 10-yard dash predicted bench press (β=-222.7; p=0.023); the model was significant (R<sup>2</sup>=0.732; p=0.011) and retained at follow-up (R<sup>2</sup>=0.750; p=0.009). At baseline, holding BMI constant, squat max was predicted by vertical jump (β=8.9; p=0.005) and 10-yard dash (β=-263.5; p=0.013). The model was significant (R<sup>2</sup>=0.923; p<0.001) and retained at follow-up (R<sup>2</sup>=0.913; p<0.001). **CONCLUSIONS:** In a sample of college rugby athletes, age, height/weight, vertical jump, and 10-yard dash were sufficient predictors of BF%, bench press, squat, and VO<sub>2</sub> max. Our results indicate that it may be reasonable for comprehensive athletic evaluation to be simplified to accommodate a lack of equipment.

3220 Board #89 June 2 8:00 AM - 9:30 AM  
**Relationship Between Clock Gene Expression, MEQ Score, and Exercise Performance**

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(No relevant relationships reported)

**PURPOSE:** To examine the relationship between human clock gene expression, chronotype, and morning/evening exercise performance. **METHODS:** Fifteen healthy young males were recruited for this study. The peak time of *Period 3 (PER3)* expression in hair follicle cells was evaluated as an indicator of the biological circadian rhythm and the Morningness-Eveningness Questionnaire (MEQ) score was used to determine the chronotype (morning, intermediate, or evening). Hair follicle cells were collected over a 24-h period at 4-h intervals from 06:00 hours by firmly holding and pulling the facial hair root. Morning and evening exercise performance was evaluated using a sleep test. The tests were performed at least one week apart using a cross-over design at 10:00 and 18:00 hours. As a physiological index, oral temperature was measured before exercise, and heart rate was measured before and during exercise. Partial correlation was used to examine the relationship between MEQ score and the peak time of *PER3* expression, exercise performance, and oral temperature. Paired *t*-tests were used to compare physiological variables between morning and evening performances. **RESULTS:** There was a moderate positive correlation between the peak time of *PER3* expression and evening performance ( $r = 0.700, P = 0.053$ ). A significant correlation was found between the oral temperature at 10:00 and improvement in performance at 18:00 (evening performance) compared to that at 10:00 ( $r = 0.735, P < 0.05$ ). There was no relationship between the MEQ score and performance. There was no significant correlation between the peak time of *PER3* expression and the MEQ score. **CONCLUSIONS:** The present study suggested that the internal clock time evaluated based on gene expression may affect exercise performance. When the peak time of *PER3* expression is late, performance may be higher at 18:00 compared to that at 10:00. Higher body temperature at 10:00 may be a good marker for higher performance at 18:00. Further research is required to investigate the relationships among circadian rhythm of clock genes expression, chronotype, and performance in competing athletes.

3221 Board #90 June 2 8:00 AM - 9:30 AM  
**Changes in Blood pH and Ammonia Following Repeat Sprint Performance**  
 Gregory R. Davis, Jordan Perett, Danielle Rudesill, David Bellar. *University of Louisiana at Lafayette, Lafayette, LA.*  
*(No relevant relationships reported)*

The relationship between relative intensity and changes in blood pH and ammonia are not well characterized. **PURPOSE:** The primary aim of the study was to determine how changes in relative exercise intensity following repeat sprint performance affect changes in blood pH and blood ammonia concentrations. **METHODS:** Healthy college-age males ( $n = 12$ ) completed one 30 second Wingate cycle sprint test as a familiarization trial. A minimum of 48 hours after the familiarization trial, participants returned to the lab. Resting venous and capillary blood samples were obtained to determine blood ammonia, pH, and lactate levels. Participants then completed 3 Wingate sprint tests, separated by 5 minutes each. Finger capillary blood was immediately obtained after each test to determine lactate and pH values. After the final test, an additional venous blood sample was obtained to determine blood ammonia values. **RESULTS:** Data are shown as 1<sup>st</sup> vs. 2<sup>nd</sup> vs. 3<sup>rd</sup> tests, respectively. There was a significant effect for time for peak power ( $750.08 \pm 39.55$  vs.  $675.42 \pm 30.01$  vs.  $615.60 \pm 37.72$  Watts);  $F = 4.66$ ,  $p = 0.05$ , mean power ( $632.67 \pm 30.71$  vs.  $561.25 \pm 22.16$  vs.  $524.40 \pm 26.46$  Watts);  $F = 5.04$ ,  $p = 0.04$ , pH ( $7.72 \pm 0.01$  vs.  $7.63 \pm 0.02$  vs.  $7.62 \pm 0.02$ );  $F = 70.18$ ,  $p < 0.01$ , and lactate ( $12.36 \pm 1.14$  vs.  $14.10 \pm 1.13$  vs.  $16.95 \pm 1.22$  mg/dL);  $F = 42.02$ ,  $p < 0.01$ . Blood ammonia values did increase from pre- to post-exercise ( $0.33 \pm 0.09$  vs.  $1.07 \pm 0.22$  mg/dl);  $t = 3.62$ ,  $p < 0.01$ , but there was no correlation between post-exercise ammonia values and change in peak or mean power. There was a weak, but significant correlation between change in peak power and change in pH ( $R^2 = 0.34$ ,  $p = 0.05$ ) and change in mean power and change in pH ( $R^2 = 0.44$ ,  $p = 0.02$ ). **CONCLUSIONS:** Greater reductions in peak power and mean power correlated with change in blood pH, but not post-exercise ammonia values.

3222 Board #91 June 2 8:00 AM - 9:30 AM  
**Impact of Calf Temperature Changes on Neuromuscular Function in Elite Taekwondo Athletes**  
 Bo Geun Lee<sup>1</sup>, Somi Yun<sup>1</sup>, Yun Bin Lee<sup>1</sup>, Mingi Jung<sup>1</sup>, Dahye Lim<sup>1</sup>, Ah Reum Jung<sup>1</sup>, Woong Hee Lee<sup>1</sup>, Eunjin Hwang<sup>1</sup>, Ik Jin Kwon<sup>2</sup>, Dae Taek Lee<sup>1</sup>. <sup>1</sup>*Kookmin University, Seoul, Korea, Republic of.* <sup>2</sup>*Chung-Ang University, Seoul, Korea, Republic of.*  
*(No relevant relationships reported)*

**PURPOSE:** This study investigated the impact of lower body temperature changes on neuromuscular function in elite Taekwondo athletes. **METHODS:** Eighteen Korean National Taekwondo Team athletes (10 men,  $24 \pm 2$  yrs,  $190 \pm 5$  cm,  $77 \pm 11$  kg; 8 women,  $24 \pm 3$  yrs,  $174 \pm 7$  cm,  $63 \pm 10$  kg) were recruited. They participated in two separate tests. In one test, their calf was cooled by ice packs. In another test, their calf was warmed by hot packs. Before and after each thermal treatment, Hoffmann reflex (H-reflex; Hmax, Mmax, H/Mmax ratio), static (eye-closed single leg balance, eye-closed single leg balance, in sec) and dynamic balance (leg reach to front, left-back diagonal, and right-back diagonal directions, in cm) and four different jumps (Counter Movement Jump, Counter Movement Jump Arm Throwing, Drop Jump, and Stiffness Jump) were tested. Test order was randomly assigned. The room temperature was maintained at  $23\text{--}25^\circ\text{C}$  and 60% relative humidity. **RESULTS:** Calf skin temperature was  $33.2 \pm 1.1$  and  $33.2 \pm 0.5^\circ\text{C}$  before and  $12.2 \pm 1.5$  and  $40.1 \pm 1.3^\circ\text{C}$  after cooling and warming test, respectively. Hmax increased by cooling from  $4.5 \pm 1.9$  at rest to  $5.6 \pm 1.7$  mV ( $p < 0.05$ ) while no changes were noticed after warming ( $p > 0.05$ ). No changes were found in Mmax after both thermal treatments. H/Mmax ratio was increased after the cooling from  $51.3 \pm 9.6$  to  $65.3 \pm 17.8\%$  ( $p < 0.05$ ) while no changes were found in warming treatment (from  $47.0 \pm 28.5$  to  $65.3 \pm 17.8\%$ ,  $p > 0.05$ ). Dynamic balance significantly increased after warming ( $p < 0.05$ ), but static balance was not changed after warming ( $p < 0.05$ ). Cooling decreased both static and dynamic balances. Drop Jump reduced by cooling from  $53.3 \pm 12.9$  to  $45.1 \pm 11.0$  cm, but other jump performances were not significantly changed after thermal treatments. **CONCLUSIONS:** Hmax, which represents neural activation, was increased after cooling. Mmax, which is directly related to muscle neuron activation, was not significantly changed by thermal treatment. These explain an increase of H/Mmax ratio after cooling. Cooling impacts on motor neuron pool activation. Balance and jump performances decreased after cooling, and dynamic balance increased after warming.

3223 Board #92 June 2 8:00 AM - 9:30 AM  
**No Effects of Skin Pressure Depth on Reaction Time**  
 Taylor L. Curtis, Landyn Van Overbeke, Antonio Meikel, Jeffrey W. Bell. *Southwest Minnesota State University, Marshall, MN.*  
 (Sponsor: Serge P. von Duvillard, Ph.D., FACSM, FECS, FACSM)  
*(No relevant relationships reported)*

Depth of pressure on skin mechanoreceptors may affect reaction time. Athletes such as wrestlers that depend on skin proprioception for performance may utilize reaction time differences based on pressure differences. It is unknown whether training could affect this response. **PURPOSE:** The purpose of this study was to determine whether depth of pressure or athlete status affects reaction time. **METHODS:** Forty college students (20 wrestlers, 15 non-wrestling athletes, and 5 non-athletes) participated in a reaction time study where three weights (5 g, 10 g, and 30 g) were dropped from 50 cm onto the bicep while subjects were blindfolded and wearing earplugs. Each weight was dropped three times in a randomized order. All trials were recorded using a high-speed camera (Fastec IL3) at 1200 Hz and calculated as the time from skin deformation until first hand movement. After removal of outliers, 36 subjects' data for the average reaction time to the weight drops (29 wrestlers, 13 non-wrestling athletes, and 4 non-athletes) were analyzed using a 3x3 (weight x group) General Linear Model in SPSS v. 24. **RESULTS:** There were no main effects for athlete status group or weight ( $p = 0.38$ ), even though heavier weights elicited a non-significant faster response (5 g =  $140.28 \pm 16.44$  ms, 10 g =  $136.75 \pm 17.63$  ms, 30 g =  $128.86 \pm 18.02$  ms). **CONCLUSIONS:** There is no evidence to suggest that wrestlers should train to react to a variety of contact pressures on the upper arm.

3224 Board #93 June 2 8:00 AM - 9:30 AM  
**Acute Cognitive Anxiety is Positively Related to Maximal Strength Performance**  
 Joseph P. Carzoli<sup>1</sup>, Michael H. Haischer<sup>1</sup>, Daniel M. Cooke<sup>1</sup>, Amber M. Shipherd<sup>2</sup>, Trevor K. Johnson<sup>1</sup>, Edward P. Davis<sup>1</sup>, Dan J. Belcher<sup>1</sup>, Robert F. Zoeller<sup>1</sup>, Michael Whitehurst, FACSM<sup>1</sup>, Michael C. Zourdos<sup>1</sup>. <sup>1</sup>*Florida Atlantic University, Boca Raton, FL.* <sup>2</sup>*Texas A&M University-Kingsville, Kingsville, TX.*  
*(No relevant relationships reported)*

A flexible program allows the athlete to choose the daily training session based upon their readiness prior to the session. There is no consensus regarding the best pre-training readiness assessment. One proposal has been that elevated acute anxiety would be related to performance, however, there are equivocal findings related to the benefit of high anxiety and strength performance. **PURPOSE:** Therefore, the purpose of this investigation was to examine the relationship between somatic and cognitive anxiety on acute one-repetition maximum (1RM) back squat performance. **METHODS:** Fifty-eight resistance-trained males ( $n=41$ ) and females ( $n=17$ ) (age:  $23 \pm 3$  yrs; body mass:  $80.64 \pm 16.49$  kg) completed the Revised Competitive State Anxiety Inventory-2 (CSAI-2) questionnaire prior to performing a 1RM back squat. Additionally, participants completed a perceived self-efficacy (PSE) questionnaire in which participants stated what they believed they were 100%, 75%, and 50% confident they could squat for a 1RM. Next, following a 5-minute dynamic warm-up, subjects completed a validated 1RM back squat protocol. To provide the dependent variable the difference of each PSE value was taken from the 1RM (1RM-PSE). Pearson's product moment correlations were then utilized to determine the relationship between the somatic and cognitive anxiety subscales of the CSAI-2 and 1RM-PSE difference at each reported percentage of confidence. **RESULTS:** Participants squatted more than predicted at the 100% ( $13.25 \pm 18.00$  kg) and 75% confidence ( $3.5 \pm 15.75$  kg) and less than predicted at 50% confidence ( $-5.00 \pm 15.25$  kg). Cognitive anxiety was positively and significantly related to 1RM-PSE at all confidence levels: 100% ( $r=0.43$ ,  $p < 0.01$ ), 75% ( $r=0.41$ ,  $p < 0.01$ ), and 50% ( $r=0.37$ ,  $p < 0.01$ ), while somatic anxiety was not significantly related to performance at any confidence level (100%:  $r=0.16$ ,  $p=0.23$ ; 75%:  $r=0.16$ ,  $p=0.24$ ; 50%:  $r=0.04$ ,  $p=0.77$ ). **CONCLUSIONS:** These results indicate that increased acute cognitive anxiety is associated with better than predicted squat strength, while increased acute somatic anxiety is not associated with acute strength. If utilizing a flexible training template, cognitive anxiety should be one of the pre-training readiness factors which is used to select resistance training load.

3225 Board #94 June 2 8:00 AM - 9:30 AM

**A 3-year Analysis of Game Demands in Women's Division I College Basketball**Lynda B. Ransdell, FACSM<sup>1</sup>, Teena Murray<sup>2</sup>, Dierdra Bycura<sup>1</sup>, Paul Jones<sup>3</sup>. <sup>1</sup>Northern Arizona University, Flagstaff, AZ. <sup>2</sup>University of Louisville, Louisville, KY. <sup>3</sup>University of Louisville, Louisville, KY.*(No relevant relationships reported)*

Women's division I college basketball is demanding, thus non-contact injury rates are high, and key performance markers such as lower body power may decline at the end of the season due to high chronic training stress. Quantifying and monitoring athlete training loads is fundamental to managing injury risk, explaining acute changes in performance, increasing understanding of training responses, and planning and modifying training. Wearable devices using GPS and accelerometry (i.e., Catapult® OptimEye S5) provide new opportunities for advancing sport science in basketball. To date, no research has examined the game demands of women's division I college basketball using Catapult® technology.

**PURPOSE:** To quantify the game demands of 6 women's basketball players from a top Division I program (.781% win percentage) over a 3-year period, and to compare the positional differences of guards and posts during regular- and post-season games, and wins versus losses.

**METHODS:** Six female athletes (20.35 ± 1.6 yrs) wore Catapult S5® units in a garment resembling a sports bra during 89% of practices and games (Catapult Sports, Melbourne, Australia). Data were collected in real-time. Data, including Player Load (PL), Player Load per minute (PL/min), Inertial Movement Analysis (IMA), and Jumps (volume and intensity), were analyzed using Catapult OpenField Software (Version 1.14.1+).

**RESULTS:** For the 3-year period, average player load ranged from 613-642, and it increased each year. This indicates that athletes were able to continue to increase their average player load each season. Average player load and average player load per minute was higher for wins than for losses. High IMA was similar for wins and losses. When data were examined by player position, guards accumulated higher average player loads, and higher average player loads per minute than posts. Differences in IMA by player position were inconsistent from year to year.

**CONCLUSIONS:** Wearable devices such as Catapult® provide important workload information that can be used to assess and guide player practice and game demands, including differences by player position. Future research should examine how player load relates to specific aspects of game performance (FT%, FG%) and to injury prevention.

3226 Board #95 June 2 8:00 AM - 9:30 AM

**Assessing The Impact Of A Governed Focal Point On Broad Jump Performance In Collegiate Females**

Madeline Phillips, Robert T. Sanders, Jared R. Feister, Andy M. Bosak, Hannah E. Nelson, Russell K. Lowell, Brandon M. Ziebell. Liberty University, Lynchburg, VA. (Sponsor: Dr. James Schoffstall, FACSM)

*(No relevant relationships reported)*

The broad jump (BJ) test is frequently utilized to evaluate how far a person can jump and what their resulting lower body power will be. Hence, it is important that the BJ test be administered correctly for a person to jump as far as possible. The standard BJ test has no set focal point for a subject which causes the subject to look wherever they choose. However, prior research with vertical jump performance suggests a set focal point contributes to higher jumps. Therefore, it is logical to assume that a set focal point may assist in greater BJ performance, but to the best of the researchers' knowledge, the impact of a governed focal point (FP) vs. non-governed focal point (NFP) on BJ performance has not been assessed. **PURPOSE:** To investigate the potential differences between a FP vs. NFP on BJ performance in no less than averagely fit college-age females. **METHODS:** After having descriptive data (Ht, Wt, BF%, age) recorded, 33 averagely fit college-age females participated in an 8 min dynamic warm-up. Subjects were then given a four minute passive recovery (PR) period after the warm up and then completed four familiarization jumps (ie. trials). After another 4 min PR period, subjects completed two series of jumps (ie. four trials apiece) in a counterbalanced order with either a FP or NFP for each jump. The FP and NFP jump series were separated by 4 min of PR. The farthest jump for FP vs. NFP was compared using Paired-Samples T-Tests with significant differences occurring at  $p \leq 0.05$ . **RESULTS:** No significant differences ( $p = 0.291$ ) occurred between FP (180.74 ± 19.9 cm) and NFP (179.63 ± 20.0 cm). **CONCLUSION:** The results suggest that FP has no significant impact on BJ performance using no less than averagely fit college-age females, yet 39.4% of the subjects did benefit from an FP. Future research may be required to assess the impact of FP vs. NFP on broad jump performance using no less than averagely fit college-age males as well as athletes who perform horizontal jumping actions (running long jump, triple jump, etc.). Additional research may be

required to assess the impact of a sports specific focal point vs. non-governed focal point on broad jump performance with no less than averagely fit female and male population.

3227 Board #96 June 2 8:00 AM - 9:30 AM

**Effect Of Exercise On Cognitive Performance And Systemic Bdnf Levels In An Elderly Mexican Population**Ermilo Canton Martinez, Ivan Renteria, Patricia Garcia Suarez, David Martinez Corona, Alberto Jimenez-Maldonado. Universidad Autónoma de Baja California, Ensenada, Mexico. *(No relevant relationships reported)*

The ageing is a progressive process that reduces the functional abilities that affect the life in humans. Furthermore, studies have indicated that the ageing is associated with morphological changes in the hippocampus, the last condition seem induces cognitive deficiencies. **PURPOSE:** To determine the effect of a functional exercise training on cognitive performance and systemic BDNF in an elderly Mexican population.

**METHODS:** 19 elderly-healthy participants (Age = 69.1 ± 7.5 yr.; body weight (BW) = 74.3 ± 12.8 kg; height = 155 ± 0.7 cm; BMI = 29.7 ± 5.6 kg/m<sup>2</sup>) were recruited in this study. The subjects were randomly divided in two groups: Control (C; n=11; 10 women; 1 man) and Functional Exercise (FE; n=8; 6 women; 2 men). Before to start the FE program. The physical activity level (PA) and the years of education (YE) were determined in the groups. The PA was not statistically different in the groups (C: 6.24 ± 3.05 vs FE: 8.7 ± 1.49,  $p = 0.07$ ). The YE was similar between the groups (C: 5.81 ± 1.5 vs FE: 6.9 ± 2.9 yr,  $p = 0.3$ ). After this, the FE program was applied.

The protocol consisted in 36 sessions of aerobic and stretching exercises. 24 hours of finished, the exercise program the miminetal test and the 6-minute walking test (6 MWT) was applied in the two groups. The systemic BDNF levels at basal state also were evaluated. **RESULTS:** The FE walked more distance in the 6MWT compared with C (C: 329.1 ± 39.6 m vs EF: 844.4 ± 172.6,  $p < 0.01$ ). The cognitive performance was better in FE with respect to C (C: 21.18 ± 4.2 vs FE: 27.44 ± 0.8 ( $p < 0.01$ ). There was a positive correlation between the distance walked in the 6MWT and the cognitive performance ( $r = 0.68$ ,  $p < 0.01$ ). Finally, FE showed lower systemic BDNF levels than C (C: 18 676 ± 2264 pg/ml vs FE 15 766 ± 2064 pg/ml,  $p = 0.01$ ). **CONCLUSION:** The data of the present study suggest that FE to long-term improved the cognitive performance in older people. However, the last effect was not accompanied with a higher BDNF concentration in the periphery at least in a Mexican population.

3228 Board #97 June 2 8:00 AM - 9:30 AM

**Associations Between Off-Season Player-Tracking Data and Changes in Vertical Jump Parameters in Female Basketball Players**

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*(No relevant relationships reported)*

Commercial player-tracking systems help quantify the volume and intensity of activity during practices and games. When combined with neuromuscular fitness testing data, longitudinal analysis of player-tracking data may provide insight into the dose-response relationship between training loads and changes in fitness levels. Such insights may ultimately help drive the program design process for athletes so as to optimize their physiological adaptations and maximize their readiness.

**PURPOSE:** Examine the associations between player-tracking data and changes in vertical jump parameters over the course of off-season training in Division I female basketball players.

**METHODS:** Ten female collegiate basketball players were recruited at the beginning of off-season training. They each performed countermovement jump (CMJ) tests on two force plates before and after three months of off-season training. Each testing session involved CMJ's with three loads (0, 20, 40 kg). The ground reaction force data were used to calculate the average concentric force and velocity of each CMJ. The data from the three load conditions were used to establish a force-velocity profile and estimate maximal force at zero velocity ( $F_0$  [m/s]) and maximal velocity at zero force ( $V_0$  [N/kg]). Training loads were monitored with a player tracking system during each practice of the off-season. Each players' Player Load (PL) and Player Load per Minute (PL/Min) were recorded for each practice and averaged over the entire off-season period. Simple linear regression models were used to determine the associations between average off-season player-tracking data and changes in force-velocity parameters.

**RESULTS:** The changes in  $F_0$  and  $V_0$  across the off-season were  $-0.65 \pm 1.24$  and  $3.29 \pm 5.04$ , respectively. The average off-season PL and PL/Min were  $442 \pm 47$  and  $5.00 \pm 0.54$ , respectively. Off-season PL did not correlate to changes in  $F_0$  ( $r = 0.03$ ;  $p = 0.93$ ) or  $V_0$  ( $r = 0.02$ ;  $p = 0.95$ ). Off-season PL/Min was also not correlated to changes in  $F_0$  ( $r = 0.01$ ;  $p = 0.97$ ) or  $V_0$  ( $r = 0.06$ ;  $p = 0.86$ ).

**CONCLUSION:** Neither average off-season PL or PL/Min were able to predict changes in CMJ force-velocity parameters. The average volume and intensity of off-season practice sessions did therefore not affect the jumping ability of female Division I basketball players.

3229 Board #98 June 2 8:00 AM - 9:30 AM  
**The Relationship Between Lower Extremity Strength and Overhead Squat**  
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 (No relevant relationships reported)

Impaired lower extremity muscle strength can put athletes at risk of injuries. Assessing the relationship between muscle strength and knee instabilities during overhead squat (OHS) can help prevent injuries of collegiate female athletes. **Purpose:** Examine the relationship between lower extremity muscle strength and the depth and knee wobbling during overhead squat (OHS). **Methods:** Eight in-season Division I collegiate women's tennis athletes and 10 in-season Division I collegiate women's basketball athletes (age:  $18.94 \pm 1.35$  yrs., height:  $1.75 \pm 0.08$  m, weight:  $71.61 \pm 14.05$  kg) participated. Participants' knee flexor, extensor, and hip abductor muscle strength were measured with a hand held dynamometer and the average of three trials was normalized by body weight (%BW). Participants then performed three consecutive OHS as low as possible and were video recorded for post processing from the frontal and sagittal planes. Following the assessment, participants were grouped into Above Parallel (AP) or Below Parallel (BP) depth and knee wobbles or no wobbles during OHS. **Results:** The mean differences of knee flexor, extensor, and hip abductor strength were compared for BP and AP groups. Three participants were grouped into BP and 15 were grouped into AP. An independent t-test showed significant differences of left hip abductor strength of AP (mean= $17.82 \pm 4.05$  %BW), compared to BP (mean= $21.67 \pm 1.41$  %BW);  $t(18) = -2.900, p = 0.016$ . No significant differences were found between muscle strength and knee wobbling. **Conclusion:** Overall, no relationship between knee wobbling and the lower extremity strength was found. However, there was a statistically significant relationship in OHS depth and hip abductor strength on the left side. Previous studies have demonstrated decreased hip abductor strength may cause patellofemoral pain syndrome (PFP) and knee valgus. Future studies should look at increasing hip abductor strength and its effects on PFP and knee valgus during functional movements.

3230 Board #99 June 2 8:00 AM - 9:30 AM  
**Hypersomnia is Negatively Related to Maximal Strength Performance**  
 Dan J. Belcher<sup>1</sup>, Michael H. Haischer<sup>1</sup>, Daniel M. Cooke<sup>1</sup>, Joseph P. Carzoli<sup>1</sup>, Amber M. Shipherd<sup>2</sup>, Robert Varieur<sup>1</sup>, Trevor K. Johnson<sup>1</sup>, Edward P. Davis<sup>1</sup>, Robert F. Zoeller<sup>1</sup>, Michael Whitehurst, FACSM<sup>1</sup>, Michael C. Zourdos<sup>1</sup>. <sup>1</sup>Florida Atlantic University, Boca Raton, FL. <sup>2</sup>Texas A&M University-Kingsville, Kingsville, TX.  
 (No relevant relationships reported)

Previously, ratings of performance self-efficacy (PSE) have been positively related to athletic performance. However, it has been proposed that sleeping dysfunction may disrupt PSE predictions. **PURPOSE:** Therefore, the purpose of this investigation was to examine the relationship between insomnia and hypersomnia on self-predicted acute one-repetition maximum (1RM) back squat performance. **METHODS:** Fifty-eight resistance-trained males ( $n=41$ ) and females ( $n=17$ ) (age:  $23 \pm 3$  yrs; body mass:  $80.64 \pm 16.49$  kg) completed the Oviedo Sleep Questionnaire (OSQ) prior to performing a 1RM back squat. Additionally, participants completed a PSE questionnaire regarding what they believed they were 100%, 75%, and 50% confident they could squat for a 1RM. Then following a brief dynamic warm-up, subjects completed a validated 1RM back squat protocol. The difference of each PSE value was then taken from the 1RM and converted to percentage (1RM-PSE) to assess differences between predicted and actual 1RM outcomes. Next, the 1RM-PSE value was converted to a percentage to determine the percentage difference between actual 1RM and predicted 1RM at each level of confidence. Pearson's product moment correlations were used between the insomnia and hypersomnia subscales of the OSQ and the percentage 1RM-PSE difference at each confidence level. **RESULTS:** Participants squatted a greater amount than predicted at 100% ( $14.21 \pm 22.86\%$ ) and 75% ( $4.71 \pm 15.28\%$ ) levels of confidence, and less than predicted at the 50% confidence level ( $-2.04 \pm 12.16\%$ ). Hypersomnia was inversely and significantly related to the 1RM-PSE percentage difference at the 50% confidence level (50%:  $r = -0.26, p < 0.05$ ) and approached significance at the 75% confidence level ( $r = -0.23, p = 0.08$ ). However, hypersomnia was not significantly related to the 1RM-PSE percentage at 100% confidence ( $r = -0.18, p = 0.18$ ). The insomnia subscale was not significantly related to performance at any level of prediction confidence (100%:  $r = -0.04, p = 0.79$ ; 75%:  $r = 0.07, p = 0.63$ ; 50%:  $r = -0.04, p = 0.78$ ). **CONCLUSIONS:** These results indicate that hypersomnia (i.e.

acute excessive sleepiness) is associated with worse than predicted maximal strength performance in the squat at lower PSE confidence level. Therefore, acute sleep patterns should be considered as a readiness assessment.

3231 Board #100 June 2 8:00 AM - 9:30 AM  
**Acute Anxiety is Not Significantly Related to Repetitions Performed in the Back Squat**  
 Hector G. Paez<sup>1</sup>, Michael H. Haischer<sup>1</sup>, Daniel M. Cooke<sup>1</sup>, Joseph P. Carzoli<sup>1</sup>, Amber M. Shipherd<sup>2</sup>, Trevor K. Johnson<sup>1</sup>, Edward P. Davis<sup>1</sup>, Robert Varieur<sup>1</sup>, Robert F. Zoeller<sup>1</sup>, Michael Whitehurst, FACSM<sup>1</sup>, Michael C. Zourdos<sup>1</sup>. <sup>1</sup>Florida Atlantic University, Boca Raton, FL. <sup>2</sup>Texas A&M University-Kingsville, Kingsville, TX.  
 (No relevant relationships reported)

Flexible resistance training programs allow for athletes to autoregulate daily training variables based upon readiness prior to the training session. Although factors such as physical recovery, anxiety, and sleep can affect acute performance there is no consensus regarding the best training evaluation to assess readiness to train. In fact, somatic and cognitive anxiety have been both positively and negatively related to athletic performance, thus the findings for these factors as readiness indicators are equivocal. The Revised Competitive State Anxiety Inventory-2 (CSAI-2) is a common scale which allows for the acute assessment of both anxiety traits. **PURPOSE:** Therefore, the purpose of this investigation was to examine the relationship between somatic and cognitive anxiety using the CSAI-2 scale on maximal repetitions performed at 70% of one-repetition maximum (1RM) in back squat. **METHODS:** Fifty-eight resistance-trained males and females (age:  $23 \pm 3$  yrs; body mass:  $80.64 \pm 16.49$  kg) completed the CSAI-2 questionnaire prior to performing a 5-minute dynamic warm-up and a 1RM back squat. Following 1RM testing, subjects had a standardized rest period of 10 minutes prior to completing two single-repetition sets on the squat at 30%, 40%, 50%, 60%, 70%, 80% and 90% of the established 1RM for which the data is included elsewhere. After the submaximal single repetition sets, subjects had a 10-minute rest period before completing one set on the back squat to volitional failure at 70% of the established 1RM. Pearson's product moment correlations were then utilized between the somatic and cognitive anxiety subscales of the CSAI-2 to determine if any relationship existed with the number of repetitions completed at 70% of 1RM. **RESULTS:** Somatic anxiety ( $r = -0.20, p = 0.13$ ), cognitive anxiety ( $r = 0.19, p = 0.17$ ) and self-confidence ( $r = 0.05, p = 0.72$ ) subscales of the CSAI-2 were not significantly correlated with back squat performance during maximal repetitions to failure at 70% of 1RM. **CONCLUSIONS:** None of the CSAI-2 subscales were related with repetitions performed to volitional failure in the squat. However, we caution that this analysis did not examine maximal strength performance, and should only be applied to repetitions performed to failure at submaximal intensities.

3232 Board #101 June 2 8:00 AM - 9:30 AM  
**Grit is Not Significantly Related to Repetitions Performed in the Back Squat**  
 Robert J. Pratt<sup>1</sup>, Michael H. Haischer<sup>1</sup>, Daniel M. Cooke<sup>1</sup>, Joseph P. Carzoli<sup>1</sup>, Amber M. Shipherd<sup>2</sup>, Trevor K. Johnson<sup>1</sup>, Edward P. Davis<sup>1</sup>, Robert Varieur<sup>1</sup>, Robert F. Zoeller<sup>1</sup>, Michael Whitehurst, FACSM<sup>1</sup>, Michael C. Zourdos<sup>1</sup>. <sup>1</sup>Florida Atlantic University, Boca Raton, FL. <sup>2</sup>Texas A&M University-Kingsville, Kingsville, FL.  
 (No relevant relationships reported)

Several psychological factors have been linked to acute strength performance through a variety of psychometric analyses. Recent research suggests that the "grittier" a person is, the greater their perseverance and passion for long-term goals. Although grit has shown promise in predicting long-term performance, the association between grit and acute strength performance is yet to be determined. **PURPOSE:** Therefore, the purpose of this investigation was to examine the relationship between grit as determined by the Short Grit Scale (Grit-S) and total repetitions performed to volitional failure at 70% of one-repetition maximum in the back squat. **METHODS:** Fifty-eight resistance-trained males and females (age:  $23 \pm 3$  yrs; body mass:  $80.64 \pm 16.49$  kg) completed Grit-S prior to performing a one-rep max back squat (1RM). Following a 5-minute dynamic warm-up, subjects completed a validated 1RM back squat protocol. Following 1RM testing, subjects had a standardized rest period of 10 minutes prior to completing two single-repetition sets on the squat at 30%, 40%, 50%, 60%, 70%, 80% and 90% of the established 1RM for which the data is included elsewhere. After the submaximal single repetition sets, subjects had a 10-minute rest period before completing one set on the back squat to volitional failure at 70% of the established 1RM. A Pearson's product moment correlation was utilized to determine any relationships between Grit-S total repetitions performed at 70% of 1RM. **RESULTS:** There was a wide range of repetitions performed across all subjects (6-28) with an average of  $14 \pm 4$  repetitions. However, grit as determined by the Grit-S was not significantly related to total repetitions performed at 70% of 1RM in the back squat ( $r = -0.11, p = 0.42$ ). **CONCLUSIONS:** These results indicate that higher levels of grit are not associated

with repetitions performed to failure and submaximal back squat intensities. However, we suggest that the Grit-S should be used to assess long-term commitment to athletic training as well as a possible indicator of chronically improved performance.

3233 Board #102 June 2 8:00 AM - 9:30 AM  
**Relationship Between Fitness Testing and Performance Statistics in Baseball: A Longitudinal Study**

Thejasvi Reddy Anantasagar<sup>1</sup>, Vishak Vinod<sup>2</sup>, Richard A. Karasch<sup>1</sup>, James G. Disch<sup>1</sup>, Zacharias Papadakis<sup>1</sup>. <sup>1</sup>Rice University, Houston, TX. <sup>2</sup>University of Houston, Houston, TX. (Sponsor: Peter W. Grandjean, FACSM)  
 (No relevant relationships reported)

Fitness testing (FT) is a contributing factor for success in most sports. Little evidence exists related to baseball FT and performance statistics (PS). **PURPOSE:** To examine relationships between FT and selected PS in NCAA Division I baseball team. **METHODS:** We followed the same players for a period of 5 years and we recorded their FT and PS, N = 414 (age 19.8 ± 1.3 yr, weight 89.9 ± 8.3 kg). Grip strength (GS), vertical jump height (VJ), and squat 1RM (SQ) were examined with regards to batting average % (b/avg%), slugging % (slg%), on-base % (ob%), earned run average (era), batting average against % (b/avg-a%), and strike-out per innings pitched for 9 innings (so/ip)\*9. FT and PS were normalized to z-scores. Missing data were estimated from least squares prediction from non-missing variables. Multiple forward stepwise regression was used to evaluate the relative impact of FT on PS (JMP® Pro 13). **RESULTS:** GS is significantly correlated with b/avg% (r=0.26, p<0.0001), slg% (r=0.34, p<0.0001), ob% (r=0.23, p<0.001), era (r=0.39, p<0.0001), and so/ip\*9 (r=0.1, p=0.03). VJ is significantly correlated with slg% (r=0.17, p=0.0007), era (r=0.25, p<0.0001), b/avg-a% (r=0.14, p=0.005), and so/ip\*9 (r=0.18, p=0.0002). SQ is significantly correlated with b/avg% (r=0.30, p<0.0001), slg% (r=0.37, p<0.0001), era (r=-0.10, p=0.04), b/avg-a% (r=-0.14, p=0.005), and so/ip\*9 (r=0.26, p<0.0001). Era was selected as the independent variable with the highest goodness of fit significantly correlating with GS (p<0.0001), VJ (p<0.0001), and SQ (p<0.0001) with adjusted R<sup>2</sup>=0.23. **CONCLUSIONS:** The results indicate that FT correlates with PS. GS, VJ, and SQ appeared to provide the greatest predictive power of era PS. FT accounted for 23% of the variance in era PS. Besides GS, VJ, and SQ, a prudent FT approach for performance coaches may be to also focus on improving other FT variables, such as bench press, standing long jump, 10-m sprint, back strength, and flexibility. This approach may translate to improved PS other than era PS.

3234 Board #103 June 2 8:00 AM - 9:30 AM  
**The Short Grit Scale Does Not Relate to Acute One-Repetition Maximum Back Squat Performance**

Trevor K. Johnson<sup>1</sup>, Michael H. Haischer<sup>1</sup>, Daniel M. Cooke<sup>1</sup>, Joseph P. Carzoli<sup>1</sup>, Amber M. Shipherd<sup>2</sup>, Edward P. Davis<sup>1</sup>, Robert Varieur<sup>1</sup>, Robert F. Zoeller<sup>1</sup>, Michael Whitehurst, FACSM<sup>1</sup>, Michael C. Zourdos<sup>1</sup>. <sup>1</sup>Florida Atlantic University, Boca Raton, FL. <sup>2</sup>Texas A&M University-Kingsville, Kingsville, TX.  
 (No relevant relationships reported)

An individual's level of "grit" is determined by their perseverance and passion for long-term goals. Existing data have demonstrated that grit has predicted success above what could be explained by talent alone. However, these existing data are based upon subjective questionnaires, including a recent meta-analysis in which grit was measured in relation to academic performance. To our current knowledge there is no research that evaluates the relationship between grit and acute athletic performance. **PURPOSE:** Therefore, the purpose of this investigation was to examine the relationship between grit as determined by the Short Grit Scale (Grit-S) and acute one-repetition maximum (1RM) back squat performance. **METHODS:** Fifty-eight resistance-trained males and females (age: 23±3yrs; body mass: 80.64±16.49 kg) completed the Grit-S questionnaire prior to performing a 1RM back squat. Additionally, participants completed a perceived self-efficacy (PSE) questionnaire in which participants stated what they believed they were 100%, 75%, and 50% confident they could squat for a 1RM. Next, following a 5-minute dynamic warm-up subjects completed a validated 1RM back squat protocol. To provide the dependent variable the difference of each PSE value was taken from the 1RM (1RM-PSE). Pearson's product moment correlations were then utilized between the Grit-S and 1RM-PSE difference at each reported percentage of confidence. **RESULTS:** Participants squatted more than predicted at the 100% (13.25±18.00 kg) and 75% confidence (3.5±15.75 kg) and less than predicted at 50% confidence (-5.00±15.25 kg). Grit-S was not significantly correlated with 1RM-PSE Difference at all percentages; 100% (r=0.17, p=0.21), 75% (r=-0.20, p=0.14), 50% (r=0.11, p=0.40). **CONCLUSIONS:** These results indicate that the character trait, grit, as measured by the Grit-S is not a factor which explains acute maximal strength performance. However, since grit is defined as someone's perseverance and passion for long-term goals we suggest that grit be investigated as a possible factor influencing chronic athletic performance and improvement over time.

3235 Board #104 June 2 8:00 AM - 9:30 AM  
**Effects of Weighted vs Light-Rope Jumping on Upper Extremity Strength and Countermovement Jump Performance**

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 (No relevant relationships reported)

**Purpose:** To compare the effects of weighted versus light-rope jumping on maximal upper extremity strength and jump performance. **Methods:** Twenty-two recreationally active females (Age: 20.27 ± 1.03yrs; height: 165.05 ± 7.17cm; mass: 68.97 ± 16.37kg) participated in a four-week rope-jumping training intervention. Assessment measures were obtained pre-and post-training intervention. Maximal isometric strength of the elbow flexors (EF), elbow extensors (EE), and grip strength (GS) were assessed via dynamometry. Additionally, countermovement jump (CMJ) height, peak power (PP), and peak velocity (PV) values were assessed using a jump mat and linear position transducer. Following pretesting, participants were randomly assigned to either a weighted rope (WR: .91kg; n = 11) or light rope (LR: .11kg; n = 11) group. The training protocol consisted of participants performing two, 4-minute sets of alternating 30s of jumping (cadence of 120/min) with 30s of rest; a third set was added to the training protocol during weeks three and four. Repeated-measures analyses of variance were performed on all pre- and post-testing measures. **Results:** No time x group interaction was revealed (p > 0.05), however, a main effect of time was observed for both GS and EF (F(1, 20) = 6.25, p = 0.021 & F(1, 20) = 5.78, p = 0.026, respectively), revealing increases in both groups for EF (WR: 6.3%; LR: 7.5%) and GS (WR: 8.7%; LR: 3.2%). CMJ height analysis revealed no interaction (p > 0.05), however, a main effect of time (F(1, 19) = 5.611, p = 0.029) was observed. PP and PV analyses revealed no significant interactions (p > 0.05), however, a main effect of time was observed for both PP and PV (F(1, 19) = 9.54, p = 0.006 & F(1, 19) = 7.33, p = 0.014, respectively). Collectively, CMJ height, PP, and PV values increased in the WR group by 5.5%, 6.5%, and 6.6%, and in the LR group by 1.1%, 1.9%, and 1.25%, respectively. **Conclusion:** Although no differences were observed between groups in strength nor jump performance, our data suggest that consistent jump rope training, regardless of rope weight, has a significant influence on upper extremity strength and jump performance.

3236 Board #105 June 2 8:00 AM - 9:30 AM  
**Performance Factors Related to Throwing Distance in Collegiate Track Athletes**

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 (No relevant relationships reported)

**Purpose:** The purpose of this study was to identify potential correlations between upper and lower body power, balance, flexibility, and body composition in relation to actual throwing performance in collegiate throwers. **Methods:** 12 collegiate throwers (8 male, 4 female; minimum of 4 years of experience) performed a series of functional tests and a competition level throw. Participants performed a brief warm up prior to each test. Upper body power was determined using a seated medicine ball throw (9kg male, 6kg female) performed laying on a bench at a 45° incline. Lower body power and reaction time were measured using a vertical jump mat (Probotics Inc, Huntsville, AL) which provided jump height, ground reaction time, and an overall power factor (OPF). Balance was assessed during single leg trials for each leg on a Biodex balance system (Biodex Medical Systems Inc., Shirley, NY). Flexibility was assessed by sit and reach. Body composition was measured by means of air displacement plethysmography (Bod Pod; Cosmed USA Inc. Concord, CA). Functional testing results were compared to actual competition throws, which took place at a sanctioned meet within 3 days of testing. Comparisons between functional tests and competition throws were made using Pearson's R (linear) and Spearman's Rho (nonlinear) tests to identify correlations. **Results:** Nonlinear correlations were found between throwing distance and body fat percentage (rho=-0.699; p=0.011), and OPF (rho=0.609; p=0.047). Linear correlations were found between throwing distance and overall lead leg stability (r=0.701; p=0.011), and lead leg medial/lateral stability (r=0.688; p=0.013). **Conclusions:** These data suggest that body fat percentage, lower body power, and lead leg stability are each correlated with throwing distance. Improvements in these areas could lead to improvements in overall throwing distances in collegiate throwers.

3237 Board #106 June 2 8:00 AM - 9:30 AM

**Anthropometric and Performance Statistics Comparisons in Baseball Pitchers: A Longitudinal Study**

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(No relevant relationships reported)

Athletic ability, performance, and motor skills depend greatly on human proportionality. Practicing sports at a high level is associated with a person's ability to meet the biomechanical demands of a particular sport or playing position. The ideal somatotype of athletes in different sports and within the same sport has been described. However, there is limited evidence regarding the association between the anthropometric characteristics, such as body weight (BW), body height (BH), and body fat % (BF%) of collegiate baseball pitchers and baseball performance statistics (PS). **PURPOSE:** To compare BW, BH, BF% and selected baseball-specific PS, such as earned run average (era), batting average against % (b/avg-a%), and strike-out per innings pitched for 9 innings (so/ip)\*9 in NCAA Division I pitchers; to examine the relationship between BW, BH, BF% and baseball-specific PS. **METHODS:** During a 5-year period, 210 collegiate pitchers (age 19.7 ± 1.2 yr; weight 92 ± 8.2 kg) were assessed for body weight (BW), body height (BH), and body fat % (BF%). The following pitchers' baseball statistics were collected: era, b/avg-a%, and (so/ip)\*9. BW, BH, BF%, and PS were normalized to z-scores. Missing data were estimated from least squares prediction from non-missing variables. Forward multiple stepwise regression was used to evaluate the relative impact of BW, BH, and BF% on PS (JMP® Pro 13). **RESULTS:** BH is significantly correlated both with b/avg-a% (r=-0.18, p=0.0104) and era (r=0.22, p=0.0010). BW is significantly correlated with (so/ip)\*9 (r=0.22, p=0.0016). BF% is significantly correlated with both era (r=-0.26, p=0.0001) and (so/ip)\*9 (r=-0.14, p=0.0472). Strike-out per innings pitched for 9 innings was selected as the independent variable with the highest goodness of fit significantly correlating with BW (p=0.0004), BH (p=0.0004), and BF% (p=0.0022) with adjusted R<sup>2</sup>=0.12. **CONCLUSIONS:** The results indicate that BW, BH, and BF% of pitchers correlate with b/avg-a%, era, and (so/ip)\*9. BW, BH, and BF% appeared to provide the greatest predictive power of (so/ip)\*9. The selected anthropometric variables accounted for 12% of the variance in (so/ip)\*9. Runs are usually scored by hits. Coaches and trainers want pitchers to prevent runs. Therefore, they may need to account for other factors besides BW, BH, and BF%.

3238 Board #107 June 2 8:00 AM - 9:30 AM

**Effect Of Warm-up Intervention On Physical Performance: Meta-analysis**

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(No relevant relationships reported)

Warm-ups have been often used prior to exercise and sports. Numerous warm-up intervention studies have been conducted to maximize physical performance, yet results remain controversial. **PURPOSE:** The purpose of this study was, using meta-analysis techniques, to examine the effect of warm-up intervention on physical performance. **METHODS:** Relevant studies were identified by conducting electronic databases such as Medline, Cochran Library, and SPORTDiscus by a systematic literature search (key terms: warm-up and physical performance). Outcome measurement of physical performance included sprint, jump, flexibility, agility, power, and sports related skills (ball dribbling and penalty kick). Standardized mean difference effect size (ES) was calculated based on the difference in physical performance between pre- and post-intervention or post values of treatment and control group, respectively. A random effects model was used to provide an overall ES and 95% confidence interval (CI). Moderator analyses were conducted to evaluate the effects of study gender, warm-up type (static vs. dynamic), and performance type (sprint vs. jump vs. flexibility vs. others) on overall ES. Heterogeneity was examined using Cochran's Q statistic. All analyses were conducted using Comprehensive Meta Analysis (Version 3). **RESULTS:** Out of 1379 potentially relevant articles, 54 studies were selected based on initial screening of titles and abstracts. A total of 12 studies met the inclusion criteria and 71 ESs were calculated. The overall mean ES was not significant (ES = .035; 95% CI = -.058, .128). Moderator analyses showed that studies with flexibility (.196; .074, .318) had a greater ES than sprint (-.127; -.328, .073), jump (.020; -.100, .140), and others (.089; -.268, .446),  $Q_{\text{between}}(Qb) = 8.491, df = 3, p = .037$ . However, other moderator variables had no effect on the mean ES: warm-up type,  $Qb = 1.800, df = 2, p = .407$ ; gender,  $Qb = 0.243, df = 2, p = .886$ . **CONCLUSION:** In this meta-analysis, the evidence is insufficient to conclude that the warm-up interventions are effective in improving physical performance. However, warm-up might have a small effect on improving flexibility.

3239 Board #108 June 2 8:00 AM - 9:30 AM

**Positional Impact on Physiological and Performance Variables in Women's Collegiate .22 Bore Rifle Shooting**

Sarah Henry, Peter Chrysosferidis, Nicholas Murray, G. A. Ryan. Georgia Southern University, Statesboro, GA.

(No relevant relationships reported)

Competitive rifle shooting is rapidly becoming a staple sport in American collegiate athletics. Over 300 universities in the United States now have shooting programs. Accurate shooting requires immense physiological and biomechanical control. **PURPOSE:** The purpose of this study was to determine physiological (heart rate [HR] and respiratory rate [RR]) and performance differences in three shooting positions (Stand, Kneel, and Prone) during competitive .22 caliber bore rifle shooting. **METHODS:** 9 Division I collegiate women's rifle shooters participated in the study. HR and RR data were collected for each participant via a bio-harness. Each participant completed 10 sighting shots and 10 performance shots recorded for accuracy, using an NCAA approved computer scoring system. Each participant shot in the three positions following NCAA competition rotation. A one-way ANOVA was run to determine the impact of positioning on all variables of interest, with post-hoc LSD analysis on all significant omnibus results. **RESULTS:** A significant difference was noted for Total Score ( $F(2,25) = 6.258, p = 0.007$ ). Post-hoc analyses revealed that scores were significantly worse in the Stand position ( $80.0 \pm 9.6$ ) compared to Prone ( $92.5 \pm 5.1, p = 0.002$ ). Kneel score ( $86.8 \pm 6.6, p = 0.066$ ) compared to Stand approached, but was not statistically different. Significance was approached with RR ( $p = 0.059$ ), with RR being highest in Prone ( $6.4 \pm 2.1$  breaths), compared to Stand ( $4.4 \pm 2.1$  breaths) and Kneel ( $3.9 \pm 1.3$  breaths). No significant differences were noted for HR ( $p = 0.862$ ). **CONCLUSION:** The data suggest that the Prone position yielded the highest scores, and a potentially elevated RR. This suggests that the ground-assisted positioning of the rifle, and slightly elevated RR, aid in scoring accuracy in collegiate women's .22 caliber rifle shooters. Conversely, lowest scores were recorded in the Stand position. This could be due to the weight (~17lb) of the rifle needing to be held steady in this position.

3240 Board #109 June 2 8:00 AM - 9:30 AM

**Validation Of Triathlon Time Prediction Methods For Amateur Triathletes**

Todd Buckingham<sup>1</sup>, Rebecca W. Moore<sup>2</sup>, David Ferguson<sup>1</sup>, Nicholas Myers<sup>1</sup>, Karin A. Pfeiffer, FACSM<sup>1</sup>. <sup>1</sup>Michigan State University, East Lansing, MI. <sup>2</sup>Eastern Michigan University, Ypsilanti, MI.

(No relevant relationships reported)

Individuals new to triathlon may have difficulty accurately predicting their finish time. Equations (Schabert et al., Hue et al.) have been developed that predict Olympic distance triathlon finish time. However, triathletes were elite level with a sample size of 10 or fewer, making it uncertain if these findings are relevant to a larger sample of amateur triathletes. An online calculator (QT2) is also available to predict triathlon times, but it has not been validated. **PURPOSE:** To assess the criterion and convergent validity of two scientific equations and the QT2 in predicting actual finish time of an Olympic distance triathlon for amateur triathletes. **METHODS:** Participants were collegiate, amateur triathletes who completed an Olympic distance triathlon during 2017. Participants performed six exercise tests, as close to their race as possible, either before or after, and all tests were performed on separate days. Body composition was assessed via BodPod. Three of the exercise tests (peak treadmill speed, 4 W/kg cycle, 30-minute bike/20-minute run) were used in the scientific equations. For these, participants visited the laboratory at Michigan State University or Eastern Michigan University on three separate occasions. Blood lactate was measured for each test. The remaining three exercise tests, which participants completed on their own (400y swim, 20-minute cycle, 5k run), were used in the QT2. Pearson correlations evaluated relationships for criterion and convergent validity. Eight amateurs could not complete the 4 W/kg cycle, so analyses were also run with their data removed. **RESULTS:** Twenty-seven triathletes ( $20.6 \pm 2.0$  years, 37.0% female, actual finish time 2:48:00 ± 0:34:32) have completed testing. The QT2 ( $r = 0.865, p < 0.001$ ), Hue ( $r = 0.883, p < 0.001$ ), and Schabert ( $r = 0.392, p < 0.05$ ) were associated with actual finish time. The QT2 and Hue ( $r = 0.859, p < 0.001$ ) and Schabert and Hue ( $r = 0.394, p < 0.05$ ), were associated with each other. When athletes who modified the 4 W/kg cycle were removed from the analyses, relationships with Schabert disappeared. **CONCLUSIONS:** The QT2 and Hue equation were closely associated with actual finish time. The QT2 involves easily accessible tests, unlike both scientific equations, which require blood lactate testing. Because of this, the QT2 may be preferred by amateurs.

3241 Board #110 June 2 8:00 AM - 9:30 AM  
**The Effects of Simulated Altitude Masks on Aerobic Endurance in Trained Individuals**  
 Melissa Renee Cook. *Indiana Wesleyan University, Marion, IN.*  
*(No relevant relationships reported)*

Oxygen-dependent exercise at altitude has demonstrated ability to increase maximal oxygen uptake over a time. Traditional means of altitude training can be time-consuming and expensive, so alternative methods that simulate altitude exposure have been developed. These masks maintain that they induce the same cardiorespiratory fitness changes that an athlete training at altitude would experience. They also claim that these improvements occur in a shorter training periods than typical altitude training protocols. However, there is little research to support these claims. **PURPOSE:** The purpose of this study is to measure the potential effects of training at a simulated altitude on aerobic endurance using a two-week YMCA cycle ergometer protocol. **METHODS:** Based on subjects'  $\dot{V}O_2$ max scores, 17 subjects were put into one of three groups, a control group (CG), a group training without the mask (No-mask), and a group training with the mask (mask). Each training session had the participants cycle for twelve minutes, at 50-60% of their heart rate reserve (HRR), followed by a 3-minute cool-down. Eight training sessions were completed within two weeks. **RESULTS:** Using a 3X2 mixed ANOVA, for within subjects, there was not a significant increase in  $\dot{V}O_2$ max ( $F(1,2,14)=.873, P>.05$ ). Means  $\pm$  SD for CG were pre 44.72 $\pm$ 9.69 and post 45.07 $\pm$ 8.96ml/kg/min. Means  $\pm$  SD for no-mask group were pre 42.70 $\pm$ 8.83 and post 44.10 $\pm$ 11.47ml/kg/min. Lastly, the means  $\pm$  SD for mask group means were pre 45.50 $\pm$ 8.72 and post 47.91 $\pm$ 8.96ml/kg/min. There were no significant differences in  $\dot{V}O_2$ max between the control and experimental groups ( $F(1,2,14)=.170, P>.05$ ) either. Although the between groups data was not statistically significant, there was a greater increase in the mask group's aerobic endurance compared to the two other groups. **CONCLUSION:** When looking at the increase in  $\dot{V}O_2$ max in response to a leg ergometer protocol, all three groups demonstrated an increase in  $\dot{V}O_2$ max at the completion. Those who trained with simulated altitude masks showed the greatest improvement from pre- to post-testing, which could be a result of the mask use, in addition to the participant's outside training. The improvement shown in the other two groups may be a result of the participants' continued training outside of the study, as well as other factors.

3242 Board #111 June 2 8:00 AM - 9:30 AM  
**Dynamic Strength Following Focal Knee Joint Cooling**  
 Joo-Sung Kim. *University of Miami, Coral Gables, FL.*  
 (Sponsor: Perry, Arlette C, FACSM)  
*(No relevant relationships reported)*

Focal knee joint cooling (FKJC) has been found to increase quadriceps strength during isometric contraction. It is unknown, however, if a similar response will occur with dynamic modes of muscle contraction such as concentric and eccentric. **PURPOSE:** To determine the effects of FKJC on isometric, concentric and eccentric modes of muscle contraction in the quadriceps muscle. **METHODS:** Twenty-one subjects (age=22.7 $\pm$ 3.1year, height=170.4 $\pm$ 10.8cm, weight=74.2 $\pm$ 16.4kg) without lower extremity injury participated. All subjects received 20 minutes of FKJC for which two 1.5L plastic bags, filled with crushed ice, were applied to the anterior and posterior surface of the knee joint. The same bags filled with candy corn were used in the same manner for the sham treatment. FKJC and sham treatments were randomly administered to subjects on different days. An isokinetic dynamometer was used to quantify strength during isometric contraction and concentric and eccentric contraction at 60°/s and at 180°/s. For each muscle contraction mode, subjects were asked to perform 3 repetitions at their maximal effort before and immediately after treatment. Knee extension peak torque (Nm) was calculated, and the mean of the 3 trials for each mode of muscle contraction was used for statistical analysis. Separate 2 (treatment condition) by 2 (time) repeated measures ANOVAs were conducted with the alpha level set at .05. **RESULTS:** There were no significant interactions or main effects for any of the contraction modes ( $p>.05$ ). For display of descriptive data, pre-and post-ice treatment's means and standard deviations are presented: isometric (pre-ice:234.0 $\pm$ 67.5, post-ice:237.5 $\pm$ 72Nm), concentric 60°/s (pre-ice:188.5 $\pm$ 58.1, post-ice:185.1 $\pm$ 58.1Nm), concentric 180°/s (pre-ice:170.6 $\pm$ 50.5, post-ice:169.2 $\pm$ 53.5Nm), eccentric 60°/s (pre-ice:246.5 $\pm$ 88.8, post-ice:250.1 $\pm$ 85.0Nm), eccentric 180°/s (pre-ice:224.8 $\pm$ 75.0, post-ice:223.8 $\pm$ 76.2Nm). **CONCLUSION:** Twenty-minutes of FKJC did not change quadriceps strength during isometric, concentric, or eccentric muscle contraction. FKJC is not beneficial for increasing quadriceps isometric or dynamic strength in healthy individuals.

3243 Board #112 June 2 8:00 AM - 9:30 AM  
**Longitudinal Correlation of Sleep Time, Strength Gains, and Performance in Collegiate Baseball Players: A Pilot Study**

Delmas Bolin, FACSM<sup>1</sup>, James Buriak<sup>2</sup>, John Creasy<sup>2</sup>, Gabrielle Deucher<sup>2</sup>, Emily Whitaker<sup>2</sup>, Adam Childers<sup>2</sup>. <sup>1</sup>*Performance Medicine of Southwestern Virginia, Roanoke, VA.* <sup>2</sup>*Roanoke College, Salem, VA.*  
*(No relevant relationships reported)*

Sleep time influences lean body mass in dieting adults; sleep has not been demonstrated to influence anabolic processes in collegiate athletes. Longer sleep time is correlated with improved performance in sports.

**Purpose:** We followed 14 baseball players to describe sleep patterns and investigate their relationship to strength gains from weight training and performance parameters over a semester.

**Methods:** The study was approved by Roanoke College IRB. 14 baseball players were chosen at random and agreed to participate. Body composition was determined pre and post study by bioimpedance. Sleep/wake time were recorded using Actigraph monitor. Participants followed standard preseason conditioning & weight lifting regimen; 3 lift maximum pre and post study were recorded for biceps curl, dip, chest press, shoulder press, pull up and squat. Pitchers accuracy of fastball and skill pitches (curve, etc) were recorded during games.

**Results:** 13 of 14 athletes completed the study. 1 withdrew due to injury. The players sleep profile showed a significant difference between the shortest (311 $\pm$ 48 min/night) and longest sleepers (430 $\pm$ 54 min/night) ( $p<.05$ ). For statistical evaluation, "short sleepers" (<6.0 hours, n=8) and "long sleepers" (>6 hours, n=5) categories were used. Body composition: long sleepers tended to gain less body fat (0.22  $\pm$  0.64%) compared to short sleepers (0.63  $\pm$  1.65%) but was not significant ( $p=0.61$ ) Long sleepers had strength gains in all 6 weight categories compared to short sleepers but changes were not significant ( $p=0.6$ ). Pitching accuracy (strikes/total pitches) for fast ball correlate with night-before-performance sleep time, but were not significant.

**Conclusion:** This study demonstrates remarkable variation of sleep time in baseball athletes over a semester; the shortest sleepers had about 180 fewer hours of sleep than longest sleepers. Pilot data on weight training and performance demonstrates interesting trends relative to sleep time, but the study is not powerful enough to generate statistically significance. Our body composition results agree with previously published data and suggest further study is warranted.

## G-39 Free Communication/Poster - Recovery

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
 Room: CC-Hall B

3244 Board #113 June 2 8:00 AM - 9:30 AM  
**Jumping To Conclusions: The Recovery-Monitoring Service 'Jump Test' Is Sensitive To Neuromuscular Fatigue in Recreational Runners**

Luke J. Montzingo<sup>1</sup>, Kyler Eastman<sup>1</sup>, Kris Homsis<sup>2</sup>, Jeff Knight<sup>1</sup>.  
<sup>1</sup>*Under Armour, Connected Fitness, Austin, TX.* <sup>2</sup>*Under Armour, Athlete Performance and Innovation, Portland, OR.*  
**Reported Relationships:** L.J. Montzingo: *Consulting Fee; Under Armour Connected Fitness.*

Numerous studies over the last decade have shown a relationship between countermovement vertical-jump (VJ) performance and training load in both competitive team-sport athletes as well as in elite runners. As such, VJ performance serves as a marker of neuromuscular fatigue. However, less clear is the degree to which this relationship persists in non-elite, recreational 'run' athletes. 'Jump Test' is a footwear-integrated self-testing utility that measures and analyses repeated-VJ performance. **PURPOSE:** To determine how repeated-VJ performance, as measured before each training bout by average flight time and monitored via 'Jump Test', varies with training load in recreational 'run' athletes over a six-week period. **METHOD:** Eleven moderately trained (1-6 runs/week, 10-60 miles/week, >3 months) subjects (2F, 9M; 33.6  $\pm$  4.5 years) were enrolled voluntarily. Subjects followed a six-week training program devised to impose significant training loads that could be deemed counter-productive to performance (i.e. induce over-reaching if not over-training). Training was divided into three 2-week phases: baseline training (BL), overload training (OL), and active recovery (AR). Each weekday subjects performed the 'Jump Test' and rated their perceived level of muscle soreness. Training data was collected and analyzed via the mobile application *MapMyRun*. Chronic and acute training loads were computed. Training phase comparisons were made using paired T-tests. **RESULTS:** VJ performance decreased progressively throughout the first week of OL (z-score, -0.2  $\pm$  -1.0, OL vs 0.3  $\pm$  -0.8, BL;  $p < 0.01$ ). Furthermore, reduced jump scores correlated with an increase in chronic training load (5.8  $\pm$  -3.8, OL vs. 3.1  $\pm$  -

2.5, BL  $r = -0.45$ ,  $p < 0.01$ ) and an overall increase in subjects' self-reported muscle soreness ( $2.7 \pm 0.9$ , OL vs.  $3.4 \pm 1.0$ , BL;  $r = 0.3$ ,  $p < 0.01$ ) during that week. **CONCLUSION:** Pre-workout, repeated-VJ performance was measured with a shoe-borne, jump-testing utility in recreational athletes over six weeks of variable training load. It was found VJ performance fluctuates with training load and perceived muscle soreness. The close relationship demonstrated between jump scores and self-reported measures suggests 'Jump Test' is a practical tool for monitoring neuromuscular fatigue and informing training load.

3245 Board #114 June 2 8:00 AM - 9:30 AM  
**Evaluating The Potential Impact Of Fatigue On Ultimate Frisbee Players During Tournament Play**

Jared Feister, Robert T. Sanders, Chris Carver, Hannah E. Nelson, James Kelly, Andy Bosak, James Schoffstall, FACSM. *Liberty University, Lynchburg, VA.* (Sponsor: Dr. James Schoffstall, FACSM)  
*(No relevant relationships reported)*

Previous research has evaluated the quality of recovery from bouts of athletic events. Various measures have been used to assess recovery, yet most methods were somewhat problematic for rapid data collection. When costs are a limitation, it may be best to seek less expensive alternative methods of evaluating recovery. **PURPOSE:** To evaluate potential fatigue of collegiate ultimate frisbee athletes over two days of tournament play (TP) utilizing the perceived recovery status scale (PRSS) and ratings of perceived exertion (RPE). **METHODS:** Nineteen college-aged males participated in the study. Occurring over two days of TP, PRSS and RPE were recorded during 5 frisbee matches with each match separated by 30min. Two minutes prior to the first and second half, PRSS was recorded for each athlete and 2 minutes after each half, RPE was recorded. **RESULTS:** Significant differences occurred in PRSS with a decrease in values from the 2<sup>nd</sup> to the 5<sup>th</sup> matches ( $p = 0.006$ ) and within the 2<sup>nd</sup> half of comparable matches ( $p = 0.031$ ). No RPE recordings were significant. **CONCLUSION:** The results suggest that much of the variance in fatigue and fatigue-related measures occur between the 2<sup>nd</sup> and 5<sup>th</sup> matches of TP. The cumulative effects of fatigue during TP may have been a result of several potentially uncontrollable factors. Note, decreased perceived recovery could be related to the increased stress levels that occurred because of the amplified significance of the final match. Future research may evaluate other quantifiable recovery data (i.e. HRV and GPS) during tournament play.

3246 Board #115 June 2 8:00 AM - 9:30 AM  
**An Assessment of a 15 vs. 30 Second Recovery Period on Vertical Jump Performance**

Hannah E. Nelson, Andy Bosak, Russell K. Lowell, Branden M. Ziebell, Robert T. Sanders, Jared Feister, Madeline M. Phillips. *Liberty University, Lynchburg, VA.* (Sponsor: Dr. James Schoffstall, FACSM)  
*(No relevant relationships reported)*

The vertical jump (VJ) test is often used to assess an individual's lower body peak power. The standard recovery time between subsequent jumps is typically 30 seconds (secs) with a completion of 3-6 jumps. Prior studies have reported no significant difference between 30 vs. 60 secs recovery on VJ performance. However, it may be possible that a shorter passive recovery (PR) period may allow for maintenance or improvements in jumping performance versus the standard recovery time and therefore, potentially contribute to a more time efficient testing session. In contrast to this, if an individual is not completely recovered before their next jump, it is possible that their performance may be diminished compared to earlier jumps. To the best of the researchers' knowledge, the impact of a shorter PR period, such as 15 vs. 30 secs PR, on VJ performance has not been assessed. **PURPOSE:** To investigate potential differences between a 15 vs. 30 secs PR period on VJ performance in no less than averagely fit college-age males. **METHODS:** After measuring descriptive data (Ht., Wt., BF%, age), 31 averagely fit college-age males completed an 8 minute (min) dynamic warm-up on a cycle ergometer. Subjects were given a 4 min PR during which their reach height was measured. Following the PR, four familiarization jumps were completed using a VJ measurement device. After another 4 min PR, the subjects completed 2 series of jumps, with 6 trials each, in a counterbalanced order with either 15 (FIF) or 30 (THI) secs of recovery between each jump. The FIF and THI jump series were separated by 6 min of PR. Excluding the first jump, the highest jump for FIF and THI were compared using Paired-Samples t-Tests with significant differences occurring at  $p \leq 0.05$ . **RESULTS:** Significant differences ( $p = 0.016$ ) occurred between FIF ( $69.64 \pm 8.61$  cm) and THI ( $70.35 \pm 8.99$  cm). **CONCLUSION:** The current results suggest that 30 secs of PR between jumps is optimal recovery for performance during the VJ test, while 15 secs of PR may hinder peak VJ performance in averagely fit college-age males. Although THI was less than a centimeter above FIF, a sufficient number of subjects had improved performance during THI. Future research may assess the impact of 15 vs. 30 secs PR on VJ performance using highly fit collegiate athletes that use vertical jump as a sport specific movement.

3247 Board #116 June 2 8:00 AM - 9:30 AM  
**The Effect Of Varying Self-myofascial Release Duration On Subsequent Athletic Performance**

Jake Phillips, David Diggin, Deborah L. King, Gary A. Sforzo, FACSM. *Ithaca College, Ithaca, NY.* (Sponsor: Gary Sforzo, FACSM)  
*(No relevant relationships reported)*

Self-myofascial release (SMR) treatments appear to enhance joint range of motion (RoM) and restore movement function but the effects of different SMR durations on athletic performance have yet to be examined. **PURPOSE:** To investigate the effects of different SMR treatment durations (1 minute and 5 minutes) on joint RoM, power, and agility. **METHODS:** Twenty-four volunteers participated with ankle and knee joint RoM assessed using modified weight-bearing (WBL) and kneeling lunge (KL) tests. Vertical jump (VJ) performance and pro-agility (PA) sprint performance were also examined. All tests were conducted before and immediately after one-minute (SMR\_1) and five-minutes (SMR\_5) of SMR and immediately following a control (CONTR) condition. SMR was done on the quadriceps and triceps surae muscle groups using a standardized protocol and foam roller. Differences in dependent variables (VJ height, PA run time, WBL distance, KL angle) between treatment groups (SMR\_1, SMR\_5, CONTR) at two time-points (pre- and post-treatment) were analyzed using a 3 x 2-way repeated measures analysis of variance (ANOVA). Alpha = 0.05. Effect sizes (ES) were calculated to clarify the magnitude of the effect of differences between means from pre- to post-treatment for each treatment condition. **RESULTS:** KL angle increased following SMR\_5 (16.4%; ES = 0.85) when compared with SMR\_1 (12.5%; ES = 0.58). WBL distance showed little change following SMR treatments and the CONTR condition exhibited little effect on RoM tests. VJ height decreased following SMR\_5 (5.1%; ES = 0.26) but changed little following SMR\_1 (0.7%; ES = 0.03) and CONTR (1.9%; ES = 0.10) conditions. PA run time improved slightly following SMR\_1 (1.1%) but deteriorated following CONTR (1.2%) and SMR\_5 (0.5%). Effect size calculations for changes in PA, however, were trivial across all conditions (0.06 - 0.15). **CONCLUSION:** Extended periods of SMR may be recommended should improvements in joint RoM be required. If power output is a critical requirement of subsequent tasks, prolonged SMR treatment (i.e., 5-min) should be avoided.

3248 Board #117 June 2 8:00 AM - 9:30 AM  
**Fascia Stretch Training-7 Induces Similar Metabolic Response, But Lower Mechanical Stress**

Filipe Dinato de Lima<sup>1</sup>, Ubiratan Contreira Padilha<sup>1</sup>, Amilton Vieira<sup>1</sup>, Marco A. Dourado<sup>1</sup>, Lee E. Brown, FACSM<sup>2</sup>, Martim Bottaro<sup>1</sup>. <sup>1</sup>University of Brasilia, Brasilia, Brazil. <sup>2</sup>California State University, Fullerton, CA. (Sponsor: Lee E. Brown, FACSM)  
*(No relevant relationships reported)*

The strength training is the most efficient modality to improve muscle volume and strength in health and disease. Recently, a new method of training including static stretching named Fascia Stretch Training (FST-7) has emerged. It is argued that the FST-7 could induce greater muscle swelling, known as an important hypertrophic stimulus. However, the acute responses to FST-7 have not been established. **PURPOSE:** To compare mechanic and metabolic responses from FST-7 with traditional strength training protocols. **METHODS:** Twelve resistance-trained men (age:  $29.0 \pm 6.1$  years; weight:  $84.4 \pm 10.3$ kg; height:  $1.78 \pm 0.06$ m) participated of the study. The volunteers attended to the laboratory in four non-consecutive days. The first session was used to familiarization with the testing procedures. On the following sessions, volunteers performed randomly one of the three training protocols: 1) FST-7: seven sets of 10 isokinetic knee extension with a 40-sec rest-interval and 20-sec of quadriceps static stretching; 2) Control (CON): seven sets of 10 isokinetic knee extension with a passive 40-sec rest-interval; and 3) Traditional (TRA): seven sets of 10 isokinetic knee extension with a passive 120-sec rest-interval. Total work (TW) of each protocol was recorded. Muscle swelling (MS) and blood lactate (BL) was measured before and after each exercise protocol. Repeated measures multifactorial ANOVA was used to analyze data. **RESULTS:** On TW, there was a significant main effect for protocol ( $F = 23.843$ ;  $p < 0.001$ ). FST showed a lower TW ( $11823.01 \pm 1735.06$ J) than CON ( $13976.08 \pm 2378.07$ J) and TRA ( $15510.77 \pm 2250.56$ J). On MS, there was no significant protocol and time interaction ( $F = 0.380$ ;  $p = 0.69$ ). All protocols showed a similar increase in MS after training session ( $p < 0.001$ ). On BL, there was no significant protocol and time interaction ( $F = 2.166$ ;  $p = 0.14$ ). All protocols showed a similar increase in BL after training session ( $p < 0.001$ ). **CONCLUSIONS:** FST, CON and TRA induce a similar increased in metabolic responses. However, FST produce lower mechanic stress than CON and TRA. These results suggest that FST may not be a superior stimulus than previous traditional strength protocols to induce muscle hypertrophy.

3249 Board #118 June 2 8:00 AM - 9:30 AM

**Could Knee Extension And Leg Press Exercises Induce Different Time Course Of Muscle Recovery?**

Marco A. Dourado<sup>1</sup>, Filipe Dinato de Lima<sup>1</sup>, Amilton Vieira<sup>1</sup>, Lee E. Brown, FACSM<sup>2</sup>, Martim Bottaro<sup>1</sup>. <sup>1</sup>University of Brasilia, Brasilia, Brazil. <sup>2</sup>California State University, Fullerton, CA. (Sponsor: Lee E. Brown, FACSM)

(No relevant relationships reported)

Single- (SJ) and multiple-joint (MJ) resistance exercises are recommended for strength and hypertrophic gains. However, the levels of mechanical strain and hence muscle damage may be distinct between MJ and SJ resistance exercises. Studies comparing symptoms of muscle damage following MJ and SJ exercises are lacking. **PURPOSE:** This study investigated the time course of symptoms of muscle recovery after two knee extension exercises in resistance-untrained men.

**METHODS:** Seven men (25 ± 4 yrs) were randomly assigned to perform a unilateral MJ multi-joint resistance exercise (i.e. leg press, LP) and a unilateral single-joint resistance exercise (i.e. seated knee extension, KE) with the contralateral limb. Participants performed 8 sets of 10 repetition maximum of both exercises with 2 min rest between sets. Muscle edema (ME), peak torque (PT), 1-legged countermovement (CMJ), and muscle soreness (MS) were measured pre, post, 24, 48, 72 and 96h following exercise.

**RESULTS:** ME of the rectus femoris returned to baseline at 48h after LP exercise, and at 24h after the KE exercise. ME of the vastus lateralis recovered at 24h after both exercises. PT recovered at 24h, and there was no difference between both exercises (p>0.05). CMJ returned to the baseline values 72h after the LP exercise, and 24h after the KE exercise. Muscle soreness of the rectus femoris was greater at 48h after KE when compared to LP exercise. There was no difference between exercises in the magnitude of MS response in vastus lateralis (p>0.05).

**CONCLUSIONS:** Resistance-untrained men experience different muscle recovery following LP and KE exercises. The MJ condition was more stressful for knee extensors muscles than SJ, taking more time to recover from muscle damage.

3250 Board #119 June 2 8:00 AM - 9:30 AM

**Assessment of Countermovement Jump Performance Recovery in Professional Soccer Players Using an Inertial Sensor**

Malachy P. McHugh, FACSM<sup>1</sup>, Tom Clifford<sup>2</sup>, Will Abbott<sup>3</sup>, Susan Y. Kwiecien<sup>1</sup>, Ian J. Kremenik<sup>1</sup>, Joseph J. Devita<sup>1</sup>, Glyn Howatson, FACSM<sup>4</sup>. <sup>1</sup>Nicholas Institute of Sports Medicine and Athletic Trauma, Lenox Hill Hospital, New York, NY. <sup>2</sup>Newcastle University, Newcastle, United Kingdom. <sup>3</sup>Brighton and Hove Albion F.C., Lancing, United Kingdom. <sup>4</sup>Northumbria University, Newcastle, United Kingdom.

(No relevant relationships reported)

**Purpose**

We recently demonstrated accelerated recovery of strength and more rapid resolution of pain in professional soccer players wearing phase change material (PCM) cooling garments post game. During that study, recovery of countermovement jump (CMJ) mechanics was assessed using a wireless inertial sensor (BTS G-Sensor 2, Brooklyn, NY). The purpose of this study was to compare recovery of CMJ mechanics between PCM and control and thereby determine if this sensor is useful for assessing recovery.

**Methods**

In a randomized, crossover design, 11 elite professional soccer players wore either PCM shorts cooled to 15°C (PCMcold) or ambient temperature (PCMamb; control) for 3 h after a game. CMJ performance was assessed pre game and at 12, 36 and 60 h post game. The following metrics were assessed: flight height (calculated from time in air), jump height (flight height + difference between standing height and takeoff height), low force (unweighting during initiation of countermovement), countermovement (distance dropped during countermovement), force at end of countermovement, rate of force development, eccentric power, peak propulsive force, maximum power, and peak landing force. Data are expressed as % of baseline and analyzed with Treatment (PCMcold vs. PCMamb) by Time (Baseline, 12, 36, 60 h post game) repeated measures ANOVA.

**Results**

Over the 3-day post-game period PCMcold resulted in better CMJ flight height (PCMcold 104% of baseline, PCMamb 90%; P=0.007) and jump height (PCMcold 110%, PCMamb 95%; P=0.035). Other kinetic and kinematic measures were not different between PCMcold and PCMamb. Overall, low force was progressively higher on the days after the game (P=0.018, 55% higher at 60 h) indicating that players did not unweight themselves as much during the initiation of the countermovement. Additionally, peak landing force was progressively lower on the days after the game (P=0.012, 89% of baseline at 60 h). These effects on low force and landing force did not impair recovery of jump heights as jump heights had fully recovered by 60 h.

**Conclusions**

The better CMJ performance when players wore PCM cooling shorts post game is evidence of accelerated recovery. This inertial sensor provides a portable and practical means of assessing recovery in elite soccer players.

3251 Board #120 June 2 8:00 AM - 9:30 AM

**Effect Of Cold Water Immersion On Skin Temperature: A Thermography Study**

Braulio Sánchez-Ureña<sup>1</sup>, Daniel Rojas-Valverde<sup>1</sup>, Randall Gutiérrez-Vargas<sup>1</sup>, Juan Carlos Gutiérrez-Vargas<sup>1</sup>, Christopher T. Minson, FACSM<sup>2</sup>. <sup>1</sup>National University of Costa Rica, Heredia, Costa Rica. <sup>2</sup>University of Oregon, Oregon, OR. (Sponsor: Christopher Todd Minson, FACSM)

(No relevant relationships reported)

Cold water immersion (CWI) is a recovery method in sports, acting through a reduction in body temperature and improved muscular function by limiting post-exercise inflammation. Infrared Thermography (IRT) is a non-invasive technique to measure skin temperature, and has been used in the diagnosis of hyperthermic muscles, such as occurs with delayed onset muscular soreness. To our knowledge, there are no studies using IRT to analyze the skin temperature in the recovery process following fatiguing exercise. **PURPOSE:** To compare the effect of two CWI protocols as a recovery treatment on skin temperature. **METHODS:** 40 healthy male subjects (age 21.8 ± 2.76 yrs, body mass 73.15 ± 8.15 kg, height 176.6 ± 5.3 cm, and body fat 13.5 ± 3.4%). Subjects went through a fatiguing protocol: 8 sets/30 secs countermovement jumps with 90 second pauses between series. Subjects were randomized in three conditions: control group (CG) (passive recovery, 12 min sitting in a 23 °C room); continuous CWI (CnCWI) (12 min in water at 12 ± 0.4 °C); and intermittent CWI (InCWI) (2 min CWI at 12 ± 0.4 °C, 1 min in a controlled environment at 23°C, until the 12 min of CWI were completed). Maximal lower limb skin temperature (MST) was measured at pre, post24 and post48 hours via IRT camera (FLIR T450). Repeated measures ANOVA were used. Significance was set at p< 0.05.

**RESULTS:** No between group interaction effects were found in the dominant limb in the frontal plane (F(4,74)= 0.89, p= 0.47): post24 (CG: 33.5±1.1°C vs. CnCWI: 33.4±1.4°C, InCWI: 33.7±0.8°C); post48 (CG: 34.2±0.9°C vs. CnCWI: 33.9±0.8°C, InCWI: 33.6±0.8°C), or in the posterior plane (F(4,74)= 0.54, p= 0.70): post24 (CG: 33.3±1.2°C vs. CnCWI: 33.3±0.7°C, InCWI: 33.5±0.9°C); post48 (CG: 33.2±0.8 vs. CnCWI: 33.8±1.9°C, InCWI: 33.5±1°C). Similarly, no between group interactions were observed in the non-dominant limb in the anterior plane (F(4,74)= 0.68, p= 0.64): post24 (CG: 33.4±1.0°C vs. CnCWI: 34±2.1°C, InCWI: 33.6±0.9°C); post48 (CG: 34.1±0.9°C vs. CnCWI: 33.9±1 °C, InCWI: 34.0±1°C), or for the posterior plane (F(4,74)=0.70, p=0.59), post-24 (CG: 33.1±0.9°C vs. CnCWI: 33.2±0.7°C, InCWI: 33.5±1°C); post48 (CG: 33.1±0.9°C vs. CnCWI: 33.3±0.7°C, InCWI: 33.6±1.1°C). **CONCLUSIONS:** Neither CWI protocol reduced mean or maximal lower limb skin temperature at 24 nor 48 hours post fatiguing protocol.

3252 Board #121 June 2 8:00 AM - 9:30 AM

**Reproducibility of the RMSSD Index of Heart Rate Variability in Recovery After Exercise**

Lucieli T. Cambri, Jaqueline A. Araújo, César S.A. Mello, Geovane J. Tolazzi, Fabiula I. Novelli, Gisela Arsa. Federal University of Mato Grosso, Cuiabá, Brazil.

(No relevant relationships reported)

Heart rate variability (HRV) is an important parameter that allows evaluate parasympathetic reactivation after physical exercise. However, because its a cardiac phenomenon evaluated in non-stationary conditions, it is fundamental to evaluate its reproducibility in post exercise recovery. **PURPOSE:** To analyze whether the RMSSD index of HRV shows reproducibility in both passive and active after maximal exercise recovery. **METODOLOGY:** Eleven young healthy (22.1 ± 3.2 years, 23.5 ± 2.3 kg/m<sup>2</sup>) and untrained men (36.1 ± 5.2 mL/kg/min) were evaluated. HRV was evaluated by LnRMSSD (heart rate monitors - transformed into a natural logarithm), which reflects the parasympathetic activity, after maximal progressive exercise (cycle ergometer) every 30s throughout the 10 min of test and retest of passive recovery (seated position) and active (5 min at 15W e then at 5 min passively) after exercise. The Shapiro Wilk test was used to test the normality of data, test T-Student's and Wilcoxon were used to compare each recovery of test and retest (p<0,05). Intraclass correlation coefficient (ICC) was used to evaluate the relative reproducibility and standard error of measurement (SEM) and coefficient of variation (CV) to the absolute reproducibility. **RESULTS:** There was difference between test and retest for LnRMSSD only at 120s (p: 0.00) in passive recovery and at 420s (p: 0.04) in active. Reproducibility was observed to both recovery types - in passive recovery: very high at 90, 270, 480 and 570s (ICC: 0.90 - 0.95) and high at 60, 120 to 240, 300 to 450, 510, 540, 600s (ICC: 0.72 - 0.89); at active recovery: high at 30, 150, 240, 270, 330 to 420, 480, 510 and 540s (ICC: 0.70 - 0.87) and moderate at 60, 120, 180, 210, 300, 450, 570 and 600s (ICC: 0.50-0.69). During passive recovery CV varied between 12.83 - 39.73% and SEM between 0.33 - 1.14 ms and during active recovery varied between 16.58 - 39.51% and 0.43 - 1.05 ms. **CONCLUSION:** The RMSSD index is reproducible in

both passive and active recovery after maximal exercise in young men. Therefore, it can be used as a reliable index to evaluate cardiac parasympathetic reestablishment after maximal exercise. Supported by CNPq (process 443361/2014-2) and CAPES.

- 3253 Board #122 June 2 8:00 AM - 9:30 AM  
**Perceived Recovery Status is Associated with Back Squat One-Repetition Maximum Self-Efficacy**  
 Michael H. Haischer<sup>1</sup>, Daniel M. Cooke<sup>1</sup>, Joseph P. Carzoli<sup>1</sup>, Amber M. Shipherd<sup>2</sup>, Trevor K. Johnson<sup>1</sup>, Edward P. Davis<sup>1</sup>, Dan J. Belcher<sup>1</sup>, Robert F. Zoeller<sup>1</sup>, Michael Whitehurst, FACSM<sup>1</sup>, Michael C. Zourdos<sup>1</sup>. <sup>1</sup>Florida Atlantic University, Boca Raton, FL. <sup>2</sup>Texas A&M University-Kingsville, Kingsville, TX.  
 (No relevant relationships reported)

Self-efficacy (SE) is defined as an individual's belief in their ability to successfully complete a task. According to SE theory, physiological and affective states can exert influence on efficacy beliefs, thereby affecting performance outcomes. Additionally, fluctuation in daily readiness can also impact performance outcomes due to factors such as stress, sleep problems, or poor physiological recovery from previous bouts of training. To evaluate daily readiness through the assessment of these performance factors, a variety of scales and questionnaires exist. One such assessment, the Perceived Recovery Status (PRS) scale, asks individuals to indicate how well recovered they feel on a 0-10 Likert scale. However, despite widespread usage of the PRS scale, no study has examined if pre-training recovery is indeed related to increased SE. **PURPOSE:** To investigate the relationship between recovery as indicated by the PRS scale and SE in resistance trained individuals prior to a one-repetition maximum (1RM) back squat test. **METHODS:** Fifty-eight resistance-trained males (n=41) and females (n=17) (age: 23±3 yrs, body mass: 80.64±16.49 kg) completed the PRS scale and a modified version of the Self-Efficacy Questionnaire for Athletes (mSEQ-A), prior to a 1RM back squat test. The mSEQ-A required participants to rate, on a 0-100 Likert scale, how confident they were that they could beat their previous back squat personal record by any load. Next, following a 5-minute dynamic warm-up, subjects completed a validated 1RM back squat protocol. A Pearson's product moment correlation was used to determine any relationships between PRS ratings and SE beliefs. **RESULTS:** Mean PRS rating was 7.7±1.5, while mean mSEQ-A rating was 52.4±35.7. Regression analysis revealed that the PRS scale was significantly related to SE as determined by the mSEQ-A ( $r=0.39$ ,  $p<0.05$ ). **CONCLUSIONS:** The PRS scale was significantly related to SE. These findings reflect the fact that individuals who perceived themselves to be more well-recovered, also perceived themselves to be more likely to succeed in a 1RM test.

- 3254 Board #123 June 2 8:00 AM - 9:30 AM  
**Electromagnetic Field Application Effects on Recovery and Power after Sport-Specific Exercise Intervention: Feasibility Study**  
 Nauris Tamulevicius<sup>1</sup>, Tanuj Wadhi<sup>1</sup>, Emily A. Daniels<sup>1</sup>, Guillermo R. Oviedo<sup>2</sup>, Stephen Baeder<sup>1</sup>. <sup>1</sup>The University of Tampa, Tampa, FL. <sup>2</sup>University Ramon Llull, Barcelona, Spain.  
 (No relevant relationships reported)

Electromagnetic field application (EFA) has demonstrated increased vasomotor function of vessels throughout the body and thus on microcirculatory blood flow regulation in the clinical population. It is unknown if EFA can positively influence recovery and improve physical conditioning in tennis players. **PURPOSE:** To determine if EFA optimizes recovery and improves anaerobic/power parameters in female college tennis players. **METHODS:** Subjects for this study consisted of female NCAA Division II tennis players (n=7, age 19.7±1.3 y.o., weight 65.7±9.7 kg, height 168.1 ±2.04 cm). EFA was used 22 times across a 4 week period after sport-specific training or after matches. EFA protocol included 8 minutes of laying on the BEMER EFA, which transmitted weak electromagnetic field of flux density 35-50  $\mu$ Tesla (highest level). Subjects were also required to express their Rate of Perceived Fatigue (RPF scale 0-10) before and after every application. Standardized 30 s Wingate tests were performed before the 1<sup>st</sup> week of the application, 1 week after, 3 weeks after, and 4 weeks after EFA recovery protocol. Heart rate (HR), O<sub>2</sub> saturation and blood lactate (BL) were analyzed pre, post, post-1 min, post-3 min, post-5 min, and post-10 min after the Wingate tests. **RESULTS:** Absolute Peak Power (APP) increased after 22 EFA applications from 428.7±118.5 W to 491.5±113.4 W ( $p=0.063$ ) and Relative Peak Power (RPP) increased from 6.5±1.2 W/kg to 7.5±0.9 W/kg ( $p=0.063$ ). BL levels decreased post-1 minute from 11.2±1.15 mmol/L to 9.8±1.5 mmol/L ( $p=0.063$ ).  $\Delta$ RPF before and after application decreased significantly from 2.57±0.79 to 1.43±0.79 ( $p=0.034$ ). Although APP, RPP, and BL post-1 minute improved, it was not significant ( $p=0.063$ ) possibly because of the relatively small sample size. Changes in other anaerobic/power parameters were not as notably expressed. **CONCLUSION:** Improved microcirculatory blood flow could suggest that APP and RPP increased over the span of a 4-week period in female tennis players. Significant decrease in RPF

suggests that EFA might be an effective tool to use for recovery after sport-specific training and/or matches for tennis players. Considering the observed changes in 4 weeks, supplementary studies using a larger sample size should be explored.

- 3255 Board #124 June 2 8:00 AM - 9:30 AM  
**Effects of Recovery Type on Blood Lactate and Performance Following Repeated Wingate Tests in Females**  
 Madison L. Kirkpatrick, Boe M. Burrus. Humboldt State University, Arcata, CA. (Sponsor: Vincent J Paolone, FACSM)  
 (No relevant relationships reported)

The optimal type of recovery to maximize performance and regain homeostasis after maximal exercise in sport has mixed results. There is a lack of research on the effect of a longer duration active recovery protocol on blood lactate and performance in repeated Wingate tests. Also, minimal research exists with females in this area. **PURPOSE:** To determine if an active recovery of a prolonged duration at a moderate intensity is more beneficial for subsequent anaerobic performance than passive recovery by analyzing blood lactate and anaerobic performance variables across Wingate tests. **METHODS:** Subjects completed an incremental test to determine their peak power output, and 50% of peak power was used as the active recovery intensity. A 15 minute recovery time frame was used. Blood lactate measurements were collected after the first Wingate, at five-minute increments of the recovery protocol, and after the second Wingate. RPE was also collected after each Wingate test. **RESULTS:** A significant interaction was found between recovery and time for blood lactate ( $F = 6.935$ ;  $p = 0.000$ ). Blood lactate levels were significantly lower for the active recovery trial at all time points of recovery, but no significant difference in performance was observed for any of the variables measured between the passive and active trials. **CONCLUSION:** Based on previous research, the lower lactate values and performance might not be as connected as previously thought. However, the lower lactate levels can still be beneficial to recovery after intense exercise and repeated attempts, but there may be no effect of blood lactate clearance on performance. It is possible that a buildup of H<sup>+</sup> ions decreases muscle cell contractility enough for both recovery types that differences in performance between the two conditions are miniscule and therefore may be negligible when using the current parameters.

- 3256 Board #125 June 2 8:00 AM - 9:30 AM  
**Respiratory Impedance Enhances Recovery and Performance During Repeated Bouts of High-Intensity Exercise**  
 Peggy A. Plato, Isabel L. Romero, Olivia M. Nierhake, Andrew W. Tsao. San Jose State University, San Jose, CA. (Sponsor: Craig Cisar, FACSM)  
 (No relevant relationships reported)

Impedance threshold devices (ITD) were initially developed to maintain blood pressure during battlefield trauma. By creating a greater negative intrathoracic pressure, venous return is enhanced (Ryan et al., 2008). Convertino et al. (2005) found that spontaneous breathing through an ITD increased stroke volume and cardiac output during the initial 10 s of standing from a squat position and was an effective countermeasure against hypotension initiated by the squat-to-stand test. **PURPOSE:** This study evaluated the efficacy of using an ITD during recovery following three consecutive 30 s, high-intensity exercise bouts on a bicycle ergometer. **METHODS:** Fifteen participants (11 men, 4 women, 24 ± 1 years-of-age,  $M \pm SEM$ ) completed two exercise conditions separated by at least 7 days: control (no ITD) and breathing through an ITD during recovery (ResQGARD®, Advanced Circulatory Systems, Eden Prairie, MN). Each exercise bout was performed with a resistance set at 60 g/kg body weight followed by a 4 min recovery between bouts. **RESULTS:** Ratings of perceived exertion ranged between 7.9 and 9.5 on the Borg category-ratio scale during the three exercise bouts with ratings slightly lower during the ITD condition ( $F(1, 54) = 4.774$ ,  $p < .05$ ). There was a significant interaction effect for ratings of perceived recovery ( $F(3, 40) = 2.980$ ,  $p < .05$ ) with participants indicating they felt better recovered after bout 3 when using the ITD. There was also a significant interaction effect for mean power ( $F(2, 28) = 3.842$ ,  $p < .05$ ) with power better maintained during bout 3 when using the ITD (416 ± 32 W vs. 400 ± 34 W for the control condition). In contrast, there were no significant effects of the ITD on peak power or blood lactate compared to the control condition. **CONCLUSION:** Using an ITD between repeated bouts of high-intensity exercise may help individuals feel better recovered and, thus, able to maintain higher mean power during subsequent exercise bouts.

3257 Board #126 June 2 8:00 AM - 9:30 AM  
**The Effect Of Self-myofascial Release As A Warm-up On Muscular Strength And Power**

Theodore M. DeConne, II, Marc Robertson, William Lunn.  
*Southern Connecticut State University, New Haven, CT.*  
 (No relevant relationships reported)

Individuals are often instructed to use a foam roller as a warm-up (WU), despite a lack of evidence supporting performance enhancement claims attributed to foam rolling self-myofascial release (FR-SMR). Studies have investigated whether foam rolling can be used to enhance performance; however, more research is required.

**PURPOSE:** To determine whether variations of an acute bout of FR-SMR WU will affect maximal muscular strength and power performance differently than a placebo SMR WU.

**METHODS:** Adult men (N=3) and women (N=3) [N=6, age=23.5 ± 3.39 years, height=66.08 ± 4.77 cm, and average mass=67.46 ± 17.57 kg] were recruited for the study. This study was an intra-participant design consisting of one condition comparing the impact of three different WU conditions on two performance tests. Each participant randomly performed one of the three WU conditions each day: 1) FR-SMR plus dynamic WU (FR-D), 2) FR-SMR only (FR), and 3) FR "shadowing" plus dynamic WU (noFR-D). The "shadowing" condition involved the foam rolling movements without the actual roller. Routines were separated by a week, for a total of three weeks. The performance tests were completed after each WU in the following order: a counter-movement squat jump (CMSJ) on a force platform and 10 repetitions maximum (10RM) bench press. The CMSJ was used to measure relative maximal power and the 10RM bench press was used to assess relative maximal strength. A one-way multivariate ANOVA was used to test significance in performance between WU conditions ( $p < 0.05$ ).

**RESULTS:** There were no significant differences in maximal strength or power between FR-D, FR, and noFR-D (relative maximum power: FR-D=54.93 ± 3.92 W/kg, noFR-D=56.03 ± 5.95 W/kg, FR=56.59 ± 4.08 W/kg; relative maximum strength: FR-D=0.83 ± 0.34 kg/kg, noFR-D=0.82 ± 0.33 kg/kg, FR=0.88 ± 0.36 kg/kg) ( $p=0.980$ ).

**CONCLUSIONS:** Integration of FR SMR into a WU offers no additional benefits to produce maximal strength or power. While FR did not enhance maximal strength and power, FR did not appear to be detrimental to the production of maximal strength and power.

3258 Board #127 June 2 8:00 AM - 9:30 AM  
**The Effects of a Proprietary Resistance Garment Technology on Exercise and Recovery Energy Expenditure**

John Paul M. Arreglado, Samantha Silva, Edward Jo. *Cal Poly Pomona, Pomona, CA.*  
 (No relevant relationships reported)

Previous research demonstrates the benefits of compression exercise garments as it relates to performance and recovery. For instance, compression garments have attenuated delayed onset of muscle soreness and increased the rate by which muscular contractile kinematics were restored. However, the overall body of research related to the use of compression garments have failed to evaluate its full complement of potential applications in sport and exercise. Physico with their Pro Resistance Technology has innovated a new line of compression garments that may apply added resistance to physical movements ranging from every day activities to high intensity athletic training. In turn, the purported benefits include facilitated performance and body composition adaptations due the added metabolic demand and musculoskeletal stress. There is limited empirical information regarding the effects of such class of compression garments on energy expenditure across various exercise modes.

**PURPOSE:** The purpose of this investigation is to examine the effects of Physico compression garments on exercise and recovery energy expenditure in NCAA collegiate athletes. **METHODS:** In a randomized, cross-over design study, 16 healthy male (n=8) and female (n=8) subjects underwent a series of exercises wearing either the experimental (Physico) compression garment (EXP) or general exercise attire (CON) while simultaneously undergoing indirect calorimetry and heart rate measurements. **RESULTS:** When examining the data in aggregate the EXP increased oxygen consumption and energy expenditure by 15%, ventilation rate by 22%, and heart rate by 18% during an entire bout of exercise in comparison to non-specialized sports garments ( $p < 0.05$ ). The improvement in oxygen consumption, energy expenditure, ventilation and heart rate was statistically equivalent between sexes and among each exercise task. Post-workout recovery measures for oxygen consumption, energy expenditure, ventilation, and heart rate did not differ between EXP and CTL conditions. **CONCLUSIONS:** We conclude that the use of the Physico compression garment may enhance the metabolic demand of an exercise bout which provides some insight into their benefits relating to performance and physiological adaptations to training.

3259 Board #128 June 2 8:00 AM - 9:30 AM  
**Sleeping Patterns of NCAA D1 Collegiate Athletes: A Sex Comparison**

Courtney L. Benjamin<sup>1</sup>, William M. Adams<sup>2</sup>, Ryan M. Curtis<sup>1</sup>, Yasuki Sekiguchi<sup>1</sup>, Gabrielle E.w. Giersch<sup>1</sup>, Anne M. Muholland<sup>1</sup>, Douglas J. Casa, FACSM<sup>1</sup>. <sup>1</sup>University of Connecticut, Storrs, CT. <sup>2</sup>University of Connecticut, Storrs, CT and University of North Carolina, Greensboro, NC.  
 (No relevant relationships reported)

**PURPOSE:** To compare male and female sleep surrounding competition in NCAA Division 1 athletes. **METHODS:** 22 collegiate male soccer athletes (mean±SD; age, 20±0 y; height, 181.2±6.5 cm; mass, 79.4±6.9 kg) and 11 collegiate female cross-country runners (mean±SD; age 19±1 y; height 168.4 ± 7.7 cm; mass 58.8 ± 9.6 kg) participated in this study, in which their sleeping behaviors were captured using a wrist-worn actigraphy device throughout the entire competitive season. Metrics captured included: Heart rate Variability (HRV), Hours of Sleep (SleepHours), Sleep Need (SN), Sleep Efficiency (SE), Sleep Disturbances (SD), Wake Time (WT), Light Sleep Time (LS), Slow Wave Sleep Time (SWS), Rapid Eye Movement Sleep Time (REM), and Time in Bed (TiB). A linear mixed effect model assessed the differences between male and female athletes during one night prior to competition (COMPpre) and the night following competition (COMP). The total number of observations and the number of athletes were recorded (COMPpre: 300 observations, 33 athletes; COMP: 267 observations, 30 athletes). The results are reported as mean difference (MD) with 95% confidence intervals (95%CI). **RESULTS:** The female athletes experienced significantly less SN on COMPpre than males (MD [95%CI], - 0.53h [-1.00, -0.05],  $p=0.03$ ). No other sleep variables were significantly different on COMPpre.

In regards to COMP, the female athletes obtained more SleepHours, LS, REM, and TiB than males (SleepHours, 1.13 h [0.11, 2.15],  $p=0.03$ ; LS, 0.98h [0.29, 1.66],  $p=0.01$ ; REM, 0.63h [0.32, 0.94],  $p<0.001$ ; TiB, 1.24h [0.25, 2.23],  $p=0.02$ ). However, females experienced more SD than their male counterparts (SD, 3.77 [1.17, 6.37],  $p=0.01$ ). The female athletes also experienced less SWS than males on COMP (SWS, -0.41h [-0.76, -0.06],  $p=0.02$ ). **CONCLUSION:** The findings of this study illustrated that the female athletes were more rested prior to competition, which could be related to the men's team having midweek games and less sleep continuity. Future investigation is warranted to determine the potential causes of the differences on COMP.

Increased sleep duration and quality could positively affect performance on the field and in the classroom, which is important for the collegiate cohort. Future studies should standardize the sleep quality metrics relative to SleepHours.

**G-40 Free Communication/Poster - Muscle Architectural Adaptations - Hypertrophy and Atrophy**

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
 Room: CC-Hall B

3260 Board #129 June 2 9:30 AM - 11:00 AM  
**Effects Of Glutamine Supplementation On Overload-induced Muscle Growth And Function In Mice**

Kimberly Huey, FACSM, Kyle Godwin. *Drake University, Des Moines, IA.*  
 (No relevant relationships reported)

Muscle hypertrophy induced by functional overload (FO) provides an *in vivo* model to study muscle growth. Glutamine has been shown to improve muscle function, maintain contractile protein levels, and reduce inflammation; however, its effects during muscle growth is unclear. **PURPOSE:** These experiments tested the hypothesis that glutamine supplementation positively impacts the skeletal muscle response to a growth stimulus as evidenced by greater hypertrophy, increased growth factor levels, and improved contractile function compared to placebo. **METHODS:** Mice underwent FO of the plantaris or sham surgery. *In vivo* plantaris force and fatigue resistance (% of maximal force after 10 contractions) were measured 14 days after FO or sham in mice receiving daily glutamine (1 g/kg body mass) or placebo (n= 7-9/group). Insulin-like growth factor 1 (IGF-1) was measured in the plantaris by ELISA after 14 days of FO or sham. Data were analyzed with 2-way ANOVAs. **RESULTS:** FO increased plantaris mass independent of treatment; however, glutamine tended to enhance muscle hypertrophy compared to placebo (Placebo: 15 ± 0.6 vs. 28 ± 2 mg and Glutamine: 16 ± 0.5 vs. 34 ± 3 mg, for sham and FO, respectively,  $p < 0.05$ ). Maximal isometric force relative to body mass was unchanged with FO, independent of glutamine. Fatigue resistance was increased with FO compared to sham, independent of glutamine (Placebo: 39 ± 4 vs. 50 ± 5% and Glutamine: 33 ± 2 vs. 56 ± 2%, for sham and FO, respectively,  $p < 0.05$ ). Muscle levels of IGF-1 were significantly increased with FO, independent of glutamine

(Placebo:  $55 \pm 7$  vs.  $848 \pm 131$  pg/mg protein and Glutamine:  $25 \pm 10$  vs.  $813 \pm 174$  pg/mg protein, for sham and FO, respectively,  $p < 0.05$ ). **CONCLUSIONS:** Functional overload was associated with significant hypertrophy, elevated IGF-1 levels, and increased fatigue resistance, but these adaptations were not enhanced with glutamine supplementation.

Supported by Iowa Space Grant Consortium Undergraduate Research Award

3261 Board #130 June 2 9:30 AM - 11:00 AM  
**Contribution Of Exercise, Physical Activity, And Protein To Functional Cross-sectional Area And Intramuscular Adipose Tissue**

Kyle J. Hackney<sup>1</sup>, Nathan D. Dicks<sup>1</sup>, Kara A. Stone<sup>1</sup>, Christopher J. Kotarsky<sup>1</sup>, Allison M. Barry<sup>1</sup>, Jill Keith<sup>1</sup>, Steven Mitchell<sup>2</sup>, Wonwoo Byun<sup>3</sup>, Sherri N. Stastny<sup>1</sup>. <sup>1</sup>North Dakota State University, Fargo, ND. <sup>2</sup>Sanford Health, Fargo, ND. <sup>3</sup>University of Utah, Salt Lake City, UT.

(No relevant relationships reported)

Muscle cross sectional area (CSA) has historically been used as a measure for skeletal muscle size, however, functional cross sectional area (FCSA), defined as the area of muscle isolated from adipose tissue within the CSA, is more closely associated with muscular health. The visible adipose tissue beneath the muscle fascia, defined as intramuscular adipose tissue (IMAT), has also been linked to metabolic abnormalities at increased levels in clinical populations. In contrast, in some healthy populations IMAT may be used as a fuel source for physical activity (PA) and dietary intake may influence IMAT.

**PURPOSE:** This study examined factors that predicted FCSA and IMAT in the knee extensors (KE) of younger and older men and women. **METHODS:** Ninety-eight participants (46 male, 52 female) were classified as younger (20-35 yr) and older (50-65 yr) as well as sedentary (< 2 days per week) and active (3+ days per week) based on self-reported age and concurrent resistance and aerobic exercise training status. All participants completed anthropometry measurements, lower body muscle function testing, a 3-day dietary intake log, and wore an accelerometer for seven days. Participants then completed magnetic resonance imaging (MRI) scanning of the lower limbs. Muscle CSA was determined by manually tracing the KE and FCSA and IMAT were derived through color thresholding. Independent samples t-tests were conducted and two separate step-wise regression analyses were performed to predict FCSA and IMAT. **RESULTS:** IMAT (cm<sup>2</sup>) was significantly higher in the sedentary ( $3.74 \pm 1.93$ ) vs. active ( $1.85 \pm 0.56$ ) as well as in older ( $3.14 \pm 2.05$ ) vs. younger ( $2.74 \pm 1.25$ ) ( $P < 0.05$ ). Protein intake (g·kg<sup>-1</sup>·day<sup>-1</sup>) was also significantly higher in active ( $1.63 \pm 0.55$ ) vs. sedentary ( $1.19 \pm 0.40$ ) ( $P < 0.05$ ). Gender, age, concurrent exercise training status, and protein intake significantly predicted 70% of the variance in FCSA ( $P < 0.01$ ), while concurrent exercise training status and light PA predicted 33% of the variance in IMAT ( $P < 0.01$ ). **CONCLUSION:** Concurrent exercise, protein intake, and light PA are major determinants of skeletal muscle health and may require further investigation to mitigate aging and activity related loss of muscle quality. Funding: Sanford Health/ NDSU Collaborative Research Seed Grant Program

3262 Board #131 June 2 9:30 AM - 11:00 AM  
**Muscle Morphology is Not Altered in PGC-1 $\alpha$  Transgenic Mice following Bupivacaine Injection**

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(No relevant relationships reported)

Peroxisome proliferator-activated receptor- $\gamma$  coactivator-1 $\alpha$  (PGC-1 $\alpha$ ) is a transcriptional activator shown to stimulate mitochondrial biogenesis. PGC-1 $\alpha$  overexpression has been shown to reduce muscle damage and wasting in a variety of pathophysiological conditions. However, how PGC-1 $\alpha$  accomplishes this is unknown. **PURPOSE:** To examine the effects of muscle specific overexpression of PGC-1 $\alpha$  on muscle fiber size distribution, cross-sectional area (CSA), 4EBP-1 protein content, and MyoD gene expression during muscle regeneration. **METHODS:** 23 C57BL/6 (WT) and 24 Transgenic (A1) mice were used for this study, with A1 mice having muscle specific overexpression of the protein PGC-1 $\alpha$ . Mice were injected with either PBS or Bupivacaine (MAR) at 12 weeks of age. Tibialis anterior (TA) muscle and tibiae were excised 3 days and 28 days post injection. Tissue was immediately frozen for morphology and gene expression analysis using RT-qPCR. **RESULTS:** PGC-1 $\alpha$  gene expression was 15-fold greater in A1 mice compared to WT mice ( $p < 0.05$ ). There was no difference between TA mass/Tibia length ratio in any mice 3 days or 28 days post-injection with bupivacaine. In WT mice 3 days post-bupivacaine injection, MyoD gene expression was 50% higher ( $p < 0.05$ ) than the PBS control group. In A1 mice 3 days post-bupivacaine injection, MyoD gene expression was 75% lower than PBS control group. P-4EBP-1/4EBP-1 content was 50% higher in WT mice 3 days post-bupivacaine injection compared to the PBS control group. In A1 mice 3 days post-bupivacaine injection, P-4EBP-1/4EBP-1 was ~50% lower compared to the PBS

control group ( $p < 0.05$ ). 28 days post-bupivacaine injection there was a 18% decrease in CSA in WT mice, however there was no change in CSA of A1 mice ( $p < 0.05$ ). In WT mice 28 days post-bupivacaine injection, there was an increase in the proportion of small fibers (<300 $\mu$ m<sup>2</sup>) and a decrease in the proportion of large fibers (>900 $\mu$ m<sup>2</sup>). In A1 transgenic mice 28 days post-bupivacaine injection, there were no differences in fiber size distribution. **CONCLUSION:** Muscle specific overexpression of PGC-1 $\alpha$  has been shown to protect muscle from damage. We demonstrate no change in muscle morphology in mice that overexpress PGC-1 $\alpha$  in muscle. The altered microenvironment could be due to a shift away from proliferation of myoblasts towards differentiation.

3263 Board #132 June 2 9:30 AM - 11:00 AM  
**Characterizing a Novel Rodent Exercise Model to Explore the Permanency of Myonuclear Accretion During Muscle Adaptation**

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(No relevant relationships reported)

Myonuclear density increases during skeletal muscle hypertrophy, and it has been postulated that newly-acquired myonuclei are permanent and constitute a "muscle memory" of previous adaptation; however, the available evidence supporting this is equivocal. **PURPOSE:** To determine if myonuclear accretion in skeletal muscle is permanent following a period of prolonged detraining after training utilizing a novel progressive weighted-wheel running (PoWeR) protocol. **METHODS:** PoWeR training involved the progressive addition of weight (2-6g) to an un-balanced running wheel over 8 weeks. Four month old female C57BL/6J mice (n=8-10/group) performed PoWeR, while another cohort performed PoWeR followed by 12 weeks of detraining. Age-matched ambulatory controls were used for baseline comparisons. Following training and detraining, the soleus and plantaris muscles underwent immunohistochemical analyses. **RESULTS:** Wet weight of the soleus muscles, when normalized to body weight (mg/g), was greater in the PoWeR trained mice when compared to the in the controls,  $0.48 \pm 0.05$  and  $0.36 \pm 0.02$ , respectively ( $P < 0.05$ ). Similarly, normalized plantaris muscle mass was increased following PoWeR training ( $0.51 \pm 0.04$ ) when compared to the controls ( $0.58 \pm 0.05$ ;  $P < 0.05$ ). This resulted in a 32% and 14% increase in normalized wet weight after PoWeR in the soleus and plantaris muscles, respectively ( $P < 0.05$ ). Fiber cross-sectional area (CSA) was 22% greater in the soleus and 15% greater in the plantaris ( $P < 0.05$ ), while myonuclei per fiber increased by 32% and 41% in the soleus and plantaris, respectively ( $P < 0.05$ ). Additionally, there was a fiber-type shift toward a more oxidative phenotype in the soleus and plantaris. After detraining, normalized muscle wet weight and muscle fiber CSA are returning towards baseline, while the fiber-type distribution shifted from slow-to-fast. Myonuclear density following detraining is currently being quantified. **CONCLUSION:** PoWeR provides a methodological advantage over exercise models currently used in mice since it is non-surgical, and elicits oxidative and hypertrophic adaptations in both slow-twitch and fast-twitch muscles. Moreover, the data gathered in this study will provide new insight into the plasticity of myonuclear number following detraining of hypertrophied muscles.

3264 Board #133 June 2 9:30 AM - 11:00 AM  
**Effect Of Repeated Bouts Of Resistance Exercise On Skeletal Muscle Proteolytic Response In Rat.**

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(No relevant relationships reported)

Resistance training (RT) increases the skeletal muscle mass and strength. It has been reported that activation of the mammalian target of rapamycin (mTOR) signaling, which is important for skeletal muscle protein synthesis, is attenuated by increasing exercise bout. However, the effect on proteolytic response is unclear. **PURPOSE:** The present study aimed to investigate the changes in proteolytic responses to repeated bouts of resistance exercised. **METHODS:** Male Sprague-Dawley rats were randomly assigned into four groups: Sedentary (SED), resistance-exercised with 1bout (1B), 2bouts (2B), 3bouts (3B). RT protocol consisted of 50 repetitions of maximal isometric contraction of the right gastrocnemius muscle by direct electric stimulation under anesthesia. Muscle samples were collected 3h and 6h after the final exercise session. **RESULTS:** Phosphorylation of p70S6K increased in all trained groups (1B: 15 fold, 2B: 10 fold, 3B: 8 fold,  $P < 0.05$ ). And there was also significant difference between 1B and 3B. The protein ubiquitination increased in all trained groups of 1.2-fold in SED ( $P < 0.05$ ). And Light chain 3 (LC3), which is a marker for autophagy, increased in all trained groups of 1.5-fold in SED ( $P < 0.05$ ). MuRF-1 mRNA showed a significant 5.1-fold increase with training ( $P < 0.05$ ). However, there were no effect of repeated bouts of RT in muscle proteolytic response. **CONCLUSIONS:** The present results suggest

that the muscle protein proteolytic response was activated by RT. In addition, the activation of mTOR signaling attenuated with the increase in RT bouts, but the level of activation of proteolytic response did not change.

3265 Board #134 June 2 9:30 AM - 11:00 AM

### Elevating Protein Synthesis: Turn it Down a Notch

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(No relevant relationships reported)

**PURPOSE:** Notch signaling is thought to be crucial in regulating skeletal muscle regeneration, however, the impact Notch signaling has on other skeletal muscle processes (e.g. protein synthesis) remains unclear. The purpose of this project was to determine the effects of Notch inhibition on protein synthesis during the myogenic program.

**METHODS:** C2C12 cells were treated with or without a  $\lambda$ -secretase inhibitor (GSI) to determine the effect of Notch inhibition on anabolic signaling and protein synthesis during myoblast proliferation and differentiation. Samples were collected and analyzed for components of Notch, anabolic signaling (PTEN/AKT/mTOR pathway), and protein synthesis (via puromycin incorporation).

**RESULTS:** GSI treatment reduced Notch signaling: c-myc ( $P < 0.05$ ) and Hes1 ( $P < 0.01$ ). GSI treatment elevated pmTOR Ser2448 ( $P < 0.05$ ), pmTOR Ser2481 ( $P < 0.05$ ), pTSC2 Thr1462 ( $P < 0.05$ ), and protein synthesis ( $P < 0.05$ ) in C2C12 myoblasts. GSI-treated C2C12 myotubes demonstrated increases in pAKT Thr308 ( $P < 0.01$ ), pAKT Ser473 ( $P < 0.05$ ), pTSC2 Thr1462 ( $P < 0.001$ ), pmTOR Ser2448 ( $P < 0.05$ ), and protein synthesis ( $P < 0.01$ ). GSI treatment lowered PTEN expression in myotubes ( $P < 0.05$ ).

**CONCLUSIONS:** These results demonstrate that Notch signaling may regulate protein synthesis via the PTEN/AKT/mTOR pathway.

3266 Board #135 June 2 9:30 AM - 11:00 AM

### Apoptosis In Recovering Human Skeletal Muscle after High Intensity Cycling In Men Receiving Ergogenic Rg1 Compound

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(No relevant relationships reported)

**PURPOSE:** To examine the impact of high intensity exercise on cell death in human skeletal muscle during recovery with Rg1 supplementation, which has been shown to increase endurance performance. **METHODS:** Using randomized double blind placebo controlled crossover design, twelve young men were studied on three occasions: Placebo, Rg1 (1 mg) and Rg1 (5 mg) supplementation 1 h prior to a high-intensity exercise. Biopsied samples were taken from vastus lateralis before, immediately after and 3 h after a 1-h cycling exercise at 75%  $VO_{2max}$ . **RESULTS:** Apoptotic and necrotic cells in vastus lateralis increased immediately after 1 h cycling (80-140% and 80-120%,  $P < 0.05$ ), concurrent with macrophage infiltration (both CD68+ and CD163+). Increases in iNOS and myogenic factor Myf5 mRNA levels after exercise were further elevated during Rg1 supplemented trial. Rg1 (5 mg) significantly increased high intensity endurance performance and accelerates the disappearance of apoptotic and necrotic cell number occurred 3 h after exercise during recovery. **CONCLUSION:** High intensity exercise increased cell death in human skeletal muscle after high intensity aerobic exercise. The ergogenic compound Rg1 accelerates phagocytosis to remove unhealthy muscle cell in exercised skeletal muscle.

3267 Board #136 June 2 9:30 AM - 11:00 AM

### Systemic Effect On Myotube Size After Sprint Exercise Combined With Nutrients

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<sup>2</sup>School of Health and Medical Science, Örebro University, Örebro, Sweden.

(No relevant relationships reported)

**PURPOSE:** To study systemic effects of sprint exercise combined with nutrient ingestion on muscle cell hypertrophy. It was hypothesized that the size of human muscle cells increases when they are exposed to post-exercise serum in nutrient but not in placebo condition. Previously studies have shown that oral ingestion of essential amino acids (EAA) and carbohydrate results in higher activation of Akt/mTOR signalling and higher rate of muscle protein synthesis following sprint exercise in humans. Both local and systemic factors may contribute to these effects. Moreover, If the nutrient-induced effects on signalling and muscle protein synthesis result into muscle hypertrophy is not known. In this study we "isolate" the systemic effects by exposing cultured muscle cells for post sprint exercise serum from either nutrient ingestions or placebo.

**METHODS:** This study is based on a previous study, were healthy subjects performed three 30-s sprints with 20 minutes rest in between. Subjects ingested a flavoured drink containing EAA and maltodextrin (nutrient) or only flavoured water (placebo) during the sprint exercise session up to 15 min after the last sprint in a randomized order with one month interval. Blood samples were collected before during and up to 200 minutes after the last sprint and were analyzed for EEA, insulin lactate and glucose. Human myoblasts were isolated from vastus lateralis and differentiated into multinucleated myotubes, which were cultured in serum collected from 5 subjects from the sprint exercise study described above. Blood samples, obtained at 80 min after the last sprint, were chosen since the peak values for the accumulation of insulin and EAA occur approximately at that time point.

**RESULTS:** Both serum insulin (6-fold;  $P < 0.05$ ) and plasma leucine levels (2.6-fold;  $P < 0.01$ ) were higher after nutrient compared to placebo 80 min post-exercise. Plasma lactate and glucose levels did not differ between the conditions. Myotube size was 16% larger after exposure to post sprint exercise serum obtained during nutrient as compared to placebo ( $P < 0.05$ ).

**CONCLUSIONS:** Systemic factors may stimulate muscle hypertrophy after sprint exercise when combined with nutrient ingestion. If such a systemic effect may be counteracted by intracellular metabolic perturbations after sprint exercise is not known.

3268 Board #137 June 2 9:30 AM - 11:00 AM

### Comparing Muscle Hypertrophy and Myosin Heavy Chain Content between Relative Intensity and Repetition Maximum Resistance Training

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(No relevant relationships reported)

Comparison of resistance training (RT) methodologies is a critical component of determining appropriate and specific recommendations for health and human performance. Repetition maximum (RM) training typically consists of performing each exercise to momentary failure, thus providing a RM each day of training. Relative intensity based on sets and repetitions ( $RI_{SR}$ ) conversely uses a percentage of a maximum or estimated maximum, typically not leading to failure. **PURPOSE:** To compare 10-weeks  $RI_{SR}$  or RM resistance training on skeletal muscle fiber size and protein accretion in well-trained subjects. **METHODS:** Fifteen well-trained males (age = 26.9±3.9yrs, body mass = 86.2±12.1kg) participated in the study ( $RI_{SR}$  group, n=7; or RM group, n=8). Muscle biopsies of the vastus lateralis were sampled 72 hours before beginning the intervention and again 72 hours after the final training. The 10-week RT program consisted of several phases: strength-endurance, maximum strength, a planned overreach, and a taper. The RM group achieved a daily maximum in each lift while the  $RI_{SR}$  group used a variety of submaximal training loads not leading to muscular failure. Workloads measured by volume load were similar between groups ( $p > 0.05$ ). A 2x2 mixed design ANOVA and effect size using Hedge's  $g$  were performed for Type I cross-sectional area (CSA), Type II CSA, myosin heavy chain (MYH)1, MYH2, and MYH7. **RESULTS:**  $RI_{SR}$  significantly increased Type I CSA ( $p = 0.018$ ) and Type II CSA ( $p = 0.012$ ). None of the MYH proteins reached statistical significance for either group ( $p > 0.05$ ). Between-group effect sizes favored the  $RI_{SR}$  group for all variables: Type I CSA  $g = 0.48$ , Type II CSA  $g = 0.50$ , MYH1  $g = 0.31$ , MYH2  $g = 0.87$ , and MYH7  $g = 0.59$ . **CONCLUSIONS:** These results suggest RT utilizing a  $RI_{SR}$  approach may provide superior intramuscular outcomes compared to RM training in higher level lifters.

3269 Board #138 June 2 9:30 AM - 11:00 AM

### Elevated Myostatin Expression Promotes Skeletal Muscle Fibrogenic Cell Expansion Following ACL Injury

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(No relevant relationships reported)

Anterior cruciate ligament (ACL) injuries induce quadriceps muscle maladaptations that contribute to protracted weakness. We have previously shown negative morphological and cellular changes in the quadriceps following an ACL injury that promote a pro-fibrotic muscle environment. There are many unknown initiators and contributors to fibrotic pathways and understanding the mechanisms, cell types, and factors involved in the progression of fibrosis is critical for developing treatment strategies.

**PURPOSE:** To determine the contribution of myostatin to the development of a pro-fibrotic muscle environment following an ACL injury.

**METHODS:** We obtained muscle biopsies from the injured and non-injured vastus lateralis of young adults (n=14; 23±4 yr). Expression of myostatin, transforming growth factor- $\beta$  and other regulatory factors were investigated. Immunohistochemical analyses were performed to assess fibrogenic cell expansion, and primary fibroblasts were isolated from muscle biopsies and subsequently treated with myostatin *in vitro*.

**RESULTS:** Injured limb skeletal muscle demonstrated an approximate 100% increase in myostatin gene ( $p < 0.005$ ) and protein ( $p < 0.0005$ ) expression, which correlated ( $p < 0.05$ ) with fibroblast abundance in the injured limb. Human fibroblasts expressed the activin type IIB receptor, underscoring the regulatory ability of myostatin. Treatment with myostatin induced a 70% increase in the proliferative rate of primary human muscle-derived fibroblasts ( $p < 0.05$ ).

**CONCLUSIONS:** These findings support an integral role for myostatin in promoting fibrogenic alterations within skeletal muscle following an ACL injury. Supported by NIH grants: K23 AR062069 and P30 AG024832 and the John Sealy Memorial Endowment Fund.

3270 Board #139 June 2 9:30 AM - 11:00 AM  
**Comparisons The Strength Performance of Sarcopenia Defined by AWGS & EWGSOP Criteria Among Elderly**  
 Yu-Tzu Liu, Li-Lan Fu. *National Taiwan Sport University, Taoyuan, Taiwan.*  
*(No relevant relationships reported)*

**PURPOSE:** The aim of the present study was to identify a better criteria of sarcopenia for community-dwelling older Taiwanese.

**METHODS:** Sixty-two community dwelling people (48 men and 14 women) over 65 years were recruited from Taoyuan, northern Taiwan. Participants were interviewed by trained investigators using Short Portable Mental Status Questionnaire (SPMSQ) and Physical Activity Readiness Questionnaire. Body composition was measured by skinfold (SF) and Body Mass Index (BMI). Strength functional performances were obtained by sit to stand (SS), arm curl (AC), eight-inch walk (EW), grip strength (GS), knee strength (KS) using the standard procedures. Sarcopenia was defined according to the Asian Working Group for Sarcopenia (AWGS) and Report of the European Working Group on Sarcopenia in Older People (EWGSOP). One-way ANOVA test was used to compare the differences within groups.

**RESULTS:** Of the 62 subjects (76.79 ± 5.32 yrs), 18 were classified in sarcopenia group (ASG) and 44 were normal group (ANG) by AWGS. Ten were classified in sarcopenia group (ESG) and 53 were normal group (ENG) by EWGSOP. The strength performances were different in ASG and ANG, included in SS, AC, EW, GS left and GS right hand ( $p < 0.05$ ), except KS extension and flexion ( $p > 0.05$ ). The strength performances were also different in ESG and ENG, included in AC, EW, GS left and GS right hand, except SS, KS extension and flexion ( $p > 0.05$ ), as listed in Table 1.

**CONCLUSIONS:** Both AWGS and EWGSOP can effectively define sarcopenia in community-dwelling older Taiwanese, especial AWGS. Supported by NSC 97-2410-H-179-007-MY2.

	ASG	ANG	ESG	ENG
SS (times)	10.62 ± 4.05*	13.87 ± 3.24	11.78 ± 4.28	13.76 ± 3.22
AC (times)	13.31 ± 7.00 *	18.30 ± 4.96	14.71 ± 6.64*	18.29 ± 5.09
EW (second)	7.63 ± 3.23 *	6.08 ± 1.68	7.55 ± 2.87*	5.94 ± 1.61
GS left (kg)	21.52 ± 3.65 *	29.82 ± 7.00	22.82 ± 4.17*	30.24 ± 7.19
GS right(kg)	21.28 ± 2.90*	30.71 ± 6.46	23.34 ± 4.57*	30.94 ± 6.69
KS extension (kg)	20.23 ± 8.34	23.55 ± 6.10	22.29 ± 7.89	23.04 ± 6.25
KS flexion (kg)	12.52 ± 5.18	13.46 ± 3.57	13.83 ± 5.01	13.02 ± 3.43

3271 Board #140 June 2 9:30 AM - 11:00 AM  
**Long-term Physical Inactivity Exacerbates Hindlimb Unloading-induced Soleus Muscle Atrophy In Young Rats**  
 Toshinori Yoshihara<sup>1</sup>, Takamasa Tsuzuki<sup>1</sup>, Chang Shuo-wen<sup>1</sup>, Toshiharu Natsume<sup>1</sup>, Ryo Kakigi<sup>2</sup>, Noriko Ichinoseki-Sekine<sup>3</sup>, Shuichi Machida<sup>1</sup>, Takao Sugiura<sup>4</sup>, Hisashi Naito<sup>1</sup>. <sup>1</sup>*Juntendo University, Inzai, Japan.* <sup>2</sup>*Juntendo University, Bunkyo-ku, Japan.* <sup>3</sup>*The Open University of Japan, Chiba, Japan.* <sup>4</sup>*Yamaguchi University, Yamaguchi, Japan.*  
*(No relevant relationships reported)*

Physical inactivity (sedentary lifestyle) in adulthood increases a degree of aging-related skeletal muscle weakness; however, it has been unclear whether long-term physical inactivity in childhood exacerbates subsequent disuse-induced skeletal muscle atrophy.

**PURPOSE:** This study investigated the effects of long-term physical inactivity in childhood on subsequent hindlimb unloading-induced muscle atrophy in rat soleus muscle.

**METHODS:** Forty-eight 3-week-old male Wistar rats were assigned randomly into control (CON, n = 24) or physical inactivity (IN, n = 24) groups. Rats in the IN group were housed in a narrow cage with half of the usual floor space to limit the range of their movement. After 8 weeks (12-week-old), the rats (CON & IN) were exposed to hindlimb unloading. The soleus muscles were quickly removed before (0 d, n = 6/each group), 1 day (1d, n = 6/each group), 3 days (3d, n = 6/each group) and 7 days (7d, n = 6/each group) after unloading. mRNA and protein levels were determined by RT-PCR and Western blot analysis. Statistical significance was established at  $p < 0.05$ .

**RESULTS:** Although 7-days of hindlimb unloading significantly decreased soleus muscle weight (CON; -28%, IN; -33%,  $p < 0.001$ ), the decrease was drastically in IN group (Inactivity × Unloading,  $p = 0.0009$ ). A significant interaction between inactivity and unloading ( $p < 0.01$ ) was observed on the HDAC4 and NF-κB protein expressions. The HDAC4 and NF-κB expressions in the IN group increased significantly 1 day after onset of hindlimb unloading (CON; 1.4 and 1.2, IN; 5.1 and 2.7 fold change from each 0d, respectively). Moreover, their downstream targets *Myogenin* and *MuRF1* mRNA levels were upregulated by long-term physical inactivity (Inactivity,  $p < 0.05$ ).

**CONCLUSIONS:** Our data suggest that long-term physical inactivity exacerbates hindlimb unloading-induced disuse muscle atrophy in young rat soleus muscle, which may be mediated by HDAC4 and NF-κB-induced *MuRF1* mRNA upregulation. Supported by JSPS KAKENHI Grant Number 17K01765.

3272 Board #141 June 2 9:30 AM - 11:00 AM  
**Blood Lipid is Associated with Skeletal Muscle PPARδ Protein Content after a 10-week Resistance Exercise Training**  
 Vincent C.W. Chen<sup>1</sup>, Chang Woock Lee<sup>2</sup>, James D. Fluckey<sup>3</sup>, Steven E. Riechman<sup>3</sup>. <sup>1</sup>*Georgian Court University, Lakewood, NJ.* <sup>2</sup>*University of Houston-Victoria, Victoria, TX.* <sup>3</sup>*Texas A&M University, College Station, TX.*  
*(No relevant relationships reported)*

Peroxisome proliferator activated receptors (PPARs) are main regulators of blood lipid profile while PPARδ is the most abundant PPARs isoform in skeletal muscle. Although skeletal muscle is a major player in lipid metabolism, the association between muscle PPARδ and blood lipid profile is currently unknown. **PURPOSE:** The purpose of this study was to investigate the association between muscle PPARδ protein content and blood lipid in the context of resistance exercise training. **METHODS:** Fifteen untrained, healthy young men (n=8) and women (n=7) performed a 10-week progressive whole-body resistance exercise training program. Muscle samples were obtained from the vastus lateralis muscles 24 hours before the first exercise and 24 hours after the last exercise. Blood samples were collected from antecubital veins immediately before the first and the last exercises. Western Blotting was conducted to quantify the PPARδ content, and serum lipid profile was analyzed. **RESULTS:** While PPARδ protein content was not correlated with blood lipid profile before the training, it was negatively correlated with total cholesterol ( $R = -0.731$ ,  $R\text{-square} = 0.534$ ,  $P = 0.04$ ) and LDL ( $R = -0.746$ ,  $R\text{-square} = 0.557$ ,  $P = 0.033$ ) after the training. **CONCLUSION:** The results imply that resistance exercise training may enhance the regulation of blood lipid via PPARδ.

	PPARδ Protein Content (AU)	
	Before Training	After Training
Triglyceride (mg/dL)	0.023	0.086
Total Cholesterol (mg/dL)	0.027	<b>0.534 *</b>
HDL (mg/dL)	0.025	0.033
LDL (mg/dL)	0.012	<b>0.557 *</b>

\*  $P < 0.05$ , significant correlation. Data are R-square ( $R^2$ ).

3273 Board #142 June 2 9:30 AM - 11:00 AM  
**Comparing The Effects Of Nexrutine And Exercise In Modulating The Pathophysiology Of Cachexia In Treatment Naïve Prostate Cancer Mouse Model**  
 Darpan Patel, Derek Wallace, Kira Pamerleau, Paul Rivas, Nicolas Musi, A Pratap Kumar. *University of Texas Health Science Center at San Antonio, San Antonio, TX.*  
*(No relevant relationships reported)*

Oncologists encourage nutritional and physical interventions to improve outcomes in cancer patients with cachexia; however, it is inconclusive how these interventions

affects the pathophysiology of cachexia. **PURPOSE:** To compare the effects of Nexrutine® (Nex; a natural bark extract of the Amur cork tree) and exercise in modulating the pathophysiology associated with cachexia in treatment naïve transgenic adenocarcinoma of mouse prostate (TRAMP) model. **METHODS:** Forty-five, 10-week old male TRAMP mice were randomized to control (Con), Nex (600 mg/kg pelleted into chow) or exercise (Ex; voluntary wheel running). At 4, 8, 12 and 20 weeks, gastrocnemius muscle was collected to quantify intramuscular IGF-1, myostatin, TNF- $\alpha$ , proteolysis-inducing factor (PIF) and ubiquitin (Ub). An ANOVA with Tukey's post hoc test was done with significance set at  $p < 0.05$ . **RESULTS:** Analysis of gastrocnemius mass revealed significant group differences ( $F=4.159, p=0.02$ ) with both Nex and Ex groups having greater mass compared to Con ( $p < 0.05$ ). A treatment response was observed for myostatin ( $F=4.762; p=0.01$ ), PIF ( $F=8.633, p=0.001$ ) and Ub ( $F=19.55, p < 0.001$ ). Specifically, Ex mice had significantly lower concentrations of myostatin, PIF and Ub compared to Con ( $p < 0.01$ ). Group comparisons at 20 weeks showed significantly lower concentrations of PIF ( $F=22.85, p < 0.001$ ) with Ex ( $p < 0.001$ ) and Nex ( $p=0.03$ ) significantly lowering PIF concentrations compared to Con. Time point comparisons for Ub revealed significant differences at weeks 4 ( $F=32.35, p < 0.001$ ) and week 8 ( $F=16.24, p=0.002$ ), respectively, with Ex mice having significantly lower concentrations of Ub compared to Con mice ( $p=0.004$ ) at both time points. **CONCLUSION:** The results of this study suggest that Nex and Ex similarly maintain muscle mass in treatment naïve TRAMP mice by reducing tumor specific cachectic protein PIF. Exercise was capable of reducing downstream Ub; however, the mechanisms by which Nex elicits a protective effect require further study.

3274 Board #143 June 2 9:30 AM - 11:00 AM  
**Dietary Protein Intake and Muscular Health with Aging: Countermeasures for Sarcopenia and Dynapenia**  
 Kara A. Stone<sup>1</sup>, Christopher J. Kotarsky<sup>1</sup>, Nathan D. Dicks<sup>1</sup>, Daniel M. Streeter<sup>1</sup>, Allison M. Barry<sup>1</sup>, Jill Keith<sup>2</sup>, Rachel Iverson<sup>1</sup>, Sherri N. Stastny<sup>1</sup>, Shannon David<sup>1</sup>, Wonwoo Byun<sup>3</sup>, Steven Mitchell<sup>1</sup>, Kyle J. Hackney<sup>1</sup>. <sup>1</sup>North Dakota State University, Fargo, ND. <sup>2</sup>University of Wyoming, Laramie, WY. <sup>3</sup>University of Utah, Salt Lake City, UT.  
 (No relevant relationships reported)

Protein intake and aerobic and resistance exercise have been suggested as effective stimuli for muscle growth and function in the young and old. However, the magnitude of these stimuli combined is not completely understood. **PURPOSE:** To examine relationships between total protein intake and combined aerobic and anaerobic training on muscle size and strength in sedentary and active adults. **METHODS:** A total of 98 subjects were divided into the following groups: active younger females (AYF), sedentary younger females (SYF), active older females (AOF), sedentary older females (SOF), active younger males (AYM), sedentary younger males (SYM), active older males (AOM), and sedentary older males (SOM). Subjects completed an assessment of knee extensor peak torque (KEPT), a 3-day dietary intake log, and magnetic resonance imaging (MRI) scan for muscle cross-sectional area analysis of the right quadriceps (CSAq). Two stepwise regression models were used to examine the relationship of gender, protein intake, activity level, and age, with CSAq and KEPT. **RESULTS:** Mean differences are displayed in the table below. Gender, protein intake, age and physical activity were predictive for CSAq ( $F(1, 93) = 11.798, R^2 = 0.725, p < 0.01$ ). Additionally, gender, age, and physical activity were predictive for KEPT ( $F(1, 94) = 14.309, R^2 = 0.631, p < 0.01$ ). **CONCLUSION:** The results suggest that changes in skeletal muscle size and strength are related to differences in age, gender, total daily protein intake, and physical activity. Furthermore, concurrent exercise appears to be an intervention to potentially mitigate sarcopenia and dynapenia in older adults.

	AYF	SYF	AOF	SOF	AYM	SYM	AOM	SOM
KEPT	152.1 ± 26.8	138.6 ± 32.9*†‡	122.5 ± 28.4*†‡	101.9 ± 21.7**†‡	254.3 ± 57.8*	195.1 ± 35.1#	214.3 ± 39.6*‡	185.8 ± 48.2#
CSAq	55.8 ± 7.3	50.7 ± 78.5*†‡	50.1 ± 6.6*†‡	42.1 ± 6.7**†‡	85.1 ± 13.0*	65.8 ± 10.1#	74.6 ± 7.4*‡	64.8 ± 7.7*‡

\*denotes significance from AYF, # denotes significance from AYM, † denotes significance from SYM, ‡ denotes significance from SYF, ‡ denotes significance from AOM, ‡ denotes significance from AOF, ° denotes significance from SOM. All significance levels set at  $p < 0.05$

Funding: Sanford Health/ NDSU Collaborative Research Seed Grant Program

3275 Board #144 June 2 9:30 AM - 11:00 AM  
**Constant And Progressive Resistance Exercise Reduces Anabolic Signaling But Increased Myofiber Hypertrophy In Human Skeletal Muscle**  
 Dr. Sebastian Gehlert. *Universität Hildesheim, 31143 Hildesheim, Germany.*  
 (No relevant relationships reported)

**PURPOSE:** To determine the effects of progressive (PR) and constant (CO) loading induced by resistance exercise (RE) on anabolic signaling, myofibrillar damage and selective type I and II myofiber hypertrophy when RE is prolonged and interrupted over time. **METHODS:** 15 healthy male subjects (24 ± 3 years) conducted six weeks of progressive (PR) (n=8) or constant (CO) (n=7) RE on a leg extension and leg press machine. Subjects conducted in sum 14 training units with 3 training sessions per week. Each session consisted of 3 sets with 10-12 repetitions on each machine. At baseline (T0) after the 1<sup>st</sup> (T1), 3<sup>rd</sup> (T2), 7<sup>th</sup> (T3), 10<sup>th</sup> (T4), 13<sup>th</sup> (T5) and 14<sup>th</sup> (T6) RE session, skeletal muscles biopsies from vastus lateralis muscle were collected at 45min post RE. Subjects of PR increased RE load by 5% each week while in the CO group RE-load was constant. Continuous training was performed up to T5 and stopped for 10 days followed by a final TU 14. **RESULTS:** In PR and CO increases in p70s6k and rpS6 phosphorylation ( $P < 0.05$ ) were detected at all time points (T1-T6) compared to T0. However, rpS6 and p70s6k was decreased from T1 to T4 in PR ( $p < 0.05$ ) but not in CO. Reduced signaling recovered after pausing RE in PR with an increase from T5 to T6 ( $p < 0.05$ ). Myofibrillar damage was increased in PR and CO ( $p < 0.05$ ) at T1 but gradually decreased up to T5 in both groups. There was a tendency for lower myofibrillar damage in PR at T4 and T5. Type I myofibers showed increased myofiber diameter (8%) at T5 ( $p < 0.05$ ) with no group differences. Type II fibers increased (12%) in both groups ( $p < 0.05$ ) but more in PR than CO at T5 ( $p < 0.05$ ). **CONCLUSIONS:** While PR offers increased potential for type II myofiber hypertrophy and increases sarcomeric stability over the time course of repeated RE compared to CO, it is associated with decreased anabolic signaling upon repeated RE stimulation. Anabolic signaling does not reflect structural adaptability but its decreased sensitivity towards loading.

3276 Board #145 June 2 9:30 AM - 11:00 AM  
**Amino Acid Transport and Metabolism Alterations Following 12 Weeks of Resistance Training with Supplementation**  
 Paul A. Roberson<sup>1</sup>, C. Brooks Mobley<sup>1</sup>, Cody T. Haun<sup>1</sup>, Petey W. Mumford<sup>1</sup>, Matthew A. Romero<sup>1</sup>, Wesley C. Kephart<sup>1</sup>, Shelby C. Osburn<sup>1</sup>, Christopher G. Vann<sup>1</sup>, Christopher M. Lockwood<sup>2</sup>, Michael D. Roberts<sup>1</sup>. <sup>1</sup>Auburn University, Auburn, AL. <sup>2</sup>Lockwood, LLC, Draper, UT.  
 (No relevant relationships reported)

**PURPOSE:** Amino acid transporters within skeletal muscle have gained attention for their potential role in stimulating muscle protein synthesis (MPS). The purpose of this study was to determine if amino acid transporters and proteins involved in amino acid metabolism are related to skeletal muscle hypertrophy following resistance training with different nutritional supplementation strategies. **METHODS:** 43 untrained, college-aged males were separated into a Maltodextrin Placebo (PLA, n=12), Leucine (LEU, n=14), or Whey Protein Concentrate (WPC, n=17) group and underwent 12 weeks of total-body resistance training performed 3 days per week while supplementing twice daily. Each group's supplement was standardized for total energy, fat, and LEU and WPC groups were standardized for total Leucine (6 g/d). Skeletal muscle biopsies were obtained prior to training (PRE) and ~72 h following subjects' last training session (POST). **RESULTS:** LAT1 protein levels demonstrated a time effect ( $p < 0.001$ ; 3.01-fold increase) and group effect ( $p=0.043$ ), whereby PLA increased significantly more than LEU and WPC ( $p < 0.05$ ; 5.01-fold vs. ~2-fold increase). A time effect was observed for PAT1 ( $p=0.047$ ; 1.36-fold increase) and BCKDHA ( $p < 0.001$ ; 1.81-fold increase) protein levels, while SNAT2, BCAT2, and ATF4 protein levels were unaltered ( $p > 0.05$ ). Changes in muscle fiber cross sectional area (CSA) demonstrated a time effect for Type I fibers ( $p=0.045$ ; +370  $\mu$ m) and Type II fibers ( $p < 0.001$ ; +1061  $\mu$ m). No strong, significant correlations existed for changes in assayed proteins with changes in Type I or II fiber CSA, nor were PRE protein values indicative of alterations in muscle CSA. **CONCLUSIONS:** LAT1 protein levels increase in response to resistance training, and LEU and WPC supplementation reduced training-induced increases in this protein. Furthermore, proteins related to amino acid transport and metabolism do not appear to dictate skeletal muscle hypertrophy.

3277 Board #146 June 2 9:30 AM - 11:00 AM  
**Resistance Training-Induced Muscle Hypertrophy is Related to Androgen Receptor Content not Intramuscular or Systemic Hormones**  
 Robert Morton<sup>1</sup>, Koji Sato<sup>2</sup>, Michael Gallagher<sup>1</sup>, Sara Oikawa<sup>1</sup>, Paul McNicholas<sup>1</sup>, Satoshi Fujita<sup>3</sup>, Stuart Phillips, FACSM<sup>1</sup>.  
<sup>1</sup>McMaster University, Hamilton, ON, Canada. <sup>2</sup>Kobe University, Kobe, Japan. <sup>3</sup>Ritsumeikan University, Shiga, Japan. (Sponsor: Stuart Phillips, FACSM)  
 (No relevant relationships reported)

There is substantial inter-individual variability in resistance exercise training (RET)-induced skeletal muscle hypertrophy. **PURPOSE:** To determine if systemic circulating and/or intramuscular hormones were related to the RET-induced hypertrophy. **METHODS:** Resistance-trained young men (mean  $\pm$  SEM; 23  $\pm$  1 yr, 86  $\pm$  2 kg, 181  $\pm$  1 cm, previously performing RET  $\geq$  2 times per wk for 4  $\pm$  2 yr) undertook individually supervised RET four times per week for 12 wk. Fat- and bone-free (lean) body mass (LBM) and individual fibre type cross sectional area (CSA) were evaluated by dual x-ray absorptiometry and immunohistochemistry, respectively. Backwards elimination and principal component regression were used to evaluate shared variance between systemic proposedly anabolic hormones and RET-induced changes in muscle mass (n=49). Intramuscular free testosterone levels, dihydrotestosterone levels, 5 $\alpha$ -reductase expression, and androgen receptor content were evaluated in the highest- (HIR; n=10;  $\Delta$  LBM = 2.1  $\pm$  0.8 kg) and lowest- (LOR; n=10;  $\Delta$  LBM = 0.6  $\pm$  0.9 kg) responders to the 12 wk of RET. **RESULTS:** No hormone measured before exercise, after exercise, pre-intervention, or post-intervention, using unadjusted or principal component regression, shared significant common variance with the change in type 1 CSA, type 2 CSA, or LBM. No hormone, in blood- or muscle, was different between HIR and LOR. The steroidogenic enzyme 5 $\alpha$ -reductase increased following RET in the HIR (P<0.01) but not the LOR (P=0.32). Androgen receptor content remained unchanged with 12 wk of RET, but was higher in HIR versus LOR both pre- and post-intervention. **CONCLUSION:** Neither systemic nor intramuscular hormones are related to RET-induced skeletal muscle hypertrophy in resistance-trained young men. Instead, these data demonstrate that intramuscular androgen receptor content may be an important component of the individual variation between high- and low-hypertrophy responders to RET.

Supported by NSERC of Canada grant to SMP and trainee award to RWM

3278 Board #147 June 2 9:30 AM - 11:00 AM  
**Ghrelin Attenuates Muscle Atrophy In Tumor-bearing Mice**  
 Haiming Liu, Jose M. Garcia. University of Washington, Seattle, WA.  
 (No relevant relationships reported)

Cachexia is a multi-organ syndrome characterized by muscle and fat wasting. Ghrelin is a hormone known to release growth hormone and to stimulate appetite by binding to its receptor growth hormone secretagogue receptor (GHSR)-1a. However, recent data suggest that not all effects of ghrelin are mediated through this receptor.

**PURPOSE:** To investigate if ghrelin attenuates cancer-induced muscle atrophy in a GHSR-1a-independent manner.

**METHODS:** 5-6-month-old male C57BL/6J GHSR-1a wildtype (WT) and knockout (KO) mice were inoculated with 1x10<sup>6</sup> heat-killed (HK, control) or live Lewis Lung Carcinoma (LLC) cells in the right flank. When the tumor was palpable (1 wk), tumor-bearing mice were injected with vehicle (saline solution, TV) or ghrelin (0.8 mg/kg, TG), IP twice a day, while HK mice were injected with vehicle (n = 8-10). Body weight, lean body mass and fat mass were measured by NMR before tumor implantation and 2 weeks after tumor noted. Gastrocnemius (GAS) muscles were harvested for analysis 2 weeks after tumor noted.

**RESULTS:** Tumor implantation induced a significant decline in body weight and fat mass in both strains. As expected, ghrelin attenuated the fat loss in WT (TV vs. TG: -52% vs. -23% from baseline, p = .009) but not in KO (TV vs. TG: -56% vs. -60%, p = .85). Tumor-induced muscle loss was attenuated by ghrelin from 16% to 8% in WT (p = .004) and from 25% to 19% in KO (trend in significance, p = .06). Similarly, the decrease in fiber cross-sectional area of GAS muscles was prevented by ghrelin in WT (TV vs. TG: p = .008; HK vs. TG: p = .472) but this difference did not reach significance in KO. In addition, the mRNA levels of 'atrogenes' atrogin-1 and MuRF-1 in GAS muscle significantly increased in response to tumor implantation in both strains. With ghrelin treatment, the increase of atrogin-1 and MuRF-1 in WT was decreased by 5-fold (p = .022) and 7-fold (trend, p = .058), respectively. In KO tumor-bearing mice, the attenuation of atrogin-1 and MuRF-1 by ghrelin was 5-fold (p = .008) and 6-fold (trend, p = .07), respectively.

**CONCLUSION:** Ghrelin mitigates cancer-induced muscle atrophy at least in part through GHSR-1a-independent mechanisms.

This work was funded by the U.S. Dept of Veterans Affairs (MERIT grants BX002807 and CX000174) and NIH Grant AG040583 to JMG.

3279 Board #148 June 2 9:30 AM - 11:00 AM  
**Resistance Training-induced Decrease In Circulating C1q Is Associated With Attenuated Muscle Degradation In Senescent Mice**  
 Naoki Horii<sup>1</sup>, Masataka Uchida<sup>1</sup>, Natsuki Hasegawa<sup>1</sup>, Shumpei Fujie<sup>1</sup>, Eri Oyanagi<sup>2</sup>, Hiromi Yano<sup>2</sup>, Takeshi Hashimoto, FACSM<sup>1</sup>, Motoyuki Iemitsu<sup>1</sup>. <sup>1</sup>Ristumeikan University, Kusatsu, Japan. <sup>2</sup>Kawasaki University, Kurashiki, Japan. (Sponsor: Takeshi Hashimoto, FACSM)  
 (No relevant relationships reported)

Our recent study has showed that reduction of aging-induced elevation of serum C1q level by resistance training was involved in muscle hypertrophy in old adults. C1q activates Wnt/ $\beta$ -catenin in aged muscle, resulting in enhancement of muscle protein degradation-related genes, such as MuRF-1 and Atrogin-1. Although resistance training attenuates muscle protein degradation, it is still unclear that resistance training-induced decrease in serum C1q level is associated with attenuation of muscle protein degradation. **PURPOSE:** The purpose of this study was to investigate whether resistance training-induced change in circulating C1q level affects muscle protein degradation in senescent mice. **METHODS:** Male 13-week-old SAMP1 mice (Young) and 38-week-old SAMP1 mice (Aged) were randomly divided into three groups; young-sedentary control (Young-Con), aged-sedentary control (Aged-Con) and aged-resistance training (Aged-RT) groups (n=10 each group). Resistance training was performed 3 days a week for 12 weeks using a climbing ladder with 70% of 1 repetition maximum weight. **RESULTS:** Muscle strength and mass and cross-sectional area (CSA) of tibialis anterior muscle in the Aged-Con group significantly decreased as compared with the Young-Con group (p<0.05), whereas those in the Aged-RT group significantly increased as compared with the Aged-Con group (p<0.05). Serum C1q level and expression levels of muscle  $\beta$ -catenin, MuRF-1 and Atrogin-1 proteins significantly increased in the Aged-Con group as compared with the Young-Con group (p<0.05), whereas those expression levels in the Aged-RT group significantly decreased as compared with the Aged-Con group (p<0.05). Additionally, serum C1q level was positively correlated with protein expression levels of muscle MuRF-1 (r = 0.713, p<0.05) and Atrogin-1 (r = 0.584, p<0.05), but was negatively correlated with muscle mass (r = -0.469, p<0.05) and CSA (r = -0.595, p<0.01). **CONCLUSIONS:** These results suggest that resistance training-induced decrease in serum C1q level is associated with attenuation of muscle protein degradation thereby leading to muscle hypertrophy in senescent mice.

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## G-41 Free Communication/Poster - Movement Disorders

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
 Room: CC-Hall B

3280 Board #149 June 2 9:30 AM - 11:00 AM  
**Relationship Between Variability Of Posterior Lower Extremity Muscles And Speed In Individuals With Parkinson's Disease**

Kerry J. Bollen, Clinton J. Wutzke, Caitlin A. Bryson, John P. Collins. George Mason University, Fairfax, VA. (Sponsor: Randall E. Keyser, FACSM, FACSM)

(No relevant relationships reported)

**Background:** Individuals with Parkinson's Disease (PD) demonstrate progressive decreases in gait speed and difficulty with intralimb coordination when walking. Commonly, people with PD walk with reduced step length that may be associated with suboptimal activation of flexor muscles including the gastrocnemius and hamstrings. Individuals with PD often increase cadence to overcome reduced step length regardless of walking speed. Therefore, investigation of variability in locomotor muscles while walking overground may provide insight into walking behavior during community ambulation. **Purpose:** To determine associations between variability of lower extremity muscle activation and gait speed during the stance phase to swing phase transition in individuals with PD. **Methods:** Adults with idiopathic PD completed the 10-meter walk (10MW) overground at their preferred walking speed while on their anti-Parkinson's medication. Surface EMG was placed bilaterally on the biceps femoris (BF), medial hamstrings (MH), and medial gastrocnemius (MG). Gait events (heel contact, toe off) were identified via lower extremity kinematics using a motion capture system. Coefficients of variation during (CV) during 50-60% of the normalized gait cycle, identified as terminal stance phase (tST) and 60-70% of the gait cycle, termed initiation of swing phase (iSW) were calculated for the three muscles. **Results:** 9 adults (7M, age  $\bar{x}$ =71.0, height  $\bar{x}$ =172.2cm, weight  $\bar{x}$ =78.0kg) walked overground

( $\bar{x}$ =16 steps used in analysis), with an average gait speed of  $1.12 \pm 0.19$  m/s. Those with slower gait speeds ( $<1.1$  m/s), had a higher mean CV of MG activation during iSW ( $p=0.02$ ). There was no difference between the CV of the MH, BF during tST and iSW. However, there was an interaction between gait speed and CV of the MH and BF with variability in the MG activation during iSW ( $p<0.01$ ). Variability was primarily due to differences in duration, timing, and magnitude of activation for these muscles during each step. **Conclusion:** Uniformity of the timing and magnitude of muscle activation was related to gait speed in individuals with PD. Increased step to step variability of MG, BF, and MH activation and timing suggests a less stable gait pattern with functional consequences in people with PD.

3281 Board #150 June 2 9:30 AM - 11:00 AM  
**Different Elbow Positions Do Not Interfere In Handgrip Strength In Parkinson's Disease**

Sacha Clael, Camila Wells, Elaine Brandão, Rafaela do Vale, José Celi, Junhiti Nagazawa, Tamara Paiva, Jhonatan Rodrigues, Liana Caland, Lidia Bezerra. *University of Brasília, Brasília, Brazil.*

(No relevant relationships reported)

The studies with handgrip strength have been using the protocol of American Society of Hand Therapists (ASHT), in which the elbow is maintained flexed at 90°. However, people with Parkinson's disease (PD) show general loss of strength and the contraction of the muscles used to sustain this position may be not possible and may reduce the value of handgrip strength. **PURPOSE:** The aim of the study was to analyze if there is difference in handgrip strength in people with PD between the two elbow positions: flexed (ASHT protocol) and extended. **METHODS:** Handgrip strength was measured in both arms in 31 persons (22 men and 9 women), age  $66.06 \pm 8.48$ , diagnosed clinically with PD with the elbow at two positions: flexed (ASHT protocol) and extended. Positions comparisons were made using paired t-test and clinical effect with test d Cohen. A p-value of  $\leq 0.05$  was adopted. **RESULTS:** Handgrip strength of the right arm with the extended elbow was similar to that obtained with the flexed elbow ( $p > 0.05$ ;  $d = -0.04$ ). Handgrip strength of the left arm with the extended elbow was similar to that obtained with the flexed elbow ( $p > 0.05$ ;  $d = -0.12$ ). There are not statistical difference between elbow positions in both arms side.

Table 1 - Comparisons between elbow positions.

Side	Elbow in Extension (Mean $\pm$ SD)	Elbow in Flexion (Mean $\pm$ SD)	p	d
Right	31.48 $\pm$ 8.77	31.87 $\pm$ 9.24	0.64	-0.04
Left	28.58 $\pm$ 8.04	29.61 $\pm$ 8.63	0.07	-0.12

$p$  = significantly;  $d$  = Cohen test

**CONCLUSIONS:** There are no differences between elbow positions, people with PD can do handgrip strength with elbow in extension if will be more comfortable.

3282 Board #151 June 2 9:30 AM - 11:00 AM  
**Analysis Of Cortical Hemodynamics During Dual Task Walking In Individuals With Parkinson's Disease**

Takuto Fujii, Taeyoung Jung, Ovande Furtado, Travis Watkins, Justin Shamunee, Eumbi Lee. *California State University, Northridge, Northridge, CA.*

(No relevant relationships reported)

In addition to motor deficits, cognitive issues are common among individuals with Parkinson's disease (PD). Executive function plays an important role in performing multi-tasks, such as dual task walking (DTW). Compromised gait and cognitive functions are often observed in people with PD when they perform DTW, which can affect their activities of daily living. Limited research examined the brain activity during DTW in people with PD.

**PURPOSE:** To analyze cortical hemodynamic activities of the prefrontal cortex (PFC) during DTW in individuals with PD. **METHODS:** 11 individuals with PD (aged  $72.8 \pm 5.53$ ) and 10 controls ( $71 \pm 10.56$ ) participated in this cross-sectional study. All participants completed a series of walking trials under three test conditions including usual walking (W), walking with serial three subtraction (WS3), and walking with autobiographical memory tasks (WQA). They were asked to walk at a comfortable pace while a functional near-infrared spectroscopy (fNIRS) system captured oxyhemoglobin (HbO<sub>2</sub>) values of the PFC. All participants completed five trials for each test condition on a 30-meter walkway. Each walking trial consisted of 20-second quiet standing, 30-second walking, and 20-second quiet standing. **RESULTS:** The PD group showed overall higher HbO<sub>2</sub> values across all three test conditions than the control. Repeated measures analysis of variance (ANOVA) revealed significant differences among three conditions in both groups (all  $p$ -values  $< .05$ ). Post hoc analyses showed that the PD group significantly increased HbO<sub>2</sub> values from W to WS3 by 39.6% as well as from W to WQA by 26.7%, but no change was noted between WS3 and WQA. The control group showed significant differences in HbO<sub>2</sub> values in all pairwise comparisons among three conditions. In addition,

a significant groups x conditions interaction was found in HbO<sub>2</sub> values ( $p<.01$ ).

**CONCLUSION:** DTW elicited a greater level of brain activation with an increase of cortical hemodynamics in individuals with PD as compared to control. Furthermore, our results suggest that cortical hemodynamic responses to various level of difficulties in concurrent tasks were different between people with and without PD. These findings should be considered when providing dual task motor training is provided for people with PD.

3283 Board #152 June 2 9:30 AM - 11:00 AM

**Differences in Muscle Activity During Cycling in Healthy Aging and Parkinson's Disease: Pilot**

Rebecca J. Daniels, Christopher A. Knight. *University of Delaware, Newark, DE.*

(No relevant relationships reported)

**DIFFERENCES IN MUSCLE ACTIVITY DURING CYCLING IN HEALTHY AGING AND PARKINSON'S DISEASE: PILOT**

Rebecca J. Daniels, Christopher A. Knight  
 University of Delaware, Newark, DE

Coordination in cycling, defined by EMG burst timing, is well studied in healthy adults and trained cyclists. Little is known about these parameters in older adults (OA) and people with Parkinson's disease (PD), though cycling is a commonly prescribed exercise modality in these populations. **PURPOSE:** To investigate muscle activity patterns during cycling in OA and PD compared to healthy young adults (YA). It was hypothesized that people with PD would exhibit less discrete bursts, evidenced by prolonged burst duration, compared to OA and YA. **METHODS:** Participants were 4 OA ( $73.3 \pm 4.9$  years,  $BMI=27.2 \pm 5.7$   $kg \cdot m^{-2}$ , 3 males), 6 adults with PD ( $71 \pm 11.9$  years,  $BMI=30.7 \pm 7.3$   $kg \cdot m^{-2}$ , 6 males, Hoehn & Yahr stage 1-3), and 5 YA ( $21 \pm 1.6$  years,  $BMI=22.6 \pm 1.8$   $kg \cdot m^{-2}$ , 4 males). Electromyograms (EMG) were recorded from the vastus lateralis (VL), medial gastrocnemius (GA), biceps femoris, soleus (SO), tibialis anterior (TA), and rectus femoris (RF) of the dominant leg during recumbent bicycling. Subjects cycled at 60, 80, and 100 revolutions per minute (RPM) at the lowest resistance setting. EMG was rectified and normalized to the peak EMG during the 80 rpm condition in each muscle. A 4th order low pass Butterworth filter with a cutoff of 7 Hz was used to create linear envelopes. Timing of the EMG burst onset and offset were calculated in relation to top dead center, as well as EMG burst duration over 10 revolutions per subject in the 60 and 100 RPM conditions. A 2x3 repeated measures analysis of variance was used to compare the timing of EMG activity for each muscle between the 60 and 100 rpm conditions among the groups. Significance was set at  $p<0.05$ . **RESULTS:** There were no significant group by cadence interactions. Cadence effects were observed in burst duration of TA ( $F=9.53$ ,  $p<0.01$ ), SO ( $F=12.98$ ,  $p<0.01$ ), VL ( $F=10.97$ ,  $p<0.01$ ), RF ( $F=6.21$ ,  $p=0.02$ ), and GA ( $F=7.89$ ,  $p=0.01$ ). Compared to YA, people with PD had 86.6° longer burst durations in TA ( $F=6.34$ ,  $p<0.01$ ), 69.1° in VL ( $F=8.73$ ,  $p<0.01$ ), and 65.7° in GA ( $F=5.57$ ,  $p=0.01$ ). **CONCLUSION:** Although preliminary, these results suggest that increased burst durations in key muscles during cycling alter coordination in people with PD.

3284 Board #153 June 2 9:30 AM - 11:00 AM  
**Spatial Measures Of Straight-line Walking And Walking With A Turn In People With Parkinson's Disease**

Caitlin A. Bryson. *George Mason University, Fairfax, VA.*

(Sponsor: Randall Keyser, FACSM)

(No relevant relationships reported)

Dynamic balance is often impaired in people with Parkinson's Disease (PD). Control leading to and during a turn for people with PD further challenges dynamic balance and is a common contributor to a loss of balance. During a task with a turn, people with PD modify walking patterns in order to maintain dynamic balance. These modifications, however, may vary among people with PD. Identification of walking behaviors that contribute to impaired dynamic balance is key to improve function and development of balance-focused interventions for people with PD.

**PURPOSE:** To determine differences in spatiotemporal measures between straight-line walking and walking with a turn in people with PD.

**METHODS:** Ten adults with PD (2F/8M, age:  $69.9 \pm 8.9$ ; height:  $169.6 \pm 8.1$  cm; weight:  $75.3 \pm 8.3$  kg) walked across a 6m pressure sensitive walkway in 1) a forward direction (F) and 2) a forward walk including a 180° turn (T). The right (R) leg was identified as the OUT leg and the left (L) identified as the IN leg. Participants were categorized based on time to complete the Timed Up and Go (TUG) test. Five adults had TUG times faster than the mean, 9.27s, and five were slower. Step length (SL), width (SW), and foot angle (FA) were examined during both trials. An unpaired, Welch's t-test was used for analysis between groups.

**RESULTS:** Those with faster TUG times had larger SL (L:  $p=0.0006$ ; R:  $p=0.0004$ ) and SW (L:  $p=0.0004$ ; R:  $p=0.0008$ ) bilaterally during F trial compared to slower. During the T trial, the faster group increased SL bilaterally (L:  $p=0.0022$ ; R:  $p<0.0001$ ) and increased SW on the L ( $p=0.035$ ), but not the R. FA was less in the faster group during F trial for the R leg ( $p=0.0352$ ), but was greater for the R leg in the T trial ( $p=0.0001$ ).

**CONCLUSIONS:** Individuals with faster TUG times demonstrated increased SL, SW, and reduced R FA during straight-line walking. Individuals with decreased SW may have compensated for impaired stability by decreasing SL. When walking included a turn, individuals with faster TUG times increased SW in the IN leg and increased the FA of the OUT leg compared to those with a slower TUG time, suggesting that people with PD who have functional impairments may utilize different strategies than those with without. Increased understanding of spatiotemporal aspects including during a turn is critical to optimize treatment.

3285 Board #154 June 2 9:30 AM - 11:00 AM  
**Breathing And Vision Effects On Balance, Attention, And Respiratory Complexity During Standing In Parkinson's Patients**

Luis Hernandez, John Manning, Christina Odeh, Shuqi Zhang.  
 Northern Illinois University, Dekalb, IL.  
 (No relevant relationships reported)

**INTRODUCTION:** Regulation of balance requires attentional involvement inversely proportional to efficacy of postural control system. Sample entropy (SE) of center of pressure (CoP), a non-linear measure, reflects complexity of postural control system indicating attentional involvement. Parkinson patients (OAP) may requisite more attention during balance than healthy controls (OAH). Due to internal perturbances during standing, respiration may affect balance in individuals with deteriorated postural control systems.

**PURPOSE:** To investigate 1) effects of breathing and visual conditions on attention and balance 2) group effect on respiratory complexity, attention, & balance between OAP & OAH.

**METHODS:** 12 subjects, OAH (n=6) & OAP (n=6), were recruited and instructed to stand on force plate, feet oriented 15° apart and look at 5cm-diameter spot eye level on wall 1.5m away. Subjects were asked to maintain balance for 2 minutes under eyes open and eyes closed conditions and thoracic (Th), abdominal (Ab), & neutral breathing conditions. Meanwhile, Th and Ab motion was record through Biocapture system, all equipment synched. SE was calculated in Matlab for CoP in anteroposterior (X) (SampEn<sub>CoP,x</sub>) and mediolateral (Y) (SampEn<sub>CoP,y</sub>) directions and Th (SampEn<sub>Th</sub>) and Ab (SampEn<sub>Ab</sub>) motion. CoP-related measures were calculated in Bioanalysis software for average velocity ( $\bar{v}$ ) (cm/s), 95% sway area (SA) (cm<sup>2</sup>), and average displacement in X (D<sub>x</sub>) and Y (D<sub>y</sub>) directions (cm).

**RESULTS:** Group, breathing, & visual effects were examined on non-linear and CoP-related measures via Factorial MANOVA with later application of ANOVAs as needed. Significant group and visual effects were seen in CoP-related measures, Wilks' Lambda = .363 (p<.000) and .781 (p<.034), respectively. OAP showed greater D<sub>x</sub> (5363 ± 2411 vs. 2963 ± 1424), SA (10.7677±10.6678 vs. 4.8564±3.6306), and  $\bar{v}$  (3.1264±1.1616 vs. 2.4184 ± .9371) than OAH, while EC showed greater  $\bar{v}$  than EO (3.1904±1.2207 vs. 2.3343 ± .7770).

**CONCLUSION:** OAPs showed similar attentional involvement and respiratory complexity with OAH during standing balance, though OAP displayed worse balance performance than OAH. Breathing condition did not significantly affect attentional involvement or balance performance. Visual condition significantly affected balance performance.

3286 Board #155 June 2 9:30 AM - 11:00 AM  
**The Effects of Cadence on Torque Asymmetry**

Ashley N. Fox, John W. Farrell, III, Rebecca D. Larson.  
 University of Oklahoma, Norman, OK. (Sponsor: Christopher Black, Ph.D., FACSM)  
 (No relevant relationships reported)

Bilateral asymmetry in peak crank torque has been observed in both cyclist and non-cyclist. However, the relationship between exercise intensity, cadence rates, and bilateral asymmetry is not fully understood. Additionally, a need for establishment of normative values for bilateral asymmetry still exists. **PURPOSE:** Therefore, the purpose of the current study was to examine bilateral asymmetry in peak crank torque during 3 graded exercise tests (GXT) at 3 different cadence zones. **METHODS:** 20 subjects, 10 females and 10 males, participated in this study. Subjects were classified to either a cycling trained group (CT, n=8) or non-cycling trained group (NCT, n=12). Over the course of 3 visits subjects, both groups performed 3 GXTs at 3 different cadence zones. Cadence zones consisted of Self-Selected (SS), High (100 to 115 rpm), and Low (55 to 70 rpm). The first GXT was performed at the SS cadence with the remaining two being performed either at High or Low cadence, which was randomly assigned. Peak crank torque was measured using a dual power meter on cycle ergometer, and calculated as the absolute difference between the lower limbs. Peak crank torque was assessed at the initial stage (IS), the stage in which the onset of blood lactate accumulation (OBLA) occurred, and the stage in which peak power output (PPO) was achieved for the 3 different GXTs. Two way repeated measures ANOVA was used to determine if significant differences between groups and conditions existed. **RESULTS:** Significant group by condition interactions were present. No significant condition differences were present between all cadences zones (IS, OBLA, or PPO)

(P>0.05). No significant group differences were present at IS or OBLA. However, significant group differences were present at PPO (CT 7.69±5.61 vs. NCT 4.42±4.47). **CONCLUSION:** The findings of the current study suggest that torque is unaffected by cadence selection at IS, OBLA, and PPO. The current study also showed that significant differences did not exist between the CE and NCE in torque asymmetry until PPO. This finding suggests that at PPO cyclist may be altering their kinematics in order to maintain desired cadences or power outputs more so than non-cyclists. Therefore, further research is needed to understand the potential effect on cycling performance.

3287 Board #156 June 2 9:30 AM - 11:00 AM  
**Fast Six-minute Walking Induced Abductor Hallucis Muscle Recruitment In Individuals With Flatfoot**

Chieh-Ning Huang, Chu-Yuan Chiang, Kuang-Wei Lin, Wen-Wen Yang, Yun-Chi Chang, Li-Ling Pan, Li-Wei Chou.  
 NATIONAL YANG-MING UNIVERSITY, Taipei, Taiwan.  
 (No relevant relationships reported)

**Purpose:** This study examined lower extremity muscle activities before and after six-minute treadmill walking at highest speeds in individuals with flatfoot. **Methods:** Eight individuals with flatfoot (4 women, 4 men, age = 24.8±2.4 years) with no other history of lower extremity injury in six months and no neurological disease, participated in this study. Subjects were first screened using subtalar static navicular drop tests. Surface electromyography (BIOPAC system, USA) of the abductor hallucis muscle (AbdH), tibia anterior, gastrocnemius, and peroneus longus muscles were recorded during maximum voluntary isometric contractions (MVIC). Next, three-dimensional motion capture system (Vicon motion system, UK) was used to assess dynamic navicular mobility during walking. Subjects were then asked to walk on the treadmill at their maximal pace for 6 minutes. After walking, the MVIC and dynamic navicular mobility were assessed again. Median frequency (MedF) of EMG during MVIC was calculated for both before and after 6-minute walking. **Results:** Our preliminary results show substantial increase in the MedF of the AbdH (10.2Hz ± 29.9Hz), suggesting an increase in motor unit recruitment in AbdH with 6-minute fast treadmill walking. MedF of tibia anterior was significantly decreased 16.7 ± 11.5Hz after fast treadmill walking, but no significant change was observed in peroneus longus and gastrocnemius. Subjects exhibited similar navicular drop before (17.3 ± 5.4 mm) and after (16.0 ± 5.2 mm) fast treadmill walking. **Conclusion:** Six-minute fast treadmill walking induced greater muscle recruitment of the AbdH in individuals with flatfoot. We infer that the AbdH of flat foot doesn't function as a dynamic stabilizer during walking. However, how increased work loads in other lower extremity muscles results in greater activity of AbdH remains to be investigated. The observation that muscle activity of AbdH increased when the other extrinsic muscle fatigue indicates that 6 minutes walking can serve as functional training of the intrinsic muscles to support the medial longitudinal arch.

3288 Board #157 June 2 9:30 AM - 11:00 AM  
**Heel Strike Provokes 'Position of No Return' during Side-Cutting Maneuver.**

Issei Ogasawara, Ph.D.<sup>1</sup>, Yohei Shimokochi, Ph.D.<sup>2</sup>, Ken Nakata, Ph.D., M.D.<sup>1</sup>. <sup>1</sup>Osaka University, Osaka, Japan. <sup>2</sup>Osaka University of Health and Sport Sciences, Osaka, Japan.  
 (No relevant relationships reported)

Knee valgus (VL) and internal rotation (IR) combined with hip adduction (AD) and IR, so called "position of no return (Ireland 1999)", is a risky position for non-contact ACL injury. To date, what motion factor induces this multi-articular excursion is not well studied.

**PURPOSE:** To examine whether a foot strike pattern (forefoot or heel first) differentiates the multi-articular loading pattern and results in the risky hip and knee kinematics during side-cutting.

**METHODS:** Twenty-five collegiate athletes performed side-cutting on the force plate (FP) in heel impact (HC) and forefoot impact (FC) conditions. In HC, subjects were asked to strike heel first when they touch the FP, in FC, the subjects used their forefoot to touch the FP throughout the stance phase. Kinematic and ground reaction force data were measured with the optical motion capture system and FP from 10 trials for each condition. The hip and knee 3D moments were calculated. The occurrence rate of simultaneous knee VL+IR combined with hip AD+IR moments in each time increment of 100 % stance phase was compared between conditions (Chi-square test, p < 0.01). The peak knee and hip joint angular velocities (JAVs) were also compared between conditions using paired sample t-test with p < 0.01.

**RESULTS:** HC showed significantly higher occurring rate of the hip AD+IR combined with knee VL+IR moments than that of FC in first 50 % of stance phase (HC vs FC, maximally 22 % vs 13 %, p < 0.01, Fig.1). Peak knee VL, hip AD and hip, IR JAVs in HC were significantly higher than those in FC (HC vs FC, 178.3 ± 84.2 vs. 136.6 ± 70.2, 170.5 ± 65.1 vs. 127.6 ± 73.0, 165.4 ± 84.1 vs. 103.7 ± 50.1, [unit : deg/s], p < 0.01).

**CONCLUSION:** The heel strike was found to induce the knee VL+IR combined with hip AD+IR moments, which forced the joints to move toward the 'position of no return', implying that the heel strike may increase the risk of ACL injury. Decelerating with forefoot is therefore recommended for a safety multi-articular biomechanics.

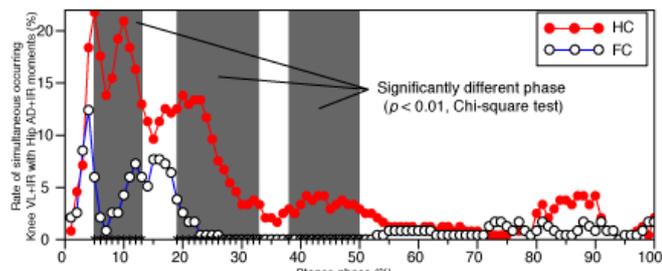


Fig 1. Time course difference of the rate of simultaneous occurring of the Knee VL+IR combined with hip AD+IR during side-cutting motion. Gray-shaded zones showed the significant rate differences between foot conditions.

3289 Board #158 June 2 9:30 AM - 11:00 AM  
**Motor Unit Discharge Characteristics And Walking Performance Of Individuals With Multiple Sclerosis.**

Leah A. Davis<sup>1</sup>, Awad M. Almklass<sup>2</sup>, Hamilton Landon<sup>1</sup>, Taian Vieira<sup>3</sup>, Alberto Botter<sup>3</sup>, Roger M. Enoka<sup>1</sup>. <sup>1</sup>University of Colorado Boulder, Boulder, CO. <sup>2</sup>King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia. <sup>3</sup>Politecnico di Torino, Torino, Italy.  
 (No relevant relationships reported)

**PURPOSE:** To examine the associations between strength, force steadiness, and motor unit discharge characteristics of lower leg muscle with assessments of walking performance and disability status in individuals with multiple sclerosis (MS).

**METHODS:** Persons with MS (n=23, 9 men, 53 ± 7 yrs) attended 1 to 3 evaluation sessions that were performed before, immediately after, and 4 wks after a clinical trial of neuromuscular electrical stimulation. Outcomes included 3 questionnaires (Patient Determined Disease Steps [PDDS], Modified Fatigue Impact Scale [MFIS], and MS Walking Scale-12 [MSWS-12]), 25-ft walk test, 6-min walk test, and maximal torque and force steadiness (10 and 20% MVC) for lower leg muscles. High-density surface EMG recordings were obtained from the tibialis anterior (TA), soleus (Sol), and medial gastrocnemius (MG) during the steady contractions and decomposed into discharge times of motor unit action potentials.

**RESULTS:** Greater levels of self-reported disability (PDDS, MFIS, MSWS-12) were associated with less distance walked in 6 min and longer times to walk 25 ft. Mean interspike intervals (ISI) were 110 ± 23 ms and 102 ± 22 ms (10% and 20% MVC force, respectively) for TA motor units (n = 1,634), 138 ± 36 ms and 135 ± 34 ms for MG motor units (n=696), and 150 ± 33 ms and 145 ± 34 ms for Sol motor units (n = 902). A multiple regression model explained 40% (P=0.001) of the variance in 6-min distance with two predictor variables: mean ISI of MG (partial r = -0.48) and MVC dorsiflexor torque of the more affected leg (partial r=0.37). Similarly, another multiple regression model explained 47% of the variance (P<0.001) in 25-ft time with three predictor variables: mean ISI of soleus (partial r=0.51), MVC dorsiflexor torque of the more affected leg (partial r = -0.43), and force steadiness of the plantar flexors (partial r = 0.39).

**CONCLUSION:** Moderate amounts of the variance in two walking tests for persons with MS were explained by mean discharge times of action potentials by motor units in plantar flexor muscles during steady submaximal contractions, the strength of the dorsiflexor muscles in the more affected leg, and force steadiness during an isometric contraction.

This research was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the NIH (R03HD079508).

3290 Board #159 June 2 9:30 AM - 11:00 AM  
**Overground Locomotor Training in Incomplete Spinal Cord Injury: Effects on Balance and Gait**

Brian T. Neville, Clinton J. Wutzke, Donal Murray, Caitlin A. Bryson, Kerry J. Bollen, John P. Collins, Andrew A. Guccione. George Mason University, Fairfax, VA. (Sponsor: Randall Keyser, FACSM)  
 (No relevant relationships reported)

**Introduction:** Restoration of ambulatory function in individuals with motor-incomplete spinal cord injury is the primary aim of rehabilitation. However, optimal training methods to improve balance and gait in this population have not been established. **Purpose:** To determine changes in balance and gait following a task-specific, performance-based training protocol for overground locomotor training (OLT) in individuals with motor-incomplete spinal cord injury (iSCI). **Methods:** Convenience sample, pilot study. Nine males and three females (38.5±16.4 years old,

AIS C or D, >6 months post-SCI) participated in two 90-minute OLT sessions per week for 12 to 15 weeks. OLT sessions are built on three principles of motor learning: practice variability, task-specificity, and progressive overload (movement complexity, resistance, velocity, volume). Training uses only voluntary movements without body weight support, robotics, or other assistive devices. Subjects used ambulation aids as necessary. Outcome measures collected at baseline and post-intervention. Measures of interest include Berg Balance Scale (BBS) and Functional Ambulation Inventory (SCI-FAI) for all participants. Spatiotemporal measures were collected from six participants that walked on a pressure-sensitive walkway. **Results:** 11 participants completed OLT and one participant completed 15 of 24 sessions due to scheduled surgery. The BBS scores showed a mean score improvement of 4.33±4.64 (p<0.01). SCI-FAI scores showed a mean score increase of 2.17±3.76 (p=0.07), with six of the participants scoring at least 18 out of 20 possible points post-training. One individual progressed from using a rolling walker pre-training to no assistive device post-training. SCI-FAI score for this individual did not change [19/20] but preferred gait speed increased 168% [0.30 to 0.81 m/s], step length increased 104% [0.33m to 0.68m], and mean center of pressure to center of mass (CoP-CoM) distance in the sagittal plane increased 132% [2.55cm to 5.91cm] after training. **Conclusion:** This pilot demonstrates improvements in balance and some gait characteristics using a novel task-specific, performance-based OLT for chronic motor incomplete SCI.

3291 Board #160 June 2 9:30 AM - 11:00 AM  
**Decline in Gait Speed Across Clinical Populations Indicates Increased Risk of Falling**

Cortney Armitano, Steven Morrison. Old Dominion University, Norfolk, VA.  
 (No relevant relationships reported)

The process of aging is typically associated with a general decline in sensorimotor and neuromuscular function that become apparent during different movements including gait. Spatiotemporal measures at preferred walking speed have been used to quantify functional capacity of a person's walking ability and, clinically, to assess the impact neurological disorders have on gait. For example, persons with multiple sclerosis (MS) and Type 2 diabetes (T2DM) often present with gait and balance problems which can lead to increased risk of falling. **PURPOSE:** This study was designed to assess differences in gait and falls risk for healthy individuals compared to persons diagnosed with MS or T2DM. **METHODS:** Twenty three healthy adults (controls), 23 persons diagnosed with MS, and 23 individuals with T2DM participated in this study. Falls risk was assessed using the Physiological Profile Assessment (PPA). For gait, participants performed 3 trials at their preferred gait speed while walking across a pressure sensitive mat. Measures of velocity, step length, stride length, and step time were used to assess gait. A within-subject, repeated-measures generalized linear model was used to analyze the data. **RESULTS:** The results revealed significant differences in falls risk between the three groups with the MS persons exhibiting the greatest risk score (MS 2.51±1.4, T2DM 0.84±0.7, control 0.22±0.6). There was significant group difference in walking velocity with the MS persons walking at a significantly slower velocity (mean 89.6m/s) compared to the controls (mean 117.2m/s) and the T2DM group (mean 111.8 m/s; F<sub>2,64</sub>=14.12, p<0.001). The differences in walking speed were also reflected by significant differences in step length (F<sub>2,64</sub>=12.50, p<0.001) and stride length (F<sub>2,64</sub>=11.39, p<0.001) between the three groups. The changes in step/stride length were not reflected by similar changes in step/stride time. **CONCLUSION:** Overall, significant differences in walking speed and spatiotemporal parameters were found between healthy adults and individuals with MS and T2DM. The decline in gait speed appears to be associated with an increased risk of falling. The basis for the reduction in gait speed would appear to be driven by reductions in the length of the step/stride taken rather than alteration of the duration of the step/stride events.

G-42 Free Communication/Poster - Walking Biomechanics

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
 Room: CC-Hall B

3292 Board #161 June 2 9:30 AM - 11:00 AM  
**Influence Of Different Sole Thickness On Biomechanical Parameters Of Human lower Extremity**

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 (No relevant relationships reported)

**Background:** Different athletic shoe outsole thickness can influence human movement from the aspects of both performance enhancement and injury prevention.

**Purpose:** To investigate the influence of different outsole thickness on lower extremity muscle activity, kinematics, and kinetics during walking and running.

**Method:** Twelve male college students (age: 20.9±0.7, height: 172.0±2.1cm, body mass: 63.0±3.4 kg) were tested. Four sole thickness (original commercial shoe, 1, 2, and 3 cm increased outsole thickness) were tested. Elastic modulus was tested using a universal testing machine (Instron-5544, US). The running tests were performed on a treadmill with a fixed speed (3.33 m/s) and continued for 8min. Walking tests were performed on a force platform (AMTI, US, 400×600mm). A motion capture system (VICON, Oxford, UK) was used to obtain kinematic data. Wireless surface electromyography testing system (Noraxon, US) was used to obtain the surface electromyography (sEMG) data. One-way analysis of variance with repeat measures (ANOVA) was used to compare differences in muscle activity, kinematic, and kinetic outcome variables. Statistical significance was set at  $\alpha = 0.05$ .

**Results:**

The 1 cm sole thickness has the highest elastic modulus (0.80MPa) and the 3cm is the lowest (0.25MPa). The co-contraction index value of 1cm group was significantly less than the others in both initial (0.55±0.14, P<0.05) and final (0.53±0.13, P<0.05) stage of running. At the toe off, the knee angle of 2 cm (131.0±9.5 deg, P<0.05) and 3 cm (132.7±4.6 deg, P<0.05) group increased significantly comparing to 0cm (125.0±5.4 deg) group in walking test.

**Conclusion:**

The outsole thickness of 1cm reduced muscle co-contraction during running. Knee joint increased with the increasing of sole thickness at the time of toe off when walking.

(bioelectrical impedance analysis), and stride length (SL) were measured. Surface EMG activity of the right quadriceps and hamstring muscle group, heart rate, and oxygen consumption (VO<sub>2</sub>) were measured during walking at self-selected (SS) speed at the following stride lengths: (1) SS, (2) 10% below SS, (3) 20% below SS, (4) 10% above SS, (5) 20% above SS, and (6) 30% above SS. Repeated measures ANOVA were used to determine serial patterns and paired t-tests for differences between different SL. **RESULTS:** VO<sub>2</sub> was significantly lower at SS SL than 20% below SS SL and VO<sub>2</sub> of 20% below SS SL was lower than 10% below and 10% above SS SL. VO<sub>2</sub> of 10% and 20% above SS SL was lower than 30% above SS SL (P < 0.05). Heart rate was significantly lower at SS SL than 20% below and 10% and 30% above SS SL. Heart rate of 10% and 20% above SS SL was lower than 30% above SS SL (p<0.05). EMG activity in the quadriceps muscle was significantly lower at SS SL than 20% below SS SL and EMG activity of 20% below SS SL was significantly lower than 10% below SS SL. EMG activity of 10% above SS SL was lower than 20% above SS SL (P<0.05). There were no differences in the EMG activity of the hamstring muscle group.

**CONCLUSION:** Preliminary results from this ongoing study demonstrate that energy costs increase at values above and below self-selected stride length at a SS speed, resulting in a U-shape curve in oxygen consumption and muscle activity in quadriceps muscle. SS SL appears to be optimal in terms of walking energy efficiency compared to shorter and longer SL. These results suggest that the SS locomotive pace in humans is that at which the most efficient energy cost can be maintained. Further studies are necessary to investigate the effect of stride length alteration training on the energy cost and efficiency of walking.

3293 Board #162 June 2 9:30 AM - 11:00 AM

**How Pain Management for Osteoarthritic Knee Influences Gait: A Case Study**

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*(No relevant relationships reported)*

Osteoarthritis (OA) is the most common joint disorder in the US. Pain management has been a commonly investigated treatment for knee OA, little is known about the effects pharmacologic interventions have on gait. **PURPOSE:** To investigate the effects of pharmacological interventions on gait. **METHODS:** A 47-year-old male (1.7 m, 75 kg) with a diagnosed left knee medial compartment OA with severe bone on bone joint space narrowing with marginal osteophytes and subchondral sclerosis participated in this study. Three medication regimens (no medication (NM), over the counter NSAID (NSAID), and a prescription pain medication (PPM)) were used for this study. Trials were randomized and data was collected at the end of a week with a 7 day wash out period before the next trial. Testing consisted of a 5-minute walk at a self-selected pace on an instrumented treadmill. Data was collected using Vicon Nexus and sagittal plane kinematics and kinetics were analyzed using Visual 3d. **RESULTS:** At the ankle the PPM led to a peak plantarflexion moment that was two times greater at push-off (0.66 Nm/kg) compared to the NM condition (0.31 Nm/kg) in the affected limb. At the knee, the NM condition had more flexion at both foot contact and flexion during loading compared to both the PPM and NSAID in the affected limb. The loading knee extension moment of the affected limb was elevated in the NM condition (2.3 Nm/kg) compared to the PPM condition (1.5 Nm/kg). When comparing the affected limb to the unaffected limb, the loading knee extension moment was more symmetrical between the two sides in the PPM condition compared to both the NM and the NSAID condition. The affected knee experienced greater loading in the sagittal plane in both of these conditions. **CONCLUSION:** The results of this case study suggest that medications alter lower extremity biomechanics of both the affected and unaffected limb during gait. In the sagittal plane it appears that at the knee the use of prescription medication leads to more symmetrical gait in loading and reductions in knee loading moments. At the ankle the prescription pain medication appears to allow for the push-off moment to be increased and more similar to healthy gait. When considering the sagittal plane at the ankle and knee the prescription pain medication appears to restore normal and healthy gait patterns in a subject with knee OA.

3294 Board #163 June 2 9:30 AM - 11:00 AM

**The Effect of Change on Stride Length on Muscular Activity and Energy Cost during Walking**

Hae Ryong Chung<sup>1</sup>, Travet Witherspoon Jr<sup>1</sup>, Moroni de Moors<sup>1</sup>, Jin hee Jeong<sup>2</sup>, Chris Pitsikoulis<sup>3</sup>. <sup>1</sup>Clayton State University, Morrow, GA. <sup>2</sup>Augusta University, Augusta, GA. <sup>3</sup>Aurora University, Aurora, IL.

*(No relevant relationships reported)*

Human bipedalism is the most unique locomotive form in the terrestrial environment and can be performed for a prolonged period of time. To maintain this form of locomotion humans have adopted physiological and mechanical strategies to minimize and conserve energy. **PURPOSE:** To study the effects of stride length change on the electromyographic (EMG) activity of the quadriceps and hamstring muscle groups and oxygen consumption. **METHODS:** Male (n=6) subjects (age = 23.25 ± 0.95 years) were recruited for this study. Height, weight, body composition

3295 Board #164 June 2 9:30 AM - 11:00 AM

**Does Music-Based Rhythmic Auditory Cueing Alter the Correlation Structure of Stride Times?**

Scott W. Ducharme, Dylan C. Perry, Colleen J. Sands, Elroy J. Aguiar, Christopher C. Moore, Catrine Tudor-Locke, FACSM. *University of Massachusetts, Amherst, Amherst, MA.* (Sponsor: Catrine Tudor-Locke, FACSM)

*(No relevant relationships reported)*

The time interval from heel strike to subsequent heel strike (i.e., stride time) has been shown to be statistically persistent, i.e., long or short stride times are likely to be followed by subsequent stride times of similar magnitude. This persistence is thought to represent complex, adaptive locomotor behavior. Rhythmic auditory cueing (RAC) entails instructing participants to synchronize their foot strike timing to an auditory metronome. While RAC reduces stride time variability, it also eliminates stride time persistence, which may indicate reduced adaptability. Alternatively, matching foot strike timing to a musical tempo instead of a metronome may yield less precise temporal synchronization, thereby preserving the correlation structure of the time series. **PURPOSE:** To determine if music-based RAC reduces the persistence of stride time variability. **METHODS:** Nine young, healthy adults (mean±SD age 22.9±2.0 years, height 171.0±11.7 cm, mass 75.4±14.9 kg) walked along an oval course (40 m) for six 5-minute trials. Three of the trials consisted of walking at self-selected slow, normal, and fast walking speeds. The remaining three trials entailed participants walking while matching their foot strike timing to the tempo of a song. Using a commercially available app, the tempo of a single song was altered to 80, 100, and 125 beats per minute. Participants performed separate, randomly ordered trials while matching each song tempo. Stride times were obtained via an ActiGraph accelerometer at the right heel. Detrended fluctuation analysis was used to quantify the extent of statistical persistence of stride times. A repeated-measures ANOVA was used to test for effects of RAC on stride time persistence. **RESULTS:** There was a main effect of RAC on stride time persistence ( $F_{1,8} = 5.26, p = 0.05$ ), as persistence decreased when participants entrained to music, compared to self-selected walking. However, this effect was not consistent across all participants, as 3 of the 9 individuals exhibited greater persistence during RAC trials. **CONCLUSION:** Similar to reports of metronome entrainment, synchronizing step timing to music resulted in an overall modified correlation structure closer to random, which is associated with less adaptive behavior. Future studies may consider testing RAC to more complex songs with various beats.

3296 Board #165 June 2 9:30 AM - 11:00 AM

**Does Arm Swing Frequency Match Alterations in Stride Frequency during Treadmill Walking?**

Sarah M. Garcia, Jacqueline T. Brine-Doyle, Marcella J. Myers. *St Catherine University, St. Paul, MN.* (Sponsor: Mark Blegen, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** To determine whether arm swing frequency matches alterations in stride frequency above and below preferred stride frequency while walking on a treadmill at a range of speeds. **METHODS:** At each of 4 self-selected speeds, 10 female participants (mean age: 27.6 yr, range: 20-47 yr) walked on a treadmill while attempting to match their stride frequency to the beat of an audio metronome beating at one of three different

frequencies: 90%, 100%, and 110% of the preferred stride frequency at that speed. Speeds used were: Low (slowest kinematically smooth speed), Mid1 (0.2 mph below "most comfortable" speed), Mid2 (0.2 mph above "most comfortable" speed), and High (fastest normal walking speed). On three separate days, participants completed, in a randomized order, 12 5-minute trials at each combination of the 4 walking speeds and 3 stride frequency levels. From video of the third test session, actual stride frequency and arm swing frequency was determined for 10 consecutive strides/swings in both the third and fourth minutes of the trial.

**RESULTS:** Seven of the ten participants were able to maintain actual stride frequencies very close to the nominal frequency of the metronome; actual SF values were different from nominal SF values by an average of only 1.6% (range 0.7% to 7.4%) in this group, while the other three participants were unable to match the nominal SF successfully (range 15% to 21% different from nominal). For the seven participants who could achieve the nominal SF, the correlation between arm swing frequency and stride frequency was almost exact ( $r=0.99$ ). Interestingly, the three participants who could not achieve the nominal SF also had arm swing frequencies that correlated very strongly with their stride frequency ( $r=0.99$ ).

**CONCLUSIONS:** The very tight coupling of the frequency of alternation of the arms and legs in our participants, even when using stride frequencies above or below the preferred frequency for a given speed, indirectly supports a common central pattern generator source for the pacing of these movements.

This research project was funded by a 3M Faculty/Student Collaborative Grant through the St. Catherine University, St. Paul, Minnesota.

3297 Board #166 June 2 9:30 AM - 11:00 AM  
**Local Dynamic Stability is Affected By Soldier-Relevant Torso Loads and Gait Speeds**

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 (No relevant relationships reported)

For soldiers, falling while carrying heavy loads can lead to serious injury. Nonlinear analyses, such as local dynamic stability (LDS), can quantify gait stability. LDS can be affected by both load and speed. Studies on soldier-relevant torso loads at multiple speeds are lacking.

**PURPOSE:** To determine if soldier-relevant loads at 3 speeds affect LDS of the trunk and pelvis during gait.

**METHODS:** 10 healthy adults (5M, 5F) walked on a treadmill at 3 speeds (1.15, 1.35, 1.55 m/s) under 3 loaded vest conditions (1.3, 15, 27 kg). Trunk and pelvis marker data were collected for 2 min. Short term local divergence exponents (LDE) of marker velocity data in the mediolateral, anteroposterior and vertical directions (ML, AP, V) were calculated to quantify LDS by measuring the rate at which each stride changes from the prior stride. Larger LDE values indicate decreased LDS. Linear regressions analyses tested the effects of load (L1, L2, L3) and speed (S1, S2, S3).

**RESULTS:** LDS decreased with increased load in all directions at the trunk (LDE Mean±SD; ML:  $0.44±0.02$ ,  $0.45±0.02$  for L2 and L3 respectively,  $p = 0.001$ ; AP:  $0.39±0.02$ ,  $0.41±0.01$ ,  $0.43±0.01$  for L1, L2 and L3,  $p ≤ 0.009$ ; V:  $0.68±0.04$ ,  $0.72±0.04$ ,  $0.77±0.04$  for L1, L2 and L3,  $p ≤ 0.021$ ) and in the vertical direction at the pelvis ( $0.55±0.04$ ,  $0.58±0.40$ ,  $0.62±0.39$  for L1, L2 and L3,  $p ≤ 0.019$ ). Conversely, ML and AP LDS increased with increasing speed at the trunk (ML:  $0.48±0.02$ ,  $0.44±0.02$ ,  $0.41±0.02$  for S1, S2 and S3,  $p < 0.001$ ; AP:  $0.43±0.01$ ,  $0.41±0.01$ ,  $0.39±0.02$ ,  $p < 0.001$  for S1 vs S2 and S1 vs S3) and pelvis (ML:  $0.32±0.02$ ,  $0.30±0.01$ ,  $p = 0.004$  for S1 vs S2; AP:  $0.42±0.02$ ,  $0.37±0.03$ ,  $0.36±0.02$ ,  $p ≤ 0.001$  for S1 vs S2 and S1 vs S3). However, vertical LDS decreased with increasing speed at the trunk ( $0.71±0.04$ ,  $0.71±0.05$ ,  $0.75±0.04$ ,  $p ≤ 0.012$  for S1 vs S3 and S2 vs S3) and pelvis ( $0.57±0.04$ ,  $0.57±0.05$ ,  $0.61±0.02$ ,  $p ≤ 0.006$  for S1 vs S3 and S2 vs S3).

**CONCLUSIONS:** Preliminary results suggest that increasing speed with a heavier load increases stability. However, the decrease in vertical LDS with increased speed indicates that more energy may be required to control the vertical motion of the trunk and pelvis, and may lead to earlier fatigue. Inclusion of more participants may reveal interaction effects of load and speed not yet detected.

Funding: BU's Dudley Allen Sargent Research Fund and the DoD SMART Scholarship.

3298 Board #167 June 2 9:30 AM - 11:00 AM  
**Long Term Functional Metrics Following Direct Anterior Total Hip Arthroplasty**

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 (No relevant relationships reported)

Total hip arthroplasty (THA) is an effective treatment for patients suffering from end-stage primary hip osteoarthritis. The most common reported outcomes of THA relate to restoration of mobility and decrease of pain. Gait velocity and the Timed Up and Go (TUG) provide functional metrics to quantify improvements during rehabilitation.

**PURPOSE:** The purpose of this study was to examine differences in gait velocity and TUG measures in direct anterior approach THA patients during recovery compared to healthy controls.

**METHODS:** Eight unilateral THA patients and 11 healthy controls were recruited for participation. Data collection occurred pre-operatively and at 6 time-points up to 2 years post-operatively. Participants performed 6 walking trials over a 4-m walkway to determine self-selected velocity and 3 TUG trials. A 2x7 repeated measures ANOVA assessed differences in mean gait velocity and TUG ( $α < 0.05$ ).

**RESULTS:** A significant interaction was found for both velocity ( $p = 0.002$ ) and TUG ( $p < 0.01$ ). Post-hoc analysis identified a significant time effect in the THA group for velocity ( $p < 0.01$ ) and TUG ( $p = 0.01$ ). Post-hoc independent t-tests identified that THA velocity was less than controls at three-weeks post-operatively; there was a significant effect of time in the THA group (Figure 1a). There were no significant group differences in TUG at any time point, but there was an effect of time in THA group TUG measures (Figure 1b).

**CONCLUSIONS:** Improvements in gait velocity and TUG measures within in THA group supports THA as a successful treatment. However, changes in velocity over time may suggest functional degradation at the 2 year time-point. While there are no differences between 1 and 2 year velocities, we observed THA participants exhibiting a faster velocity at 1 year than six-weeks post-operatively. Yet at 2 years, velocity was no longer faster. This suggests that long-term maintenance of functional measures should remain a clinical consideration for THA patients.

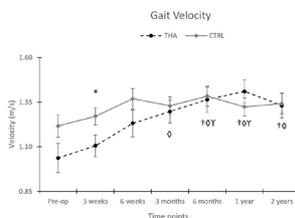


Figure 1a. Average self-selected gait velocities for total hip arthroplasty patients (THA) and healthy control (CTRL) groups across data collection time-points. \*  $p < 0.05$  for difference between groups. For THA group only, †  $p < 0.05$  for difference compared to pre-surgery, ‡  $p < 0.05$  for difference compared to 3 weeks post-surgery, §  $p < 0.05$  for difference compared to 6 weeks post-surgery.

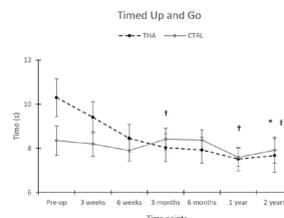


Figure 1b. Average Timed Up and Go completion times for total hip arthroplasty patients (THA) and healthy control (CTRL) groups across data collection time-points. †  $p < 0.05$  for difference compared to pre-surgery, ‡  $p < 0.05$  for difference compared to 3 weeks post-surgery, §  $p < 0.05$  for difference compared to 6 weeks post-surgery.

3299 Board #168 June 2 9:30 AM - 11:00 AM  
**Concurrent Validity Of A Gait Analysis Application Vs. Slow-motion Video For The Assessment Of A 400 M Walk Test**

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 University of Mount Union, Alliance, OH.  
 (No relevant relationships reported)

Our lab developed a cell phone application to assess gait parameters during a 400 m Walk Test. It has the potential to improve the feasibility and effectiveness of allied healthcare professionals. **PURPOSE:** To test the concurrent validity of a cell phone gait assessment application by comparing results to those found through slow motion video analysis of participants completing a 400 m walk test. The hypothesis is that there will be agreement between the application and video for gait speed, cadence, and turn duration. **METHODS:** Seven female and six male apparently healthy adults (Age =  $40.7 ± 7.5$  years) participated in this study. Participants completed a single trial of a 400 m walk test at a self-selected pace on a 25-meter, linear course. Ends of the course were marked with a cone, and dashed lines were positioned 2.5 meters inward from each cone. Two investigators were present at each test session. One video recorded the participant with a cell phone camera at 30 fps, which was later analyzed for steady-state gait speed, cadence, and turn duration. A second investigator used the gait application to assess the same parameters in real time. Paired t-tests were used to test for significant differences between the two assessment methods. Significance was

established *a priori* at  $\alpha = 0.05$ . **RESULTS:** There were no significant differences between the gait application and video for gait speed ( $1.694 \pm 0.352$  vs.  $1.693 \pm 0.347$  m/s, respectively) or turn duration ( $4.165 \pm 0.761$  vs.  $4.171 \pm 0.762$  s, respectively). There was, however, a small but significant difference between the gait application and video for cadence ( $129.9 \pm 14.0$  vs.  $129.1 \pm 13.6$  steps/min, respectively). **CONCLUSION:** For middle aged adults across a broad spectrum of gait speeds, the gait application is a valid method to evaluate steady-state gait speed and turn duration of a 400 m walk test. Although there was a significant difference between the gait application and video for cadence, the one step per minute difference is not likely to be clinically meaningful.

3300 Board #169 June 2 9:30 AM - 11:00 AM

### Amputee's Gait Assessment for Successive Steps by Miniature Triaxial Load Cells

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(No relevant relationships reported)

**PURPOSE:** To Evaluate the Amputee's Gait for Successive Steps. An evaluation and assessment of human gait has been studied by using many systems to perform and analyze the spatio-temporal, kinematic, kinetic, neuro-muscular and energetic data. In order to understand the disorders of the human foot, it is essential to know its anatomy and biomechanics. Since the mechanics of the abnormal foot can adversely affect the normal functioning of the ankle, knee, hip and back, it was the purpose of this investigation to quantify the forces under different regions of amputee's foot and evaluate their gait. **METHODS:** Ranu's (1) system was used to evaluate specific aspects of foot functioning during abnormal gait. It consisted of a miniature triaxial load cell 8 mm in thickness and 19 mm square. A shoe was instrumented with five load cells, three on the sole and two on the heel. This system was used to measure forces under different areas of the feet of below knee amputees for successive steps. **RESULTS:** Six below knee amputees of mean age 47.2 years and mean weight 64.5 kg were investigated. The gait of amputees were studied from 1<sup>st</sup> step on a temporary pylon (1<sup>st</sup> Run) to a final 'normal' gait on a permanent prosthesis (2<sup>nd</sup> Run, one month later). Results for forces (Heel-Lateral, 1<sup>st</sup> Run)  $40.5 \pm 1.4$ , forces (1<sup>st</sup> Metatarsal, 1<sup>st</sup> Run)  $2081.3 \pm 62.4$  and forces (Big Toe, 1<sup>st</sup> Run)  $72.2 \pm 2.46$ . Results for forces (Heel-Lateral, 2<sup>nd</sup> Run)  $122.3 \pm 4.1$ , forces (1<sup>st</sup> Metatarsal, 2<sup>nd</sup> Run)  $156.1 \pm 5.21$  and forces (Big Toe, 2<sup>nd</sup> Run)  $254.3 \pm 8.8$ . These data clearly show a significant improvement in amputees gait from the 1<sup>st</sup> run and as compared with the 2<sup>nd</sup> run, 202 (Heel-Lateral), 93(1<sup>st</sup> Metatarsal) and 114 (Big Toe) % improvement,  $p > 0.10$ . **CONCLUSIONS :** It is concluded that this method of analyzing gait is sensitive, simple, accurate, and can be used as a diagnostic tool in the management of patients with lower extremity disabilities for successive steps. For amputees it was possible to identify misalignments from the output of the various load cells. This method also allowed in identifying and correcting problems in the painful below knee stump. It helped below knee amputees to walk nearly normally.

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3301 Board #170 June 2 9:30 AM - 11:00 AM

### Non-linear Lower Extremity Joint Torque Changes Observed during Preparation for Walk-to-run Gait Transition

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(No relevant relationships reported)

**PURPOSE:** To investigate lower extremity torque components changes in preparation for gait transition with increased walking speed. **METHODS:** 11 male and 3 female college students (age:  $22.6 \pm 1.9$  years, body mass:  $75.4 \pm 12.8$  kg, height:  $1.73 \pm 0.08$  m) were recruited for this study. Participants walked on a force plates embedded treadmill (AMTI, MA, USA) with continuously changed walking speed approaching walk-to-run transition. Ground reaction forces and kinematic data (VICON, Oxford, UK) were obtained at sampling rate of 1000 Hz and 200 Hz, respectively. The results of inverse dynamics were further decomposed into net joint torque (NET), gravitational torque (GTT), motion-dependent torque (MDT), contact torque (EXT), and generalized muscle torque (MST) for the last five strides before gait transition. One-way MANOVA employed to exam the difference among the five strides. Post hoc polynomial trend analyses were also employed to examine the trend with the five strides whenever suitable. **RESULTS:** Significant difference of all three lower extremity joints was detected during stance phase. Positive / negative values represent extension / flexion torque. EXT and MST of ankle ( $0.15 \pm 0.02$  vs.  $0.15 \pm 0.03$  vs.  $0.16 \pm 0.02$  vs.  $0.15 \pm 0.02$  vs.  $0.01 \pm 0.01$  nm/kg;  $-0.18 \pm 0.02$  vs.  $-0.18 \pm 0.03$  vs.  $-0.19 \pm 0.03$  vs.  $-0.18 \pm 0.02$  vs.  $-0.04 \pm 0.01$  nm/kg); knee ( $-0.60 \pm 0.11$  vs.  $-0.64 \pm 0.11$  vs.  $-0.74 \pm 0.12$  vs.  $-0.70 \pm 0.11$  vs.  $-1.34 \pm 0.12$  nm/kg;  $0.51 \pm 0.09$  vs.  $0.55 \pm 0.09$  vs.  $0.63 \pm 0.09$  vs.  $0.59 \pm 0.10$  vs.  $1.25 \pm 0.09$  nm/kg) displayed significantly decrease / increase at last stride before gait transition during early stance phase ( $p < .05$ ), as were the knee ( $-0.27 \pm 0.03$  vs.  $-0.31 \pm 0.04$  vs.  $-0.28 \pm 0.04$  vs.  $-0.28 \pm 0.04$  vs.  $-0.13 \pm 0.02$

nm/kg;  $0.36 \pm 0.03$  vs.  $0.41 \pm 0.03$  vs.  $0.39 \pm 0.04$  vs.  $0.38 \pm 0.04$  vs.  $0.23 \pm 0.02$  nm/kg) and hip ( $0.74 \pm 0.08$  vs.  $0.78 \pm 0.07$  vs.  $0.73 \pm 0.08$  vs.  $0.75 \pm 0.09$  vs.  $0.21 \pm 0.04$  nm/kg;  $-1.11 \pm 0.07$  vs.  $-1.15 \pm 0.07$  vs.  $-1.13 \pm 0.06$  vs.  $-1.15 \pm 0.07$  vs.  $-0.74 \pm 0.03$  nm/kg) responses at end of stance phase ( $p < .05$ ). These variables also displayed significantly quadratic trend as speed increase ( $p < .05$ ). **CONCLUSIONS:** Nonlinear changes in active / passive torques magnitudes observed during gait transition through continuously increased walking velocity. Gait transition was initiated during strides before gait transition.

3302 Board #171 June 2 9:30 AM - 11:00 AM

### The Effect Of Soccer History On Tibial Strain During Load Carriage

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(No relevant relationships reported)

Tibia stress fracture (TSF) is common in military recruits. Female Soldiers experience a higher rate than their male counterparts. TSF occurs most frequently in Basic Combat Training (BCT) and has been partially attributed to repetitive impact loading from tasks such as load carriage. Tibia mechanical properties could be improved as a result of training with multi-directional loading (MDL) (e.g. soccer). However, it has yet to be determined whether the improved tibia strength observed with MDL could result in resistance of bone deformation (lower strains) due to load carriage. **Purpose:** To examine the effects of a soccer history and incremental load carriage on tibial bone strain. **Methods:** 20 female soccer players (20±1 yr) and 20 mass- and height-matched healthy women (21±1 yr) participated in this study. They completed four walking tasks with 0kg, 10kg, 20kg, and 30kg loads on a force instrumented treadmill at 1.67 m/s. Participants' tibia CT models were combined with subject-specific musculoskeletal models for forward-dynamic computer simulations and finite element analyses. Strains from the middle third of the bone shaft were analyzed. One-way ANOVAs were performed.  $\alpha = 0.05$ . **Results:** Significant differences in strains were found among walking conditions and between the two groups (All  $p < 0.0001$ ). The mean  $\pm$  SE strains during load carriage (0kg, 10kg, 20kg, and 30kg) were  $562 \pm 3$   $\mu$ s,  $634 \pm 3$   $\mu$ s,  $736 \pm 7$   $\mu$ s, and  $825 \pm 4$   $\mu$ s in tension for soccer players, respectively, and  $684 \pm 3$   $\mu$ s,  $791 \pm 3$   $\mu$ s,  $1152 \pm 7$   $\mu$ s, and  $1015 \pm 4$   $\mu$ s, for controls, respectively, resulting in an 18-36% difference in strains during load carriage. Compressive strains were  $849 \pm 4$   $\mu$ s,  $960 \pm 4$   $\mu$ s,  $1092 \pm 10$   $\mu$ s, and  $1180 \pm 7$   $\mu$ s in soccer players and  $1039 \pm 4$   $\mu$ s,  $1179 \pm 7$   $\mu$ s,  $1749 \pm 11$   $\mu$ s, and  $1552 \pm 7$   $\mu$ s in controls showing similar percent differences as tensile strains (18-38%). **Conclusion:** Participants with a soccer history benefited from significantly lower strains than healthy controls during incremental load carriage. Lower tibial strains during load carriage may be protective from TSF in those with a history of soccer, although this has yet to be demonstrated experimentally. These findings suggest that physical training involving MDL may be an ideal exercise modality for preconditioning prior to BCT for female recruits. US ARMY #W81XWH-15-1-0006.

3303 Board #172 June 2 9:30 AM - 11:00 AM

### Older Adults That Choose To Not Report Their Falls History Biomechanically Present as Fallers

Eryn N. Murphy, David W. Keeley, Robert H. Wood. *New Mexico State University, Las Cruces, NM.*  
(No relevant relationships reported)

**Purpose:** This study aimed to better understanding the gait biomechanics of individuals that voluntarily choose to not report their history of falling, or lack thereof, against older adults who self-reported a history of falling or not falling. **Methods:** The sample included 1390 people over the age of 60 years (failed to report = 182, fallers = 605, non-fallers = 603). Participants were recruited from multiple testing sites across the Southwest United States. Multiple analysis of variance was conducted to test for differences between individuals that failed to report (FTR), fallers (F), and non-fallers (NF), as well as group differences within variables of the pace factor, including cadence, gait velocity and stride length. For the multivariate analysis, alpha was set at  $\alpha = 0.15$  with follow-up analysis alpha corrected using the Bonferroni technique and set at  $\alpha = 0.05$ . **Results:** MANOVA analysis for differences on the set of pace factor variables revealed that there is a significant difference between groups ( $p < 0.001$ ) on the set of variables inclusive of cadence, gait velocity and stride length. Follow-up univariate analysis revealed significant differences in each of the pace factor variables ( $p < 0.05$ ). Pairwise comparisons indicated the position of these differences. Specifically, with regard to cadence, there was no difference between FTR and F, however there is a significant difference between FTR and NF, with NF having significantly faster cadence (FTR =  $93.5156$ spm, NF =  $97.5341$ spm,  $p = 0.005$ ). Similarly, there was no difference between FTR and F in gait velocity, however there was a significant difference between FTR and NF, with NF presenting with significantly higher gait velocities (FTR =  $60.6517$ cm/s, NF =  $69.8126$ cm/s,  $p < 0.01$ ). Finally, in regards to stride length, FTR was not different from F, but was significantly different from NF, with NF presenting with significantly longer stride lengths (FTR =  $77.3885$ cm, NF =  $86.2104$ cm,  $p < 0.01$ ). **Conclusion:** In many falls

screenings, individuals are asked to self-report a history of falling. Based on these results, clinicians should understand that across pace factor variables established to be predictive of falls risk, individuals that choose not to self-report their history of falling appear to present with biomechanical measures that more closely resemble fallers.

### G-43 Free Communication/Poster - Macronutrient and Exercise Metabolism

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
Room: CC-Hall B

#### 3304 Board #173 June 2 9:30 AM - 11:00 AM Influence Of Short, Disrupted Sleep And High-intensity Interval Exercise On Fasting And Post-prandial Blood Lipid And Lipid-related Antioxidant Responses In Healthy Men

Matthew N. Peterson<sup>1</sup>, Zacharias Papadakis<sup>1</sup>, Jeffrey S. Forsse<sup>1</sup>, Fernando Gutierrez<sup>1</sup>, J. Kyle Taylor<sup>2</sup>, Li Qian<sup>2</sup>, Omar Brito-Estrada<sup>2</sup>, Kathryn Dugan<sup>2</sup>, Peter W. Grandjean, FACSM<sup>1</sup>.  
<sup>1</sup>Baylor University, Waco, TX. <sup>2</sup>Auburn University-Montgomery, Montgomery, AL. (Sponsor: Peter W. Grandjean, FACSM)  
(No relevant relationships reported)

Exercise is known to impart transient blood lipid responses that appear consistent with reduced cardiovascular disease risk; yet, it is unclear how short, disrupted sleep (SDS) modifies post-exercise fasting and postprandial blood lipid and lipid-related antioxidant responses to a single episode of exercise. **PURPOSE:** To determine the influence of a single night of SDS on fasting and postprandial blood lipid and lipid-related antioxidant responses after HIIE. **METHODS:** Fifteen male participants (age 31.1 ± 5.3 yr; weight 83.5 ± 11.4 kg; BMI 25.8 ± 2.7 kg/m<sup>2</sup>; VO<sub>2</sub>max 49.1 ± 8.5 ml/kg/min) completed a non-exercise control trial after 9 to 9.5 hrs of reference sleep (REF), HIIE by treadmill running (90% and 40% of VO<sub>2</sub>reserve in 3:2 min ratio) to expend 500 kcal after reference sleep (REF+EX) and HIIE after 3 to 3.5 hrs of short and disrupted sleep (SDS+EX) in a randomized crossover design. Blood samples were obtained by the same technician under standardized conditions just before, immediately after (IPE), 1 hr after exercise (1 HR) and just before a high-fat meal - 1240 kcal (56 g fat; 145 g carbohydrate; 38 g protein) and again 2, 4 and 6hrs after meal ingestion and at equal intervals during REF. Total, high-density and low-density lipoprotein cholesterol (HDLc and LDLc) and paraoxonase-1 concentration were measured up to 1 hr post-exercise. Post-prandial triglyceride was measured and area under the curves - total (AUCt) and incremental (AUCi) were calculated. Lipid and lipid-related antioxidant responses were analyzed using 3 (condition) by 3 (sample point) repeated measures ANOVAs. AUCt and AUCi were measured using one-way, 3 (condition) repeated measures ANOVAs. **RESULTS:** HDLc (+6.3%, p = 0.0023) and paraoxonase-1 (+10.8%, p < 0.0001) increased and triglyceride (-18.5%, p < 0.0001) decreased after REF+EX and SDS+EX; TAUct and AUCi remained refractory to exercise and short, disrupted sleep. **SUMMARY:** Exercise transiently increased fasting HDL cholesterol and related antioxidant concentrations and reduced triglyceride levels, but did not modify total or incremental triglyceride AUC in response to a post-exercise high-fat meal. Short, disrupted sleep did not influence these responses.

#### 3305 Board #174 June 2 9:30 AM - 11:00 AM Effects Of Pre-exercise Sucrose Ingestion On Thermoregulatory Responses To 5-km Running

Patrick Wilson. Old Dominion University, Norfolk, VA.  
(No relevant relationships reported)

**PURPOSE:** Carbohydrate feeding, in particular fructose, is associated with increased dietary thermogenesis and body temperature at rest. Whether these effects influence the thermoregulatory responses to heavy exercise remains uncertain. **METHODS:** A total of 28 runners (26 men, 2 women; 35.2 ± 9.6 years) with the ability to finish a 5-km in 16 to 23 minutes completed this randomized, double-blind, placebo-controlled trial. Runners were pair-matched based on their self-reported maximal 5-km running speed and assigned to consume a beverage containing 750 mL of water plus either 100 g of sucrose or 0.8 g of aspartame. Beverages were consumed 60 minutes before the 5-km, which was conducted at 93% of maximal 5-km speed in a temperate environment (21-22°C, 53% relative humidity). Gastrointestinal temperature, Thermal Sensation Scale (TSS) and Feeling Scale (FS) were recorded before beverage ingestion, every 10 minutes during rest, and every 1-km during the 5-km run. Rating of Perceived Exertion (RPE) was also recorded every 1-km. Two-way mixed ANOVAs with repeated measures and independent t-tests were used to examine treatment effects. **RESULTS:** Treadmill speed for the 5-km run was well-matched (13.8 ± 1.0 vs. 13.8 ± 1.0 km/h; p = 0.98) between the groups. Gastrointestinal temperature was not different between the carbohydrate (38.7 ± 0.4°C) and placebo (38.6 ± 0.4°C) groups by the end of the

5-km (p = 0.49). No group x time interactions or main effects for group were found for gastrointestinal temperature, TSS, FS, or RPE. A group x time interaction was found for TSS (F = 2.1, p = 0.02, partial η<sup>2</sup> = 0.075). Significant time effects were found for gastrointestinal temperature, TSS, FS, and RPE (all p < 0.001, partial η<sup>2</sup> = 0.38 to 0.91), with temperature, TSS, and RPE increasing, and FS decreasing, over time. **CONCLUSIONS:** Ingestion of 100 g of sucrose 60 minutes before exercise does not affect gastrointestinal temperature during near-maximal 5-km running in a temperate environment, and therefore does not likely modify the risk of heat illness.

3306 Board #175 June 2 9:30 AM - 11:00 AM

#### Blood Glucose Control Following Single-Leg and Double-Leg Cycling

Shane Draper, John McDaniel. Kent State University, Kent, OH.  
(No relevant relationships reported)

When exercise is confined to a small muscle mass, greater blood flow to that muscle allows for greater muscle specific intensity compared to whole body exercise. The greater muscle specific intensity results in greater glucose oxidation for any given VO<sub>2</sub>, which may optimize exogenous blood glucose uptake following the exercise. **PURPOSE:** Thus, the purpose of this study was to determine the influence of reduced muscle mass exercise (single leg cycling) on post exercise blood glucose control. **METHODS:** Seven healthy college age students completed the study in which they arrived fasted and were administered an oral glucose tolerance test (OGTT) following 4 conditions: no exercise, following 30 minutes of single leg cycling, following 30 minutes of double leg cycling matched for VO<sub>2</sub>, and following 30 minutes of double leg cycling matched for power. VO<sub>2</sub>, RER, and carbohydrate oxidation were recorded throughout the exercise. Two 4 x 2 repeated measures ANOVAs were performed on condition (single leg, double leg VO<sub>2</sub> and double leg power) and time (baseline and average blood utilization as well as baseline and peak blood glucose). **RESULTS:** Despite the fact that carbohydrate oxidation was greater during the single leg cycling ((1.4 ± 0.45 grams) of carbohydrate utilized per minute during single leg compared to (1.0 ± 0.49 g/min) during double leg matched for VO<sub>2</sub> and (0.87 ± 0.43 g/min) during double leg cycling matched for power), there was no difference (p > 0.05) in average blood glucose uptake between single leg cycling (126 ± 8 mg/dL) and double leg cycling when matching for VO<sub>2</sub> (121 ± 10 mg/dL) and power (125 ± 10 mg/dL) when compared to baseline (124 ± 13 mg/dL). Additionally, there was no difference in peak blood glucose between single leg cycling (160 ± 17 mg/dL) and double leg cycling when matching for VO<sub>2</sub> (154 ± 20 mg/dL) and power (155 ± 19 mg/dL) when compared to baseline (159 ± 18 mg/dL). **CONCLUSION:** We conclude that the greater glucose utilization during single leg cycling had no effect on blood glucose uptake following an OGTT. This study was partially supported by the Kent State University School of Health Sciences Small Grant.

3307 Board #176 June 2 9:30 AM - 11:00 AM

#### Influence of Acute Resistance Exercise on Post-Exercise Glycemic Control

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Shippensburg University, Shippensburg, PA.  
(No relevant relationships reported)

**PURPOSE:** To study the effects of acute resistance exercise on the body's ability to regulate blood sugar in active, resistance trained, adults. **METHODS:** The study included eight participants (2 female, 6 male; age: 20.63±1.85 years; mass: 80.99±24.67 kg; height: 173.31±9.96 cm; body fat: 16.73±6.65%). Initially, informed consent, 10-repetition maximum (10-RM) for the three resistance exercises (squat, biceps curl, and bench press) and demographic measurements were obtained. Subjects completed three trials on separate days. One resting trial and two exercise trials (squat only; full body: all three exercises) were completed. The subjects performed five sets (6 reps/set) using the 10-RM load. In each exercise trial, the subject consumed a 25% carbohydrate beverage (4ml/kg of body mass) after completion of exercise. All trials (resting included) involved a 75-minute oral glucose tolerance test (OGTT). Blood glucose (BG), heart rate (HR), blood pressure (BP) and blood lactate (BL) measures were collected before and following exercise. Blood pressure, and HR were also measured following the OGTT. **RESULTS:** OGTT response was not significantly different based on trial. Area under the curve (AUC) did not differ significantly by trial. Resting AUC was 5.8% greater than the squat only trial and 2.5% greater than the full body trial. There were no significant differences between exercise trials for BL, HR, or mean arterial pressure (MAP). Rate of perceived exertion was significantly greater for full body (15.88 ± 1.81) vs. squat (13.63 ± 1.06). **CONCLUSIONS:** Resistance exercise was not shown to significantly affect glucose regulatory response during recovery. The volume of active muscle did not seem to influence the OGTT response. Resistance exercise may not be as potent as aerobic

exercise in promoting acutely enhanced glycemic control. Future investigations into post-exercise glycemic control should be expanded to include a larger sample size and varied resistance exercises.

3308 Board #177 June 2 9:30 AM - 11:00 AM

**Accuracy, Precision And Comfort Of A Microdialysis Device For Continuous Real-time Blood Lactate Monitoring**

Ben J. Lee<sup>1</sup>, Julianne Doherty<sup>1</sup>, Ania M. Hiles<sup>1</sup>, Daniel Carney<sup>2</sup>, Mark C. O'Connell<sup>2</sup>. <sup>1</sup>University of Chichester, Chichester, United Kingdom. <sup>2</sup>Probe Scientific, Thurleigh, United Kingdom.

**Reported Relationships:** B.J. Lee: Contracted Research - Including Principle Investigator; Probe Scientific.

**BACKGROUND:** In critically ill patients blood lactate is measured as a marker of tissue perfusion, with increasing lactate being associated with insufficient perfusion and poorer prognosis. Serial monitoring of blood lactate is a valuable tool in predicting in-hospital mortality, with a better prognosis observed when blood lactate concentrations are decreasing. A device that allows for automated, continuous monitoring of blood lactate removes the need for a practitioner to draw samples, and could provide more effective patient monitoring. **PURPOSE:** Evaluate the performance of a peripheral intravenous microdialysis device and online *in-vitro* diagnostic lactate biosensor system for continuous automated blood lactate monitoring. **METHODS:** Twenty volunteers (age 27 ± 8 years; stature 175 ± 10 cm; mass 76.5 ± 13.8 kg) completed one experimental visit. An 18-gauge catheter was inserted into an antecubital vein, and a microdialysis device (MicroEye® PME012, Probe Scientific, UK) inserted into the catheter. The MicroEye® was perfused at 1mL/hour with 0.9% sodium chloride containing anticoagulant (Fondaparinux). The outlet of the MicroEye® was connected to the inlet of a lactate flow cell (ContinuMon®, Probe Scientific, UK) for continuous lactate monitoring. A second catheter was introduced into a peripheral vein in the contralateral forearm for reference blood sampling. Venous blood was sampled at 10-minute intervals throughout 30 minutes of rest, and at the end of five 3-minute incremental exercise stages, beginning at 70 watts and increasing by 35 Watts per stage. Comfort for each arm was assessed using a 9-point scale ranging from unnoticeable (8) to painful (0). The relationship and agreement between reference and MicroEye® values assessed via least mean square and Bland-Altman analysis. **RESULTS:** Paired samples falling within the clinical range (0-4 mM; n = 152) gave an R<sup>2</sup> of 0.93 (y = 1.002), a mean bias of 0.027 mM, and an upper and lower limit of agreement of 0.54 and -0.49 mM respectively. Subjective comfort was not different between the MicroEye(R) (7 ± 1) or reference arm (7 ± 1) at any point in the trial. **CONCLUSION:** The MicroEye(R) microdialysis catheter and ContinuMon(R) continuous lactate monitoring system exhibits good agreement when following exercise induced blood lactate changes in the clinical range.

3309 Board #178 June 2 9:30 AM - 11:00 AM

**Influence Of Muscle Action On Energy Expenditure: Concentric Vs. Eccentric Vs. Both**

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(No relevant relationships reported)

**PURPOSE:** Previous studies have found the energy cost of eccentric exercise to be approximately 1/7 to 1/4 that of concentric exercise, but no study has directly compared concentric-and eccentric-only resistance exercise. Therefore, we compared energy expenditure between squats performed with concentric or eccentric muscle actions.

**METHODS:** 12 healthy men (20.9±1.1yrs) with a BMI<26 performed three exercise protocols once weekly designed to compare energy expenditure between different muscle actions: concentric (CON), eccentric (ECC), and a trial incorporating both concentric and eccentric (BOTH). Subject's 1RM was determined using a plate-loaded squat machine. Each protocol was randomly assigned in a counterbalanced order and required subjects to perform 4 sets of 10 reps with 50% of 1RM. Repetition speed (2sec), ROM, and rest intervals were identical across protocols. Expired air was collected continuously before (15min), during (12min), and after (30min) each exercise protocol using a metabolic cart. Data were analyzed using a two-way repeated measures ANOVA, with Fisher's least significant difference (LSD) post hoc analyses wherever appropriate.

**RESULTS:** Rates of energy expenditure (kcal·min<sup>-1</sup>) were significantly greater (p<0.05) during sets 1 through 4 of CON and BOTH compared to ECC (see Table). CON was also greater than BOTH for sets 2 and 4. After exercise, CON > ECC at +5 and +10min, and BOTH > ECC at +5min. Significant differences (p<0.05) in total energy expenditure (kcal) included CON (58.1±6.27) > BOTH (50.7±5.92) > ECC (40.9±3.33).

**CONCLUSION:** When squats were performed with 2sec CON or ECC muscle actions and 50% of 1RM, the energy cost of ECC was 2/3 to 3/4 that of CON exercise, whereas previous studies have reported ECC was about 1/4 of CON. A possible explanation may be that slower muscle actions used in our study resulted in elevated energy cost of eccentric muscle actions due to increased time under tension.

	Set 1	Set 2	Set 3	Set 4	+5min	+10min
<b>Energy Expenditure (kcal·min<sup>-1</sup>)</b>						
CON	4.3±0.44 #	4.5±0.45 #*	4.3±0.51 #	4.4±0.50 #*	2.6±0.59 #	2.0±0.32 #
ECC	3.3±0.30	3.0±0.27	3.0±0.33	2.9±0.33	2.0±0.39	1.7±0.30
BOTH	4.4±0.65 #	3.5±0.42 #	4.2±0.58 #	3.5±0.38 #	2.3±0.25 #	1.9±0.18

Values are MEANS±SD; # denotes p<0.05 vs corresponding ECC value; \* denotes p<0.05 vs corresponding BOTH value; significance for this study was set at p<0.05.

3310 Board #179 June 2 9:30 AM - 11:00 AM

**The Effects Of Exercise To Bmp-4-mediated Browning On White Adipose Tissue In Obese Rats**

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(No relevant relationships reported)

**PURPOSE:** Bone morphogenetic protein-4(BMP-4) play a key role in regulating adipocyte differentiation and browning. The aim of this study is to observe the effect of treadmill running on the protein expression of BMP-4 and UCP-1 which is a marker protein associated with thermogenesis to discuss the effect of exercise on adipogenesis and browning in adipose tissue roundly.

**METHODS:** Before the formal experiment, we established a rat model of obesity with 8-week high-fat diet. The 20 11-week obese rats were obtained, and randomly divided into sedentary high-fat-diet group(SHD) and exercise high-fat-diet group(EHD). Other 20 11-week chow-diet rats were randomly divided into sedentary chow-diet (SCD) and exercise chow-diet (ECD) groups. Rats in the ECD and EHD had 8 weeks training (60%-70% VO<sub>2max</sub>, 50 minutes/day, 5 days/week). The white adipose of inguinal subcutaneous tissue (SAT), Periepididymal white adipose tissue (PAT) were collected.

**RESULTS:** 1) In SAT, obesity has a very little effect in promoting protein expression of BMP-4 and UCP-1. Exercise significantly increased the protein expression of BMP-4 and UCP-1 on obese rats, but had little effect on chow diet rats. 2) In PAT, obesity can decrease the expression of BMP-4 protein, but little effect on UCP-1. Exercise significantly increased the protein expression of BMP-4 and UCP-1 on chow diet rats, but had little effect on obese rats. (The data are shown in table)

**CONCLUSIONS:** The effect of high-fat diet on adipocyte differentiation and browning is different in different tissues in obese rats, and exercise can exacerbates this differences.

	Expression of BMP-4 and UCP-1 protein in adipose tissue			
	SAT		PAT	
	BMP-4	UCP-1	BMP-4	UCP-1
SCD	1.00±0.00	1.00±0.00	1.00±0.00	1.00±0.00
ECD	1.05±0.13	0.99±0.15	1.31±0.05 <sup>a</sup>	1.19±0.08 <sup>a</sup>
SHD	1.10±0.18	1.23±0.25	0.79±0.07 <sup>ab</sup>	1.02±0.15
EHD	1.27±0.09 <sup>abc</sup>	1.97±0.51 <sup>abc</sup>	0.76±0.08 <sup>ab</sup>	0.91±0.11 <sup>b</sup>

<sup>a</sup> P<0.05vs.SCD each protein in the same tissue ; <sup>b</sup>P<0.05vs.ECD; <sup>c</sup> P<0.05vs.SHD

3311 Board #180 June 2 9:30 AM - 11:00 AM

**Acute Exposure to a High-Fat High-Sugar Diet Alters Wheel Running Activity**

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(No relevant relationships reported)

**BACKGROUND:** Literature shows that chronic exposure to a high-fat high-sugar (HFHS) Western diet decreases voluntary physical activity, mainly through decreased duration of activity. **PURPOSE:** To determine if acute exposures to standard chow and a HFHS diet affect voluntary activity levels in male mice. **METHODS:** Eight-week-old male C57BL/6J male mice (n=20) were singly housed and provided with running wheels. Wheel running activity was measured daily via mounted odometers. Distance (km) and duration (min) were used to calculate average speed (m/min).

Mice were randomly assigned to two experimental groups that alternated between the HFHS diet (20% protein, 35% carbohydrate, 45% fat, with 20% fructose water) and a standard chow diet (24.3% protein, 40.2% CHO, 4.7% fat) in three 5-day cycles followed by two 8-day cycles. At study initiation, Group 1 began with the HFHS diet and Group 2 began with standard chow. At the end of each cycle period, both groups switched to the opposing diet. Data were analyzed using a repeated measures model

with distance, duration, and speed for each cycle as dependent variables and diet, group, and diet\*group interaction as fixed effects. Alpha value was set a priori at 0.05 and post-hoc tests used Tukey's HSD. **RESULTS:** Acute exposure to the HFHS diet decreased speed ( $p=.0075$ ), while distance ( $p=.7527$ ) and duration ( $p=.1077$ ) were not altered. No overall group effects on distance ( $p=.3670$ ), duration ( $p=.3747$ ), or speed ( $p=.5266$ ) were observed; however, animals exposed to the chow diet first (Group 2) showed an increase in activity duration ( $p=.0040$ ) when exposed to a HFHS diet in all cycles. **CONCLUSION:** Acute exposure to a HFHS diet only decreased speed, which is surprising given the literature on chronic HFHS exposure that has shown decreases in distance. The observed increase in activity duration in mice that had chow at the initiation of wheel-running exposure (Group 2) suggests that acute and chronic effects of a HFHS diet on physical activity level differ in mice.

3312 Board #181 June 2 9:30 AM - 11:00 AM  
**The Effect Of Interval Training On Aerobic Capacity In Mice Growth Restricted In Early Life**

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*(No relevant relationships reported)*

Previous research has found that early life undernutrition increases the risk of cardiovascular disease later in life. It is hypothesized that exercise training could mitigate the cardiovascular impairments of early life undernutrition. **PURPOSE:** To evaluate the effects of early life undernutrition on changes in exercise capacity after 8 weeks of treadmill (TM) training in a mouse model. **METHODS:** Using a cross fostering model, pups were undernourished during gestation (GUN), lactation (PUN), or both (GUN+PUN) by feeding FVB mouse dams a low protein (8%) diet. The control (CON) group was fed an isocaloric diet (20% protein) during all windows of development. At PN21 (21 days post-natal), all mice were weaned and fed the control diet. Thus, all physiological effects of undernutrition were isolated to early life. To evaluate exercise capacity, maximal work on a TM was performed at PN39 (baseline), PN67 (midpoint), and PN95 (post). Starting at PN41, 28 mice were trained on the TM 5 days/week for 8 weeks with alternating 8 mins at 85% and 2 mins at 55% of their max workload for 1 hour. The sedentary group of 30 mice ran on the TM 3 days/week for 15 mins at 10m/min. Data were analyzed using a repeated measures ANOVA to detect change in exercise capacity over time and an ANOVA with Tukey post-hoc test (alpha level  $p<0.05$ ) to detect differences in exercise capacity between groups. **RESULTS:** After 4 weeks of TM training, there was a significant difference in exercise capacity change over time between the TM trained ( $+5.0\pm 3.9$  J[FDI] oules (J)) and sedentary groups ( $+2.5\pm 6.0$ J) ( $p=0.03$ ). Differences in exercise capacity change over the first 4 weeks were trending toward significance between groups (GUN:  $2.8\pm 1.4$ J, PUN:  $1.7\pm 1.2$ J, PUN+GUN:  $6.0\pm 1.2$ J, CON:  $4.6\pm 1.4$ J.) ( $p=0.057$ ). No significant changes were observed from weeks 4 to 8 between or within groups. **CONCLUSION:** Results indicate that 4 weeks of exercise training can improve exercise capacity in mice who were undernourished during gestation and gestation plus lactation, but not undernutrition during lactation only. PN1-21 is associated with cardiac growth and the nutrient restriction could potentially limit cardiac growth factors preventing stroke volume adaptations with training.

3313 Board #182 June 2 9:30 AM - 11:00 AM  
**Effects Of High-fat Diet And Exercise On Total Plasma Macronutrient Contents By Fourier-transform Infrared Spectroscopy**

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*(No relevant relationships reported)*

High fat-low carbohydrate (HFLC) diets are increasingly considered by endurance athletes to enhance their performances and overall health. Total macronutrient contents in plasma may be affected by diets and exercise. **PURPOSE:** To examine the effects of HFLC diet and an acute bout of exercise on total plasma macronutrient contents in trained males. **METHODS:** Eight trained distance runners (age =  $39.5\pm 9.9$  years and  $VO_{2max} = 47.9\pm 7.6$  mL/kg/min) that were on high-carbohydrate (HC) diets adopted the HFLC diet for 3 weeks, which consisted of 70% of overall caloric intake from fats and no more than 50g of carbohydrates. At the end of each diet trial, participants performed an indoor treadmill exercise for 50 minutes at varying race paces followed by an outdoor 5-km time trial. Overnight fasting blood samples were collected at pre- (baseline) and post-exercise (24-hours) to analyze changes in total plasma lipids, proteins, and carbohydrates using attenuated total reflectance Fourier-transform infrared spectroscopy (ATR FT-IR). The O-H stretch vibrational band of water was used to normalize the IR spectra and the protein content was quantified by measuring the amide I peak intensity at  $1600 - 1700$   $cm^{-1}$ . To quantify the lipids and carbohydrates, the samples were lyophilized and measured by the intensities at  $2800 - 3000$   $cm^{-1}$  and  $800 - 1200$   $cm^{-1}$ , respectively. **RESULTS:** The ATR FT-IR analysis showed that total plasma proteins remained unchanged (HC baseline =  $135.20\pm 4.20$  and HFLC baseline =  $135.24\pm 3.91$  AU). However, the HC diet at baseline

showed a significant accumulation of lipids ( $30.06\pm 7.75$  AU, 95% CI = 6.93) and carbohydrates ( $42.92\pm 11.62$  AU, 95% CI = 10.39). Additionally, total lipids in the HC diet significantly decreased at 24-hours post-exercise (from  $30.06\pm 7.75$  to  $28.51\pm 7.91$  AU,  $p=0.016$ ). **CONCLUSION:** A short-term high-fat diet does not significantly alter any macronutrient contents in plasma, whereas a high-carbohydrate diet increases an accumulation of lipids and carbohydrates. Elevated plasma lipids and carbohydrates with a high-carbohydrate diet may be due to decreased insulin sensitivity, which consequently led to increased plasma lipid contents. Notably, decreased total plasma lipid content following an acute bout of exercise suggests that lipids were the primary energy substrate.

3314 Board #183 June 2 9:30 AM - 11:00 AM  
**Methodological Considerations to Evaluate the Effect of Physical Activity on Fluoride Metabolism in Children**

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*(No relevant relationships reported)*

Physical activity can influence absorption and excretion of fluoride (F). However, the evidence is still limited and often contradictory; studies in rats showed a significant reduction in plasma F concentration at light exercise intensity, while a study with healthy human adults had an increase in plasma concentration and a decline in renal clearance rate of F, with increasing exercise intensity. **PURPOSE:** To investigate recruitment and acceptance of an experimental protocol (phase I) and the development of methodological procedures (phase II). **METHODS:** Parents of children (5 to 8 years) were recruited from schools in Brazil. In phase I, parents were asked to complete socio-economic, physical activity (Netherlands Physical Activity Questionnaire) and feasibility questionnaire. The latter explored parents' willingness for their child to participate and reasons for refusing consent. In phase II, children participated in two test conditions: high intensity exercise and resting with blood lactate and F in urine and saliva samples collected before and after the exercise trial. **RESULTS:** Only 77 out of 350 parents approached agreed to participate. The majority (54.6%) of the families were from middle socio-economic class. Seventy percent of the children were considered predominately inactive according to an established cut-off point. Fifty-five percent of the parents who responded, would consent their child to participate in the study. The main reason for refusal of consent was collection of blood samples from children (62% and 69% said "no" for finger prick and vein blood collection respectively). In phase II, four children were recruited and one provided assent for blood collection. F concentration of parotid saliva from this participant was 0.01  $\mu$ g/ml, both at rest and after exercise. Blood lactate concentration and mean F concentration increased from before (Pre) to after (Post) exercise (Lactate Pre: 4.3 mmol/l vs. Post: 14.4 mmol/l; Mean F concentration urine Pre: 0.58  $\mu$ g/ml vs. Post: 0.63  $\mu$ g/ml). **CONCLUSIONS:** Some of the questions related to recruitment rate and acceptability of measurements were answered in this study. However, participants' willingness to be randomized and their acceptance of and compliance with a high intensity exercise protocol still needs to be explored in a randomized feasibility trial.

3315 Board #184 June 2 9:30 AM - 11:00 AM  
**Relationships Among Fatigue Thresholds Derived From Neuromuscular, Metabolic, and Ventilatory Parameters**

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*(No relevant relationships reported)*

A number of fatigue thresholds have been developed to describe fatigue-induced changes in various physiological factors including muscle activation, blood lactate, and gas exchange. These fatigue thresholds, however, may correspond to different exercise intensities depending on the variable from which they were derived as well as their underlying mechanisms. **PURPOSE:** The purpose of the present study was to examine the relationships and compare power outputs among fatigue thresholds derived from neuromuscular, metabolic, and ventilatory parameters. **METHODS:** Fifteen college-aged males (mean age  $\pm$  SD =  $22.1 \pm 1.7$  years,  $78.0 \pm 9.4$  kg,  $176.5 \pm 5.6$  cm) volunteered to perform an incremental test to exhaustion on an electronically-braked cycle ergometer for determination of their physical working capacity at the fatigue threshold ( $PWC_{FT}$ ), lactate threshold (LT), ventilatory threshold (VT), and gas exchange threshold (GET). The incremental test involved recording electromyographic (EMG) signals from the vastus lateralis as well as measurements of blood lactate from the fingertip and gas exchange using open circuit spirometry. **RESULTS:** The results of the one-way ANOVA with repeated measures and follow-up paired samples *t*-tests indicated that the LT ( $132 \pm 14$  W) occurred at a significantly ( $P < 0.05$ ) lower power

output than the  $PWC_{FT}$  ( $153 \pm 33$  W), GET ( $155 \pm 33$  W), and VT ( $177 \pm 27$  W). In addition, the VT occurred at a higher output than the LT,  $PWC_{FT}$ , and GET, whereas there was no difference in power outputs between the  $PWC_{FT}$  and GET. Furthermore, there were no significant inter-correlations among any of the fatigue thresholds ( $r = -0.03 - 0.35$ ), except between the GET and VT ( $r = 0.70$ ). **CONCLUSIONS:** Based on the significant mean differences in power outputs and non-significant correlations, the findings of the present study indicated there were no relationships among indicators of fatigue identified through changes in muscle activation ( $PWC_{FT}$ ), blood lactate (LT), and measurements of gas exchange (VT and GET). These findings suggested there is a dissociation among the exercise intensities associated with the  $PWC_{FT}$ , LT, VT, and GET, and thus, each originate from separate physiological mechanisms.

3316 Board #185 June 2 9:30 AM - 11:00 AM

**Hemodynamic and Body Fluid Response to Water Ingestion**

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*(No relevant relationships reported)*

Despite a paucity of information regarding the hemodynamic changes associated with moderate fluid ingestion, the popular, unsubstantiated recommendation for most adults to ingest 8 x 8 ounce glasses of water daily (1888 mL) remains prevalent. **PURPOSE:** The purpose of this study was to determine the hemodynamic and body fluid changes associated with consuming water at temperatures of 4° C & 37° C and two volumes of 7 & 21 mL/kg. **METHODS:** 10 subjects (age  $22.3 \pm 1.3$  yr, ht.  $1.74 \pm .15$  m., body mass(bm),  $75.1 \pm 18.5$  kg, 4♂) reported to the lab in a euhydrated state and refrained from ingestion of food and beverage (except water) for 10 hrs and no water 2 hours pre-trial. 30 minutes of rest preceded venipuncture for hematocrit (H), plasma specific gravity (PSG), and plasma density (PD) analyzed by digital refractometry. Hemodynamic values of heart rate (HR), stroke volume (SV) and cardiac output (Q) were obtained by a non-invasive impedance cardiography system. All measures were obtained pre-water ingestion (PRE) and at 20 minute intervals following water ingestion (T1, T2, & T3). Immediately following the PRE, subjects ingested C7, C21, H7 or H21 with the volume calculated from individual bm at a mean of 526 and 1577 mL for 7 and 21 trials, respectively. Subjects served as their own control in the randomized assignment of trials. **RESULTS:** Statistical analysis by ANOVA was applied to these data and revealed NSD ( $p > .05$ ) among all trials. Mean values for all four trials are depicted in the following table:

	PRE	T1	T2	T3
H (%)	46.2 ± 4.4	47.2 ± 6.8	46.1 ± 6.5	46.9 ± 5.9
PSG (gm/cm <sup>3</sup> )	1.035 ± .02	1.031 ± .02	1.026 ± .01	1.026 ± .01
PD (gm/mL)	1.025 ± .01	1.024 ± .01	1.024 ± .01	1.025 ± .01
HR (b/min)	62 ± 7	60 ± 7	59 ± 7	58 ± 7
SV (mL/b)	90.3 ± 14.5	93.8 ± 18.2	95.9 ± 15.8	98.7 ± 17.3
Q (L/min)	5.60 ± .80	5.60 ± .83	5.62 ± .79	5.72 ± .72

**CONCLUSION:** The ingestion of water in volumes and temperatures mimicking current practices among many adults results in minimal expansion of blood volume or changes in hemodynamic function. Apparently, consuming considerable water without excessive loss of fluid from either environmental conditions or exercise induced temperature regulation, is safe with no adverse impact on non-exercising individuals.

3317 Board #186 June 2 9:30 AM - 11:00 AM

**Comparison Of Intramuscular Adipose Tissue Content Using Two-point Dixon Imaging With Two Segmentation Techniques Based On T1-weighted Imaging**

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*(No relevant relationships reported)*

The adipose tissue infiltrated within the muscle is known as intramuscular adipose tissue (IntraMAT) and increasing of IntraMAT have a potential risk of insulin resistance. T1-weighted (T1W) imaging is one of the basic pulse sequences to measure IntraMAT using a histogram-based thresholding technique based on signal intensity. The Otsu and the Midpoint methods based on T1W imaging have been used to measure IntraMAT in the literature. Now two-point Dixon is recognized as the gold standard sequence to determine adipose tissue content. However, it is unknown that relationship between adipose tissue content determined by Dixon imaging and that determined by T1W imaging. **PURPOSE:** The purpose of this study was to compare IntraMAT content determined by Dixon imaging with T1W imaging which was calculated by

two different thresholding techniques, i.e. Otsu and Midpoint methods. **METHODS:** Subjects were 13 older ( $72 \pm 6$  years) and 19 young ( $26 \pm 5$  years) men. Axial images of the mid-thigh were taken using two-point Dixon and T1W imaging. From these images, IntraMAT content of vastus lateralis (VL) and biceps femoris-long head (BF-L) was calculated. For the T1W images, we applied two different segmentation algorithms, known as the Otsu and Midpoint methods, to determine adipose tissue. Using fat and water images by Dixon technique, IntraMAT content of VL and BF-L was also calculated. **RESULTS:** IntraMAT content in VL determined by Dixon and Otsu was significantly higher than that of Midpoint (Dixon  $12.2 \pm 2.4\%$ , Otsu  $11.0 \pm 4.4$  and Midpoint  $0.6 \pm 0.8\%$ ,  $p < 0.01$ ). IntraMAT content in BF-L determined by Dixon and Otsu were significantly higher than Midpoint (Dixon:  $12.7 \pm 3.2\%$ , Otsu:  $21.4 \pm 10.0\%$  and Midpoint:  $1.7 \pm 2.9\%$ ,  $p < 0.01$ ). Furthermore, IntraMAT content in BF-L determined by Otsu was significantly higher than Dixon (Dixon:  $12.7 \pm 3.2\%$  and Otsu:  $21.4 \pm 10.0\%$ ,  $p < 0.01$ ). There were significant correlations of IntraMAT content between Dixon and Otsu in both muscles (VL:  $r = 0.686$  and BF-L:  $r = 0.790$ ,  $p < 0.05$ ) and between Dixon and Midpoint in both muscles (VL:  $r = 0.403$  and BF:  $r = 0.766$ ,  $p < 0.05$ ). **CONCLUSION:** Although Otsu method overestimates IntraMAT content of BF-L, it could apply with caution depending on muscle. Midpoint method is likely to underestimate compared with any other techniques, therefore, we should extra care to use it.

3318 Board #187 June 2 9:30 AM - 11:00 AM

**Impact of Sitting on a Stability Ball on Metabolism and Vascular Resistance During Arm Ergometry.**

Charles RC Marks, Jennifer Duggan, Emmanuel Jianis, Cecelia Goulette. *Oakland University, Rochester, MI.* (Sponsor: Jonathan K. Ehrman, FACSM)

*(No relevant relationships reported)*

Past studies demonstrated that sitting on a stability ball (SB) elevates submaximal  $VO_2$  without affecting heart rate or blood pressure during arm ergometry when compared to sitting on a chair (C). However, no reports have been made to determine if nutrient metabolism or vascular resistance (VR) are also affected. **PURPOSE:** To determine if sitting on a SB affects fat and carbohydrate metabolism and vascular resistance during arm ergometry when compared to C. **METHODS:** Eighteen Female ( $22 \pm 3$  yrs) and eleven male ( $23 \pm 3$  yrs) apparently healthy participants underwent two stages of submaximal arm ergometry for two conditions (order randomized): sitting on a SB or sitting on a C.  $VO_2$  and  $VCO_2$  were recorded after the third minute of each stage and used to determine indicators of fat g/min (FAT) and carbohydrate g/min (CHO) use. Cardiac Output (Q) was assessed by  $CO_2$  rebreathing and was measured immediately after the  $VO_2$  and  $VCO_2$  recordings. Blood Pressure (BP) was measured following the Q. BP was used for calculating mean arterial pressure (MAP) and then MAP and Q for calculating VR. Repeated Measures ANOVA was used to determine sitting mode effects ( $\alpha = 0.05$ ). **RESULTS:** There were no significant sitting mode effects for VR ( $P = 0.334$ ) and CHO ( $P = 0.120$ ). However, there was a significant sitting mode effect for FAT ( $P = 0.017$ ). FAT was 24% to 36% higher on the SB (Stage 1:  $0.114 \pm 0.112$  g/min; Stage 2:  $0.059 \pm 0.075$  g/min) than on C (Stage 1:  $0.087 \pm 0.102$  g/min; Stage 2:  $0.038 \pm 0.013$  g/min). **CONCLUSION:** When compared to sitting on a C, exercising on a SB during arm ergometry can elevate an indicator of fat metabolism without affecting an indicator of carbohydrate metabolism or vascular resistance.

3319 Board #188 June 2 9:30 AM - 11:00 AM

**The Influence of Environmental Temperature on Metabolic Flexibility in Young Healthy Adults During Exercise**

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*(No relevant relationships reported)*

Metabolic flexibility is the ability of an organism to match fuel oxidation to its availability. It tends to be compromised in individuals suffering from metabolic diseases, lipo- and glucotoxicity, and mitochondrial dysfunctions. Recent incremental maximal oxygen consumption exercise studies performed in cold environments have demonstrated an increase in lipid oxidation over a wide range of exercise intensities. Whether metabolic flexibility is compromised or altered by a drive in lipid utilization during exercise in the cold remains unclear.

**PURPOSE**

The aim of the present study was to investigate whether metabolic flexibility is altered during incremental maximal exercise to volitional fatigue in a cold environment.

**METHODS**

Ten healthy participants ( $22 \pm 1$  yrs,  $68.1 \pm 7.8$  kg,  $169.7 \pm 4.9$  cm,  $21.1 \pm 9.7$  %BF) dressed in shorts and a t-shirt, performed four maximal incremental treadmill tests to volitional fatigue, in a fasted state. Tests were performed in a cold ( $0.89^\circ C \pm 1.8$ ) (CO) or a thermoneutral (TN) environment ( $22.0^\circ C \pm 0.9$ ), with and without a pre-exercise ingestion of a 75-g glucose solution. Paired t-tests were performed to compare the effects of temperature using the difference between glucose and non-glucose conditions. Differences in averaged respiratory exchange ratio ( $\Delta RER$ ) during the

entire exercise period, maximal fat oxidation ( $\Delta\text{MFO}$ ), and where MFO occurred along the exercise intensity spectrum ( $\Delta\text{Fat}_{\text{max}}$ ) were analysed via whole-body indirect calorimetry.

#### RESULTS

No statistical differences in fat utilization during CO exercise when compared to TN as indicated by  $\Delta\text{RER}$  ( $0.05 \pm 0.02$  vs.  $0.05 \pm 0.02$ ;  $p = 0.584$ ),  $\Delta\text{MFO}$  ( $0.21 \pm 0.18$  vs.  $0.16 \pm 0.13$   $\text{g}\cdot\text{min}^{-1}$ ;  $p = 0.133$ ) and  $\Delta\text{Fat}_{\text{max}}$  ( $13.3 \pm 19.0$  vs.  $0.6 \pm 21.3$   $\% \text{VO}_{2\text{peak}}$ ;  $p = 0.266$ ) in CO and TN, respectively.

#### CONCLUSION

A cold environment increases lipid contribution as metabolic fuel during exercise, and may be considered in training and health-intervention strategies. In the present study, an acute glucose ingestion causing a shift in carbohydrate utilization, was similar in both the cold and thermoneutral environment, indicating that exercising in a cold environment does not compromise metabolic flexibility. Future exercise studies should investigate the metabolic influences of high-fat diets and acute lipid overload in cold and warm environments.

3320 Board #189 June 2 9:30 AM - 11:00 AM

#### Attenuated Fat Oxidation Rates in ME/CFS Patients

Jeff Cournoyer, Graham Salmun. *Nova Southeastern University, Miami, FL.*

(No relevant relationships reported)

Chronic Fatigue Syndrome (CFS) is a condition characterized in part by inexplicable severe fatigue, and post-exertional malaise (PEM), which is defined by crippling exhaustion coupled with flu-like symptoms resulting from physical and/or mental exertion. Fear of severe PEM in CFS patients often leads to extended inactivity periods and as a consequence, the disease state is characterized by a highly sedentary lifestyle with activity levels far below those typically observed in sedentary healthy controls (HC). Prior studies on CFS have observed impairments in aerobic capacity ( $\text{VO}_2$  max) coupled with increased rates of perceived exertion during a GXT; however, no study to date has examined if these impairments in aerobic capacity are correlated with a reduced fat oxidative capacity at increasing exercise intensities. **PURPOSE:** The purpose of our study is to identify changes in fat oxidation patterns during increasing exercise intensities as a result of the CFS disease state. **METHODS:** Twenty male patients ( $39.6 \pm 12.4$  yrs) were divided into two groups: CFS ( $N=14$ ) and HC ( $N=6$ ). Participants were asked to perform a maximal exercise test on a cycle ergometer, with an initial resistance of 60 Watts and increasing by 30 Watts until volitional fatigue was reached or a peddling cadence of 55-65 RPM was no longer maintained.  $\text{VO}_2$  Max, time to exhaustion (tE), Maximal Fat Oxidation (MFO) and Total Fat Oxidation (TFO) were recorded for all participants and 2-tailed T-tests were used to determine significant differences between the two groups. **RESULTS:** MFO (HC mean: 617 g/day, CFS mean: 339.5 g/day;  $p < 0.05$ ) and TFO (HC mean: 10 kcal, CFS mean: 2.8 kcal;  $p < 0.05$ ) were lower in CFS patients, but no significant difference was observed in tE (HC mean: 11.2 minutes, CFS mean: 8.1 minutes;  $p < 0.05$ ),  $\text{VO}_2$  Max (HC mean: 27.9 ml/kg/min, CFS mean: 26.3 ml/kg/min;  $p = 0.66$ ) or FatMAX (CFS: 41.2% of  $\text{VO}_2$  Max, HC: 48.9% of  $\text{VO}_2$  Max;  $p > 0.05$ ). **CONCLUSION:** Patients diagnosed with CFS displayed significantly lower capacity for fat oxidation than HC, though their tE was not significantly less. This might indicate a propensity for CFS patients to spend more time in an anaerobic state.

3321 Board #190 June 2 9:30 AM - 11:00 AM

#### High Doses Of Branched-chain Amino Acids Supplementation Associated To Sprint Interval Training Improves Metabolic Profile

Elias de França, Ana Paula Xavier, Erico Chagas Caperuto. *Universidade São Judas Tadeu, São Paulo, Brazil.*

(No relevant relationships reported)

High doses of BCAA supplementation have unclear effects on cardiovascular diseases (CVD) biomarkers and energy metabolism in humans, even more when its associated to sprint interval training (SIT).

**PURPOSE:** The aims of this study was to evaluate the effects of BCAA supplementation associated with SIT on energy metabolism and CVD biomarkers. **METHODS:** 40 overweight and sedentary volunteers (height:  $169 \pm 8$  cm; age:  $32 \pm 7$  y; weight:  $74.5 \pm 10.7$  Kg) were randomly distributed into 4 groups: S-PLA= sedentary + placebo; S-BCAA= sedentary + BCAA; SIT-PLA= SIT + placebo and, SIT-BCAA= SIT + BCAA. Supplementation was 300 mg/kg<sup>-1</sup>/dia<sup>-1</sup> of BCAA (plus 200 mg/kg<sup>-1</sup>/dia<sup>-1</sup> of maltodextrin) or 500 mg/kg<sup>-1</sup>/dia<sup>-1</sup> of waxy maize (placebo), 3 times-a-day, for 8 weeks. During this period, SIT-PLA and SIT-BCAA groups did cycle ergometer training 3 days/wk (4-8 sets of 30-s "all-out" bouts, with 4.5 min. recovery between sets). Pre- and post-treatment CVD biomarkers variables were evaluated:  $\text{VO}_{2\text{peak}}$ , total cholesterol (TC) and their fractions (HDL and LDL), triglycerides, C-reactive protein (PCR), HbA1c, %BF, also respiratory exchange ratio (RER), blood glucose [GI] and lactate [La] concentration, at rest and during exercise, as energy metabolism variables. **RESULTS:** Post-treatment  $\text{VO}_{2\text{peak}}$  increased ( $p < 0.05$ ) significantly in the SIT-PLA (95% CI: 2 to 7.6 mL.kg<sup>-1</sup>.min<sup>-1</sup>, Cohen's  $d = 0.41$ ) and SIT-BCAA (1 to 7.7, -0.50)

groups only, with no difference between them; There was no treatment effect ( $p > 0.05$ ) in %BF, TC and PCR in any groups; However, in the SIT-BCAA group only, there was a decrease ( $p < 0.05$ ) in HbA1c (-5.03 to -0.88%, 0.85), LDL (-42.90 to -1.03 mg/dl, 0.51) and an increase in HDL (2.91 to 18.85 mg/dl, -1.24), while triglycerides decreased ( $p < 0.01$ ) in both S-BCAA (-185.96 to -7.95 mg/dl, 1.09) and SIT-BCAA (-119.68 to -28.74 mg/dl, 1.19) groups only; Treatment effect was observed on RER which decreased in SIT-BCAA group only ( $p < 0.01$ ,  $\eta^2 = 0.218$ ) and tend to decrease in SIT-PLA group only ( $p = 0.06$ ,  $\eta^2 = 0.069$ ); [GI] decreased in S-BCAA ( $p < 0.01$ ,  $\eta^2 = 0.440$ ), SIT-PLA ( $p < 0.01$ ,  $\eta^2 = 0.287$ ) and SIT-BCAA ( $p < 0.001$ ,  $\eta^2 = 0.460$ ) groups only, with no difference between them; [La] decreased in SIT-PLA group only ( $p = 0.02$ ,  $\eta^2 = 0.220$ ).

**CONCLUSIONS:** BCAA supplementation associated with SIT promotes some synergistic changes on CVD biomarkers and energy metabolism.

3322 Board #191 June 2 9:30 AM - 11:00 AM

#### L-glutamine and L-alanine Improve Energy Status and Skeletal Muscle Cytoprotection in Rats Submitted to Heavy Resistance Exercise

Julio -, Tirapegui, Raquel Raizel, Audrey Coqueiro, Andrea Bonvini, Thaís Hypólito, Amanda Garcia, Rafael Lara. *University of São Paulo, São Paulo, Brazil.*

(No relevant relationships reported)

Strenuous exercise results in muscle damage and low cellular energy levels, which activates the AMP-activated protein kinase (AMPK), a sensor of energy status, as well as induces the expression of forkhead box O1 (FOXO1), linked to delayed skeletal muscle regeneration. Glutamine and alanine are the most important gluconeogenic and cytoprotection-related amino acids, and have been demonstrated to attenuate exercise-induced muscle damage and inflammation. However, whether these amino acids have a role in regulating energy status and muscle damage during heavy resistance exercise (HRE) remain largely unknown. **PURPOSE:** To evaluate the effects of chronic oral supplementation with L-glutamine and L-alanine in their free form (GLN+ALA, ALA) or as the dipeptide L-alanyl-L-glutamine (DIP) on energy status, muscle damage and cytoprotection markers in skeletal muscle of rats submitted to heavy resistance exercise (HRE). **METHODS:** Forty adult male Wistar rats (n 8/ group) were submitted to 8-week HRE, which consisted of climbing a ladder with progressive loads (25 to 100% of body weight), and to supplementation delivered in a 4% solution in drinking water, in the last 21 days of HRE. Phosphorylation of AMPK and FOXO1, as well as the expression of apoptosis-inducing factor (AIF) and the 27 kDa heat shock protein (HSP27) were assayed in tibialis anterior muscle by western blotting. **RESULTS:** HRE promoted skeletal muscle damage by increasing AIF and HSP27 contents in muscle of CTRL (by 85%) and ALA (by 158%) groups ( $p < 0.05$  vs sedentary). Conversely, GLN+ALA and DIP attenuated these effects. Additionally, supplements containing L-glutamine decreased the exercise-induced phosphorylation of AMPK by 24% ( $p < 0.05$  vs. CTRL and ALA groups) and of FOXO1 by 53% in muscle of rats treated with GLN+ALA and DIP ( $p < 0.05$  vs. SED, CTRL and ALA groups). **CONCLUSION:** Chronic oral supplementation with L-glutamine (given along with free L-alanine or as dipeptide) improved muscle energy status by decreasing AMPK phosphorylation and promoted muscle protection by decreasing FOXO1 phosphorylation and HSP27 and AIF contents in response to HRE. Supported by FAPESP Grant 2012/21087-4.

3323 Board #192 June 2 9:30 AM - 11:00 AM

#### Effects Of A Liquid Breakfast With Varying Doses Of Whey And Soy On Appetite, Energy Intake And Hormone Response

Svetlana Nepocatych, Caroline E. Melson, Takudzwa A. Madzima. *Elon University, Elon, NC.* (Sponsor: Eric Hall, FACSME)

(No relevant relationships reported)

**PURPOSE:** The study examined the effects of a liquid breakfast meal containing varying doses of whey (WP) and soy protein (SP) on appetite, subsequent energy intake, and hormone response.

**METHODS:** Seventeen participants (age:  $27 \pm 7$  y, body fat:  $21.5 \pm 6.9\%$ , basal metabolic rate:  $1741 \pm 391$  kcal/day) in randomized order consumed one of five isoenergetic liquid breakfast meals (~500kcal) including control (CHO), low WP (LWP; 21.5 g), high WP (HWP; 43 g), low SP (LSP; 25 g) and high SP (HSP; 50 g) followed by an *ad libitum* lunch 3 hours later. Appetite profile was measured before, immediately after and hourly during the 3 hour postprandial period. Plasma concentrations of leptin and insulin were measured before, at 30 and 180 minutes after the meal and were analyzed via ELISA. A 5 x 3 (meal x time) repeated measures ANOVA were used to analyze data. Significance was accepted at  $p < 0.05$ .

**RESULTS:** Energy intake at lunch per kilogram of body weight was significantly higher after CHO ( $11 \pm 3.6$  kcal/kg) compared to LWP ( $9.5 \pm 2.9$  kcal/kg), HWP ( $9.1 \pm 3.0$  kcal/kg), and HSP ( $9.1 \pm 3.0$  kcal/kg) but not compared to LSP ( $10.2 \pm 2.7$  kcal/kg). Participants hunger, desire to eat, and estimated amount of food to be consumed

were higher, whereas, satiety and fullness were lower after CHO ( $p < 0.05$ ) compared to LWP, HWP and HSP but not compared to LSP. There were no significant differences ( $p > 0.05$ ) observed in postprandial leptin or insulin responses between meals, however, a significant change over time was observed for insulin ( $p = 0.02$ ) but not leptin ( $p > 0.05$ ). Insulin increased by  $293 \pm 89$  ng/ml at 30 min and decreased by  $-291 \pm 92$  ng/ml at 180 min post meal, whereas, leptin decreased by  $-37 \pm 29$  ng/ml and  $-10 \pm 5$  ng/ml at 30 and 180 min, respectively.

**CONCLUSIONS:** Liquid breakfast meals with higher doses of whey and soy protein reduced subsequent energy intake at lunch and were rated as more satiating compared to an isoenergetic CHO meal. In addition, postprandial levels of leptin and insulin did not differ between meals suggesting that acute changes in energy intake and satiety perception may not be influenced by circulating leptin levels.

**3324 Board #193 June 2 9:30 AM - 11:00 AM**  
**Dietary Amino Acid Availability and Anabolic Signaling Molecule Phosphorylation is Blunted in Maintenance Hemodialysis Patients**

Nicholas A. Burd, Stephan van Vliet, Sarah K. Skinner, Joseph W. Beals, Hsin-Yu Fang, Alexander V. Ulanov, Scott A. Paluska, FACSM, Kenneth R. Wilund. *University of Illinois at Urbana-Champaign, Urbana, IL.* (Sponsor: Scott A. Paluska, FACSM) (No relevant relationships reported)

Skeletal muscle mass loss is a common feature in patients with renal failure receiving maintenance hemodialysis (MHD) therapy. Dietary protein (amino acids) is one of the main anabolic stimuli to skeletal muscle tissue in humans, and impairments to anabolic stimuli over time may lead to muscle mass loss. However, there are major gaps in our knowledge of how muscle mass is regulated by protein intake in MHD patients. **PURPOSE:** To compare dietary protein digestion and absorption kinetics and phosphorylation of anabolic signaling proteins after mixed meal ingestion in MHD patients and age- and BMI-matched controls. **METHODS:** 8 MHD patients (age:  $56 \pm 5$  y; BMI:  $32 \pm 2$  kg/m<sup>2</sup>) and 8 controls (age:  $50 \pm 2$  y; BMI:  $31 \pm 1$  kg/m<sup>2</sup>) received primed continuous infusions of L-[1-<sup>13</sup>C]leucine and ingested a mixed meal (546 kcal, 20 g protein, 59 g carbohydrate, 26 g fat) with protein provided as intrinsically L-[5,5,5-<sup>2</sup>H<sub>3</sub>] leucine labeled eggs. Breath, blood, and muscle biopsies were collected to determine amino acid concentrations, leucine enrichments, and phosphorylation of mTORC1 on Ser2448 during a 5 postprandial period. **RESULTS:** Postprandial release of dietary leucine into circulation over 5 h was reduced in MHD patients ( $41 \pm 5\%$ ) vs. controls ( $61 \pm 4\%$ ;  $P = 0.03$ ). The feeding-mediated increase in mTORC1 phosphorylation was blunted in MHD patients (0.6-fold above basal) vs. controls (1.1-fold above basal;  $P = 0.006$ ) at 5 h of the postprandial period. **CONCLUSION:** Our data demonstrated impaired kinetics of digestion/absorption of dietary proteins and reduced postprandial plasma amino acid availability in circulation after mixed meal ingestion in MHD patients when compared to age- and BMI-matched controls. This diminished dietary amino acid availability may have partly contributed to the blunted anabolic signaling mechanisms in MHD patients.

Supported by the Egg Nutrition Center (ENC)

**G-44 Free Communication/Poster - Behavioral Aspects and Correlates of Concussions**

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
 Room: CC-Hall B

**3325 Board #194 June 2 9:30 AM - 11:00 AM**  
**Concussion History Moderates Relationships Between Neural and Clinical Outcomes in Special Operations Forces Personnel**

Cassie B. Ford<sup>1</sup>, Michael J. Cools<sup>1</sup>, Stephen M. DeLellis<sup>2</sup>, Shawn F. Kane, FACSM<sup>2</sup>, Robert H. Lutz<sup>2</sup>, James H. Lynch, FACSM<sup>2</sup>, Jason P. Mihalik<sup>1</sup>. <sup>1</sup>The University of North Carolina at Chapel Hill, Chapel Hill, NC. <sup>2</sup>United States Army Special Operations Command, Fort Bragg, NC.

**Reported Relationships:** C.B. Ford: Contracted Research - Including Principle Investigator; UNC received funding from the United States Army Special Operations Command to conduct this work.

Computerized neurocognitive tests such as Immediate Postconcussion Assessment and Cognitive Test (ImPACT) evaluate athletes at baseline and post injury in clinical and research settings. Visual and sensory performance (VSP) assessments evaluate and improve performance in both healthy and post-injury populations. These assessments are differentially sensitive to concussion history. The relationship among injury history, neurocognitive testing, VSP assessments and structural neuroimaging within the Special Operations Forces (SOF) population is unknown.

**PURPOSE:** To test whether cortical thickness (CT) mediates, and concussion history moderates, relationships among cognitive and visual-sensory tests. **METHODS:** SOF personnel completed the following: 3T high-resolution MRI, ImPACT, and VSP tests (Nike SPARQ or Senaptec Sensory Station). The SOF personnel were categorized by self-reported concussion history (none, 1+). We used FreeSurfer to reconstruct and segment the cerebral cortex. After examining bivariate correlations between all variables, path analyses tested whether CT mediated select relationships between ImPACT composites and VSP outcomes, with concussion history as a moderator.

**RESULTS:** 155 SOF personnel (149 males; 54 self-reported concussion history) were imaged and completed ImPACT; 147 also completed VSP tests (127 Nike SPARQ; 20 Senaptec) during healthy baseline testing. There was a significant total effect of ImPACT Verbal Memory and CT (for regions associated with motor function and semantic responses) on Perception Span for those with a concussion history. Conversely, we found significant effects of ImPACT Motor Speed and CT on Go/No-Go, but only for those without concussion history. Although we found significant relationships between variables, there was no evidence that the effect of ImPACT composites on VSP outcomes was due to differences in CT. **CONCLUSIONS:** Concussion history differentially moderated the relationship among clinical outcome variables and neural structure, but neural structure did not mediate relationships between clinical outcomes. Understanding these relationships may help us better understand the effects of concussion and direct research towards tracking specific outcomes of clinical importance.

Supported by USASOC

**3326 Board #195 June 2 9:30 AM - 11:00 AM**  
**Concussion History Predicts Reduced Cortical Thickness in Special Operations Forces Personnel**

Jason P. Mihalik<sup>1</sup>, Cassie B. Ford<sup>1</sup>, Michael J. Cools<sup>1</sup>, Stephen M. DeLellis<sup>2</sup>, Shawn F. Kane, FACSM<sup>2</sup>, Robert H. Lutz<sup>2</sup>, James H. Lynch, FACSM<sup>2</sup>. <sup>1</sup>The University of North Carolina at Chapel Hill, Chapel Hill, NC. <sup>2</sup>United States Army Special Operations Command, Fort Bragg, NC.

**Reported Relationships:** J.P. Mihalik: Contracted Research - Including Principle Investigator; UNC received funding from the United States Army Special Operations Command to conduct this work.

Special Operations Forces (SOF) personnel are at high risk for repetitive blast and head impact exposure. Non-invasive neuroimaging techniques, such as magnetic resonance imaging (MRI), have identified concussion-related structural differences even when observable behavioral and cognitive deficits are absent. The relationship between injury history, neuroimaging, and standard clinical tests has not previously been defined in the SOF population.

**PURPOSE:** To compare cortical morphology, symptom scores, and neurocognition in SOF personnel with and without concussion history. **METHODS:** SOF personnel completed an assessment battery including 3T high-resolution MRI and the Immediate Postconcussion Assessment and Cognitive Test (ImPACT). We examined symptom reporting and the ImPACT composite scores for verbal and visual memory, visual-motor processing speed, reaction time, and impulse control. The SOF personnel were categorized by self-reported concussion history (no history vs. 1+ concussions). We used FreeSurfer (v6) to reconstruct and segment the cerebral cortex. Cortical thickness was regressed on concussion history controlling for estimated total intracranial volume. The symptom reporting and ImPACT composite scores were regressed on concussion history. **RESULTS:** We imaged 166 SOF personnel (160 males; 65 self-reported concussion history) using MRI. Of these, 155 completed the ImPACT during a healthy baseline testing session. Two brain regions had reduced cortical thickness associated with concussion history, controlling for the total intracranial volume: left pericalcarine ( $t_{164} = 2.00$ ,  $p = 0.04$ ); and left parahippocampal ( $t_{164} = 2.81$ ,  $p = 0.006$ ). One region had larger cortical thickness in those with a concussion history: right transverse temporal ( $t_{164} = 2.35$ ,  $p = 0.02$ ). Concussion history did not predict symptom or ImPACT composite score differences ( $p > 0.05$ ). **CONCLUSIONS:** Concussion history predicted cortical thickness in brain regions associated with vision and memory, which are cognitive functions affected following concussive injury. The ImPACT composites were not sensitive to concussion history.

Supported by the United States Army Special Operations Command (USASOC)

**3327 Board #196 June 2 9:30 AM - 11:00 AM**  
**Predicting Concussion Incidence from Baseline Data in High School and Collegiate Football Athletes**

Anna Klotz, Jana Ranson, Brain D. Stemper, Alok S. Shah, Michael A. McCrea, Lindsay D. Nelson. *Medical College of Wisconsin, Milwaukee, WI.*

(No relevant relationships reported)

**PURPOSE:** Sport-related concussions (SRCs) occur at an estimated rate of 300,000 per year with the highest number occurring in high school and collegiate football. It has been found that unsafe playing styles cause about 25% of football SRCs, making behavior—and the motives, attitudes, and personality traits that drive it—a credible

SRC risk factor that is largely overlooked. **METHODS:** The current study examined associations between self-report personality measures, head impact telemetry (HITS) data, and SRC incidence in a sample of high school and collegiate football players. Data were retrieved from Project Head-to-Head II, a large ( $N=1,154$ ), prospective SRC study conducted between the 2015-2017 football seasons. Participants were categorized as either "concussed" (those who completed baseline testing and were concussed during the evaluation period) or "nonconcussed" (athletes from the same teams who did not get concussed). Cumulative risk metric (CRM) is a cumulative head impact severity estimate from the HITS data and was used to operationalize playing style. **RESULTS:** Results from binomial logistic regression showed that concussion group membership was significantly ( $p \leq .05$ ) predicted by physically expressed anger, aggression, meanness, negative affect/emotionality psychoticism, detachment, and alienation, which corroborates related literature suggesting that such personality traits could lead to potentially hazardous playing styles. Nonconcussion group membership was significantly predicted by older age, more years of playing experience, communal positive emotionality, social closeness, and resilience. This suggests that maturity, playing experience, and having a pro-social personality may promote safer playing styles which could curtail the risk of concussion in football athletes. There was a great deal of uniformity among the personality traits that predicted concussion risk and the traits that predicted playing style (CRM). **CONCLUSIONS:** These findings highlight the potential role of personality in concussion risk and should be considered by coaches and athletic trainers to help develop prevention and intervention strategies that encourage on-field safety and reduce the risk of SRC.

3328 Board #197 June 2 9:30 AM - 11:00 AM

### Collegiate Football Player Parents' Perceptions of Concussion Risk

Samuel J. Haag, Angela H. Nippert, Katie J. Fischer, Lana L. Huberty. *Concordia University, St. Paul, St. Paul, MN.*

(No relevant relationships reported)

Concussion is one of the most common sports-related injuries in the United States and is especially prevalent in youth sports such as football, ice hockey, and soccer. While all stakeholders are concerned about head trauma in youth sport, parents have an especially strong influence on their children's participation in organized sports. However, few studies have analyzed how parents' knowledge of concussion in sport may affect their decisions regarding youth sport participation.

**PURPOSE:** To explore parental perceptions regarding concussion risk in football and how these perceptions influence subsequent advice offered to other parents contemplating their children's participation in football. **METHODS:** A mixed-methods approach was employed using an online questionnaire distributed to 100 parents of current NCAA Division II football players at a small Midwestern university. The questionnaire included items related to their son's football participation and concussion history as well as their own awareness and perception of concussion risk. Several items included open-ended follow-up questions to allow for qualitative responses, which were coded through inductive analysis and grouped into thematic categories. **RESULTS:** Thirty-four parents of collegiate football players completed the questionnaire (34% response rate). Thirteen (38%) respondents believed their son had experienced a concussion and nine (26%) reported their son had been diagnosed with at least one concussion while playing football. Fourteen (41%) reported the benefits of football participation outweighed the risks and 29 (85%) would still have allowed their son to play football. Only four (12%) parents reported they would discourage other parents from allowing their children to participate in football. Overall, qualitative analysis showed parents perceived the benefits of football participation outweighed the risks and would advise other parents to conduct their own risk-benefit analysis during the decision making process. **CONCLUSIONS:**

Parents of collegiate football players believe the benefits of football participation outweigh the risks and generally would not discourage other parents from allowing their children to participate in football.

3329 Board #198 June 2 9:30 AM - 11:00 AM

### Adolescent and Collegiate Knowledge and Behavior Regarding Concussion

Brent Harper, Adrian Aron, Alex Siyufy. *Radford University, Roanoke, VA.* (Sponsor: A. Lynn Millar, FACSM)

(No relevant relationships reported)

**PURPOSE:** To compare adolescent concussion knowledge and behaviors regarding concussion to that of collegiate students using a modified Rosenbaum Concussion Knowledge and Attitudes Survey (RoCKAS) questionnaire.

**METHODS:** Two groups ( $n=222$ ) completed the questionnaire. Group 1 (HSS) included female and male 9<sup>th</sup> and 10<sup>th</sup> grade high school students ( $n=190$ ) with a mean age of  $15.1 \pm 0.8$  years (64.7% female; 35.3% male) and group 2 (CS) included female and male collegiate students ( $n=32$ ) with a mean age of  $19.1 \pm 1.1$  years (78.1% female; 21.9% male). Of HSS, 59.4% reported belonging to a competitive sports team compared to 87.5% of CS ( $p=0.007$ ). A sampling of questions from the RoCKAS

questionnaire was used to assess groups for: (1) general concussion knowledge and (2) the demonstration of safe behaviors in situational decision making ("safe" or "unsafe").

#### RESULTS:

Sample survey questions evaluated if the participants were actually reading and answering the questions thoughtfully. Scores were high in both groups with no statistically significant difference (HSS 88.5%; CS 93%;  $p=0.13$ ). General concussion knowledge was correctly answered by 83.8% of the HSS compared to 93% of the CS ( $p=0.007$ ). HSS not participating in athletics were less knowledgeable than those participating in sports (20.1% compared to 13.5%,  $p=0.01$ ). HSS males not participating in sports answered incorrectly 23.4% of the time compared with HSS males in sports (12.2%,  $p=0.03$ ). No statistical significance comparing HSS females in relation to sports participation. Responses to the four situational questions analyzed identified that HSS answered unsafely on the behavior questions in a higher proportion compared to CS (87.1% vs. 17.1%,  $p=0.0001$ ). In fact, actual age of the participants negatively correlated with the behavior answers ( $r=-0.4$ ,  $p=0.0001$ ). Although older college students have safer attitudes, there was a significant difference between females and males (89.2% compared to 64.3%,  $p=0.005$ ).

**CONCLUSIONS:** HSS and CS are knowledgeable about concussion. Age is positively associated with increased knowledge. HSS participating on sporting teams are more knowledgeable, especially males. HS students make more unsafe situational decisions compared to their collegiate counterparts and female CS demonstrate the safest behavior.

3330 Board #199 June 2 9:30 AM - 11:00 AM

### Sedentary Behavior Predicts Headache Pain Following Mild Traumatic Brain Injury: Mediating Role Of Pain Catastrophizing.

Christopher Carey<sup>1</sup>, Kelly M. Naugle<sup>1</sup>, Jonathan Saxe<sup>2</sup>, Fletcher A. White<sup>3</sup>. <sup>1</sup>IUPUI, Indianapolis, IN. <sup>2</sup>St. Vincent Health, Indianapolis, IN. <sup>3</sup>Indiana University School of Medicine, Indianapolis, IN.

(No relevant relationships reported)

The acute management of mild traumatic brain injury (mTBI), particularly in athletes, typically includes a period of physical rest during symptom resolution. However, evidence for the use of rest versus physical activity to aid in mTBI recovery is mixed and may depend on symptom type and severity. Post-traumatic headaches (PTH) are one of the most common and long-lasting symptoms of mTBI. While physical activity is often used in the non-pharmacological management of primary headache disorders, the relationship between PTH's and physical activity behavior in the first month post-injury remains poorly understood. **PURPOSE:** To determine if self-reported physical activity behavior predicts headache pain in mTBI patients within 1 month of head injury, and whether psychological factors mediate this relationship. **METHODS:** Twenty-seven mTBI patients recruited from Emergency Departments completed study sessions at 1-2 weeks and 1-month post head injury. The McGill Pain Questionnaire (MPQ) provided a quantitative evaluation of the patient's headache pain experience. The International Physical Activity Questionnaire - short form assessed the amount of time in the past week participants spent on vigorous and moderate intensity activity, walking, and sitting. Participants also completed the Pain Catastrophizing Scale, which assesses negative mental responses to anticipated or actual pain. Simple and multiple linear regressions were used to test whether physical activity behavior and pain catastrophizing predicted headache pain at 1 month post injury, and whether pain catastrophizing mediated this relationship. **RESULTS:** Separate simple regression analyses indicated the following: 1) time sitting at 2 weeks post-injury predicted pain on the MPQ at 1 month ( $B=.41$ ,  $p=.035$ ), 2) time sitting at 2 weeks predicted pain catastrophizing at 1 month ( $B=.38$ ,  $p=.049$ ), 3) pain catastrophizing predicted pain on the MPQ at 1 month ( $B=.53$ ,  $p=.003$ ). When pain catastrophizing and time sitting were both entered as predictors into the same regression model, pain catastrophizing was the only significant predictor of pain on the MPQ. **CONCLUSIONS:** Results suggest that increased sitting in the acute stage of mTBI predicted greater headache pain in the subacute stage of injury, and this relationship was mediated by pain catastrophizing.

3331 Board #200 June 2 9:30 AM - 11:00 AM

### Factors Associated with Intention to Disclose Concussive Symptoms among Service Academy Cadets: The BANK Study

Johna K. Register-Mihalik<sup>1</sup>, Kenneth L. Cameron<sup>2</sup>, Laura A. Linnan<sup>1</sup>, Melissa C. Kay<sup>1</sup>, Megan N. Houston<sup>2</sup>, Karen Y. Peck<sup>2</sup>, Heidi J. Hennink-Kaminski<sup>1</sup>, Steven J. Svoboda<sup>2</sup>, Paula Gildner<sup>1</sup>, Zachary Y. Kerr<sup>1</sup>, Kevin M. Guskiewicz, FACSM<sup>1</sup>, Stephen W. Marshall<sup>1</sup>. <sup>1</sup>University of North Carolina at Chapel Hill, Chapel Hill, NC. <sup>2</sup>Keller Army Hospital, West Point, NY.

(No relevant relationships reported)

Intention to disclose concussive symptoms is a significant factor often associated with actual concussion disclosure behaviors. Understanding ItD is key to developing

culturally relevant concussion-related interventions in high risk populations.

**PURPOSE:** The purpose of this study was to examine factors influencing intention to disclose (ItD) concussion symptoms among first-year service academy cadets. **METHODS:** First-year service academy cadets at the United States Military Academy completed a validated cross-sectional survey based on the Theory of Planned Behavior, including: demographics, medical history, concussion-related knowledge (scale=0-39), attitudes (scale=6-42), subjective norms (scale=7-49), perceived control (scale=1-7), and ItD (scale=1-7). All scales had a Cronbach's alpha >0.75. Multiple linear regression predicted mean differences (MD) in ItD. Independent variables included: gender (female vs. male), race (non-Caucasian vs. Caucasian), ethnicity (non-Hispanic vs. Hispanic), previous concussion history (no vs. yes), previous concussion education (no vs. yes), socioeconomic proxy (parent without college education vs. with), concussion-related knowledge, attitudes, perceived social pressures, and perceived control over disclosure. Alpha level was set to 0.05 *a priori*. **RESULTS:** A total of 972 first-year cadets (201 Females; 281 Division I student-athletes) completed the survey (85% response rate). Average ItD was 5.9±1.2 (IQR: 6.0, 7.0). In the multivariable model, stronger ItD was associated with: being non-Hispanic (MD=0.22; p=0.042); no previous concussion education (MD=0.20 p=0.005); more favorable attitudes (MD=0.19; p<0.001) and perceived social pressures (MD=0.55; p<0.001), and more perceived control over concussion disclosure (MD=0.17; p<0.001). **CONCLUSIONS:** Our data suggest perceived social pressures strongly influence ItD. Clinicians and health educators should consider culturally and organizationally appropriate intervention strategies among service academy cadets and their key social referents including classmates, cadre, and commanding officers. In context with other factors, ethnicity and concussion education may also influence ItD. Supported in part by a grant from the NCAA-DOD Mind Matters Research Challenge.

**G-45 Free Communication/Poster - Exercise Psychology- Pedagogy**

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
Room: CC-Hall B

3332 Board #201 June 2 9:30 AM - 11:00 AM  
**Innovative Curricula Technology in the Exercise Science Classroom: Perceptions of Faculty and Students**  
Katherine E. Clark<sup>1</sup>, Judith A. Juvancic-Heltzel<sup>2</sup>, Laura A. Richardson<sup>2</sup>. <sup>1</sup>University of Mount Union, Alliance, OH. <sup>2</sup>University of Akron, Akron, OH.  
(No relevant relationships reported)

**BACKGROUND:** Selecting appropriate pedagogies for meaningful engagement of today's college students can be challenging. Adequate preparation to meet the advances and challenges in our rapidly evolving profession requires mutual collaboration and open mindedness by both faculty and students alike. **PURPOSE:** The purpose of this study was to examine perceptions of faculty and students on the use of technology-based pedagogies in Exercise Science curricula. **METHODS:** A survey exploring perceptions of the integration and utilization of technology-based tools in the classroom was administered to participants (N = 51). Survey data was also collected regarding the types of technologies integrated into their respective classrooms. **RESULTS:** Respondent demographics included 43% faculty (N = 22) and 57% students (N = 29). Results revealed 72.5% of respondents prefer enrolling in courses which utilize technology; 72.5% believe technology helps with retention of information; 43% find it frustrating to learn new technologies; and 35% find technology to be a distraction from the intended content. Results also revealed 82% of respondents have used a recorded lecture technology; 41% have used a synchronous web-based lecture tool; and 23.5% have used an in-class app. **CONCLUSIONS:** As the student profile continually changes with our rapidly evolving technological society, it is paramount that educators keep abreast and adapt curricula by implementing innovative pedagogies. Understanding students' perceptions of classroom tools provides tangible evidence that educators must not remain stagnant with teaching styles. Additionally, understanding perceptions of faculty is equally imperative as many faculty still view modified teaching styles and the incorporation of technology as a barrier to the learning experience. Future investigations should further examine the benefits and barriers of technology as a potential tool to enhance learning experiences in a higher education setting.

3333 Board #202 June 2 9:30 AM - 11:00 AM  
**The Automated Wrist Blood Pressure Cuff as Teaching Tool**  
Marvin O. Boluyt, Carly Jones, Shannon Porterfield, Brad Spencer, Ann Brennan. *Washtenaw Community College, Ann Arbor, MI.*  
(No relevant relationships reported)

**PURPOSE:** The teaching and learning potential of the wrist blood pressure cuff were explored. The hypothesis that physics (acceleration due to gravity) would explain the variance in blood pressure readings when the wrist was placed in different positions was tested. **METHODS:** Subjects (n=27) were recruited from the student, staff, and faculty populations at Washtenaw Community College. In a seated position, systolic and diastolic blood pressures (BP) were obtained with a wrist cuff (Omron BP629) while the wrist was held in three different positions: above the heart (ear level) at the heart (chest level) and below the heart (high level). The differences in BP from chest level were plotted against the distance (cm) above or below the heart for each individual and compared to the theoretical slope calculated for the acceleration due to gravity. **RESULTS:** While it was clear that gravity was the predominant factor involved in the changes in BP, the slope of the observed line was consistently less steep than that predicted. To explore potential physiological influences on the changes in blood pressure, heart rate (HR) and oxygen consumption (VO2) were measured in separate sets of experiments on 5 subjects each. Both HR and VO2 were significantly elevated when one or both arms were elevated (p < 0.05). **CONCLUSIONS:** It was concluded that gravitational acceleration explains most, but not all of the variance in BP readings when the wrist is above or below the heart, and that physiological adjustments make a small but significant impact. The wrist BP cuff may provide opportunities for teachers and learners to experimentally explore physical and physiological factors that influence BP readings.

3334 Board #203 June 2 9:30 AM - 11:00 AM  
**Effects of Situated Learning with Cooperative Learning Strategies for Older Adults on Functional Fitness**  
Chin-Yun Huang<sup>1</sup>, Hui-Chuan Wei<sup>2</sup>, Lan-Yi Chang<sup>3</sup>, Li Lan Cheng<sup>2</sup>. <sup>1</sup>Nanhua University, Chia-Yi, Taiwan. <sup>2</sup>National Chung Cheng University, Chia-Yi, Taiwan. <sup>3</sup>Transworld University, Yun-Lin, Taiwan.  
(No relevant relationships reported)

Situated learning emphasizes that learning is an important social situation that occurs within everyday functional fitness and social interaction. Such learning interaction originates from social relations, cultural history, specific commodities, real life situations, and physical activity learning environment. Although cooperative learning strategies were found to improve positive effects of interactive learning, there is a lack of research on the impacts of their use in situated cognition teaching design on fitness and cognitive function improvement in older adults. **PURPOSE:** To examine the effects of situated learning and cooperative learning strategies for older adults on functional fitness. **METHODS:** A 2x3 factorial design for experimental study. 120 older adults aged > 65 years from purposive sampling classified as high and high, high and low, and low and low were randomly assigned to ability treatment. Participants were classified as high-or low-ability according to performance on the pretest of pre-existing functional fitness. For the purpose of creating heterogeneous group of older adults for situated learning with cooperative strategies, high and low ability participants were combined into the group. The instructional module utilized a macro context design. After participants completed 18 weeks of functional fitness program, a post-test was delivered. **Results:** On instructional factor, older adults working situated learning group with cooperative learning significantly outsourced those older adults on traditional learning environment. On ability factor, older adults working group with high and high, high and low pair significantly outsourced those older adults on low and low pair. However, the group with high and high comparing to high and low pair was not significantly different condition. On Interaction, one of crucial findings to emerge from the study was older adults in the low ability /situated learning with cooperative group outsourced those older adults in the low ability /traditional learning group. **Conclusions:** The structuring situations cooperatively may result in older adults processing functional fitness more effective learning than traditional instructional model.

3335 Board #204 June 2 9:30 AM - 11:00 AM  
**Effects Of 8-week Physical Education Courses On Body Image, Anxiety, And Exercise Self-efficacy**  
 Erica J. Roelofs, Sarah R. Du Bose. *Meredith College, Raleigh, NC.*  
*(No relevant relationships reported)*

Exercise has been identified as a potential tool to mediate anxiety and improve self-efficacy and body image, however, the effectiveness of college physical education (PE) courses on psychological health needs further evaluation. **PURPOSE:** To examine the effects of 8-week PE courses on body image, anxiety, and exercise self-efficacy. **METHODS:** Seventy-five females (mean  $\pm$  SD; Age: 20.8  $\pm$  3.6 y; Height: 164.7  $\pm$  7.0 cm; Weight: 68.5  $\pm$  16.3 kg; Body fat percentage [BF%]: 27.3  $\pm$  8.7 %) enrolled in college PE courses of Kickboxing (n=14), Beginning Jogging (n=8), Intermediate Jogging (n=22), Strength Training (n=14), and Conditioning (n=15) volunteered to participate in this study. Each course met 3 times a week for 50 minutes each class period during the 8-week long course. At the start and completion of each course, participants completed the Body Shape Questionnaire, Exercise Self-Efficacy (ESE), and Social Physique Scale, and height, weight, and BF%, measured by bioelectrical impedance analysis, were recorded. **RESULTS:** There were no significant differences pre- to post-testing in weight or activity levels outside of PE in any of the 5 courses ( $p > 0.05$ ). BF% significantly decreased pre- to post-testing in Intermediate Jogging ( $p = 0.03$ ), but not in the other courses. Social physique anxiety decreased in Beginning Jogging ( $p = 0.024$ ) and Strength Training ( $p = 0.05$ ), but not in the other courses. All courses had a significant improvement in body image ( $p < 0.05$ ) and ESE ( $p < 0.05$ ). BF% had a significant negative correlation with body image ( $R = -0.53$ ,  $p < 0.05$ ) and ESE ( $R = -0.24$ ,  $p = 0.02$ ), and a positive correlation with anxiety ( $R = 0.53$ ,  $p < 0.05$ ). Individual health rating had a significant positive correlation with body image ( $R = 0.47$ ,  $p < 0.05$ ) and ESE ( $R = 0.44$ ,  $p < 0.05$ ), and a negative correlation with BF% ( $R = -0.26$ ,  $p < 0.05$ ) and anxiety ( $R = -0.42$ ,  $p < 0.05$ ). ESE had a significant positive correlation with body image ( $R = 0.40$ ,  $p = 0.003$ ) and anxiety ( $R = 0.32$ ,  $p = 0.033$ ). **CONCLUSIONS:** Lower BF% was associated with better body image, exercise self-efficacy, and lower anxiety. However, these results indicate regular exercise through 8-week PE college courses may aid in improving body image and exercise self-efficacy and decreasing anxiety even if there are no changes in weight or body fat percentage.

## G-46 Free Communication/Poster - Endocrinology/ Immunology II

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
 Room: CC-Hall B

3336 Board #205 June 2 9:30 AM - 11:00 AM  
**The Metabolic and Androgen Profiles of Exercising Women With Menstrual Disturbances**  
 Kristen J. Koltun, Nancy I. Williams, FACSM, Mary Jane De Souza, FACSM. *Pennsylvania State University, University Park, PA.* (Sponsor: Mary Jane De Souza, FACSM)  
*(No relevant relationships reported)*

Exercise associated menstrual disturbances (EAMD) are often attributed to hypothalamic inhibition of the reproductive axis secondary to energy deficiency. However, some exercising women with menstrual disturbances do not present with the traditional metabolic profile of suppressed resting energy expenditure (REE), decreased concentrations of total triiodothyronine (TT<sub>3</sub>) and leptin, and elevated ghrelin concentration typical of energy deficiency. Hyperandrogenism may be an alternative or coexisting mechanism underlying menstrual dysfunction in a subset of exercising women. **Purpose:** To determine if there are differences between the metabolic profiles of exercising women with menstrual disturbances with and without hyperandrogenism (EAMD-HA, n=30; EAMD-NA, n=67). **Methods:** Fasting blood samples were collected to assess TT<sub>3</sub>, leptin, ghrelin, sex hormone binding globulin (SHBG), and total testosterone (T) concentrations. Metabolic status was determined by TT<sub>3</sub>, leptin, ghrelin, BMI, percent body fat (%BF, DXA-derived), and measured REE compared to Harris-Benedict predicted REE (mREE/pREE). Androgen status was determined by SHBG, total T, and calculated free T; hyperandrogenism was defined as a calculated free androgen index (FAI) value  $> 2.92$  [FAI = totalT/SHBG\*100], which represented the upper bound of the 95% confidence interval for all subjects. Two-sided independent t-tests were used to compare differences between groups. **Results:** The EAMD-HA and EAMD-NA groups were similar with respect to age (22yrs), height (165.1cm), weight (57.19kg), and concentrations of ghrelin (1275.17pg/mL) and TT<sub>3</sub> (86.07ng/dL) ( $p > 0.05$ ). BMI ( $p = 0.005$ ), %BF ( $p = 0.015$ ), FAI ( $p < 0.001$ ), and leptin ( $p = 0.025$ ), total T ( $p < 0.001$ ) and cfree T concentrations ( $p < 0.001$ ) were all greater in EAMD-HA compared to EAMD-NA. SHBG concentrations ( $p < 0.001$ ) were lower in EAMD-HA compared to EAMD-NA. mREE/pREE was similar between groups and

below 0.90 (EAMD-HA: 0.87 $\pm$ 0.01; EAMD-NA: 0.86 $\pm$ 0.02,  $p > 0.05$ ). **Conclusion:** These findings support evidence that hyperandrogenism can coexist with an energy deficiency in exercising women and may contribute to menstrual disturbances. Proper screening must be conducted to ensure diagnosis and treatment of the appropriate etiology of menstrual disturbances.

3337 Board #206 June 2 9:30 AM - 11:00 AM  
**Influence of Body Fat on Bioactive and Immunoreactive Growth Hormone Exercise Responses in Women**  
 Matthew K. Beeler<sup>1</sup>, Emily M. Post<sup>1</sup>, Lydia K. Caldwell<sup>1</sup>, William H. DuPont<sup>1</sup>, John P. Anders<sup>1</sup>, Vincent H. Hardesty<sup>1</sup>, Emily C. Barnhart<sup>1</sup>, Emily C. Borden<sup>1</sup>, Jeff S. Volek<sup>1</sup>, Wesley C. Hymer<sup>2</sup>, William J. Kraemer, FACSM<sup>1</sup>. <sup>1</sup>The Ohio State University, Columbus, OH. <sup>2</sup>The Pennsylvania State University, University Park, PA. (Sponsor: William J Kraemer, FACSM)  
*(No relevant relationships reported)*

Body fat has been observed to influence bioactive growth hormone (BGH) and immunoreactive growth hormone (IGH) in men, but is unknown in women. The complexity of GH release from the anterior pituitary has increased with the discovery of two somatotrophs: band I molecular weight isoforms ( $< 30$  kD) called immunoreactive GH (IGH) and band II large molecular weight isoforms ( $> 60$  kD) called bioactive GH (BGH). **PURPOSE:** To determine the differences between untrained women with low and high body fat percentages. **METHODS:** Recreationally active women of low % body fat (LF) (N= 10), mean  $\pm$  SD: 22  $\pm$  3.4 yr, 168  $\pm$  5.3 cm, 67.8  $\pm$  5.3 kg, 17.3  $\pm$  2.0 % body fat, and women of high % body fat (HF) (N= 10); 23  $\pm$  1.9 yr, 167  $\pm$  4.3 cm, 68.4  $\pm$  5.3 kg, 34.3  $\pm$  3.7% body fat consented to participate in the study. The women were familiarized with the squat test protocol which consisted of 6 sets of 10 repetitions at 75% of their 1 RM with 2 minutes rest between sets after they were tested for 1 repetition maximum strength (1 RM) in the squat. All exercise tests were performed between 0630 and 1100 after an 8- to 12-h fast. Pre-exercise samples were obtained during the early follicular phase 15 min before test via standard venipuncture and a post-exercise sample was obtained immediately after the test. Plasma was collected and assayed for IGH using a monoclonal assay. Total BGH was assayed using the rat tibial line *in vivo* bioassay. A two-way analysis of variance (2 X 2) for group and time were used to analyze the data.  $A p \leq 0.05$  was used to define significance. **RESULTS:** No differences were observed between the groups for 1 RM strength in the squat. Both groups significantly increased their IGH concentrations pre to post-exercise: (LF: 4  $\pm$  3.1 to 18  $\pm$  3.6  $\mu\text{g}\ddot{\text{Y}}\text{L}^{-1}$ , HF: 3.9  $\pm$  3.5 to 17.2  $\pm$  3.0  $\mu\text{g}\ddot{\text{Y}}\text{L}^{-1}$ ). BGH did not increase pre to post-exercise, but both IGH and BGH values were significantly higher in the LF group than the HF group. Pre to post-exercise responses were: LF (4900  $\pm$  433 to 5200  $\pm$  393  $\mu\text{g}\ddot{\text{Y}}\text{L}^{-1}$ ), HF (1900  $\pm$  433 to 2200  $\pm$  323  $\mu\text{g}\ddot{\text{Y}}\text{L}^{-1}$ ). BGH was significantly higher than IGH values at all time points. **CONCLUSION** As previously observed in young men, body fat impacts the response of IGH to resistance exercise, even when BGH responses remain unchanged acutely. BGH in women with lower % body fat do not see the suppression that occurs in women with higher % body fat, which may be linked to GH binding protein activity.

3338 Board #207 June 2 9:30 AM - 11:00 AM  
**Associations Among Age, Physical Activity, and Serum Resistin and Adiponectin Levels**  
 Caitlyn A. Thomas, Victoria E. Warren, Kaitlin M. Frindt, Keenan R. Herman, Jennifer L. Shine, Kevin D. Ballard, Kyle L. Timmerman. *Miami University, Oxford, OH.* (Sponsor: Helaine Alessio, FACSM)  
*(No relevant relationships reported)*

Adipose tissue was considered a passive reservoir for energy storage, but now is viewed as an active endocrine organ secreting adipokines such as resistin and adiponectin. Resistin tends to be inflammatory in nature, while adiponectin tends to be anti-inflammatory, with both being related to insulin resistance. Few researchers have examined the impact of age and physical activity level on serum resistin and adiponectin within the same study. The **PURPOSE** of this study was to assess the relationships among age, physical activity level, and resistin and adiponectin levels in healthy young and older adults. **METHODS:** A convenience sample was used consisting of 20 young (10 M/10 F; age: 21.0 $\pm$ 1.2y; BMI: 24.3 $\pm$ 4.5 kg $\cdot$ m<sup>-2</sup>) and 20 older (6 M/14 F; Age: 68.4 $\pm$ 4.0y; BMI: 25.5 $\pm$ 3.1 kg $\cdot$ m<sup>-2</sup>) adults. Physical activity frequency and intensity were determined in young and older subjects using the International Physical Activity Questionnaire (IPAQ) and the Community Healthy Activities Model Plan for Seniors (CHAMPS), respectively. Enzyme-linked immunosorbent assays were used for the detection and quantification of serum resistin and adiponectin. **RESULTS:** Young and older subjects had average resistin levels of 3.49  $\pm$  0.97 ng $\cdot$ mL<sup>-1</sup> and 2.97  $\pm$  0.69 ng $\cdot$ mL<sup>-1</sup>; and adiponectin levels of 101.40  $\pm$  61.65 ng $\cdot$ mL<sup>-1</sup> and 106.03  $\pm$  59.39 ng $\cdot$ mL<sup>-1</sup>, respectively. Physical activity level

was not correlated with either resistin or adiponectin. Resistin tended to be lower in older compared to young subjects ( $p=0.056$ ). There was no significant difference in adiponectin levels between young and old subjects ( $p=0.57$ ). Adiponectin was correlated with BMI within both groups (old:  $r=-0.45$ ,  $p=0.034$ ; young:  $r=-0.46$ ,  $p=0.043$ ) and when old and young subject data were combined ( $r=-0.45$ ,  $p=0.004$ ). **CONCLUSIONS:** Body composition appears to be more predictive of serum levels of the anti-inflammatory adipokine, adiponectin, than either age or physical activity level. Surprisingly, resistin, a pro-inflammatory adipokine, was lower in older compared to young adults. Future studies with larger sample sizes and objective measures of physical activity level are warranted to better understand the relationships among age, physical activity level, and the expression of these adipokines.

3339 Board #208 June 2 9:30 AM - 11:00 AM  
**Association Between Bone Mineral Density And Vitamin D Receptor Gene Polymorphisms In Female Athletes**

Mizuki Yamada<sup>1</sup>, Naoki Kikuchi<sup>1</sup>, Kayoko Kamemoto<sup>2</sup>, Tomoka Matsuda<sup>2</sup>, Mikako Sakamaki-Sunaga<sup>1</sup>. <sup>1</sup>*Nippon Sports Science University, Tokyo, Japan.* <sup>2</sup>*Graduate School of Nippon Sports Science University, Tokyo, Japan.*  
(No relevant relationships reported)

Osteoporosis is an important health care problem in female athletes. Previous studies have shown that vitamin D receptor (VDR) gene polymorphisms are related to osteoporosis in the general populations; however, associations in female athletes are not known. **PURPOSE:** To investigate the association between bone mineral density (BMD) and VDR gene polymorphisms in female athletes.

**METHODS:** One hundred and eighty seven female athletes (age:  $20.3 \pm 1.2$  years, height:  $161.6 \pm 6.3$  cm, body weight:  $58.3 \pm 9.8$  kg, percent body fat:  $24.8 \pm 3.7\%$ ) participated in the present study. BMD of the whole-body, lumbar spine (L2-L4), and femoral neck was measured using dual-energy X-ray absorptiometry. Analyses of VDR genes Fok1, Apa1, and Taq1 polymorphisms were performed using TaqMan Genotyping Assay.

**RESULTS:** The genotype frequencies of VDR genes Fok1, Apa1, and Taq1 polymorphisms were in Hardy-Weinberg equilibrium. The VDR genotype for Fok1, FF was found in 44.9%, Ff in 41.7%, and ff in 13.4% of the subjects ( $p=0.31$ ). For Apa1, AA was found in 12.3%, Aa in 42.5%, and aa in 45.2% ( $p=0.51$ ). For Taq1, TT was found in 72%, Tt in 26.4%, and tt in 1.6% ( $p=0.54$ ). There was no significant difference in physical characteristics among the VDR Fok1, Apa1, and Taq1 genotypes. No significant difference was observed between whole body BMD, lumbar spine (L2-L4) BMD, and femoral neck BMD in association with the VDR gene Fok1, and Taq1 polymorphisms. However, the aa genotype of the VDR Apa1 polymorphism was significantly associated with lower whole-body BMD than the AA genotype ( $p<0.05$ ).

**CONCLUSIONS:** An association with the VDR gene Apa1 polymorphism was shown in this study only for whole-body BMD. In conclusion, the VDR gene Apa1 polymorphism aa genotype is associated with decreased whole-body BMD in female athletes.

3340 Board #209 June 2 9:30 AM - 11:00 AM  
**Influence Of The Difference Of Exercise Intensity On Salivary Nitric Oxide In Young Men**

Sone Ryota<sup>1</sup>, Hayashi Koichiro<sup>2</sup>, Eda Nobuhiko<sup>3</sup>, Watanabe Koichi<sup>1</sup>. <sup>1</sup>*University of Tsukuba, Tsukuba, Ibaraki, Japan, Japan.* <sup>2</sup>*Kokugakuin University, Yokohama, Kanagawa, Japan, Japan.* <sup>3</sup>*Waseda University, Tokorozawa, Saitama, Japan, Japan.*  
(No relevant relationships reported)

High-intensity exercise is related to increase the oxidative stress by excessive production of reactive oxygen species (ROS). Salivary nitric oxide (sNO) has been known to be a factor influencing the production of ROS. Therefore, there is a possibility of noninvasively evaluating ROS during exercise by measuring sNO. However, the influence of the difference of exercise intensity on sNO secretion are not well known. **PURPOSE:** The purpose of this study was to investigate the influence of different exercise intensity on salivary nitric oxide in young men. **METHODS:** Male collegiate students ( $21.6 \pm 0.4$  y.o.) were recruited and participated in this study ( $N=5$ ). All subjects carried out two different intensity exercises with random crossover design. One is a high-intensity condition that performs ergometer exercise at  $80\%HR_{reserve}$  for 30 min, and the other is a moderate condition that performs ergometer exercise at  $50\%HR_{reserve}$  for 30 min. Saliva samples were collected before (pre), immediately after (post), 30 minutes after (30 min), and 60 minutes after (60 min) each intervention. sNO concentration ( $\mu\text{mol/L}$ ) were analyzed by using the Griess reaction. sNO secretion rate ( $\mu\text{mol/min}$ ) was calculated by multiplying the absolute sNO concentration ( $\mu\text{mol/L}$ ) by the saliva flow rate (mL/min). **RESULTS:** Since there was no significant difference in the values before both interventions, the results are shown as the change from pre to post, 30 min and 60 min in sNO concentration and sNO secretion rate. The change from pre of sNO concentration in the high-

intensity significantly increased ( $P=0.021$ ) in 60 min ( $362 \pm 58 \mu\text{mol/L}$ ), whereas the change in sNO secretion rate in both conditions did not significantly change in time. In the comparison between the interventions, the change in sNO secretion rate in the high-intensity ( $0.22 \pm 0.05 \mu\text{mol/min}$ ) was significantly higher ( $P=0.040$ ) than the moderate ( $-0.01 \pm 0.05 \mu\text{mol/min}$ ) at 60 min, while the change in sNO concentration was not significantly different ( $P=0.075$ ) between the high-intensity ( $362 \pm 58 \mu\text{mol/L}$ ) and moderate ( $64 \pm 69 \mu\text{mol/L}$ ) at 60 min. **CONCLUSIONS:** In this study, sNO concentration significantly increased after the high-intensity exercise, although it did not change after the moderate exercise. It was suggested that the difference of exercise intensity may affect the response of sNO.

3341 Board #210 June 2 9:30 AM - 11:00 AM  
**Wearing Compression Garment During Prolonged Running Mitigated Tissue Vibration, Exercise-Induced Muscle Damage and Inflammation**

Sahiro Mizuno<sup>1</sup>, Tatsuhiro Maruyama<sup>1</sup>, Akitoshi Makino<sup>2</sup>, Mari Arai<sup>3</sup>, Eri Yamada<sup>3</sup>, Fumihiko Todoko<sup>3</sup>, Masaki Ishikawa<sup>2</sup>, Kazushige Goto<sup>1</sup>. <sup>1</sup>*Ritsumeikan University, Kusatsu, Japan.* <sup>2</sup>*Osaka University of Health and Sport Sciences, Osaka, Japan.* <sup>3</sup>*DESCENTE Ltd., Osaka, Japan.* (Sponsor: Robert R Kraemer, FACSM)

(No relevant relationships reported)

**PURPOSE:** To determine effect of wearing lower-body compression garment (CG) during prolonged running on tissue vibration and exercise-induced muscle damage and inflammatory responses.

**METHODS:** Ten male subjects ( $170.5 \pm 0.4$  cm,  $62.6 \pm 0.7$  kg,  $VO_{2max}$ ;  $50.6 \pm 0.7$  mL/kg/min) performed 2 exercise trials in a random order. The exercise consisted of 120 min of uphill running (7% gradient) at 60% of  $VO_{2max}$ . The exercise trials included 1) wearing lower-body CG with exerting 15 mmHg to thigh and calf [CG]; and 2) wearing lower-body garment with exerting below 5 mmHg to thigh and calf [CON]. During exercise, heart rate (HR), rating of perceived exertion (RPE), stride parameters (length and frequency) and tissue vibrations (3-axis acceleration of vastus lateralis, biceps femoris, tibia and gastrocnemius muscles) were evaluated. Jump performances and maximal voluntary contraction for knee extension (MVC) were evaluated before and immediately after, 60 min and 180 min after exercise. Blood variables were collected to determine blood glucose and lactate, serum myoglobin, and plasma IL-6, IL-1ra, IL-10, IL-8, TNF- $\alpha$  and MCP-1 concentrations.

**RESULTS:** Average HR during 120 min of exercise was significantly lower in the CG trial than in the CON trial ( $163 \pm 14$  bpm vs.  $167 \pm 11$  bpm,  $P=0.042$ ). Although stride parameters during exercise did not significantly differ between two trials, CG trials showed significantly lower tissue vibrations compared with the CON trial ( $P<0.05$ ). Jump performances and MVC were significantly decreased after exercise in both trials, whereas the CG trial showed significantly higher value of MVC at 180 min after exercise ( $92.4 \pm 8.6\%$  vs.  $85.0 \pm 11.4\%$ ,  $P=0.044$ ). There were significant increases in all of plasma cytokine concentrations after exercise in both trials ( $P<0.05$ ). Area under the curve (AUC) for IL-6 concentration during exercise and post-exercise period was significantly lower in the CG trial than in the CON trial ( $2,560 \pm 1,686$  pg/mL vs.  $4,021 \pm 3,234$  pg/mL,  $P=0.04$ ). Furthermore, AUCs for plasma IL-1ra and IL-10 concentrations during post-exercise period tended to be lower in the CG trial.

**CONCLUSION:** Wearing lower-body CG during 120 min of uphill running caused significantly lower exercise-induced increase in HR, tissue vibration, inflammation and faster recovery of muscular strength.

**G-47 Free Communication/Poster - Clinical Exercise Physiology - Other**

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
Room: CC-Hall B

3342 Board #211 June 2 9:30 AM - 11:00 AM  
**Hamstrings Muscle Activation During Different Strengthening Exercises**

Darren Z. Nin<sup>1</sup>, Pui W. Kong<sup>1</sup>, Matthew T G Pain<sup>2</sup>, Jonathan P. Folland, FACSM<sup>2</sup>. <sup>1</sup>*Nanyang Technological University, Singapore, Singapore.* <sup>2</sup>*Loughborough University, Loughborough, United Kingdom.*

(No relevant relationships reported)

Hamstring strain injuries (HSIs) occur when there is excessive strain on the muscle during eccentric contraction, with the biceps femoris (BF) being the most common injury site. The characterisation of muscle activation during different hamstring strengthening exercises may enable evidence-based prescription of preventative/rehabilitation exercises consistent with the aetiology of injury.

**PURPOSE:** To identify the hamstring strengthening exercise which elicits the highest muscle activation of the BF during eccentric contraction at longer muscle lengths. **METHODS:** Eleven resistance-trained males (age  $22.1 \pm 4.3$  years) participated in this cross-sectional study. BF and semitendinosus (ST) electromyographic (EMG) amplitude was measured during the eccentric phase (three consecutive  $15^\circ$  sectors preceding the end range-of-motion (ROM)) of six different hamstring strengthening exercises (3 repetitions, 3RM load). Common and lengthened-state variants of hamstrings resistance training exercises were compared, specifically, knee- (conventional Nordics (CN); assisted Nordics (AN); seated leg-curl with hip flexed (SLC)) and hip- (inclined hip-extension (IHE); "good morning" (GM); straight-leg hip-extension (SHE)) exercises. EMG recordings of each exercise was normalised to EMG during maximal isovelocity ( $60^\circ/s$ ) eccentric contractions (highest of 4 efforts) measured on an isokinetic dynamometer (Con-Trex, CMV AG, Switzerland) at exercise specific knee- (KJA) and hip-joint angle (HJA) configurations. 2D sagittal plane video was used to analyse ROM of exercises. **RESULTS:** EMG amplitude was progressively higher towards the end of the eccentric phase for each exercise ( $p < 0.001$ ). During the last  $15^\circ$  sector preceding end ROM, BF activity was highest in the CN ( $75.2 \pm 8.2\%$ ), followed by GM ( $69.9 \pm 6.6\%$ ) and SLC ( $67.8 \pm 7.4\%$ ); BF/ST ratio was different between exercises ( $p = 0.024$ ; CN < IHE & SHE; SLC < IHE & SHE). Muscle elongation (KJA-HJA) during end ROM was highest in the SLC ( $88.6^\circ$ ) and lowest during CN ( $-54.1^\circ$ ). **CONCLUSION:** Differences in EMG amp with ROM sector suggest that besides contraction type, joint angle also influences muscle activation during these exercises. The high BF activity and muscle elongation of the SLC during end-ROM suggest that it may be an effective hamstring strengthening exercise.

3343 Board #212 June 2 9:30 AM - 11:00 AM  
**Home-Based Exercise with Blood Flow Restriction to Restore Limb Symmetry Long After Knee Surgery**  
 Matthew A. Kilgas, Lydia Lytle, Steven J. Elmer. *Michigan Technological University, Houghton, MI.* (Sponsor: Scott Drum, FACSM)  
*(No relevant relationships reported)*

Rehabilitation following knee surgery (e.g., ACL reconstruction) is prolonged and many individuals do not completely regain their quadriceps size and strength. These persistent impairments give rise to limb asymmetry which increases risks for re-injury and osteoarthritis. **PURPOSE:** To establish exercise with blood flow restriction (BFR) as a home-based program to overcome persistent quadriceps size and strength impairments and restore limb symmetry long after knee surgery. **METHODS:** Five adults with an ACL reconstruction and/or meniscus repair ( $4.4 \pm 2.5$  years post-surgery) volunteered. Participants had at least 10% asymmetry in quadriceps size and/or strength. Participants exercised at home 4x/week for 4 weeks. Exercises included body weight squats, single-leg knee extension with resistance bands, and walking. Blood flow to the affected limb was restricted using a 15cm pressurized cuff inflated to 50% of limb occlusion pressure. Vastus lateralis and rectus femoris thickness along with knee extensor strength were measured before and after training. Percent difference between affected and contralateral limbs was used as an index of limb asymmetry. Post-training asymmetry indices were compared to healthy uninjured controls ( $n = 5$ ). **RESULTS:** Following training, asymmetry in muscle thickness decreased for the vastus lateralis ( $9.9 \pm 7.2$  vs.  $2.9 \pm 4.0\%$ ,  $p = 0.04$ ) and rectus femoris ( $11.9 \pm 7.8$  vs.  $2.6 \pm 3.5\%$ ,  $p = 0.03$ ). Knee extension strength asymmetry decreased from  $10.9 \pm 2.6\%$  to  $2.6 \pm 2.7\%$  ( $p = 0.02$ ). Post-training quadriceps size and strength asymmetry indices were not different from controls ( $<5\%$ , all  $p > 0.05$ ). **CONCLUSION:** These results extend upon early post-operative application of exercise with BFR and demonstrate that this modality can also be used to overcome persistent quadriceps impairments long after knee surgery. Exercise with BFR could serve as a cost-effective home option for improving function after supervised rehabilitation ends. Supported by Blue Cross Blue Shield of Michigan Foundation.

3344 Board #213 June 2 9:30 AM - 11:00 AM  
**Body Composition Measures Associate with Physical Performance but not Disability in Individuals with Knee Osteoarthritis**  
 Hope C. Davis<sup>1</sup>, Malia N. Blue<sup>1</sup>, Katie R. Hirsch<sup>1</sup>, Brittney A. Luc-Harkey<sup>2</sup>, Kara C. Anderson<sup>1</sup>, Abbie E. Smith-Ryan, FACSM<sup>1</sup>, Brian Pietrosimone, FACSM<sup>1</sup>. <sup>1</sup>UNC Chapel Hill, Chapel Hill, NC. <sup>2</sup>Brigham and Women's Hospital, Boston, MA.  
*(No relevant relationships reported)*

Higher body mass index (BMI) is associated with more disability in individuals with knee osteoarthritis (KOA); however, BMI does not always provide accurate information about body composition, which may be a better predictor of disability in these patients. **PURPOSE:** Determine the associations between body composition and self-reported disability (Western Ontario and McMaster Universities Osteoarthritis Index [WOMAC] function) and physical performance (20m fast-paced walk, chair-stand, stair-climb) after accounting for BMI in individuals with KOA. **METHODS:**

Body mass and height were objectively measured, and percent fat (%FM) and lean mass (%LM) were determined using dual energy x-ray absorptiometry on 47 adults with radiographically defined KOA (Kellgren-Lawrence grade 2-4; 30% male;  $60.2 \pm 8.3$  yrs; BMI =  $29.5 \pm 3.8$  kg/m<sup>2</sup>). The WOMAC function subscale, 20m fast-paced walk (WALK), chair-stand (CHAIR), and stair-climb (STAIR) were completed on the same day. Separate linear regression analyses were conducted to determine the unique variance in WOMAC and each physical performance test explained individually by %FM and %LM after accounting for BMI ( $\Delta R^2$ ). Regression models accounted for sex and K-L grade, as both have been reported to associate with disability or body composition in individuals with KOA. **RESULTS:** Higher %FM significantly associated with better physical performance after accounting for BMI (WALK:  $\Delta R^2 = 0.10$ ,  $p = 0.03$ ; CHAIR:  $\Delta R^2 = 0.16$ ,  $p = 0.01$ ; STAIR:  $\Delta R^2 = 0.13$ ,  $p = 0.02$ ). Higher %LM significantly associated with better chair-stand performance but not 20m fast-paced walk or stair-climb tests (WALK:  $\Delta R^2 = 0.04$ ,  $p = 0.17$ ; CHAIR:  $\Delta R^2 = 0.09$ ,  $p = 0.04$ ; STAIR:  $\Delta R^2 = 0.08$ ,  $p = 0.07$ ). Neither %FM ( $\Delta R^2 = 0.004$ ,  $p = 0.70$ ) nor %LM ( $\Delta R^2 = 0.001$ ,  $p = 0.84$ ) associated with WOMAC after accounting for BMI. BMI did not explain a significant amount of variance in WOMAC or physical performance outcomes ( $R^2$  range = 0.004 - 0.07,  $p > 0.05$ ) as part of any regression model. **CONCLUSIONS:** Lower %FM and higher %LM associated with better physical performance but not WOMAC. BMI did not significantly associate with WOMAC or physical performance. Future interventions should seek to increase %LM and decrease %FM, rather than focusing on overall reduction in BMI to improve physical performance. Supported by: NIH NIAMS 1R21AR067560-01.

3345 Board #214 June 2 9:30 AM - 11:00 AM  
**Effects Of Whole Body Vibration On Neuromuscular Performance In Patients With Osteoarthritis Of The Knee**  
 Javier H. Carreño, Daniel D. Cohen, Rodrigo Argothy. *Universidad del Rosario, Bogotá, Colombia.*  
*(No relevant relationships reported)*

**Effects of whole body vibration on neuromuscular performance in patients with osteoarthritis of the knee**  
**Abstract**  
**Background:** The effect of whole body vibration on strength, power and force differences (asymmetries) during the sit to stand (STS) test and isometric strength test assessed with uniaxial force platforms in patients with osteoarthritis of the knee. **Objective:** To evaluate the effects of whole body vibration on neuromuscular performance and asymmetries in lower limbs in patients with or at risk of knee osteoarthritis. **Methods:** Randomized-Controlled trial with 60 subjects (mean age of 48 years  $\pm$  14.2) with diagnosis or at risk of knee osteoarthritis (OA) but physically active, were randomly assigned to training program for 12 weeks: with vibration (WBV) and without vibration (CON). The force platforms was used for the strength measurements (Pasco fsample = 500Hz) **Results:** The data was analyzed with the software ForceDecks. Statistically significant differences were found for the CON group between Peak Vertical Force (PVF) pre-training: 655N and POST training: 837N ( $p = 0.00$ ); the rate of force development (RFD) PRE= 935Ns, POST= 1634Ns ( $p = 0.05$ ), while in the WBV group there was a non-significant increase: PVF (pre-training: 628N and POST training: 685N) ( $p = 0.29$ ); the RFD (pre-training: 1280Ns and POST training: 1354Ns) ( $p = 0.57$ ). In the WBV group there was a significant decrease of pain according to the Visual Analogue Scale (VAS). Significant differences were found between the groups being much greater in the group CON, in the isometric leg press test in RFD-200ms ( $P = 0.03$ ) and relative peak force ( $P = 0.04$ ). **Conclusion:** In individuals with knee OA 12 weeks of strength training performed with whole body vibration led to lower neuromuscular performance gains than the same training performed without vibration, however pain intensity decreases at knee, hip and lower back level according to the (VAS). **Key words:** Resistance training, acceleration training, Osteoarthritis knee, Reflex startle, Muscle strength.

3346 Board #215 June 2 9:30 AM - 11:00 AM  
**Does Blood Flow Restricted Training Improve Quadriceps Strength Following an ACL Injury?**  
 Kathryn Lucas, Darren L. Johnson, Mary L. Ireland, FACSM, Brian Noehren, FACSM. *University of Kentucky, Lexington, KY.* (Sponsor: Brian Noehren, FACSM)  
*(No relevant relationships reported)*

**PURPOSE:** Anterior cruciate ligament (ACL) injuries result in significant quadriceps weakness, causing pain and compensations in gait. High resistance strengthening is often not well tolerated after an ACL injury. Blood flow restricted training (BFRT), which uses partial occlusion of blood flow through applied cuffs, maybe an effective technique to maximize strength at low intensities. While BFRT has been well

studied in healthy populations, its effectiveness in an injured population has not been established. We hypothesized that a 4-week blood flow restricted quadriceps strengthening protocol will significantly improve quadriceps strength and the limb symmetry index of the quadriceps.

**METHODS:** Nine subjects status-post ACL injury participated in this study. After determining the subjects' preoperative isometric quadriceps strength on a Biodex and their 1 repetition maximum on each piece of exercise equipment, they then performed a 4-week BFRT protocol. Training was performed at 30% of the subject's 1 rep maximum with BFRT optimal pressure determined per manufacturer instructions. Four quadriceps strengthening exercises were performed at each session. Three sets of 10-30 repetitions were performed for each exercise. At the end of 4 weeks, quadriceps strength was reassessed. A paired t-test was used to compare pre and post intervention quadriceps strength normalized to body weight, and limb symmetry indexes were calculated.

**RESULTS:** Quadriceps strength of the involved side significantly increased ( $p < 0.000$ ) from  $2.24 \pm 0.67$  Nm/kg to  $2.82 \pm 0.71$  Nm/kg. The limb symmetry index improved from 0.70 pre-BFRT to 0.88 post-BFRT.

**CONCLUSIONS:** A four-week blood flow restricted training protocol significantly increases quadriceps strength in a preoperative ACL reconstruction population. By training at 30% of the individual's 1RM, the risk of further injury or pain is minimized. Restoring quadriceps strength before surgery may result in a faster recovery and better long term outcomes. Further research should investigate if blood flow restrictive training is appropriate for other injured populations and for postoperative care of patients who have had an ACL reconstruction.

3347 Board #216 June 2 9:30 AM - 11:00 AM  
**Effect of Fatigue on The Neuromuscular Transmission of Hamstrings During Eccentric Muscle Action**

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(No relevant relationships reported)

Electromechanical delay (EMD) is a key to evaluate the ability of neuromuscular transmission, and fatigue is believed to be associated with altered neuromuscular transmission of hamstrings, which may increase the risk of non-contact anterior cruciate ligament (ACL) injury. However, experiment evidence supporting this relationship is insufficient.

**PURPOSE:** The purpose of this study is to investigate the effect of fatigue on electromechanical delay times of hamstrings during eccentric muscle action.  
**METHODS:** Twenty female (20±2 yrs) volunteers participated in the study and EMD of semitendinosus (ST), semimembranosus (SM) and biceps femoris (BF) were determined before and after fatigue during eccentric muscle action at 120 and 240°/s. All subjects followed an isokinetic fatigue protocol until flexion torque fell below 50% of initial torque for three consecutive repetitions. A 2\*2\*3 ANOVA was used to calculate the effect of fatigue, movement velocity, type of muscle and their interaction on EMD. **RESULTS:** There was no significant difference in the EMD of the 3 muscles examined (BF: 119.0±25.3ms vs. SM: 118.9±24.0ms vs. ST: 120.3±24.9ms,  $P > 0.05$ ), irrespective of fatigue status or movement velocity. Fatigue caused a significant increase on EMD of 3 muscles examined (non-fatigue: 98.4±11.5ms vs. fatigue: 140±13.8ms,  $P < 0.001$ ). Irrespective of fatigue, EMD of the 3 muscles significantly increased with increasing movement velocity (low angular velocity: 107.8±20.9ms vs. high angular velocity: 131.0±22.5ms,  $P < 0.001$ ). **CONCLUSIONS:** Our findings suggest that fatigue decrease the ability of neuromuscular transmission of hamstrings during eccentric muscle action, irrespective of movement velocity. This would suggest that improving resistance to fatigue of hamstrings may be an effective prevention tool of non-contact ACL injury.

3348 Board #217 June 2 9:30 AM - 11:00 AM  
**Differences In The Mitochondrial Capacity Of The Right And Left Biceps Brachii Muscle**

Elizabeth Pryor, Katie Luquire, Kevin McCully, FACSM. *University of Georgia, Athens, GA.* (Sponsor: Dr. Kevin McCully, FACSM)

(No relevant relationships reported)

**PURPOSE:** Near infrared spectroscopy (NIRS) has been used to measure mitochondrial capacity of various muscles, but not specifically the biceps brachii. **PURPOSE:** Measure mitochondrial capacity using NIRS in the dominant and non-dominant arms of young healthy adults. **METHODS:** Five untrained subjects (mean age 20.4±0.7 years) were tested in the supine position with a NIRS device (Artinis, Ltd) placed in the middle of the biceps brachii muscle. Electrical stimulation (6 Hz, 25-40 mAmps) was used to activate the muscle. A 5 cm blood pressure cuff was placed proximal to the NIRS device and used for arterial occlusion (225 mmHg). The protocol consisted of 30 seconds of resting metabolism, 30 seconds of post stimulation metabolism, three minutes of ischemia followed by reperfusion to measure the rate of reoxygenation, and two mitochondrial capacity tests. The mitochondrial capacity test consisted of electrical stimulation followed by a series of 22 ischemic cuffs

lasting from 5-10 seconds, each allowing muscle reoxygenation. **RESULTS:** There was no difference in mitochondrial capacity between the dominant and non-dominant arms of the untrained subjects (Lf Tc=43.8 ± 6.8 s, Rt Tc=43.4 ± 10 s,  $P = 0.93$ ). **CONCLUSIONS:** The biceps brachii muscle had mitochondrial capacity values similar to the forearm values from previous studies, and slower than values for the gastrocnemius and quadriceps muscles. We found no evidence for differences between the dominant versus non-dominant biceps brachii muscles. Supported in part by CURO Assistantship.

3349 Board #218 June 2 9:30 AM - 11:00 AM  
**Impact of Discipline and Gender on Hamstring and Quadriceps Strength in Elite Alpine Skiers**

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(No relevant relationships reported)

**PURPOSE:** Examine the influence of discipline and gender on hamstring and quadriceps strength of elite alpine skiers. **METHODS:** Twenty-eight French national team skiers (14 male) undertook isokinetic dynamometry evaluation. Skiers were split by discipline into technical (Slalom and Giant Slalom, GpT, n=14) or speed (Super Giant and Downhill, GpS, n=14). Maximal conventional ratios (i.e. concentric) at 60°.s<sup>-1</sup> and 180°.s<sup>-1</sup> and maximal functional ratios at 60°.s<sup>-1</sup> and 90°.s<sup>-1</sup> were calculated for Hamstring-to-Quadriceps (HQ) ratio, together with isoangular HQ ratios between 30° and 90° (0° representing full extension). **RESULTS:** No gender difference in HQ peak torque ratios was apparent, yet females demonstrated a delayed quadriceps Angle of Maximal Torque (AMT). Statistical parametric mapping demonstrated lower hamstring torque and a low HQ ratio near full knee extension in female skiers regardless of velocity. A greater hamstring AMT in GpT skiers compared to GpS was observed, along with greater dynamic quadriceps strength after 72° of knee flexion in GpT skiers. **CONCLUSION:** Discipline and gender both influence the HQ strength profile of elite alpine skiers, which are further modified according to the joint angle and angular velocity employed. The data provide normative values based on gender and discipline which may be of use during pre-season isokinetic screening, which is common in practice and often used to inform subsequent knee injury prevention intervention.

3350 Board #219 June 2 9:30 AM - 11:00 AM  
**EMG Analysis of Lower Limb Muscle Activation During 6-Minute Treadmill Walking Following Novel Over-Ground Locomotor Training in Incomplete Spinal Cord Injury**

Donal Murray, Andrew A. Guccione, Kerry J. Bollen, Brian T. Neville, Caitlin A. Bryson, Randall E. Keyser, FACSM. *George Mason University, Fairfax, VA.* (Sponsor: Randall E. Keyser, FACSM)

(No relevant relationships reported)

Physiological impairments in incomplete spinal cord injury (iSCI) can include muscle weakness and altered skeletal muscle activation. Reduced voluntary muscle activation in iSCI can cause inadequate fibre recruitment and in turn the muscle may undergo adverse morphological adaptations.

**PURPOSE:** The study aimed to characterize, the level of lower limb muscle activation using surface electromyography (EMG) during 6 minutes of treadmill walking in iSCI following 12 weeks of a novel overground locomotor training (OLT) program. **METHODS:** A convenience sample of 3 individuals with iSCI (Age: 39±15.5 years, AIS C or D, >6months post-SCI) completed 12 weeks of OLT, which consisted of two 90-minute sessions per week. The principles of OLT included the motor learning concepts of task specificity, practice variability and progressive overload. Sessions were broken down into 5 segments: joint mobilization, muscle activation, task isolation, task integration and task rehearsal. Each session catered to a specific component of the gait cycle. Pre- and post-assessment included 6 minutes of treadmill walking, performed at participant's self-selected speed (0.5-1.4mph). Two sets of bipolar electrodes were placed on the muscle belly of the left lateral gastrocnemius (GA), left tibialis anterior (TA) and left bicep femoris (BF). EMG data was continuously collected over the 6 minutes. The root mean square (RMS) and peak activation of EMG during the last 10 seconds of minute 1, 3 and 6 was calculated using Matlab programming code. The values for each minute were normalized to the RMS

and peak value of the first 10 seconds of the walking bout. Cohen's *d* was calculated to determine effect size (ES) of EMG signal pre- and post-OLT, as well as comparing minute 1 to minute 6 of walking.

**RESULTS:** Following OLT the RMS during minute 6 of the GA and BF increased, difference of 37.522mV with strong ES>0.8. Comparing pre-OLT minute 1 to minute 6 shows a trend of reduced activity in the GA, TA and BF ( $\Delta$ -29.11mV,  $\Delta$ -8.71mV,  $\Delta$ -28.7mV, ES>0.63, ES>0.88 ES>0.75), yet post-OLT the trend is positive ( $\Delta$ -48.73mV,  $\Delta$ -10.49mV,  $\Delta$ 26.51mV, ES>0.74, ES>0.13 ES>0.44).

**CONCLUSIONS:** Higher RMS of the EMG during minute 6 of the walking trail could indicate greater activation of measured muscles in iSCI following OLT.

3351 Board #220 June 2 9:30 AM - 11:00 AM

### Relationships Between Quadriceps Femoris Quality And Locomotor Functions In Disabled Patients

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(No relevant relationships reported)

The patients often suffer from impairments of their lower limbs and disability of locomotion. Quadriceps femoris (QF) is one of the key muscles contributing to locomotor functions and it has been established that QF quantity is associated with locomotor functions in disabled patients. Muscle quality is defined as ratio of adipose tissue to muscle tissue. QF quality of patients could become worse by increased ratio of adipose tissue to muscle tissue. As far as we know, there were no studies showing that QF quality has a relationship with locomotor functions in disabled patients.

**PURPOSE:** The purpose of this study was to assess the relationships between QF quality and locomotor functions in disabled patients. **METHODS:** Fourteen hospitalized patients (11 patients with stroke and 3 patients with lower extremity fracture; age, 71.2 ± 16.3 years; height, 157.1 ± 9.6 cm; weight, 55.2 ± 14.7 kg; body mass index, 22.1 ± 3.7 kg/m<sup>2</sup>) participated in this study. The QF muscle quality based on echo intensity and muscle thickness as an index of muscle quantity at the mid-thigh were assessed using ultrasonography. Timed up and go (TUG) test, berg balance scale (BBS) and functional independence measure (FIM) stairs scale were assessed as locomotor functions. **RESULTS:** TUG time was significantly correlated with QF thickness ( $r = -0.68$ ,  $P < 0.05$ ). BBS and FIM stairs scale were significantly correlated with QF echo intensity and thickness, respectively ( $r = -0.57$ ,  $P < 0.05$ ;  $r = 0.83$ ,  $P < 0.05$ ;  $r = -0.57$ ,  $P < 0.05$ ;  $r = 0.69$ ,  $P < 0.05$ ). **CONCLUSIONS:** These results suggest that not only QF quantity but also quality are associated with locomotor functions in disabled patients. Furthermore, QF quality may be essential factor to influence on locomotor functions in disabled patients.

3352 Board #221 June 2 9:30 AM - 11:00 AM

### Long-term Electrically Induced Muscle Exercise Duration Modulates Distinct Gene Signaling Pathways In People With Spinal Cord Injury

Michael A. Petrie, Manish Suneja, Richard K. Shields. *The University of Iowa, Iowa City, IA.*  
(No relevant relationships reported)

Exercise as a form of medicine attenuates the development of chronic non-communicable diseases (CNCs) in people with intact nervous systems as they age. However, there is a knowledge gap regarding the influence of electrically induced skeletal muscle exercise on CNCs in people with spinal cord injury (SCI). Gene signaling pathway analysis offers an opportunity to understand the long term effects of electrically induced exercise on people with chronic and complete paralysis from SCI; providing a basis for interventions to be studied in future clinical trials. **Purpose:** To determine if long term electrically induced skeletal muscle exercise regulates complex network signaling pathways associated with improved health in people with SCI. **Methods:** 17 males with a complete SCI participated in this study. Participants completed 3, 6, or 12 months of a unilateral exercise training program using electrical muscle stimulation. After exercise training, participants underwent muscle biopsies of the trained and untrained limbs. RNA was extracted and hybridized to an exon microarray. Resulting gene expression signals were analyzed using a geneset enrichment analysis and applied to a network connectivity map. **Results:** We analyzed over 17,000 genes and 1,900 genesets curated from the Reactome database. We found that the genesets significantly increased (<25% FDR;  $p < 0.05$ ) depended on the duration of training. 52, 44, and 242 genesets were upregulated in the trained limb at 3, 6, and 12 months of training. Of the 242 genesets upregulated in the trained limbs at 12 months, 21% were directly associated with hypertrophy and metabolism/oxidative phosphorylation. Among the genes with the highest expression levels in trained muscles were MYH7(4.87±6.7) and MYH6(2.65±3.11); while MSTN(0.66±0.31) and ACTN3(0.68±0.53) were among those genes with the greatest suppression in the trained limbs. **Conclusions:** Overall health is dependent, in part, on skeletal muscle size and metabolic capacity. 6 months of chronic electrically induced exercise was sufficient to reverse hypertrophy gene pathways and improve metabolic signaling to a

more oxidative state. Future studies are underway to ascertain if electrically induced exercise attenuates the development of CNCs in people with SCI. Supported by NIH Grants R01HD084645 and R01HD082109

3353 Board #222 June 2 9:30 AM - 11:00 AM

### Low Frequency Electrically Induced Muscle Exercise Modulates Glucose Tolerance In People With SCI

Richard K. Shields, Michael A. Petrie, Jinhyun Lee, Jessica R. Woelfel. *The University of Iowa, Iowa City, IA.*  
(No relevant relationships reported)

Regular exercise is an important strategy to prevent the development of several chronic non-communicable diseases (CNCs), including metabolic inflexibility and diabetes. Skeletal muscle increases glucose uptake through two distinct pathways: Insulin receptor sensitivity pathway and the exercise induced AMPK pathway. Because people with paralysis are unable to move, they never reap the benefits of muscle exercise/activity following a meal. **Purpose:** To determine if electrically induced exercise regulates the glycemic response after an oral glucose load in people with and without a SCI. **Methods:** 8 and 14 people with and without a SCI participated in this study. Participants completed 2 sessions of a 2 hour oral glucose tolerance test at least 7 days apart. 15 minutes after ingesting 75g glucose beverage, participants sat passively (control) or were given a dose of electrically induced muscle stimulation delivered at a 3Hz frequency for 1-hour, then rested for the next hour. Glucose and insulin were measured from venous blood draws at baseline and 120 minutes. Capillary glucose measurements were performed at baseline, 30, 60, 90, and 120 minutes. A mixed design analysis of variance was used for all comparisons with pairwise comparisons where appropriate. **Results:** At baseline, neither glucose (85.5±9.4 and 93.1±6.8 mg/dL,  $p > 0.62$ ) or insulin (13.2±8.8 and 7.8±1.4 µL/mL,  $p > 0.84$ ) was significantly higher for people with a SCI compared to those without. During the oral glucose tolerance test, there was a significant decrease in the glucose AUC during the electrically induced exercise session for people with a SCI (7,763±3,670 (STIM) and 8,904±4,039 (CTL),  $p = 0.003$ ), but no difference for people without a SCI (5,205±2,487 (STIM) and 5,500±2,355 (CTL),  $p = 0.58$ ). Significantly less insulin was needed during the exercise as compared to the control session (124.1±34.8 and 190.2±40.8,  $p = 0.013$ ). **Conclusions:** A dose of low frequency electrically induced muscle exercise attenuated the severe glycemic response in people with SCI after a meal. These findings offer a unique strategy for people who are paralyzed to improve their glucose tolerance after a meal. Supported by NIH Grants R01HD084645 and R01HD082109

3354 Board #223 June 2 9:30 AM - 11:00 AM

### Muscle-tendon Elasticity: Friend or Foe When Measuring Activity-related Energy Expenditure following Exercise Training

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(No relevant relationships reported)

**PURPOSE** We examined how exercise training-induced changes in the energetic cost of walking affected accelerometer-based metrics during a standardized walking task coupled with indirect calorimetry. **METHODS** 29 breast cancer survivors were evaluated at baseline (M0) and following a 3 month physical activity intervention (M3). Participants were outfitted with a heart rate monitor and hip worn triaxial accelerometer while treadmill walking (0.89 m/s, 0% grade) for 4 minutes. Indirect calorimetry was used to measure steady state oxygen uptake (VO<sub>2</sub>) and carbon dioxide production, to objectively quantify EE. The highest VO<sub>2</sub> and corresponding heart rate over a 30 sec period were used for analyses. Percent of age predicted heart rate max (HRmax) was calculated by dividing steady state HR by the difference of 220-age. Vector magnitude, a composite of three orthogonal planes [mediolateral(x), vertical(y), & anteroposterior(z)] was used to estimate EE. Accelerations from each axis were collected during the walking task. **RESULTS** Consistent with improved fitness, percent of HRmax was decreased by -6.7% ( $p < 0.01$ ) during the walking task at M3. The energetic cost of walking, represented by VO<sub>2</sub> (mL·kg<sup>-1</sup>·min<sup>-1</sup>) was significantly decreased (M0, 10.0±1.4 vs. M3, 9.3±1.1;  $p < 0.01$ ), which corresponded with a concurrent -6.5% reduction in measured EE. Alternatively, vector magnitude (au) exhibited a significant increase (M0, 40.4±10.3 vs. M3, 45.2±13.9;  $p < 0.05$ ), that reflected larger (+24%) estimates of EE. Individual axis accelerations revealed there were no differences ( $p > 0.05$ ) in the mediolateral (x) or anteroposterior (z) planes of movement at M3. However, indicative of an altered gait, vertically (y) accelerations were significantly increased (M0, 17.8±9.1 vs. M3, 23.3±10.2;  $p < 0.01$ ). **CONCLUSION** These data suggest accelerometer-based estimates of activity related EE are not sensitive to the improvements in fitness or energetic cost of treadmill walking. Research is needed to determine if changes in muscle-tendon elasticity occurring with exercise training account for the decreased energetic cost of walking and simultaneous

increase in vertical accelerations. The divergence between actual EE and accelerometer based estimates of EE may contribute to erroneous inferences concerning free-living physical activity.

3355 Board #224 June 2 9:30 AM - 11:00 AM  
**The Test-retest Reliability And Exercise-driven Changes Of UCH-L1 In Healthy, Recreationally Active College Students**

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(No relevant relationships reported)

Concussions are common in sports, yet remain difficult to diagnose since truly objective assessments are lacking. Blood biomarkers are a potential solution to this problem. A biomarker must be sensitive and specific to head injury before it can be further studied as a clinically useful diagnostic for sport-related concussion (SRC). It must be stable over time, and remain unchanged by other factors including acute exercise.

**PURPOSE:** To investigate the test-retest reliability and acute exercise effect on a novel head injury biomarker, Ubiquitin C-Terminal Hydrolase-L1 (UCH-L1) in healthy subjects such that findings could assist with interpretation of findings in acutely injured athletes. **METHODS:** Recreationally active (>30 min activity 3 days/week) college students (n=27, males=14, age=21±2.3 yrs) completed a maximal cycle ergometer exercise test during two assessment sessions 10-14 days apart. Blood samples were collected within 10 minutes before and after each test. UCH-L1 values were determined through sandwich enzyme linked immunosorbent assays (ELISA) run in triplicate. Intraclass correlation coefficients (ICC) and 80% reliable change indices (RCI) examined the test-retest reliability of UCH-L1. A 2 (sex) x 2 (pre/post) mixed model ANOVA analyzed the acute exercise effect on UCH-L1 levels. **RESULTS:** UCH-L1 was moderately reliable in the entire cohort (ICC<sub>2,k</sub>=0.505, 80% RCI=107.0 pg/ml). Males had excellent reliability (ICC<sub>2,k</sub>=0.895, 80% RCI=44.4 pg/ml), while females had poor reliability (ICC<sub>2,k</sub>=0.094, 80% RCI=138.8 pg/ml). No significant effects of acute exercise (F<sub>1,25</sub>=0.002, p=0.966), sex (F<sub>1,25</sub>=3.981, p=0.057), or sex by exercise interaction (F<sub>1,25</sub>=1.108, p=0.303) on UCH-L1 values were found. **CONCLUSIONS:** UCH-L1 may have potential to be clinically useful in males. The high reliability and negligible effect of exercise suggest the biomarker remains stable in healthy males and is unaffected by acute exercise. Thus, changes may be attributed to external factors known to affect the biomarker such as head trauma. Conversely, the low reliability and wide RCI suggests UCH-L1 use in females should be limited. Further investigation of sex differences in reliability of UCH-L1 and feasible methods of sideline biomarker analysis are needed in hopes of improving SRC detection and identification.

3356 Board #225 June 2 9:30 AM - 11:00 AM  
**Effects of Body Position and Electrode Type on the Reliability of Bioimpedance Spectroscopy**

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**Reported Relationships:** M. Lane: Contracted Research - Including Principle Investigator; I am conducting funded research by a manufacturer of BIS technology.

**PURPOSE:** To compare multiple BIS measurements taken using the traditional approach (gel-backed wet electrodes and subject supine) to BIS measurements taken when subjects are standing or seated using fixed metal electrodes and determine the reliability of each method. **METHODS:** Twenty-five subjects (m=10/f=15) participated in the study (22 +/- 3 years, 171.5 +/- 12.0 cm, 70.9 +/- 13.6 kg). Four (whole body right side) measurements each were taken for sitting with metal electrodes (SiM), standing with metal electrodes (StM), and supine with gel-backed electrodes (SuG). Data was analyzed comparing the two back-to-back measurements both before and after repositioning as well as measurements taken before repositioning to measurements taken after repositioning (pre-to-post). **RESULTS:** Both back-to-back and pre-to-post analysis revealed all methods to be highly reliable (ICC > 0.98, %CV < 2.32). Back-to-back measurements resulted in more reliable R0 and Rinf data compared to pre-to-post repositioning data for SiM, StM, and SuG (ICC > 0.995, %CV < 0.87, SEM < 6.72 Ohms), compared to pre-to-post data for SiM, StM, and SuG (ICC > 0.987, %CV < 2.32, SEM < 13.33 Ohms). SuG produced the most reliable back-to-back measurements (SuG: ICC = 1.00, %CV < 0.34, SEM < 1.48 Ohms, SiM/StM: ICC > 0.995, %CV < 0.97, SEM < 6.72 Ohms) but had the largest reliability errors from pre-to-post compared to SiM and StM (SuG: ICC > 0.986, %CV < 2.32, SEM < 13.33 Ohms, SiM/StM: ICC > 0.991, %CV < 1.51, SEM < 10.29 Ohms). Similar results were observed when comparing SiM to StM for both back-to-back and pre-to-post measurements. **CONCLUSIONS:** Sitting with metal electrodes, standing with metal electrodes, and lying supine with gel-backed electrodes all appear to produce

reliable and repeatable BIS measurements (R0 and Rinf). Gel-backed electrodes appear to produce greater variability when measurements are taken after re-applying the electrodes compared to re-positioning with metal electrodes. Yet, back-to-back measurements have slightly greater variability with metal electrodes compared to gel-backed electrodes. BIS measurements that require tracking of changes over time appear to be more reliable when using metal electrodes over gel-backed electrodes.

3357 Board #226 June 2 9:30 AM - 11:00 AM  
**Pulmonary Testing and Exercise-Induced Bronchoconstriction in Collegiate Baseball Players**

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(No relevant relationships reported)

Testing for pulmonary conditions such as asthma and exercise-induced bronchoconstriction (EIB) is often overlooked in collegiate athletes, despite the fact that they may have profound effects on performance and health. Asthma is a chronic condition, while EIB is a transient narrowing of the airways activated by strenuous exercise. **PURPOSE:** The purpose of this analysis was to investigate the prevalence of asthma, undiagnosed asthma, and EIB in collegiate baseball players. **METHODS:** Participants with asthma were noted and removed from the EIB provocation protocol. The protocol commenced with maximal forced spirometry. Participants were encouraged to achieve a six-second plateau, and spirometry values were collected in duplicate. Participants failing to achieve a baseline forced expiratory volume (FEV<sub>1</sub>) of at least 70% of the predicted value were removed from ongoing testing. Those passing the baseline spirometry screening proceeded to a single bout of exercise on a treadmill. In stepped fashion, participants progressed to an intensity matching 80-90% of age-predicted maximal heart rate. Exercise intensity was confirmed with ventilation (35\*FEV<sub>1</sub>\*0.5 and 35\*FEV<sub>1</sub>\*0.6). Participants maintained target intensity for four minutes. Immediately post-exercise, participants resumed a seated position. Maximal forced spirometry efforts were repeated at 2, 5, 10, 15, and 20-min time points. A fall in FEV<sub>1</sub> >10% from baseline was considered positive for EIB. **RESULTS:** Thirty athletes (age: 20.3±1.9 yr, height: 184.2±6.4 cm, and weight 86.5±8.8 kg) volunteered for testing. One (3.33%) had been previously diagnosed with asthma. At baseline, two participants (6.67%) failed to obtain 70% of predicted FEV<sub>1</sub> values (labeled as potentially undiagnosed asthma and removed from ongoing testing). A total of 27 participants completed the EIB provocation protocol. Five (16.7% of cohort) failed to obtain 90% of their pre-exercise FEV<sub>1</sub> value (an indication of EIB) at one of the post-test time points. The mean drop among those failing was 30.5% with all values being reviewed by a registered respiratory therapist. **CONCLUSIONS:** The prevalence of pulmonary conditions in athletes may be masked by a lack of testing. It would seem prudent to test athletes for these conditions and create treatment plans.

3358 Board #227 June 2 9:30 AM - 11:00 AM  
**Decreased Aerobic Efficiency in Pediatric and Young Patients with Sickle Cell Disease : Race Comparison**

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 (No relevant relationships reported)

**PURPOSE:** To compare the differences in aerobic efficiency between pediatric and young Sickle Cell patients (SS) and African American (NAA) and Caucasian (NC) controls. **METHODS:** We evaluated 14 SS patients, NAA and NC age, gender and size matched using a Ramp Cycle Ergometry protocol. Oxygen consumption (absolute and indexed), carbon dioxide production, expiratory minute volume (VE), respiratory exchange ratio (RER), systolic blood pressure (SBP) and heart rate (HR) were obtained at all stages. The VE/VO<sub>2</sub> (VO2Eq) and VE/VCO<sub>2</sub> (VCO2Eq) equivalents, oxygen consumption uptake efficiency slope (OUES), VE/VCO<sub>2</sub> slope (Slope) and oxygen pulse (O2Pulse) were calculated at anaerobic threshold (AT) and maximal exercise (Max). **RESULTS:** There was no difference in SBP between SS, NAA and NC groups. Max RER was significantly elevated in SS. Indexed Max oxygen consumption (IMVO<sub>2</sub>) was significantly decreased in SS. O2Pulse and OUES were significantly decreased in SS at AT and Max. Slope, VO2Eq and VCO2Eq at Max were significantly elevated in SS. The HR at AT was significantly elevated in NAA compared to SS at AT.

	SS AT	SS Max	NAA AT	NAA Max	NC AT	NC Max
HR (BPM)	149 ± 19	186 ± 10	162 ± 14*	186 ± 11	157 ± 20	186 ± 14
O2Pulse (cc/bpm)	6.7 ± 2.4	7.4 ± 2.7	9.0 ± 2.4**	10.5 ± 2.9**	9.8 ± 3.3**	11.4 ± 3.9**
OUES	1653 ± 497	1455 ± 487	2186 ± 647*	2204 ± 534**	2416 ± 673**	2334 ± 626**
Slope	24 ± 6	29 ± 6	22 ± 4	25 ± 3*	21 ± 4	25 ± 3*
VO2Eq	27 ± 5	40 ± 6	26 ± 5	31 ± 5**	24 ± 3	31 ± 5**
VCO2Eq	27 ± 5	30 ± 5	25 ± 5	27 ± 3*	24 ± 3	27 ± 3*
RER		1.33 ± 0.18		1.17 ± 0.05**		1.18 ± 0.08**
IMVO2 (cc/min/kg)	18 ± 4	24 ± 6	24 ± 6**	32 ± 7**	25 ± 5**	35 ± 8**
SS vs NAA, SS vs NC: *p<0.05, ** p<0.01						

**DISCUSSION:** The SS showed similar responses in SBP and HR compared to control groups. The SS group showed decreased aerobic efficiency reflected by an increased VE/VO2Eq, VE/VCO2Eq and Slope with a decrease in OUES and O2Pulse. The effect was a decreased aerobic capacity reflected in the decreased IMVO2 in SS.

**CONCLUSION:** These data suggest a major determinant for the decreased aerobic capacity in sickle cell is related to a decreased aerobic efficiency and decrease oxygen carrying capacity. The data does not support significant racial differences.

#### G-48 Free Communication/Poster - Exercise-Children

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
Room: CC-Hall B

#### 3359 Board #228 June 2 9:30 AM - 11:00 AM Comparison Of Estimated And Achieved Metabolic Equivalents In Children With Severe Burns

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(No relevant relationships reported)

We measure peak oxygen consumption (VO<sub>2</sub> peak) in children with severe burns via indirect calorimetry. When we can't measure VO<sub>2</sub> peak, we estimate it using the Cooper equation (CEq). In addition, a pharmacological agent sometimes used in burns to decrease hypermetabolism is propranolol.

**PURPOSE:** It is unknown, how propranolol affects the prediction of VO<sub>2</sub> peak using CEq. Therefore, we compare predictive and measured VO<sub>2</sub> peak and metabolic equivalents (METS) in children with severe burns.

**METHODS:** Children with severe burns were randomly assigned to receive propranolol or no drug during their hospital stay. At discharge, patients underwent a treadmill exercise test using the Bruce protocol. VO<sub>2</sub> peak and METS were measured and compared to predicted values using CEq (male: VO<sub>2</sub> peak = (43.6 x height (cm) - 4547.1)/weight (kg)); female: VO<sub>2</sub> peak = (22.5 x height (cm) - 1837.8)/weight (kg)). Values are means +/- SD.

**RESULTS:** We studied 99 children with burns with admit dates between March 1990 and November 2015; with 46 children receiving propranolol and 53 receiving no drug. Mean age at burn was 12±4 years in the propranolol group and 12±3 years in the control group (p = 0.512). Height was 150±18 cm and 148±17 cm (p = 0.571); total body surface area burned was 44±12 % and 49±12 %, respectively (p = 0.072). Measured VO<sub>2</sub> peak (25.1 ± 5.6 mL/min/kg vs. 22.1 ± 4.9 mL/min/kg, p = 0.005) and METS (7.2 ± 1.6 vs. 6.3 ± 1.4, p = 0.004) were significantly higher in the propranolol group. However, the actual values were lower than the predicted values, with the propranolol group being closer to predicted values (R<sup>2</sup> propranolol: 0.24, R<sup>2</sup> control: 0.13).

**CONCLUSIONS:** This study indicates that patients receiving propranolol can achieve higher VO<sub>2</sub> peak and METS at discharge. However, estimated VO<sub>2</sub> peak and METS using CEq may need to be re-evaluated considering additional factors such as age, gender and body mass index.

This study was supported in part by: The National Institute on Disability, Independent Living, and Rehabilitation Research 90DPBU0003, 90DP0043; the National Institutes

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3360 Board #229 June 2 9:30 AM - 11:00 AM

#### Correlation Between Self-reported Physical Activity And Objective Measurement In Children With Cardiac Disease

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(No relevant relationships reported)

Children with significant cardiac disease (SCD) have lower levels of physical activity compared to population norms. Few studies have compared objective measures of physical activity (O-PA) to subjective measures of physical activity (S-PA) in children and adolescents with and without SCD. **PURPOSE:** To examine the relationship between S-PA and O-PA in children and adolescents with and without SCD.

**METHODS:** Children and adolescents with SCD (n=22; 70% single ventricle physiology, 12% pulmonary hypertension, 27% heart failure) and age and gender matched healthy controls were recruited (Total n=56; mean age 12.5 ± 2.6 years old; 39.3% female). All subjects wore a tri-axial accelerometer over their non-dominant hip for 7 days. The Evenson cutpoints for moderate-to-vigorous PA (MVPA) were applied. A minimum of 3 days with 10 hours of wear time was necessary to be included in the analysis (1 subject excluded due to inadequate wear time). Past year S-PA, in hours/week and MET hours/week, was assessed using the interviewer administered Modifiable Activity Questionnaire for Children or Adolescents (MAQ-C or MAQ-A, respectively). Past 7-day physical activity was assessed with the Physical Activity Questionnaire for Children or Adolescents (PAQ-C or PAQ-A, respectively). Relationships between the MAQ-C/A, PAQ-C/A, and the accelerometer results were assessed using Partial correlations controlled for accelerometer wear time. **RESULTS:** Significant positive relationships were found between the self-reported PAQ-C/A and O-PA in SCD within all intensities of PA (Sedentary r=-0.516, p=0.004; Light r=0.552, p=0.002; Moderate r=0.615, p<0.001; Vigorous r=0.368, p=0.046; MVPA r=0.598, p<0.001). Significant positive relationships were also found between the PAQ-C/A and O-PA in the control group with moderate PA (r=0.503; p=0.024) and MVPA (r=0.493; p=0.027). In the SCD group, there were no significant relationship of O-PA with MAQ hours/week or MAQ MET hours/week. In the control group, youth had significant positive relationships in sedentary PA and MAQ hours/week (r = -0.435, p=0.049) and MAQ MET hours/week (r = -0.450, p=0.041). **CONCLUSIONS:** The self-reported PAQ-C/A had the strongest relationship with O-PA in the SCD group. The PAQ-C/A may be a reliable tool to assess PA in children and adolescents with SCD.

3361 Board #230 June 2 9:30 AM - 11:00 AM

#### Effects Of A Therapeutic Exercise Program In Children With Non-cf Bronchiectasis: A Randomised Controlled Trial

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(No relevant relationships reported)

Non-cystic fibrosis (non-CF) bronchiectasis is a major contributor to respiratory morbidity in children and youth. Current guidelines for this patient group recommend regular exercise to improve clinical outcomes including cardiovascular fitness and quality of life. However, no study has yet evaluated the effects of exercise therapy in children with non-CF bronchiectasis. **PURPOSE:** To evaluate the effect of a 7-week movement program on fundamental movement skill (FMS) proficiency, cardiorespiratory fitness, perceived movement competence, and health-related quality of life (HR-QoL) in children with non-CF bronchiectasis. **METHODS:** Children (n = 21) investigated, mean age 7.1 ± SD 2.3 years with non-CF bronchiectasis were randomly allocated to an exercise or control group. The program consisted of 7 weekly sessions plus home exercises. Each 60-minute session consisted of 6 different developmentally appropriate games, each targeting a specific FMS. The TGMD 2 was used to assess FMS; cardiovascular fitness was assessed measuring % change in exercising heart rate (HR); perceived competence was evaluated by the athletic competence subscale from Harter's Self-Perception Profile for children. HR-QoL was assessed with the PedsQL and parental cough-specific quality of life (PCQOL). A two-way ANOVA was used to assess the effects of the program. Data were analysed according to the intention to treat principle. **RESULTS:** Average HR during sessions was 137 ± 12 bpm. There was a significant group x time interaction for both FMS subgroups, locomotor (F<sub>(1,19)</sub> = 7.6, p = 0.01) and object control skills (F<sub>(1,19)</sub> = 8.3, p = 0.01). The exercise group exhibited improvements in both locomotor (pre 29 ± 2.0,

post  $35.2 \pm 2.2$ ) and object control (pre  $27.0 \pm 2.0$ , post  $35.5 \pm 2.2$ ), while the control group showed minimal changes. The associated effect sizes (Cohen's  $d = 1.2$  and  $1.3$ , respectively) indicated a large effect on FMS. The program improved cardiovascular fitness (5.9% decline in Delta HR) with an effect size commensurate with that reported for asthmatic children completing exercise training ( $d = 0.5$ ). There were no significant changes in perceived competence and HR-QoL. **CONCLUSION:** A 7-week movement program increases FMS proficiency in children with non-CF bronchiectasis and has a moderate positive effect on cardiovascular fitness.

3362 Board #231 June 2 9:30 AM - 11:00 AM  
**Predictors Of Insulin Resistance In Obese Adolescents**

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(No relevant relationships reported)

Obesity is a widespread issue that affects people regardless of age, socioeconomic status, culture, or ethnicity. This issue is commonly associated with metabolic risk factors, inherited genes and family history, as well as with unhealthy behavior such as tobacco or alcohol use. Furthermore, obesity is one of the main causes of early manifestation of chronic diseases, which account for about 70% of yearly mortality indexes worldwide. Insulin resistance (IR) is a key element in the chain of events that lead from early obesity to chronic diseases; therefore, IR screening in high-risk individuals must be under constant screening. The Homeostatic Model Assessment (HOMA) constitutes a reliable indirect method for detecting initial signs of IR presence; however, it requires the use of instruments not always available in areas of low income, where accessibility to medical equipment is limited. For this reason, finding reliable, external predictors of IR may be useful to trigger prompt interventions, or to prevent IR raise, while avoiding the need of special tools. **PURPOSE:** to evaluate a predictive model of IR in adolescents with obesity. **METHODS:** Blood samples, anthropometric information, and family history were collected from a sample of 216 obese adolescents, patients at the Children Hospital of the State of Sonora, Mexico. Hierarchical Regressions were performed to establish the predictive power of the parameters of the Metabolic Syndrome, hereditary and family history, as well as of Acanthosis Nigricans. HOMA indexes were calculated from blood glucose and insulin. **RESULTS:** After controlling age and gender, HOMA was significantly predicted through a model ( $F = 12.033$ ;  $R^2 = .371$ ;  $p < .001$ ) that included only Acanthosis Nigricans ( $b = .142$ ;  $p = .019$ ). **CONCLUSIONS:** Acanthosis Nigricans, which can be easily detected through skin exams, may represent an early indicator of risk of high HOMA, and consequently it can be used as a powerful and relatively easy assessment tool for conditions of insulin resistance in patients with obesity.

3363 Board #232 June 2 9:30 AM - 11:00 AM  
**Comparison of Body Composition in Severely Burned Children Undergoing Community Based Exercise versus Hospital Based Exercise**

Evan Ross<sup>1</sup>, Shauna Glover<sup>1</sup>, Ashley Ewald<sup>2</sup>, David Herndon<sup>1</sup>, Oscar E. Suman, FACSM<sup>1</sup>. <sup>1</sup>UTMB, Galveston, TX. <sup>2</sup>University of Tennessee, Chattanooga, TN. (Sponsor: Oscar Suman, FACSM)

(No relevant relationships reported)

**PURPOSE:** Severe burns cause long-term bone and muscle loss. Severely burned children (total body surface area burned =  $TBSA \geq 30\%$ ) enrolled in either hospital based exercise (HBEx) or community based exercise (CBEx) have been shown to preserve their lean body mass, but the effect of these programs on bone density and fat mass are unknown. **METHODS:** Severely burned children were randomly assigned at admit to HBEx or CBEx for 12 weeks to begin after hospital discharge. Dual energy X-ray absorptiometry (DEXA) scans were performed at the start and end of 12 weeks. Body mass index (BMI), lean mass index (LMI), fat mass index (FMI), percent body fat (%BF), and total body bone mineral density (BMD) were recorded. For BMI, LMI, FMI and BMD, normative percentiles for age and gender were determined. Exercise involved aerobic and progressive resistance exercises. Within and between group comparisons were performed using paired and unpaired Student's  $t$ -tests, significance was set at  $p < 0.05$ . Values are expressed as mean  $\pm$  SD. **RESULTS:** 22 patients received HBEx ( $14.3 \pm 3.1$  years, 77% male,  $TBSA = 55 \pm 12\%$ ) and 12 patients received CBEx ( $14.0 \pm 3.5$  years, 83% male,  $52 \pm 19\%$  TBSA). For HBEx, mean BMI percentile rose from 51 to 63 ( $p=0.004$ ), LMI percentile rose from 40 to 54 ( $p=0.005$ ), and BMD percentile fell from 45 to 32 ( $p=0.003$ ); FMI percentile rose from 34 to 38 ( $p=0.36$ ) and %BF did not change ( $p=0.8$ ). For CBEx, mean LMI percentile rose from 54 to 66 ( $p=0.002$ ); BMI percentile rose from 67 to 71 ( $p=0.31$ ), FMI percentile rose from 57 to 63 ( $p=0.11$ ), BMD percentile fell from 57 to 50 ( $p=0.22$ ) and %BF fell from 29% to 28% ( $p=0.72$ ). No between group comparisons were significant. **CONCLUSION:** Participation in CBEx resulted in improvements in LMI percentile

for age and gender without changes in %BF or percentile for BMI, FMI, or BMD. HBEx resulted in percentile improvements in LMI, but a decrease in BMD percentile. These results suggest that HBEx and CBEx are equivalent for maintaining lean mass, but their differential effect on BMD deserves further study. This study was supported in part by the National Institute on Disability, Independent Living, and Rehabilitation Research 90DPBU0003, 90DP0043; the National Institutes of Health R01-HD49071, P50-GM060338, T32-GM8256; the Department of Defense W81XWH-09-2-0194, W81XWH-14-2-0160; and Shriners Hospitals 84080.

3364 Board #233 June 2 9:30 AM - 11:00 AM  
**BMI versus Body Composition as Measures of Success in a Clinical Pediatric Weight Management Program**

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(No relevant relationships reported)

**PURPOSE:** To determine the proportion of patients that achieve favorable changes in body composition in the absence of improvements in body mass index. **METHODS:** Data from 52 months of clinical visits to a pediatric weight management program were extracted from electronic medical records. Body mass index (BMI) and body composition measurements were collected during clinical care. Height and weight were used to calculate BMI. BMI percentile (BMI%ile) for age and gender was determined. Bioelectrical impedance analyzers were used to measure body fat percentage (PBF). Data were analyzed to determine what proportion of patients had a favorable decrease in PBF despite an increased or unchanged BMI. **RESULTS:** Data were obtained for 1741 patients (943 females, 798 males), ages 4-21 years old, with at least two clinical visits. Initial age ( $\pm$ SD) was  $12.2 \pm 3.1$  years. Initial BMI was  $32.8 \pm 7.0$  kg/m<sup>2</sup>. Initial BMI%ile was  $98.6 \pm 1.7$ . Initial PBF was  $44.0 \pm 6.4\%$ . At follow-up, BMI increased or remained unchanged in 1148 patients (66%). PBF decreased in 928 patients (53%). There was an overall increase in BMI ( $1.20 \pm 3.03$  kg/m<sup>2</sup>,  $p < 0.0001$ ). However, BMI%ile and PBF decreased ( $-0.31 \pm 1.73$ ,  $p < 0.0001$  and  $-0.66 \pm 3.94\%$ ,  $p < 0.0001$ ). In patients whose BMI increased or remained unchanged, overall BMI%ile and PBF increased ( $0.15 \pm 0.89$ ,  $p < 0.001$  and  $0.55 \pm 3.15\%$ ,  $p < 0.0001$ ). In males, the increase in PBF was small ( $1.90 \pm 0.06$ ,  $p = 0.7$ ). Of the 779 patients whose BMI increased by  $1.0$  kg/m<sup>2</sup> or more, 239 (30.1%) had a decrease in PBF. **CONCLUSION:** Results suggest that including body fat percentage as a measure of success may be beneficial in a pediatric clinical weight management program. While patients with stable or increasing BMIs did not improve body composition overall, males demonstrated stabilized body fat percentages. In addition, of those patients whose BMI increased by  $1.0$  kg/m<sup>2</sup> or more, 30% still demonstrated an improvement in body composition. While this may not be clinically significant for the patient population as a whole, it is a measure of success for a specific subset of patients who otherwise may believe they had done poorly. This may act as a motivator for patients to continue with healthier lifestyle changes. Future research in this area may include examining age cut-offs and gender differences for the usefulness of body composition assessment.

3365 Board #234 June 2 9:30 AM - 11:00 AM  
**Enhanced Erythrocyte Antioxidant Status Following an 8-Week Aerobic Exercise Training Program in Heavy Drinkers**

Athanasios Z. Jamurtas<sup>1</sup>, Kalliopi Georgakouli<sup>1</sup>, Eirini Manthou<sup>1</sup>, Panagiotis Georgoulas<sup>2</sup>, Chariklia Deli<sup>1</sup>, Yiannis Koutedakis<sup>1</sup>, Yannis Theodorakis<sup>1</sup>, Ioannis Fatouros<sup>1</sup>. <sup>1</sup>University Of Thessaly, Department Of Physical Education & Sport Science, Trikala, Greece. <sup>2</sup>University Of Thessaly, Department Of Nuclear Medicine, Trikala, Greece.

(No relevant relationships reported)

Alcohol-induced oxidative stress is involved in the development and progression of various pathological conditions and diseases whereas exercise training has been shown to improve redox status, thus attenuating oxidative stress-associated disease processes. **PURPOSE:** to evaluate the effect of an exercise training program on blood redox status in heavy drinkers. **METHODS:** Eleven sedentary, heavy drinking men participated in an intervention where they completed an 8-week supervised aerobic training program of moderate intensity. Blood samples were collected before, during (week 4) and after intervention and analyzed for total antioxidant capacity (TAC), thiobarbituric acid reactive substances (TBARS), protein carbonyls (PC), uric acid (UA), bilirubin, reduced glutathione (GSH) and catalase activity. **RESULTS:** Catalase activity increased ( $p < 0.05$ ) after 8 weeks ( $340.7 \pm 13.3$  U mg/Hb) of intervention compared to week 4 ( $299.5 \pm 18.7$  U mg/Hb). GSH increased ( $p < 0.05$ ) after 8 weeks of intervention ( $1.22 \pm 0.16$   $\mu$ mol/g Hb) compared to the control condition ( $1.11 \pm 0.17$   $\mu$ mol/g Hb) and to week 4 ( $1.11 \pm 0.15$   $\mu$ mol/g Hb). TAC, UA, bilirubin, TBARS and PC did not significantly change at any time point. **CONCLUSION:** An 8-week aerobic

training program enhanced erythrocyte antioxidant status in heavy drinkers, indicating that aerobic training may attenuate pathological processes caused by alcohol-induced oxidative stress.

## G-48b Free Communication/Poster - Late-Breaking Abstracts

Saturday, June 2, 2018, 7:30 AM - 11:00 AM  
Room: CC-Hall B

3366 Board #: 235 June 2 9:30 AM - 11:00 AM

### Does Habituation To High Protein Intake Affect Amino Acid Handling?

Grith Højfeldt<sup>1</sup>, Jacob Bülow<sup>1</sup>, Lene Rørdam<sup>2</sup>, Peter Schjerling<sup>1</sup>, Jens Bülow<sup>2</sup>, Gerrit van Hall<sup>3</sup>, Lars Holm<sup>4</sup>. <sup>1</sup>*Institute of Sports Medicine, Bispebjerg Hospital, Copenhagen, Denmark.* <sup>2</sup>*Department of Clinical Physiology and Nuclear Medicine, Frederiksberg and Bispebjerg Hospital, Copenhagen, Denmark.* <sup>3</sup>*Clinical Metabolomics Core Facility, Clinical Biochemistry, Rigshospitalet and Department of Biomedical Sciences, University of Copenhagen, Copenhagen, Denmark.* <sup>4</sup>*School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Birmingham, United Kingdom.*

(No relevant relationships reported)

**Background:** An age related loss of muscle mass is frequent among older adults, a phenomenon termed sarcopenia. In order to circumvent this age related phenomenon, nutritional strategies of increased protein intake has been proposed, however studies investigating the effect of long-term habituation to divergent protein intakes are scarce. In this study we wish to examine if divergent levels of protein intake, is reflected in postprandial whole body protein kinetics in older male subjects.

**Method:** 12 male subjects ages 65-70 were included in a double blinded cross-over study, where each intervention consisted of a 21-day habituation period to either low or high protein intake (0.6-0.8 g/kg body weight (BW) or above 1.5 g/kg BW, respectively) interspersed by at least 60 days. At the end of each habituation period, subjects met in to an experimental trial with a primed, constant infusion of D<sub>5</sub>-PHE. A baseline blood sample was taken 90 min after infusion start. Hereafter, intrinsically labeled milk proteins, <sup>15</sup>N-phenylalanine (PHE) caseinate and D<sub>5</sub>-PHE whey were ingested in a breakfast meal. In the postprandial period blood sample were taken at 30, 60, 90, 120, 150, 180 and 240 min. All blood samples were analyzed for amino acid concentrations and PHE tracer enrichments on LCMSMS system. The gastro-intestinal (GI) absorption rate of the milk-protein derived amino acids was estimated from the appearance rate of the milk protein bound PHE tracers. The whole body protein degradation rate was calculated by subtracting the exogenous PHE appearance from the total PHE rate of appearance.

**Results:** The absorption rate of PHE from casein protein was elevated in the late postprandial period after being habituated to low protein intake (interaction: P=0.01, N=6). The absorption rate of whey protein and the endogenous rate of PHE appearance (whole body degradation rate) were not affected in the postprandial period by the habituated level of protein intake.

**Conclusion:** When habituated to a low protein diet preliminary results reveal that the absorption rate of slow digestible dietary protein is enhanced while the whole body protein degradation is not affected in the postprandial phase.

**Funding:** Supported by the Danish Dairy Research Foundation and the University of Copenhagen Excellence Programme 2016 (the CALM project).

3367 Board #: 236 June 2 9:30 AM - 11:00 AM

### Effect Of An Unhealthy Lipoprotein Distribution On Muscle Protein Synthesis Response To Whey Protein Feeding

Jakob Agergaard<sup>1</sup>, Mie C F Zillmer<sup>1</sup>, Kenneth Mertz<sup>1</sup>, Grith Højfeldt<sup>1</sup>, Peter Schjerling<sup>1</sup>, Lars Holm<sup>2</sup>. <sup>1</sup>*Institute of Sports Medicine, Bispebjerg Hospital, Copenhagen, Denmark.* <sup>2</sup>*School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Birmingham, United Kingdom.*

(No relevant relationships reported)

**Introduction:** Sarcopenia can be linked to dyslipidemia. The present study investigated how an unhealthy lipoprotein distribution (LPD) affects the sensing of hyperaminoacidemia and determines causality between LPD and development of resistance towards muscle anabolic stimuli such as whey-protein feeding.

**METHODS:** APOE<sup>-/-</sup> mice (n=12 per time-point) that develop an unhealthy LPD were compared to WT-mice (n=12 per time-point). Change in body composition was accessed from 10-20 weeks of age. At 20 weeks of age an acute trial was conducted to compare; muscle protein synthesis (MPS) measured by Puromycin labeling at post-

absorptive basal state and two post-prandial periods; 0-0.5h, and 1.5-2h post whey-protein feeding, and underlying anabolic mechanisms were accessed by RT-qPCR.

**RESULTS:** From 10-20 weeks of age, the body weight of the APOE<sup>-/-</sup> mice increased less than the WT-mice (p<0.05), whereas the lean body mass increased equally for the APOE<sup>-/-</sup> and WT-mice. Surprisingly, whey-protein did not significantly affect MPS in the post-prandial period. At 20 weeks of age, APOE<sup>-/-</sup> mice had a greater mRNA-expression for SNAT2, CD98, ATF4 and GCN2 compared to WT-mice (P<0.05). The mRNA-expression of Beclin1 was lower in APOE<sup>-/-</sup> mice compared to WT-mice (P<0.05). SLC38A9 responded to whey-protein feeding with a greater mRNA-expression at 0.5h post-feeding compared to post-absorptive state and 2h post-feeding (P<0.05).

**CONCLUSIONS:** In contrary to our hypothesis, no difference was seen between WT and APOE<sup>-/-</sup> mice in the post-prandial MPS. mRNA-expression of targets involved in amino acid sensing, and anabolic and catabolic pathways, indicated that APOE<sup>-/-</sup> mice were metabolic challenged and possibly amino acid deprived.

**Funding:** Innovation Foundation Denmark

3368 Board #: 237 June 2 9:30 AM - 11:00 AM

### The Effects of Protein Type and Added Leucine on Myofibrillar Protein Synthesis Following Concurrent Exercise

Tyler A. Churchward-Venne<sup>1</sup>, Philippe J.M. Pinckaers<sup>1</sup>, Joey S.J. Smeets<sup>1</sup>, Wouter M. Peeters<sup>1</sup>, Ian Rollo<sup>2</sup>, Luc J.C. van Loon<sup>1</sup>. <sup>1</sup>*Maastricht University, Maastricht, Netherlands.* <sup>2</sup>*Gatorade Sports Science Institute, Leicester, United Kingdom.*

**Reported Relationships:** T.A. Churchward-Venne: *Contracted Research - Including Principle Investigator; This study was externally funded by GSSI, a division of PepsiCo Inc. Any opinions or scientific interpretations expressed in this manuscript are those of the author and do not necessarily reflect the, position or policy of PepsiCo Inc.*

Protein ingestion increases skeletal muscle protein synthesis (MPS) rates. The effect of protein on MPS rates is enhanced by prior exercise. However, the effect of different types of protein on MPS is unclear and has not been evaluated following concurrent exercise. **PURPOSE:** The objective of this study was to determine the capacity of total milk protein (MILK), whey (WHEY), micellar casein (CASEIN), and soy protein, without (SOY) and with additional leucine (SOY+LEU) to support postprandial myofibrillar protein synthesis (MyoPS) following concurrent exercise. **METHODS:** 72 young recreationally active males participated in this parallel group, double-blind, randomized controlled trial consisting of two arms. In arm #1, 48 subjects (23±0.3 y) ingested 45 g of carbohydrate with either 0 g protein (CHO), or 20 g MILK, WHEY, or CASEIN protein. In arm #2, 36 subjects (23±0.5 y) ingested 45 g of carbohydrate with 20 g WHEY, SOY, or SOY+LEU. A primed continuous infusion of L-[ring-<sup>13</sup>C<sub>6</sub>]-phenylalanine with blood and muscle biopsies was applied to evaluate postprandial MyoPS over 360 minutes after exercise. **RESULTS:** In arm #1, MyoPS did not differ between treatments (P=0.12) during the postprandial period after exercise (FSR: CHO=0.051±0.003; MILK=0.061±0.003; WHEY=0.056±0.002; CASEIN=0.062±0.005 %/h). When MILK, WHEY, and CASEIN were collapsed into a single group (PROTEIN), protein-carbohydrate co-ingestion resulted in greater MyoPS rates than carbohydrate alone (FSR: PROTEIN=0.060±0.002; CHO=0.051±0.003 %/h; P=0.042). In arm #2 MyoPS did not differ between treatments (P=0.85) after exercise (FSR: WHEY=0.056±0.002; SOY=0.056±0.004; SOY+LEU=0.058±0.004 %/h). **CONCLUSION:** Total milk protein, whey, and micellar casein (arm #1) do not differ in their capacity to support postprandial MyoPS rates when co-ingested with carbohydrate following concurrent exercise in young males. Similarly, whey and soy protein, irrespective of leucine enrichment of soy (arm #2), do not differ in their capacity to support postprandial MyoPS after concurrent exercise. Co-ingestion of protein with carbohydrate results in greater postprandial MyoPS rates than carbohydrate alone, and may therefore represent a nutritional strategy to support skeletal muscle remodeling following concurrent exercise.

3369 Board #: 238 June 2 9:30 AM - 11:00 AM

### The Effect of Whey Protein Supplementation on the Recovery of Contractile Function following Resistance Training

Robert W. Davies<sup>1</sup>, Joseph J. Bass<sup>1</sup>, Brian P. Carson<sup>1</sup>, Catherine Norton<sup>1</sup>, Marta Kozior<sup>1</sup>, Matthew S. Brook<sup>2</sup>, Daniel J. Wilkinson<sup>2</sup>, Philip J. Atherton<sup>2</sup>, Ken Smith<sup>2</sup>, Philip M. Jakeman<sup>1</sup>. <sup>1</sup>*University of Limerick, Limerick, Ireland.* <sup>2</sup>*University of Nottingham, Nottingham, United Kingdom.*

**Reported Relationships:** R.W. Davies: *Contracted Research - Including Principle Investigator; Food for Health Ireland, Prof. Philip Jakeman.*

**PURPOSE:** This study investigated the effect of supplemental whey protein (WP) on acute measures of muscle protein fractional synthetic rate (FSR) and the recovery of skeletal muscle contractile function during repeated bouts of resistance training (RT).

**METHODS:** Sixteen resistance-trained men (80 [13] kg body mass; 23 [4] y; 2.6 [1.2] y RT experience; mean [SD]) completed the 7-day dietary supplement

intervention study. Subjects were randomly assigned to consume each morning in a double-blind manner either a WP supplement (WP; 0.33 g/kg; n = 8) or an isocaloric, isonitrogenous, non-essential amino acid control (CON; 0.33 g/kg n = 8) with a timed and standardised diet (35 kcal/kg/day; 2 g/kg/day protein). Peak isometric squat force (ISQ) and countermovement jump displacement (CMJ) were used to assess baseline contractile function. Subjects then completed three RT bouts (0.7 IRM back squat; 10 repetitions per set; 0.25 duty cycle; point of exhaustion = 8 [2] sets), every other day. Other activities of daily living did not exceed 3 metabolic equivalents. Repeat measurement of ISQ, CMJ, muscle pain and serum creatine kinase (CK) activity (an index of muscle damage) was taken pre-RT, +24h and +48h post-RT, each bout. Muscle protein FSR was measured between muscle biopsies taken from the vastus lateralis pre- and 5 h post- the first RT intervention using the D(2)O stable isotope tracer technique. The observed changes are reported as the mean [low, high] 90% CI, p-value (P).

**RESULTS:** A 1.0 [0.7, 1.3] fold increase ( $P < 0.008$ ) in CK and muscle pain (20 [10, 30] %;  $P = 0.011$ ) was observed +24h the first RT bout only, confirming an absence of overt muscle damage. An acute loss of ISQ was observed following all RT bouts +24h (-19 [-21, -17] %;  $P < 0.001$ ) and +48h for ISQ (-19 [-21, -17] %;  $P < 0.001$ ), and +24h for the CMJ (-7 [-9, -5] %;  $P < 0.05$ ). Whilst acute FSR was increased for WP over and above the CON (+0.275 [0.148, 0.403] %/day;  $P = 0.07$ ), no discernible difference between WP and CON was observed for any measure of contractile function, pain, or CK ( $P > 0.493$ ).

**CONCLUSIONS:** We conclude that, whilst peri-RT supplementation with WP augments muscle protein FSR, further inference of this pro-anabolic effect should not extend to acute (0 to 48 h) recovery of peri-RT muscle contractile function.

3370 Board #: 239 June 2 9:30 AM - 11:00 AM  
**Dietary Sodium Restriction Changed Calcitonin, T3, T4, and Urinary Mineral Excretion in Healthy Women**  
 Naho Serizawa<sup>1</sup>, Mamoru Nishimuta<sup>1</sup>, Naoko Kodama<sup>2</sup>, Mieko Shimada<sup>3</sup>, Yutaka Yoshitake<sup>3</sup>, Nobuko (kay) Hongu, FACSM<sup>5</sup>.  
<sup>1</sup>Graduate School of Toyo University, Gunma, Japan. <sup>2</sup>Tokyo Shokuryo Dietitian Academy, Tokyo, Japan. <sup>3</sup>Chiba prefecture University of Health Sciences, Chiba, Japan. <sup>4</sup>National Institute of Fitness and Sports in Kanoya, Kagoshima, Japan. <sup>5</sup>University of Arizona, Tucson, AZ.  
 (No relevant relationships reported)

**PURPOSE:** The purpose of this study was to examine the relationship between dietary sodium (Na) restriction and levels in hormone and urinary mineral excretion.

**METHODS:** We used a part of the metabolic balance study (the duration: 21 days) data carried out in 2004. Subjects were 11 healthy women, aged 19-23 yrs. They were divided into two levels of dietary Na groups (G), i.e. Na restricted (R) G (n = 5) (NaCl: 6 g/d) and the Control G (n = 6) (NaCl: 12 g/d). Aldosterone (ALD), calcitonin (CT), parathyroid hormone, triiodothyronine (T3) and thyroxine (T4) were measured from the blood samples collected in the fasting morning. The second voided early morning urine (EMU) minerals {Na, potassium (K), calcium (Ca), magnesium (Mg), phosphorus (P) and zinc (Zn)} were also measured.

**RESULTS:** ALD and CT levels were significantly higher in the Na RG than in the Control G (ALD: 16.5 ± 5.2 vs. 11.2 ± 3.4 ng/dL  $p < 0.001$ , CT: 34.6 ± 14.1 vs. 21.7 ± 10.0 pg/mL,  $p < 0.05$ ). T3 and T4 levels were significantly lower in the Na RG than in the Control G (T3: 99.1 ± 22.8 vs. 111.1 ± 14.9 ng/dL  $p < 0.05$ , T4: 6.2 ± 1.3 vs. 6.9 ± 1.1 μg/dL  $p < 0.01$ ). EMU-Na, Ca, Mg, P and Zn of the Na RG concentrations were significantly lower than those of the Control G (Na: 0.7 ± 0.4 vs. 1.5 ± 0.8 μmol/kg body weight (BW)/min  $p < 0.001$ , Ca: 19.3 ± 11.3 vs. 33.0 ± 16.6 nmol/kg BW/min  $p < 0.001$ , Mg: 33.6 ± 10.2 vs. 38.9 ± 9.5 nmol/kg BW/min  $p < 0.001$ , P: 165.0 ± 55.9 vs. 193.7 ± 57.4 nmol/kg BW/min  $p < 0.05$ , Zn: 50.1 ± 12.4 vs. 64.1 ± 20.0 pmol/kg BW/min  $p < 0.01$ ), respectively.

**CONCLUSION:** Our data showed that dietary Na restriction increased calcitonin and decreased both T3 and T4, and decreased minerals in the EMU. It was revealed that dietary Na restriction affects most of EMU-minerals as well as Na. This suggests that Na affected to the metabolism of the other minerals. Further studies are required to confirm the effects of Na restriction on the hormones.

3371 Board #: 240 June 2 9:30 AM - 11:00 AM  
**Effects of Olive Oil Phytochemicals and Exercise on Circulatory Leukocytes and Inflammation in Atherosclerotic Rats**  
 Tianou Zhang<sup>1</sup>, Tao Liu<sup>1</sup>, Yuzi Zhang<sup>1</sup>, Jose Amerigo<sup>2</sup>, Jing Shao<sup>1</sup>, Dongwook Yeo<sup>1</sup>, Li Li Ji, FACSM<sup>1</sup>. <sup>1</sup>University of Minnesota-Twin Cities, Minneapolis, MN. <sup>2</sup>International Society for Oleochemical, Malaga, Spain.  
 (No relevant relationships reported)

Oleochemical (Oleo) and Oleacein (Olea) are natural phenolic compounds found in extra-virgin olive oil (EVOO), exerting anti-inflammatory and antioxidant effects. Atherosclerosis, led by arterial plaque deposition, involves increased chronic

inflammation and oxidative stress. **PURPOSE:** The purpose of the study is to evaluate the immuno-regulatory and anti-inflammatory effects of Oleo/Olea supplementation and exercise training in the atherosclerotic rats. **METHODS:** Female Sprague-Dawley rats (age 4-week, n=48) were randomly divided into 4 groups fed an atherogenic diet (C) with added cholesterol (1.25%) and cholic acid (0.5%) for 12 wks. Half of the rats were supplemented with high Oleo/Olea (1000 mg/kg, HO, n=24); the other half with low Oleo/Olea (100 mg/kg, LO, n=24). In each dietary group, half group was trained (T) on treadmill for 12 wks (25m/min, 10% grade for 60 min/day, 5 days/wk), while the other half remained sedentary (S). Two separate groups of rats were fed a chow diet (n=6) and atherogenic diet (n=12), respectively without EVOO or T. Total leukocytes and differential were measured using flow cytometry. Total nitrate/nitrite (NOx) contents were determined by colorimetric assay kit. Data were shown as mean ± SEM and analyzed using two-way ANOVA. **RESULTS:** Leukocytes percentage was higher in HO vs. LO rats ( $P < 0.05$ ), but lowered 32% by T ( $P < 0.05$ ). LO and HO rats showed higher granulocytes percentage than C rats ( $P < 0.05$ ), whereas T suppressed granulocytes in HO by 27% ( $P < 0.05$ ). Neutrophils percentage was increased in HO vs. C and LO rats ( $P < 0.05$ ), but declined by 41% with T ( $P < 0.01$ ). Lymphocytes percentage was decreased in LO and HO rats ( $P < 0.05$ ) and elevated in HO+T by 23% ( $P < 0.05$ ). In addition, T tended to increase monocytes levels in LO rats ( $0.05 < P < 0.1$ ). Total NOx levels in EVOO-fed rats were decreased compared to C rats ( $P < 0.05$ ), whereas it was higher in HO-fed vs. LO-fed rats ( $P < 0.05$ ). T tended to decrease NOx in LO but increase NOx in HO rats ( $P = 0.052$ , interaction effect). **CONCLUSION:** High Oleo/Olea diet increased leukocytes, granulocytes and neutrophils percentage but decreased lymphocytes in sedentary rats, whereas exercise training significantly reversed these trends of immune markers.

3372 Board #: 241 June 2 9:30 AM - 11:00 AM  
**Effects Of A Novel Probiotic On Exercise-Induced Gut Permeability and Microbiota in Endurance Athletes**  
 Connery J. Brennan, Christopher L. Axelrod, Deborah Paul, Michaela Hull, John P. Kirwan, FACSM. Cleveland Clinic Lerner Research Institute, Cleveland, OH.  
 (No relevant relationships reported)

Exercise-induced hyperpermeability of the gastrointestinal (GI) tract contributes to abdominal pain, bloating, and fatigue; symptoms commonly expressed in Inflammatory Bowel Disease, Celiac's Disease, and Type 1 Diabetes. Therapies that can ameliorate the symptoms and conditions are lacking. **Purpose:** To assess the efficacy and feasibility of *Lactobacillus Salivarius* (UCC118) supplementation on GI permeability in healthy humans. **Methods:** In a randomized, double blind crossover study, 7 highly-trained endurance athletes ( $31 \pm 6.11$  y,  $VO_{2max} \geq 57.3 \pm 9.3$  ml/kg/min) received 4 weeks of daily probiotic or placebo supplementation. The initial 4 week period was followed by a 4 week washout, followed by an additional 4 weeks of placebo or probiotic supplementation. GI permeability, blood chemistry, and fecal microbiota were assessed before and after each 4 week intervention period. GI permeability was challenged using 2 hours of continuous treadmill running at 60%  $VO_{2max}$ . After 20 minutes of running, subjects ingested 5 grams of L-rhamnose, sucrose, and lactulose. Urine was collected before, immediately after, and every hour for 5 hours after exercise. GI permeability was measured as sugar recovered in urine as determined by LC-MS/MS. Metagenomic sequencing was performed on fecal samples with Illumina HiSeq 4000 utilizing a 2 x 150 configuration for an average of 120-130M paired end reads per sample. Beta diversity was estimated using Bray-Curtis method to reveal the microbial diversity between pre and post intervention samples. **Results:** Compared to placebo, UCC118 treatment reduced area under the curve for urine (N=5) sucrose ( $P = 0.081$ ) and rhamnose recovery ( $P = 100$ ). Gut taxonomy sequencing revealed significant changes in 60 bacterial species ( $P < 0.05$ ) after UCC118 supplementation. Additionally, there was an increase in microbial diversity after probiotic use.

**Conclusion:** The results described herein provide proof of principle that 4 weeks of UCC118 supplementation attenuates exercise-induced intestinal hyperpermeability. Molecular processes are ill-defined, so further investigation is needed to determine associated pathways, protein interactions, and impact of specific bacterial taxa. Study supported by external sponsor.

3373 Board #: 242 June 2 9:30 AM - 11:00 AM  
**The Caloric Costs and Metabolic Benefits of Wilderness Hunting in Alaska**  
 Robert H. Coker, FACSM<sup>1</sup>, Melynda S. Coker<sup>1</sup>, Larry Bartlett<sup>2</sup>, Carl J. Murphy<sup>1</sup>, Karolina Priebe<sup>1</sup>, Timothy Shriver<sup>3</sup>, Dale A. Schoeller<sup>3</sup>, Brent C. Ruby, FACSM<sup>4</sup>. <sup>1</sup>University of Alaska Fairbanks, Fairbanks, AK. <sup>2</sup>Pristine Ventures, LLC, Fairbanks, AK. <sup>3</sup>University of Wisconsin, Madison, Madison, WI. <sup>4</sup>University of Montana, Missoula, MT.  
 (No relevant relationships reported)

Epidemiological investigations have supported the healthy benefits of subsistence foods. Surprisingly, the health benefits derived from the nomadic nature of humans during the Paleolithic era have been understudied. Hunting and gathering activity that occurs far from the conveniences of civilization on public land most likely represent

the closest example of this ancient lifestyle that thrived for thousands of years.

**PURPOSE:** To determine the energy demands, and changes in body composition and metabolic risk factors in humans during a 12-day wilderness hunting immersion. **METHODS:** Four healthy men (age: 42±1 yr, BMI: 27±2 kg/m<sup>2</sup>) without any known cardiovascular, neurological, pulmonary or metabolic pathology were recruited for participation in the study. Total energy expenditure (TEE) was measured using the doubly labeled water method and a written food diary was utilized to estimate total energy intake (TEI). Body composition was measured using dual energy x-ray absorptiometry; cross sectional area of the upper thigh (XT) and intrahepatic lipid (IHL) was measured using magnetic resonance imaging/spectroscopy. Fasted blood samples were collected for the measurement of total cholesterol (TC), high (HDL) and low-density lipoproteins (LDL). Results were analyzed using paired t-tests, presented as means±SEM and considered significant at P<0.05. **RESULTS:** TEE and TEI were 4226±219 kcal/day and 2499±422 kcal/day, respectively, and resulted in a caloric deficit of 1726 kcal/day. There was a decrease in body weight (-3.2±0.2 kg), total fat mass (-3.1±0.1 kg) and visceral fat volume (-261±47 cm<sup>3</sup>). In contrast, total, leg and arm lean tissue mass and XT were preserved. There was a decrease in IHL (-0.5±0.1 % water peak). Beneficial trends were noted in blood lipids, but two of the four participants did not have their blood samples collected due to conflicts with weather and bush flight schedules. **CONCLUSION:** In the context of a chronic caloric deficit, adipose tissue and IHL decreased without any reduction in lean tissue mass or muscle mass. These alterations may reflect the interactive influence of movement constancy and caloric deficit on the health benefits of the hunter-gatherer lifestyle. Supported by NIH grant UL1GM118991, TL4GM118992, or RL5GM118990 and by a grant from the University of Montana.

3374 Board #: 243 June 2 9:30 AM - 11:00 AM  
**The Effects Of Acute Exercise On Npy/AgRP And POMC Neuron Activity In The Mouse Hypothalamus**  
 Wyatt P. Bunner, Brenton T. Laing, Hu Huang. *East Carolina University, Greenville, NC.*  
 (No relevant relationships reported)

NeuroPeptide Y/Agouti-related peptide (NPY/AgRP) and pro-opiomelanocortin (POMC) neurons are key components of the neuronal circuits that respond to various physiological condition to regulate food intake and energy homeostasis. However, far less is known about how these neurons respond to acute exercise. **PURPOSE:** To determine effects of acute exercise on the activity of AgRP/NPY and POMC neurons in the mouse hypothalamus. **Methods:** NPY-GFP reporter mice were utilized in 3 separate experiments. We randomly assigned cohort 1 (N=6) mice to a treadmill exercise with a speed of 13 M/min and an 8.75% grade for a duration of an hour group or a sedentary group, blood glucose was measured immediately post-exercise. Mice were then intracardially perfused, and their brains were isolated to examine the colocalization of the neuronal activation marker c-FOS and the signaling marker for phosphorylation of extracellular signal-regulated kinases (p-ERK) in NPY-GFP and POMC neurons. In cohort 2 (N=7) food intake was assessed following the same treadmill conditions over a 24-hour period. In the final cohort, (N=5) patch-clamp electrophysiological recordings were used to quantify changes in NPY-GFP neuron firing rate induced by exercise. **Results:** Despite normal glucose levels and food intake after the acute treadmill exercise, c-FOS and p-ERK in NPY/AgRP neurons are significantly increased (p<.05) in the exercised mice compared to the control mice. This result was further confirmed by electrophysiological recording shows that the firing rate was increased in the NPY/AGRP neurons of exercised mice. In contrast, exercise induced c-FOS expression was decreased in the POMC neurons of exercised mice. **Conclusion:** Acute treadmill exercise increases NPY/AgRP neuron activation, whereas POMC neuron activation is decreased. The responsiveness of these neurons to acute exercise is independent from food intake and glucose regulation but might associate with exercise-induced phosphorylation of ERK in the mouse hypothalamus. Supported by East Carolina University start-up fund.

3375 Board #: 244 June 2 9:30 AM - 11:00 AM  
**Markers of Non-Functional Overreaching Syndrome During the Race Across America (RAAM): A Case Study**  
 Edward K. Merritt<sup>1</sup>, David C. Nieman, FACSM<sup>2</sup>, Brian E. Barnett<sup>3</sup>, Lauren E. Parrish<sup>4</sup>, Kathryn Cardwell<sup>5</sup>, Brian R. Toone<sup>6</sup>, Arnoud Groen<sup>7</sup>, Artyom Pugachev<sup>7</sup>. <sup>1</sup>*Southwestern University, Georgetown, TX.* <sup>2</sup>*Appalachian State University, North Carolina Research Campus, Kannapolis, NC.* <sup>3</sup>*Delta State University, Cleveland, MS.* <sup>4</sup>*University of Kansas, Lawrence, KS.* <sup>5</sup>*University, Shell Lake, WI.* <sup>6</sup>*Samford University, Homewood, AL.* <sup>7</sup>*ProteIQ Biosciences GmbH, Berlin, Germany.*  
 (No relevant relationships reported)

In a previous study, global proteomics procedures identified blood proteins as potential overreaching and overtraining biomarkers, and a targeted proteomics panel of 21 proteins was developed. **PURPOSE:** To measure targeted blood protein changes in

an athlete competing in RAAM. **METHODS:** The 40-y old male athlete underwent fitness testing 4-wks pre-RAAM and 4-d post-RAAM to determine body composition and aerobic cycling capacity. During RAAM training distress score (TDS) and body mass were measured one and 2 times per day. Power output and heart rate (HR) were continuously measured during cycling. Fingerprick samples for dried blood spot samples (DBS) were obtained 4 wks, 24-h, and 2-h before the start of the race, twice per day of the race (morning/evening), and after 1 and 4 d recovery. Proteins were redisolubilized from the DBS and digested with trypsin before targeted proteomics measurements (Multiple Reaction Monitoring) on an Agilent 6400 Qq LC-MS/MS. Data was processed and analysed using Skyline. **RESULTS:** The athlete completed the 4941-km race in 10.1 d at an average moving speed of 24.5 km/h. He cycled for 20.0 h/d, with 20 h sleep for the duration of the race. Power output was 102.6 ± 8.9 watts with the highest 24-h power in the first and last 24 h (108 vs. 120 watts). TDS was 1 before the start and increased to 30 by the finish. Post-RAAM maximal aerobic capacity was 6.3% lower (61.6 vs. 57.5 mL·kg<sup>-1</sup>·min<sup>-1</sup>), and maximal HR declined 5.7% (192 vs. 181 beats/min). No changes in body mass or composition occurred. The % change in blood proteins was calculated using the average of the 2 pre-race samples and 5 samples collected on days 8, 9, and the first day of recovery. The 5 blood proteins from the DBS samples that increased the most during RAAM included complement component C7 (359%), complement C4-B (231%), serum amyloid A-4 protein (210%), inter-alpha-trypsin inhibitor heavy chain H4 (191%), and alpha-1-antitrypsin (188%). **CONCLUSION:** This case study of an ultra-endurance athlete competing in the 2017 RAAM event (4th overall) showed the typical decrease in maximal exercise performance associated with non-functional overreaching. Targeted proteomics procedures from DBS samples showed that the largest increases were measured for immune-related proteins that are involved with complement activation and the acute phase response.

3376 Board #: 245 June 2 9:30 AM - 11:00 AM  
**Safety Of Sub-maximal Aerobic Exercise During The Sub-acute Phase Of Recovery Following Sport-related Concussion**  
 Phillip R. Worts<sup>1</sup>, Scott O. Burkhardt<sup>2</sup>, S. Daniel Petty<sup>3</sup>, Lynn B. Pantone, FACSM<sup>1</sup>, Michael J. Ormsbee, FACSM<sup>1</sup>, Cathy W. Levenson, FACSM<sup>1</sup>, Jeong-Su Kim, FACSM<sup>1</sup>. <sup>1</sup>*Florida State University, Tallahassee, FL.* <sup>2</sup>*Children's Health Andrews Institute, Plano, TX.* <sup>3</sup>*Centre Pointe Health and Rehabilitation, Tallahassee, FL.*  
 (No relevant relationships reported)

Previous research suggests that strict rest for 5 days following a concussion may prolong symptom presentation. Sub-maximal aerobic exercise is an efficacious treatment for post-concussion syndrome but therapeutic aerobic exercise is not well described in sub-acutely concussed patients. **PURPOSE:** To determine if sub-maximal aerobic exercise could be safely performed in the days following a sport-related concussion. **METHODS:** Fifteen participants (16 ± 1.5 years; 9 males; 6 females) were assigned using a randomized block design to a 40% Age-Predicted heart rate (HR)<sub>MAX</sub> (40HR), 60% Age-Predicted HR<sub>MAX</sub> (60HR), or seated rest control (CON) group. Participants exercised after their initial evaluation between Day 3 and Day 7 (4 ± 1.2 days) following their concussion. Participants' HR and symptoms were monitored during the treatment. Descriptive statistics and a two-way mixed ANOVA were performed using SPSS 22. **RESULTS:** Fourteen (93%) participants were able to complete the treatment session. There was a significant interaction between group and time on heart rate  $F(3, 690, 20, 297) = 5.163, P = 0.006$ , partial  $\eta^2 = 0.484$ . HR was significantly higher in the 60HR group versus the 40HR and CON groups throughout the 20-minute treatment. The range of symptoms provoked during the treatment were: Balance problems +4 to -2; Dizziness 0 to -4; Headache 0 to -3; Fatigue 0 to -2; and Foggiessness 0 to -5. **CONCLUSIONS:** To our knowledge, this is the first study to examine aerobic exercise as a therapeutic modality during the sub-acute phase of concussion recovery. The majority of our participants were able to tolerate aerobic exercise within the first 3-7 days following a concussion and also reported a reduction in symptom severity.

3377 Board #: 246 June 2 9:30 AM - 11:00 AM  
**Is More Physical Activity Always Better? Constrained vs Additive Total Energy Expenditure Models.**  
 Erik A. Willis<sup>1</sup>, Pedro F. Saint-Maurice<sup>1</sup>, Herman Pontzer<sup>2</sup>, Charles E. Matthews, FACSM<sup>1</sup>. <sup>1</sup>*National Cancer Institute, Bethesda, MD.* <sup>2</sup>*Hunter College, New York, NY.*  
 (No relevant relationships reported)

**PURPOSE:** Strategies for the prevention and treatment of obesity require a better understanding of the association between physical activity (PA) and total energy expenditure (TEE). Current strategies are based on an additive model, where TEE and PA increases in a dose-dependent manner. However, recent evidence suggests a constrained TEE model, where increases TEE plateaus at higher levels of PA as the body adjusts to maintain an equilibrium of TEE through metabolic adaptations. Our aims were to examine the shape of the relationship between PA and TEE and to

assess the role of energy balance status (negative, stable, positive) in this association. **METHODS:** Participants were 642 older adults (50-74 yrs.) participating in the Interactive Diet and Activity Tracking in AARP study. TEE was assessed by doubly labeled water. PA, assessed by accelerometer, was estimated using three methods to calculate total PA: Vertical Axis counts per minute (CPM), Vector Magnitude CPM, and MET-hrs./d (using a machine learning algorithm [Sojourn-3x]). TEE for each subject was adjusted for anthropometric and demographic factors using linear regression. The relationship between PA and TEE was assessed using linear (i.e., correlations) and non-linear parameters (e.g., nonparametric LOESS regression curves). Percent weight change over a six month period of assessment was calculated as a proxy measurement of energy balance status. **RESULTS:** The difference in TEE between the top and bottom deciles of PA was +376(SD=341) kcal/d in the total sample, +499(SD=347) kcal/d in men, and +229(SD=318.4) kcal/d in women. TEE was positively associated with PA levels estimated by Vertical Axis ( $r=0.36$ ;  $<0.0001$ ), Vector Magnitude ( $r=0.39$ ;  $<0.0001$ ), and MET-hrs./d ( $r=0.40$ ;  $<0.0001$ ). There was no evidence of a plateau in TEE as demonstrated by the LOESS curves or the change in median TEE over PA deciles. Individuals who lost  $\geq 3\%$  of their body weight showed evidence of a plateau in TEE at higher levels of PA. **CONCLUSIONS:** Overall, PA was associated with TEE in a linear dose-dependent manner. For individual who lost weight, TEE was positively correlated with physical activity, but the relationship was stronger over the lower ranges of TEE. This study provides evidence to adopt a dynamic model for estimating energy expenditure as it pertains to obesity.

3378 Board #: 247 June 2 9:30 AM - 11:00 AM  
**Associations Of Skeletal Muscle And Appendicular Lean Body Mass With Blood Pressure And Hypertension**  
 Sunyue Ye, Chaonan Zhu, Chen Wei, Da Gan, Shankuan Zhu.  
*Zhejiang University, Hangzhou, China.*  
 (No relevant relationships reported)

**PURPOSE:** Previous studies have shown the negative effects of body fat on blood pressure (BP). However, the associations between skeletal muscle and BP remain unclear. The present study was aimed to investigate the associations of total skeletal muscle (TSM) and appendicular lean body mass (LBM) including leg and arm, with BP and hypertension.

**METHODS:** Data from 3,130 participants aged 18 to 80 years old were analyzed. Appendicular LBM including leg and arm were obtained from dual-energy X-ray absorptiometry. TSM was calculated based on appendicular LBM. Other LBM indices included TSM, and appendicular, leg and arm LBM divided either by weight, or by squared height. Adjusted multivariate linear or logistic regression models were used to analyze the associations of TSM and appendicular, leg, and arm LBM with BP or hypertension, respectively. To further investigate the associations of regional LBM with BP, arm and leg LBM were put in the linear regression models together, and the Wald test was used to compare the standardized parameter coefficients of arm and leg LBM.

**RESULTS:** TSM, and appendicular, leg and arm LBM indices were all positively associated with elevated systolic or diastolic BP after controlling for potential confounders including body fat percent and android to gynoid fat ratio, except for appendicular and leg LBM/weight. In addition, higher odds of having hypertension were observed in all TSM and appendicular LBM indices, except for leg LBM/weight. The standardized beta coefficients of arm LBM indices on systolic and diastolic BP were significantly higher than relevant indices of leg LBM, except for arm LBM/height<sup>2</sup> on systolic BP.

**CONCLUSIONS:** Total skeletal muscle and appendicular LBM especially in arms were positively associated with elevated blood pressure and hypertension, after controlling of potential confounding factors including body fat and fat distribution. Our results suggested that excess skeletal muscle especially in upper extremities may have a negative impact on BP and hypertension. Future longitudinal studies are warranted to confirm our findings.

3379 Board #: 248 June 2 9:30 AM - 11:00 AM  
**Optimal Level of Objectively Measured Physical Activity for Long-Term Weight Loss**  
 Danielle M. Ostendorf<sup>1</sup>, Janet K. Snell-Bergeon<sup>1</sup>, Jan P. Lande<sup>1</sup>, Anna E. Baron<sup>1</sup>, Angela D. Bryan<sup>2</sup>, Sarah J. Schmiege<sup>1</sup>, Dawn Comstock<sup>1</sup>, Edward L. Melanson, FACSM<sup>1</sup>, Victoria A. Catenacci<sup>1</sup>. <sup>1</sup>University of Colorado Anschutz Medical Campus, Aurora, CO. <sup>2</sup>University of Colorado Boulder, Boulder, CO.  
 (No relevant relationships reported)

**Purpose:** Existing physical activity (PA) guidelines for weight management have relied heavily on self-reported PA measures, which are typically overestimated. Our purpose was to determine the optimal level of objectively measured PA for sustaining long-term weight loss.

**Methods:** We conducted a secondary analysis of an 18 month behavioral weight loss trial, which included an exercise prescription of 300 min/wk of moderate-intensity PA. Participants received 6 months of supervised exercise during either months 0-6 or 7-12,

followed by 6 months of unsupervised exercise during either months 7-12 or 12-18. PA was objectively measured with the SenseWear armband; Participants with valid wear time ( $\geq 12$  hr/d awake time on  $\geq 3$  weekdays and  $\geq 1$  weekend day) upon completing unsupervised exercise were included in analyses. Sustained bouts ( $\geq 10$  min) of activity  $\geq 3$  METS were converted to moderate-to-vigorous intensity PA (MVPA). Receiver-operating characteristic curve analyses determined the optimal duration of bout MVPA to achieve  $\geq 5\%$  or  $\geq 10\%$  weight loss at 18 months. To identify the optimal cutoff, the Youden index (sensitivity + specificity - 1) and 95% bootstrap percentile confidence intervals were calculated using RStudio (PROC package). A linear mixed effects model examined the association between bout MVPA and weight loss.

**Results:** Participants included 143 adults (age 39.6 $\pm$ 9.4 years, BMI 34.2 $\pm$ 4.0 kg/m<sup>2</sup>, 87% female); 102 provided an 18-month weight and of these, 82 had valid SenseWear data after completion of unsupervised exercise. The optimal level of bout MVPA upon completion of unsupervised exercise was (median (95% bootstrap CI)) 209 (144-301) min/wk to achieve  $\geq 5\%$  weight loss at 18 months or 267 (108-449) min/wk to achieve  $\geq 10\%$  weight loss at 18 months. There was a dose response relationship between bout MVPA and weight loss. Participants who met 5-9.9% or  $\geq 10\%$  weight loss at 18 months were at mean $\pm$ SD 270 $\pm$ 143 or 316 $\pm$ 256 min/wk of bout MVPA upon completion of unsupervised exercise.

**Conclusions:** Results confirm the importance of high PA levels for sustaining clinically meaningful weight loss. These data validate existing guidelines with objective PA measures and suggest that  $\sim 200$ -300 min/wk of bout MVPA is the optimal duration of PA required to achieve successful long-term weight loss ( $\geq 5$ -10% weight loss at 18 months).

3380 Board #: 249 June 2 9:30 AM - 11:00 AM  
**Prevalence Of Rash Suspicious For Tinea Among Minnesota High School Wrestlers -2017-18 Season**  
 Mark A. Berg, William O. Roberts, FACSM. *University of Minnesota, St. Paul, MN.*  
 (No relevant relationships reported)

**PURPOSE:** Transmittable skin infections in sport are a concern, especially for wrestlers. We followed a geographically defined group of Minnesota high school wrestlers over the 12-week 2017-18 season to determine the prevalence of rash suspicious for tinea (RST).

**METHODS:** Nineteen high school wrestling programs in the St Paul area were contacted; 17 agreed to participate. Wrestlers undergo skin inspections prior to each competition throughout the season. Wrestlers identified during skin checks with an RST (raised, red,  $>5$ mm diameter, and with dry flaky scale) were recruited.

**RESULTS:** 39 of 510 wrestlers (7%) developed RST. 34 wrestlers consented to enter the study and had a total of 38 RST's meeting inclusion criteria (2 wrestlers developed 2 separate RST and 1 wrestler developed 3 RST). RST occurred throughout the season, with slightly more at the beginning and near the end. Slightly more RST occurred in middle competition weight categories. The most common site for RST was on the extremities (23 RST), followed by trunk (10), neck (2), face (1), and scalp (1). Empiric topical antifungal treatment had been started by 47% of the wrestlers.

**CONCLUSIONS:** RST prevalence of 7% was less frequent than found in previously reported wrestling populations. This may be the result of routine skin inspections prior to competition. Empiric topical antifungal treatment is commonly employed. Empiric antifungal treatment may be a prevention strategy that deserves further study.

3381 Board #: 250 June 2 9:30 AM - 11:00 AM  
**Current Practices of Concussion Management in Primary Care: A Survey**  
 William L. Patterson Jr.<sup>1</sup>, Kristine Karlson<sup>2</sup>, William Dexter, FACSM<sup>1</sup>, Deborah Johnson<sup>2</sup>, Christina Holt<sup>1</sup>, Ardis Olson<sup>2</sup>, Amy Haskins<sup>1</sup>. <sup>1</sup>Maine Medical Center, Portland, ME. <sup>2</sup>Dartmouth Hitchcock, Lebanon, NH.  
 (No relevant relationships reported)

**PURPOSE:** Best practices for sports-related concussions (SRC) are evolving rapidly. We aim to describe the knowledge of standardized diagnostic tools and the current practices in SRC management by primary care providers (PCPs) in Northern New England.

**METHODS:** We designed an 'action' survey, using REDCap, to query current SRC management by pediatric and family physicians in ME, NH, and VT branches of the Academy of Pediatrics (AP) and Academy of Family Physicians (AFP). An email was sent to providers with a link to a deidentified survey which included questions about demographics and clinical practices. The questions covered: frequency seeing SRC, comfort level managing SRC, awareness of current guidelines and resources, use of imaging, return to school/play, and referral patterns. At the conclusion of the survey, the respondents could view their responses compared with others, and were sent links to current guidelines.

**RESULTS:** Initial response rate is 16% (preliminary) (111 responses of 688 MEAFP and MEAP members surveyed). Demographics: 43 male, 68 female; mean age: 49.2 years; mean years in practice: 18.7. 90% (100/111) have seen a patient with SRC in the past 2 years; however, 79% (88/111) see  $\leq 1$  per month. 56% work with ATCs to

manage SRC. 61% report moderate or extreme comfort managing SRC. 91% (101/111) are aware at least 1 guideline for SRC, but only 18% (20/111) are aware of the 2016 Berlin consensus statement. 87% appropriately do not order imaging when no focal findings are found initially; but 46% (51/111) are likely to order imaging at 3 weeks even without valid indication. 70% (76/109) generally do not prescribe medications for concussion symptoms. 41% (43/106) appropriately recommend staying out of school for 2 or less days after SRC. 86% (94/109) are aware of return to play (RTP) guidelines and 90% (85/94) demonstrate appropriate management when an athlete fails a step. **CONCLUSIONS:** Clinicians responded well to a survey of current SRC practices, which provided updated clinical guideline tools. Most PCPs manage SRC; however, a majority report seeing  $\leq 1$  a month. A large proportion of PCPs do not follow current recommendations for imaging or return to school. Results could help guide future CME for SRC management.

3382 Board #: 251 June 2 9:30 AM - 11:00 AM  
**Effects of 6 Months Endurance Training on Quality of Life and Work Ability**  
 Hedwig Stenner, Lena Grams, Momme Kück, Julian Eigendorf, Sven Haufe, Uwe Tegtbur, Anette Melk, Andres Hilfiker, Axel Haverich, Meike Tiesch-Scholz. *Institute of Sports Medicine, Hanover, Germany.*  
 (No relevant relationships reported)

**Purpose:** In this prospective, randomized controlled study we assessed effects of moderate-intense supervised endurance training on quality of life and work ability in middle-aged sedentary women. **Methods:** We randomized 291 healthy, non-smoking sedentary women (45-65 years) to a 6 months endurance training (EG, 210 min/week) or a wait-list-control (CG, no change of inactive life-style). At baseline and 6-month follow-up we assessed peak oxygen uptake ( $VO_{2peak}$ ) by cardiopulmonary exercise testing, Work Ability Index (WAI) and quality of life (SF36), both by questionnaires. The metabolic syndrome score (MSS) was calculated using the siMS score. **Results:** At baseline, groups were well matched for anthropometric and cardiovascular parameters. Adherence to endurance training was  $207 \pm 17$  min/week (98 $\pm$ 5%). After intervention, the exercise group improved significantly compared to controls in  $VO_{2peak}$  (mean difference: 2.11 ml/min/kg, CI [1.41;2.79],  $p < 0.001$ ) and MSS (mean difference: 0.11 points, CI [0.053;0.175],  $p < 0.001$ ).  $VO_{2peak}$  and WAI changes correlated significantly ( $R = 0.201$ ;  $p = 0.002$ ). SF36 improved significantly in the EG compared to the CG for the subscales "Physical Role Functioning" (EG: baseline 83.7 $\pm$ 26.5, follow-up 88.1 $\pm$ 25.2, CG: 92.4 $\pm$ 19.4, 89.7 $\pm$ 22.1 respectively;  $p = 0.016$ ), "General Health Perceptions" (EG: baseline 69.3 $\pm$ 14.8, 73.6 $\pm$ 14.3, CG: 72.5 $\pm$ 13.6, 71.8 $\pm$ 14.3;  $p = 0.002$ ) and the "Sum Scale Physical" (EG: baseline 50.8 $\pm$ 6.5, 52.2 $\pm$ 6.3, CG: 52.7 $\pm$ 5.7, 52.3 $\pm$ 6.4;  $p = 0.040$ ) after exercise training. WAI changed significantly in the EG compared to the CG for "Work Ability In Relation To Demands" (EG: baseline 7.8 $\pm$ 1.3, 8.2 $\pm$ 1.2, CG: 8.2 $\pm$ 1.3, 8.1 $\pm$ 1.3,  $p = 0.003$ ), "Number of Current Diseases" (EG: baseline 2.2 $\pm$ 1.7, 1.9 $\pm$ 1.6, CG: 2.1 $\pm$ 1.7, 2.2 $\pm$ 1.9,  $p = 0.014$ ) and total score of WAI (EG: baseline 38.3 $\pm$ 5.0, 39.8 $\pm$ 4.9, CG: 39.4 $\pm$ 4.7, 39.3 $\pm$ 4.9,  $p = 0.001$ ). **Conclusion:** Our results show that a moderate personalized 6-month endurance training in middle-aged previously sedentary women improved established parameters of cardiovascular function, prevented metabolic syndrome progression, work ability and quality of life.

3383 Board #: 252 June 2 9:30 AM - 11:00 AM  
**From the Perspective of Mitophagy: Study the Mechanism of Sustained Aerobic Exercises Alleviate Brain Aging**  
 Wang Lu, Deng Wenqian, Li Xue. *Chengdu Sports Institute, Chengdu, China.*  
 (No relevant relationships reported)

Our previous work has demonstrated that sustained aerobic exercise could affect the morphology and function of mitochondria, and mitigate the mental functions decline of rats caused by D-gal.

**PURPOSE:** To investigate whether sustained aerobic exercise could alleviate aged rats' brain aging by influencing mitophagy. This project will also study the role of mitophagy in brain aging of aged rats.  
**METHODS:** Twenty-four male Sprague-Dawley rats were randomly assigned into a control group (C, n=12), and a sustained aerobic exercise group (E, n=12). Groups C received conventional feeding for four weeks, and group E received feeding and swimming training for four weeks, 60 min/day, 6 days/week. Firstly, we would analysis the effect of sustained aerobic exercise on spatial learning and memory ability of aged rats. Then, transmission electron microscope were used to observe the mitophagy in loubus fromatis; Some indicators of mitophagy were detected by immunofluorescence, such as HSP60 and LC3-II, HSP60 and LAMP1; at last, index related to the mitophagy (Beclin1, P62 and LC3) were detected by western blotting. The experimental data were reported as means $\pm$ SE, and  $P$  values  $< 0.05$  were considered significant.  
**RESULTS:** Firstly, sustained aerobic exercise could alleviate rats' brain aging in spatial learning and memory ability. Mitophagy was significantly increasing in loubus fromatis detected by transmission electron microscope and immunofluorescence. According to the western blotting test, Beclin1 (C: 0.08 $\pm$ 0.02; E: 0.63 $\pm$ 0.09;

respectively,  $P < 0.05$ ) and P62 (C: 0.05 $\pm$ 0.01; E: 0.74 $\pm$ 0.11; respectively,  $P < 0.05$ ) were significantly elevated after sustained aerobic exercise; LC3-II/ LC3-I (C: 0.12 $\pm$ 0.03; E: 1.25 $\pm$ 0.17; respectively,  $P < 0.05$ ) was also significantly increased. These indicators indicated that mitophagy was increasing after sustained aerobic exercise.

**CONCLUSIONS:** Results from this study suggest that four weeks of sustained aerobic exercise can improve spatial learning and memory ability of aged rats, by increasing mitophagy in rats' loubus fromatis. Mitophagy is playing a very important role in brain aging of aged rats.

3384 Board #: 253 June 2 9:30 AM - 11:00 AM  
**Nurse Amie (Addressing Metastatic Individuals Everyday)**  
 Erica Schleicher<sup>1</sup>, Leah Cream<sup>1</sup>, Rena Kass<sup>1</sup>, Michelle Farnan<sup>1</sup>, Xiaochen Zhang<sup>2</sup>, Katlynn Mathis<sup>1</sup>, Jessica Moyer<sup>1</sup>, Kathryn Schmitz, FACSM<sup>1</sup>. <sup>1</sup>Pennsylvania State University, Hershey, PA. <sup>2</sup>Ohio State University, Columbus, OH.  
 (No relevant relationships reported)

About 1 in 8 US women will develop invasive breast cancer in her lifetime. Complications with symptoms include inability to deliver chemotherapy, hospitalizations and survival outcomes. For patients to benefit from pharmacologic interventions, clinicians must be made aware. At present, there is no standard of care system to ensure clinicians are made aware of symptoms.

**Purpose:** To investigate the feasibility and acceptance of a symptom assessment and management platform for metastatic breast cancer (MBrCa) patients, including exercise.

**Methods:** Our team developed an interactive symptom assessment and management platform, Nurse AMIE. Patients were provided with a tablet, pedometer, and resistance bands. Nurse AMIE asked a daily question on sleep, fatigue, pain, or distress. Data from the pedometer and daily symptom questions were applied to an algorithm that resulted in a self-management intervention. Interventions included guided relaxation, social support forum, exercise, and music. Systematic symptom assessment and self-management interventions, along with weekly supportive phone calls determined whether self-management could continue or if there was a need to schedule an appointment with the clinician.

**Results:** 31 MBrCa patients had been consented to use Nurse AMIE. The initial patient adherence rate was 76%. Qualitatively, patient interviews suggest that Nurse AMIE is 'surprisingly easy to use' and the most valued interventions have been the social support forum, exercises, and music. Additionally, patients noted an improvement in fatigue while using the walking intervention. One patient who was only able to ambulate painfully with a walker at baseline now walks over 10,000 steps a day. Thus far, all initial patients have been able to self-manage with no interval visits with clinicians while using Nurse AMIE.

**Conclusion:** Nurse AMIE is an interactive platform that allows MBrCa patients to successfully self-manage symptoms while providing critical feedback. Overall, the physical activity component of this intervention is particularly well received. Qualitative feedback suggests that clinicians and patients are pleased by this comprehensive and standardized approach to assessing and managing symptoms. Further evaluation will allow us to better understand symptom assessment and management.

3385 Board #: 254 June 2 9:30 AM - 11:00 AM  
**Interindividual Variability and Adverse Responses to Body Composition with Exercise Training in Adolescents with Obesity**  
 Jeremy J. Walsh<sup>1</sup>, Gary Goldfield<sup>1</sup>, Glen Kenny<sup>2</sup>, Ronald Sigal<sup>3</sup>, Steven Doucette<sup>4</sup>, Brendon J. Gurd<sup>5</sup>. <sup>1</sup>Children's Hospital of Eastern Ontario, Ottawa, ON, Canada. <sup>2</sup>University of Ottawa, Ottawa, ON, Canada. <sup>3</sup>University of Calgary, Calgary, AB, Canada. <sup>4</sup>Nova Scotia Health Authority, Halifax, NS, Canada. <sup>5</sup>Queen's University, Kingston, ON, Canada.  
 (No relevant relationships reported)

Improved body composition (BC) is an expected outcome in adults undergoing exercise training. However, significant interindividual variability (IIV) has been observed in this response. Further, while some individuals fail to accrue training benefits, others demonstrate adverse responses, which can have implications for clinical exercise prescription. It is unknown if exercise training increases IIV and if it affects adverse response rates beyond what would be expected following a diet-only intervention in adolescents with obesity.

**PURPOSE:** To examine if exercise training increases IIV in the observed response of BC, and to quantify adverse response rates to training compared to diet-only control in adolescents with obesity. **METHODS:** Post-pubertal boys and girls (n = 143; age 15.5  $\pm$  1.4 yrs; BMI = 34.8  $\pm$  4.6 kg/m<sup>2</sup>) were randomly assigned to either a diet-only control group (n = 56), aerobic (n = 35), resistance (n = 23), or combined aerobic/resistance training (n = 29). Supervised exercise training was performed 4 x/week for 6 months. All groups received diet counseling to reduce caloric intake by 250 kcal/day. BC

outcomes were body fat % and lean body mass (LBM) measured via MRI, and waist circumference (WC). IIV was assessed by comparing the standard deviation of the observed change for each variable across control and pooled exercise groups ( $SD_{IR}$ ). A positive  $SD_{IR}$  indicates increased IIV with training. An effect size (ES) was used when the  $SD_{IR}$  was positive to characterize the magnitude of effect. Adverse responses were evaluated using a measure of typical error to establish response thresholds and expressed as an aggregated score for all BC outcomes.

**RESULTS:** All exercise groups displayed a systematic increase in IIV following training for body fat % ( $SD_{IR} = 1.77$ ,  $ES = 0.32$  [0.06, 0.89]), but not for LBM or WC ( $SD_{IR} = \text{no effect}$ ). Exercise significantly decreased the rate of adverse responses for aggregated measures of BC relative to control (7.4% vs. 20.4%,  $p < 0.05$ ), regardless of training modality.

**CONCLUSIONS:** Regardless of modality, exercise training does not systematically increase IIV across most BC measures in previously sedentary adolescents with obesity. Rather, exercise creates a positive, uniform shift in BC outcomes, thereby decreasing the rate of adverse responses and increasing positive responses.

3386 Board #: 255 June 2 9:30 AM - 11:00 AM

**Effects of Resistance Training and Doxorubicin on Creatine Transporter and Creatine Kinase Expression in Fast Muscle**

Salaheddin Sharif<sup>1</sup>, David S. Hydock<sup>1</sup>, Mackenzie Twaddell<sup>2</sup>, Allison Tigner<sup>2</sup>, Meghan Wagner<sup>2</sup>, Eric C. Bredahl<sup>2</sup>. <sup>1</sup>University of Northern Colorado, Greeley, CO. <sup>2</sup>Creighton University, Omaha, NE.

(No relevant relationships reported)

Doxorubicin (DOX) is a potent chemotherapy drug used to treat numerous cancers, but its use is limited due to its toxicities. DOX treatment may lead to skeletal muscle dysfunction which compromises quality of life for cancer patients. It is suggested that DOX inhibits creatine transporter (CreaT) and creatine kinase (CK) expression in cardiac muscle, but little is known as to how it affects CreaT and CK expression in skeletal muscle. Additionally, resistance training has been shown to alleviate DOX-induced skeletal muscle dysfunction (weakness and fatigue), but the effects of resistance training on CreaT and CK expression in DOX-treated skeletal muscle is currently unknown. **PURPOSE:** To investigate the effects of resistance training prior to and during DOX treatment on CreaT and CK expression in the primarily type II, or fast, extensor digitorum longus (EDL) muscle. **METHODS:** Thirty-six male, Sprague-Dawley rats were randomly assigned to one of four groups: sedentary+saline (SSS), sedentary+DOX (SSD), resistance training+saline (RRS), and resistance training+DOX (RRD). The resistance training protocol incorporated a raised cage model where food and water were elevated progressively which provided hindlimb loading 10 weeks prior to DOX injection and during the course of DOX treatment. Animals receiving DOX received 3 mg/kg DOX administered i.p. weekly for 4 weeks (12 mg/kg cumulative) and animals receiving saline received equivalent volumes of 0.9% NaCl as a placebo. Five days following the final DOX or saline injection, EDL muscles were excised, and Western blotting was performed to quantify CreaT and CK expression. **RESULTS:** No significant drug effect or activity x drug interaction was observed for CreaT expression, but a significant activity effect was observed for CreaT expression ( $p = 0.0479$ ). No significant main effects or interaction was observed for CK expression. **CONCLUSIONS:** Resistance training prior to and during weekly DOX administration promoted an increase in CreaT expression suggesting that resistance training may play a role in alleviating DOX-induced skeletal muscle dysfunction by enhancing substrate availability for phosphocreatine synthesis.

3387 Board #: 256 June 2 9:30 AM - 11:00 AM

**Exercise In All Chemotherapy (EnACT) Study: Implementation Of Exercise Oncology In A Clinical Setting**

Natasha Burse, Kathleen Sturgeon, Cathy Bryan, Wayne Foo, Katlynn Mathis, Jessica Moyer, Renate Winkels, Joachim Wiskemann, Kathryn Schmitz, FACSM. Pennsylvania State University, Hershey, PA.

(No relevant relationships reported)

**Purpose:** Despite exercise recommendations for cancer patients, exercise counseling is not standard of care in cancer centers across the U.S. Challenges in the field of exercise oncology persist and require strategic approaches to ensure that exercise programming is approached in a manner that is widely acceptable to patients and their clinicians. Therefore, we have conducted an implementation study to assess feasibility, adherence to exercise during chemotherapy, and logistics of operating an exercise intervention program in the infusion suite of a cancer institute.

**Methods:** The Exercise Medicine Unit at the Penn State Cancer Institute (PSCI) is located in the infusion suite of the PSCI and was opened in the Fall of 2017. Staff screened all patient visits to the PSCI infusion suite for study eligibility criteria: ECOG  $\leq 2$ , absence of absolute contraindications for exercise, solid tumor malignancy, and scheduled to receive chemotherapy. Participants completed surveys (physical activity, barriers to exercise, nutrition, work impairment, and quality of life) and physical function testing at baseline and follow up. An ACSM certified cancer exercise trainer

prescribed a personalized exercise program that has 5 components: aerobic, strength, balance, stretching, and relaxation.

**Results:** Of 317 patients screened, 42% were eligible (135), and 104 consented (77%) to the EnACT study. Characteristics of the study population include an average age of 59 years, 62% female, and 40% with metastatic disease. The top 3 cancer sites in the study were breast (23%), colorectal (17%), and pancreatic (16%). Adherence to prescribed exercise programming was 82%,  $n = 39$  completers. Overall, barriers to being active were decreased, with fewer participants reporting lack of willpower to exercise (42%, baseline; 19% follow up;  $p = 0.02$ ), and fewer citing influence from others as a barrier to exercise (19%, baseline; 3% follow up;  $p = 0.06$ ).

**Conclusion:** We report our mid-point analysis of the EnACT study. Thus far, the study is clinically feasible with 77% of eligible participants providing consent and an 82% adherence rate. Qualitative assessment with participants and health care professionals are ongoing. Collectively this study will aid in moving evidence based exercise-oncology practice into routine clinical usage.

3388 Board #: 257 June 2 9:30 AM - 11:00 AM

**Effect Of 10 Weeks Of Low-load High-repetition Resistance Exercise Training On Human Skeletal Muscle**

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(No relevant relationships reported)

Generally, high-load resistance exercise is recommended for increasing muscle mass. However, for the physically weak individuals encountering difficulties in performing high load resistance exercise, such as the elderly, women, and patients in rehabilitation, such exercise may not be effective. Recent research suggests that low-load high-repetition resistance exercise can increase muscle mass effectively, and can also contribute by facilitating mitochondrial metabolism or an adaptive phenomenon of endurance exercise.

**PURPOSE:** We aimed to investigate skeletal muscle functions, hypertrophy, and mitochondrial metabolism according to load and total work volume of exercise training based on molecular biology and physiological factors.

**Methods:** We recruited 21 men in their 20s and divided them into three groups, 80FAIL (80%RM set to failure,  $n = 7$ ), 30WM (30%RM and work matched to 80FAIL), and 30FAIL (30%RM set to failure), to perform resistance exercise three times a week for 10 weeks. Isokinetic muscle function test and Wingate test were conducted to assess their muscle function before and 72 hours after the last session. A biopsy of quadriceps femoris was performed to determine changes in muscle cross-sectional area (CSA), satellite cell activation and mitochondrial metabolism.

**Results:** After 10 weeks of exercise training, 30FAIL and 80FAIL showed an increase in peak torque, CSA, and satellite cell activation ( $p < .05$ ). In terms of endurance strength, 30FAIL was the only group that presented a significant increase after the training ( $p < .001$ ). Furthermore, 30FAIL recorded a significant rise in expression of mitochondrial biosynthesis indicators of COXIV and cytochrome c, fusion proteins (Mfn2, Opa1), fission proteins (Drp1, Fis1), and mitophagy factors (PINK1, Parkin) after the exercise training ( $p < .05$ ). Overall, 10 weeks of low-load resistance exercise training (set to failure) can activate satellite cells, thereby contributing to increase in CSA and improvement of muscle function.

**Conclusion:** Low-load high-repetition exercise training can be suggested as an effective method of muscle exercise training to enhance skeletal muscle function and aerobic metabolism at the same time by facilitating mitochondrial metabolism of the skeletal muscle.

3389 Board #: 258 June 2 9:30 AM - 11:00 AM

**Expression Of Markers Of Browning In White Adipose Tissue In Life-long Endurance Trained Athletes**

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(No relevant relationships reported)

Physical exercise and training results in adaptations in adipose tissue. Such adaptations may in part be mediated through "cross-talk" with skeletal muscle. One of these adaptations potentially relevant to energy metabolism in endurance athletes is the beiging of white adipose tissue (WAT). Beiging is the process by which WAT shows characteristics of brown adipose tissue (BAT), possibly increasing basal metabolic rate. While the process of beiging in rodents and the existence of BAT in humans has been shown previously, it is unknown if and how life-long endurance exercise influences beiging of WAT depots. **Purpose:** To study the influence of life-long training on adipose tissue markers of beiging and metabolic performance, the uncoupling protein 1 (UCP-1), CIDEA and PPAR- $\gamma$  in white adipose tissue (WAT) in sub-elite athletes. **Methods:** Periumbilical subcutaneous adipose tissue biopsies were collected from 14 life-long trained sub-elite endurance athletes (8 male, 6 female;  $VO_{2max}$  performance over 90<sup>th</sup> percentile for their age group) and 13 age-matched controls (6 male 7 female). Gene expression was analyzed on extracted RNA. Fold induction

was statistically analyzed by Student's-t-test. **Results:** UCP-1 gene expression was significantly higher in trained women compared with the control group ( $p=0.046$ ). No significant difference was found in men when comparing UCP-1 expression ( $p=0.257$ ). Expression of CIDEA was, again, significantly higher compared with controls ( $p=0.049$ ), but also in men ( $p=0.024$ ). Finally, expression of PPAR- $\gamma$  was significantly higher in trained women ( $p=0.005$ ). Again no differences were found in men ( $p=0.924$ ). **Conclusion:** Life-long endurance training results in a higher expression of brown adipose tissue markers in periumbilical WAT in women, in men only in expression of CIDEA, a factory closely associated with metabolic health. Previous results in rodents show a higher susceptibility of females to upregulate BAT markers following  $\beta$ -adrenergic signaling. A similar mechanism might be possible in humans. This effect might also be caused by differences in body fat distribution and functionality, with women having a higher prevalence for BAT.

3390 Board #: 259 June 2 9:30 AM - 11:00 AM  
**In-vivo Measurement Of Strain In The Iliotibial Band In Motion**

Kuntal Chowdhary. *Oakland University William Beaumont School of Medicine, Rochester, MI.*

(No relevant relationships reported)

**PURPOSE:** Iliotibial band syndrome (ITBS) is one of the most common overuse leg injuries. Two current theories - friction and compression - attempt to correlate the cause of lateral knee pain to the inflammation of the iliotibial band (ITB). Despite lack of consensus, both theories suggest that strain plays a key role in all potential mechanisms of injury. The purpose of this study is to measure strain in the ITB non-invasively over the skin, as a basis for further evaluation of ITBS as correlated to changing strain rates.

**METHODS:** Strain was measured using a 'strain measurement apparatus' consisting of strain gauges in a carbon fiber casing. The strain measurement apparatus was placed on biomimetic skin overlying a tendon to obtain an estimated measure of strain upon manipulation of the cords to known forces. The output generated by the apparatus was correlated to the actual strain measured by a load cell placed directly on the tendon. The 'strain measurement apparatus' was manipulated to maximize precision throughout the experimental process. In the second phase of the project, the 'strain measurement apparatus' will be used to measure strain in a porcine leg as a closer approximation of the human ITB.

**RESULTS:** The first phase of this study demonstrated a correlation between the strain measured by the apparatus and the force applied to the biomimetic tendon, as measured by the load cell. Four trials were run, with the strongest correlations in trials 2 and 3 with correlation coefficients of 0.97 ( $P<0.0001$ ) and 0.99 ( $P<0.0001$ ), respectively.

**CONCLUSIONS:** The results thus far support the hypothesis that strain can be measured in the ITB directly using strain gauges. The efficacy of the strain measurement apparatus will provide a basis for further non-invasive evaluation of the ITB as correlated to ITBS in human models.

3391 Board #: 260 June 2 9:30 AM - 11:00 AM  
**Applied Assessment and Interventional Energy And It's Effects In A Clinical Setting**

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(No relevant relationships reported)

**PURPOSE:** The purpose of this study is to evaluate interventional electron energy's ability to reduce inflammation and related symptoms such as pain. Inflammation is the underlying factor in many conditions. The origin of inflammation is the cells accumulation of waste product caused by ion channel dysfunction. The performance of neuronal ion channels are regulated by voltage or ligand. Voltage disruption in the membrane affect channel gate function. Minute changes in channel gate function leads to cell dysfunction caused by molecular structure abnormality, the result of free radical based electron instability. Free radicals are active in inflammatory processes in vitro and in vivo. Interventional electron energy modifies ionic flow across cell membranes and may correct cell function. Interventional electron energy is used to reduce cell dysfunction and inflammation by neutralizing free radicals. **METHODS:** The application of interventional electron energy is used to counteract free radical related molecular, sub-molecular and cell dysfunction causing inflammation. This method includes free radical assessment and interventional electron energy application to affected tissue. Free radical neutralization can be achieved via correction of impaired movements and pathways of affected electrons. This may result in correction to molecular structure leading to ion channel function correction within the cell membrane. This can result in the decrease of inflammation and related conditions.

**RESULTS:** Out of 144 interventional electron applications on inflammation and related pain in in knees, cervical, backs, shoulder, hands and heads, the mean deviation improvement was 4.52. The Average Improvement Percentage [(652.699213 (Sum total VAS pain scale pre-treatment)/63.9810606 (Sum total VAS pain scale post-treatment)) = 10.20 (Difference in sum totals)] [100 - 10.20 = **89.80% (Average pain reduction)**]

**CONCLUSIONS:** By integrating analytic and interventional processes, the benefit to the patient is a new accelerated assessment and treatment for rapid reduction of

inflammation and related conditions. The pain reduction %'s in this large population pilot study exceed the pain reduction %'s achieved with standard conservative therapeutic options. These results warrant further study and investigation.

3392 Board #: 261 June 2 9:30 AM - 11:00 AM  
**Forced PGC1a1 Expression Improves Oxidative Capacity And Partially Rescues Strength Following Volumetric Muscle Loss Injury**

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(No relevant relationships reported)

Volumetric muscle loss (VML) is characterized by a large volume of muscle tissue being removed from the body due to surgery or severe trauma. The remaining muscle after VML has poor function and unknown adaptive potential during physical rehabilitation. **PURPOSE:** To investigate the metabolic plasticity of the remaining skeletal muscle after VML injury. **METHODS:** VML injury was performed on the gastrocnemius muscle of 8-week old C57BL/6 mice. Study 1: Unilaterally injured VML mice performed voluntary wheel running (WR). Study 2: PGC1a1 (CMV promoter) transfection was performed on control (CON) and bilaterally injured VML mice (VML). Mice were divided into three groups: CON+PGC1a1 overexpression, VML alone, and VML+PGC1a1 overexpression. Four weeks after onset of wheel running (Study 1) or transfection interventions (Study 2), muscle strength and mitochondrial respiratory function (mitoFx) were assessed. **RESULTS:** MitoFx was ~23% greater in the uninjured limb of VML+WR mice compared to VML alone, but mitoFx in the injured limb of VML+WR mice was not different from VML alone, suggesting VML injury prevents metabolic adaptations to exercise (ANOVA  $P<0.001$ ). To determine if a faulty metabolic signaling cascade (i.e., PGC1a1) was responsible for impaired metabolic adaptation in the VML-injured muscle, direct muscle activation via sciatic nerve electrical stimulation was used to initiate oxidative gene transcription in CON and VML mice. The stimulated muscle in CON mice had ~4 fold greater PGC1a1 gene expression than the unstimulated muscle; however, there was no effect of stimulation on PGC1a1 expression in VML mice (Interaction:  $P<0.001$ ) suggesting VML injury attenuates oxidative gene regulation. Endogenous PGC1a1 activation pathways were bypassed via forced expression of PGC1a1 in Study 2. Forced expression of PGC1a1 resulted in ~33% and ~31% greater mitoFx in CON+PGC1a1 and VML+PGC1a1 mice, respectively, compared to VML alone ( $P<0.001$ ), and VML+PGC1a1 mice had 47% greater muscle strength than VML alone ( $P<0.001$ ). **CONCLUSION:** PGC1a1 activation is the limiting factor impairing metabolic plasticity in VML-injured muscle; and improving oxidative capacity of the remaining muscle after VML injury improves recovery of strength.

3393 Board #: 262 June 2 9:30 AM - 11:00 AM  
**Myonuclear Transcriptional Rate Differs in Young versus Mature Mice**

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(No relevant relationships reported)

Skeletal muscle fiber hypertrophy occurs in mature mice (>4 months old) in response to synergist ablation overload in the absence of satellite cell-mediated myonuclear accretion, whereas young mice (2 months old) are not able to hypertrophy without satellite cells. We hypothesize that young mice have higher myonuclear transcriptional activity at rest than mature mice due to the demands of developmental muscle fiber growth. Age-related differences in transcriptional rate may in part explain why young mice cannot mount the robust myonuclear transcriptional response required for overload-induced hypertrophy without satellite cells. **Purpose:** To determine whether baseline myonuclear transcription differs between young (2 months) versus mature (5 months) mice. **Methods:** Young and mature mice ( $n=4$  males/group) were pulsed with 5-ethynyl uridine (EU), a modified uridine that incorporates into nascent RNA, via intraperitoneal injection then sacrificed after a 1-hour chase. Myonuclei were defined as DAPI-positive nuclei within the myofiber, delineated by dystrophin immunostaining. EU-labeled nascent RNA was detected histochemically on frozen muscle cross-sections, and myonuclear EU intensity was quantified with semi-automated thresholding software. Muscle fiber cross sectional area (CSA) was quantified via the detection of fiber borders using automated software. **Results:** The number of EU+ myonuclei did not differ between young and mature mice. Mean transcriptional intensity per myonucleus was 10% higher in young versus mature mice, and muscle fiber CSA was 18% smaller ( $P<0.05$ ). Myonuclear transcriptional rate normalized to muscle fiber size appeared 30% higher in young versus mature mice, but did not reach statistical significance ( $P=0.07$ ).

**Conclusion:** Likely due to lower normalized myonuclear transcription relative to young mice, mature mice may possess a transcriptional reserve that allows for hypertrophy in the absence of myonuclear accretion, as previously shown by our

laboratory. The current data indicate that murine developmental age could be an important consideration for hypertrophy experiments. These results will be verified in a larger cohort of mice that will also include females.

seated balance in individuals with CP even though bone strength in the lumbar region is not significantly different compared to controls. Supported by Central RSCA and Undergraduate Research Grant, SJSU

3394 Board #: 263 June 2 9:30 AM - 11:00 AM  
**Relationships Between Muscular Strength And Body Composition In Adults With Cerebral Palsy**  
 Pooja Pal, Cory E. Low, Rachel L. Christensen, Stephanie V. Rosales, Areum K. Jensen. *San Jose State University, San Jose, CA.*  
*(No relevant relationships reported)*

Cerebral palsy (CP) is a non-progressive and permanent neurological disorder that is characterized by muscular weakness and soft tissue contracture or deformation. Adults with CP develop health risk factors and diseases, such as obesity and cardiovascular diseases, significantly more than the general population. Majority of the research focuses on interventions for children and adolescents with CP, and little is known about long-term health issues among adult CP population. Currently, limited information is available to identify the level of muscular strength in relation to the level of obesity in adults with CP.  
**Purpose:** To determine relationships between muscular strength and body composition in adult individuals with and without CP.  
**Methods:** We studied thirteen adults with and without CP. Leg muscular strength and power at 90, 150, and 210 degrees/sec were measured using Humac Norm isokinetic dynamometer. The range of motion at the knee joint was measured. Forearm muscular strength was measured using a handgrip dynamometer. Body mass index (BMI) from weight and height was calculated to identify the level of obesity.  
**Results:** Compared to healthy control, individuals with CP had significantly lower knee extensor peak torque (11.8±2.3 CP vs. 68±12.5 control, ft-lbs, P<0.05) at 90 degrees/sec, (7.5±0.6 CP vs. 53.2±11.7 control, ft-lbs, P<0.05) at 150 degrees/sec, (7.3±1.1 CP vs. 49.2±9.7 control, ft-lbs, P<0.05) at 210 degrees/sec, lower knee flexor peak torque (6.3±1.6 CP vs. 43.8±7.9 control, ft-lbs, P<0.05) at 90 degrees/sec, (6.00±1.13CP vs. 35.83±6.88 control, ft-lbs, P<0.05) at 150 degrees/sec, (7.33±1.89 CP vs. 35.17±6.47 control, ft-lbs, P<0.05) at 210 degrees/sec. In control group, there was no relationship between BMI and extensor/flexor peak torque. However, there was a significant inverse relationship between BMI and torque in CP group.  
**Conclusion:** These findings suggest that the level of obesity does not appear to influence muscular strength in healthy population. However, individuals with CP exhibit an inverse relationship between muscular strength and the level of obesity. Supported by Central RSCA and Undergraduate Research Grant, SJSU

3396 Board #: 265 June 2 9:30 AM - 11:00 AM  
**Alterations in Skeletal Architecture, Bone Mineral Density, and Muscular Strength in Adults with Cerebral Palsy**  
 Cory E. Low, Pooja Pal, Rachel L. Christensen, Areum K. Jensen. *San Jose State University, San Jose, CA.*  
*(No relevant relationships reported)*

Cerebral Palsy (CP) is a neurological disorder caused by lesions in the brain that affect motor development. It is characterized by impaired motor function and atypical development of musculoskeletal structures and muscular weakness. Individuals with CP develop osteoporosis earlier in their age compared to the general population. Bone weakness has a detrimental effect on the muscular system, which causes the CP population to be more prone to bone fracture and further immobility. To date, it is still uncertain whether structural alterations in the skeletal system in CP population have an influence on bone mineral density (BMD) and muscular strength.  
**Purpose:** To determine relationships between skeletal architecture, BMD, and muscular strength in adults with and without CP.  
**Methods:** We studied 14 participants with and without CP. Dual energy X-ray absorptiometry was used to measure regional BMD and bone mineral content (BMC) at the lumbar spine, proximal femur, and forearm regions. Architectural differences were measured as angles from a center line through the femoral neck to top and bottom of greater trochanter, and lesser trochanter. Leg and forearm muscular strength was assessed by using Humac Norm isokinetic dynamometer, and handgrip dynamometer, respectively, to measure peak torque of the left leg.  
**Results:** Individuals with CP had significantly different skeletal architectural angles presented by the top and bottom of greater trochanter (e.g., top, 56±4 CP vs. 72±3 control, degrees, p<0.05). BMC, BMD, T-scores, and Z-scores were all significantly different in the left femoral neck (e.g., T-score, -2.96 ±0.92 CP vs. -0.89±0.49 control, p<0.05) as well as in the forearm regions (e.g., radius 33%, T-score, 0.48±0.31 CP vs. -0.30±0.18 control, p<0.05). Individuals with CP had significantly lower knee extensor peak torque (e.g., at 90 degree/sec; 11.8±2.3 CP vs. 68.0±12.5 control, foot-pounds, p<0.05). Architectural angles of the femur were closely related to the level of BMD on femoral neck regions and leg muscular strength (p<0.05).  
**Conclusion:** These findings suggest that femoral skeletal architecture (via reduced angles of top and bottom of greater trochanter) has an influence on BMD and muscular strength in adults who have CP. Supported by Central RSCA and Undergraduate Research Grant, SJSU

3395 Board #: 264 June 2 9:30 AM - 11:00 AM  
**Alterations in Musculoskeletal Function and Functional Mobility in Adults with Cerebral Palsy**  
 Rachel L. Christensen, Pooja Pal, Cory E. Low, Tiffany N. Raczynski, Areum K. Jensen. *San Jose State University, San Jose, CA.*  
*(No relevant relationships reported)*

Cerebral Palsy (CP) is a type of neurological disorder marked by impaired muscle coordination and related physical disabilities due to damage in the brain before or at birth. Adult individuals with CP are more exposed to higher risk of fall and fracture mainly because of their musculoskeletal abnormalities and dysfunction. The lower state of balance and functional mobility is also related to the higher risk of fall and fracture in the general public, and is improved by gaining muscular strength and power as well as bone mineral density (BMD). To date, no studies have examined the relationship between leg muscular strength, BMD, and balance as a detector of functional mobility in the adult CP population.  
**Purpose:** To determine if there is a relationship between leg muscular strength, BMD, and seated balance in adults with CP.  
**Methods:** We studied 7 adults with CP, and 6 without CP as a control. Dual energy X-ray Absorptiometry (DXA) was used to measure bone mineral content and BMD at the lumbar spine region (L1-4). Muscular strength was assessed by using the Human Norm isokinetic dynamometer to measure peak torque, work, and power of the left leg. The Biodex was used to identify the state of seated balance by performing a limited stability test.  
**Results:** There were no significant differences in BMD of the L1-L4 region between adults with CP and the healthy controls. The CP participants had a significantly lower forward (28.6±5.5 CP vs. 69.5±8.1 control, P<0.05), backward (29.0±10.3 CP vs. 77.5±5.6 control, P<0.05), left (20.8±5.6 CP vs. 72.0±7.7 control, P<0.05), right (28.0±5.6 CP vs. 65.5±5.8 control, P<0.05), and overall (17.2±3.1 CP vs. 61.7±6.3 control, P<0.05) score values in comparison to the control group on the limited stability test. The CP group had a significantly lower knee extensor peak torque (7.3±1.1 CP vs. 49.2±9.7 control, foot-pounds, P<0.05) and knee flexion peak torque (7.3±1.9 CP vs. 35.2±6.5 control, foot-pounds, P<0.05) at 210 degrees/sec. There was a linear relationship between torque and balance for both the CP and control.  
**Conclusion:** Our findings suggest that leg muscular strength appears to influence

3397 Board #: 266 June 2 9:30 AM - 11:00 AM  
**The Effect Comparison of Foam Rolling with Passive Stretching After High Intensity Training**  
 Yuanpeng Liao, Yu Xia, Minjia Wang. *ChengDu Sports Institute, ChengDu, China.*  
*(No relevant relationships reported)*

**PURPOSE:** Objectives: To compare the effect of foam rolling (FR) and passive stretching (ST) after high intensity training.  
**METHODS:** 63 male were conclude from college students, which divided into three groups: control group, FR group and ST group. And each group included 21 subjects. All subjects finished a high intensity training session of weight-bearing squat exercise. After the training session, FR group practiced a 6-min foam rolling and ST groups practiced passive stretching. Isometric Peak torque (IPT) were measured with isokinetic system at pre-training, immediately post-training and 24h, 48h after training.  
**RESULTS:** After training, IPT was significantly decreased in all three groups (p<0.01\*\*), and there were no significant differences immediately after training. At 24h after training, IPT was significantly increased in FR and ST groups, although there were no significant differences compared with the pre-training result. At 48h after training, compare with the control group, FR and ST group's IPT was significantly increased in the (p<0.01\*\*), while there were no significant differences between these two groups; Compared pre-training and 48h post-training, no significant differences were observed in FR group, while there were still significant difference in ST group (p<0.01\*\*).  
**CONCLUSIONS:** (1) Foam rolling and passive stretching can relax muscle after high intensity training; (2) Foam rolling practice and passive stretching had possible beneficial effects at 24h and significant improvement at 48h after training; (3) Under the same condition, the effects of foam rolling practice were greater than passive stretching.

The Changes of IPT pre- and post-training (N*M)			
	Control Group	FR group	ST group
Pre- training	207.10±12.78	213.52±8.38	212.51±10.51
Immediately post-training	152.41±9.25**	157.31±7.14**	158.02±9.13**
24h post-training	153.94±9.84**	165.57±8.49**	163.25±8.81**
48h post-training	159.97±10.26**	193.71±7.57**	182.19±9.95****

3398 Board #: 267 June 2 9:30 AM - 11:00 AM  
**A Novel Application of Altitude Training Masks and High-Intensity Interval Training to Improve Exercise Performance**

Eric M. Hultquist, Haley N. Yohn, Carlo F. Tirso, Mary A. Dunyak, Jacqueline Denning, Erin L. Blaser, Brycen J. Moore, Rachel Beckmann, Joshua G. Woolstenhulme. *The George Washington University, Washington, DC.*  
 (No relevant relationships reported)

**PURPOSE:** This study seeks to examine the effects of altitude training masks (ATM, also known as respiratory fitness masks) used solely during recovery periods (low intensity intervals) during high-intensity interval training (HIIT).  
**METHODS:** Participants underwent six weeks of HIIT (3 sessions per week) with each exercise bout consisting of eight, 60-second high-intensity intervals interspersed with eight, 90-second low-intensity recovery intervals. Workloads for the high-intensity intervals were individualized to elicit heart rates within 10 bpm of each participant's maximal heart rate as assessed during a baseline graded exercise test. The low-intensity recovery intervals were prescribed at a fixed workload corresponding to approximately 10% of each participants' baseline maximal oxygen consumption ( $\dot{V}O_{2max}$ ). Participants were assigned via block randomization to either a control group (CG) or a training mask group (TMG) that only wore the ATM during the low-intensity recovery bouts of the HIIT intervention. Participants performed a graded exercise test to volitional exhaustion at both baseline and following the HIIT intervention as well as a vascular occlusion test to assess the tissue saturation index nadir (TSIN) of the gastrocnemius. Outcomes were  $\dot{V}O_{2max}$ , oxygen consumption at anaerobic threshold (AT), and TSIN.  
**RESULTS:** Twelve participants (7 women; 25.5±4.5 years; BMI: 23.6±1.5 kg/m<sup>2</sup>) have completed the study to date.  $\dot{V}O_{2max}$  increased significantly in the TMG group (40.5±3.6 to 44.5±5.4 ml/kg/min, p=0.03) but not in the CG. TSI was significantly greater in the TMG group (-17.8±7.3 to -28.3±7.3% from baseline, p=0.05) with no significant change in the CG. No change in AT was observed in either group.  
**CONCLUSIONS:** Implementing ATMs only during the low-intensity recovery intervals of HIIT training appears to improve key components of cardiorespiratory function not observed in our standard HIIT training group. These findings demonstrate a novel use of ATMs that has potential to change how ATMs are used by recreational and professional athletes. These results also have implications for the use of ATMs as potential adjunctive modalities for enhancing training effects in rehabilitative settings where improvements in short time periods are desirable.

3399 Board #: 268 June 2 9:30 AM - 11:00 AM  
**Novel Use of Respiratory Conditioning Masks during High-Intensity Interval Training to Improve Respiratory Function in Healthy Adults**

Brycen J. Moore, Erin L. Blaser, Mary A. Dunyak, Carlo F. Tirso, Jacqueline Denning, Haley N. Yohn, Eric M. Hultquist, Alison Rieck, Joshua G. Woolstenhulme. *The George Washington University, Washington, D.C.*  
 (No relevant relationships reported)

**PURPOSE:** The purpose of this study was to examine the effects of respiratory conditioning masks (RCMs, also known as altitude masks) on lung function when used only during the low-intensity recovery intervals of high-intensity interval training (HIIT).  
**METHODS:** A group of recreationally active healthy adults performed a 6-week HIIT protocol where half of the participants were randomly assigned to wear an RCM during the low-intensity rest intervals (Mask Group), or no mask (Control). Participants performed three HIIT bouts per week, where each bout included eight high-intensity intervals of 60s exercise performed within 10 beats of maximal heart rate for each subject obtained from a baseline graded exercise test to volitional exhaustion. Each high-intensity interval was immediately followed by a 90s low-intensity recovery interval at a work rate corresponding to 10%  $\dot{V}O_{2max}$  for each participant at baseline. Pulmonary function testing was also performed at baseline and following a six week intervention period.

**RESULTS:** 12 subjects (7 women, ages: 25.5±4.5 yrs, BMI: 23.6±1.5 kg/m<sup>2</sup>) to date completed the study. Expiratory reserve volume was significantly larger in the mask group compared to the control group after training (1.5±0.5 vs. 0.8±0.4L, p=0.02). Resting  $VE/\dot{V}O_2$  (41.8±6.9 vs. 28.3±2.7, p=0.001) and  $VE/\dot{V}CO_2$  (47.3±11.6 vs. 35.8±3.9, p=0.04) increased in the mask group compared to controls. In the mask group alone, at peak exercise  $VE/\dot{V}CO_2$  significantly increased at isowork rates (31.5±2.3 to 34.3±3.6, p=0.02) while the respiratory exchange ratio decreased (1.22±0.11 vs. 1.14±0.08, p=0.02). Resting  $PET\dot{O}_2$  significantly increased in the mask group alone after exercise training (111.7±6.5 vs. 115.5±6.1 mmHg, p=0.02). No other changes were observed in forced vital capacity, total lung volume, or maximal inspiratory/expiratory pressures for both groups.  
**CONCLUSIONS:** RCMs worn only during the low-intensity recovery intervals in a 6 week HIIT protocol appear to have a significant effect on select measures of respiratory and ventilatory function.  $VE/\dot{V}CO_2$  is an indicator of ventilatory drive, and changes in  $VE/\dot{V}CO_2$  have been shown to have prognostic significance for several clinical populations. Using RCMs in this novel fashion may play a role in modifying ventilatory drive.

3400 Board #: 269 June 2 9:30 AM - 11:00 AM  
**Feasibly Measuring Sitting And Physical Activity In The Office Using Bluetooth Sensing**

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 (No relevant relationships reported)

**PURPOSE:** The office is a key setting where sitting occurs and is intervened upon. Office-specific behaviour measures may help evaluate workplace intervention components, such as activity-permissive workstations. We tested whether a feasible Bluetooth sensing method can provide valid measures of office time and office-specific activities.  
**METHODS:** Workers from one building (n=29, 72% female, age 23-68 years) wore, for one workday, the activPAL3 on the thigh and the Bluetooth-enabled ActiGraph Link on the wrist and thigh. Location (office/not) was estimated by signal presence/absence at two beacons in the wearer's office, with chest-worn video cameras (McCam) as the criterion. Accuracy in location classification was assessed (F-scores) and compared (generalized estimating equations) between 60 s and 10s sampling options (i.e., feasible versus high resolution, requiring daily recharging). The validity of 60 s Bluetooth-derived measures of total time spent in the office and in office-specific activities was assessed.  
**RESULTS:** For both the wrist and thigh-worn Link, accurate classification of location (office/not) was obtained, with a significant (p<0.05) but negligible difference between the two sampling options (F-scores were all 0.98). Agreement with the criterion in daily totals showed only small mean differences (-0.2 to +6.1 min) and moderate individual differences (95% agreement limits ±30 min or ±10 min for stepping). Mean absolute percent error was very small for office time and office sitting time (<5%), moderate for standing (17-23%), and high for incidental stepping (30-49%) and purposeful walking (57-86%) due to how little of these occurred.  
**CONCLUSIONS:** The ActiGraph Link worn on the thigh or wrist can be used to validly measure office time and office activity (provided activity is measured validly) with a 60 s Bluetooth setting that facilitates multi-day measurement without recharging. Higher resolution improves accuracy but not to a meaningful degree.

3401 Board #: 270 June 2 9:30 AM - 11:00 AM  
**Absence of Functional Left Ventricular Adaption With Short-Term Resistance Exercise Training in Young Men**

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 (No relevant relationships reported)

Resistance exercise training (RET) is recognized as a health-positive stimulus, but the significance of remodelling of the left ventricle (LV) evoked by RET remains unclear, in part due to the lack of data on LV functional adaptation that accompanies the structural remodelling. **PURPOSE:** To examine the effects of 12 weeks of RET on LV twist mechanics in healthy men. **METHODS:** Forty, non-athlete men (age: 23±3 years) were randomized into 12 weeks of whole-body higher-repetition RET (20-25 repetitions/set to failure at ~30-50% 1RM; n=13), lower-repetition RET (8-12 repetitions/set to failure at ~75-90% 1RM; n=13), or an active control period (n=14). Standard, and speckle tracking echocardiography were performed at baseline, and following the intervention period. **RESULTS:** Neither 12-week program of RET altered end-diastolic volume, end-systolic volume, or ejection fraction (P>0.05). Similarly, RET did not change total LV twist, untwisting rate, twist-to-shortening ratio, untwisting-to-twist ratio, or longitudinal strain (P>0.05). **CONCLUSION:** This is the first longitudinal study to assess both LV structure and mechanics after RET in healthy men, suggesting a maintenance of LV structure and mechanics irrespective of loading

condition. These results contrast those reported from endurance exercise training and therefore present important insight into the specific contributions of RET to cardiac adaptation, even with strenuous training efforts. Future studies should directly compare the effects of RET and endurance exercise on the structure and function of the heart, and determine whether combined training regimes exceed a health threshold in patient populations.

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3402 Board #: 271 June 2 9:30 AM - 11:00 AM  
**Impaired Exercise Capacity In cTnT-delta160E Mice Validates Pre-clinical Model To Assess Exercise Interventions For HCM**

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 (No relevant relationships reported)

Reduced peak  $\dot{V}O_2$  in patients with hypertrophic cardiomyopathy (HCM) is a powerful predictor of adverse outcomes, including all-cause mortality and heart transplant. The risk of death or transplant is reduced by 21% for each 1 mL/kg/min increase in peak  $\dot{V}O_2$ . A randomized clinical trial conducted by our group demonstrated 16 weeks of moderate intensity exercise training increased peak  $\dot{V}O_2$  in HCM patients by 6% compared to usual activity. Whether exercise attenuates disease progression is unknown but is a critical question given the lack of disease modifying therapy. This is challenging to address in patients because disease typically progresses slowly and non-linearly over many years. Therefore, we propose a pre-clinical HCM model to determine the effects of exercise on phenotypic emergence and progression.

**PURPOSE:** To determine exercise capacity in a cardiac troponin T mutant (cTnT) mouse model of HCM through a graded exercise test (GXT) protocol. **METHODS:** C57Bl/6 non-transgenic (NTG) (n=6 female, n=5 male) and  $\Delta$ 160E cTnT (n=4 female, n=8 male) mice (age 10-12 months) were subjected to a human parallel mouse GXT w/staged increases in inclination (0°-15°) and speed (6m/min up to 30 m/min). Mice were acclimated (4 days, 30 min day) and tested on a metabolic treadmill in a randomized and blinded fashion at UM Nutrition Obesity Research Center. Test was terminated when mouse remained in contact w/shock grid at treadmill rear for 5 sec. Two sample t-tests were used for data analysis. **RESULTS:** Baseline and peak  $\dot{V}O_2$  were significantly lower in cTnT compared to NTG mice (baseline: 83.12 mL/kg/min  $\pm$  2.07 vs 95.58 mL/kg/min  $\pm$  3.61; peak: 102.35 mL/kg/min  $\pm$  2.04 vs 119.20 mL/kg/min  $\pm$  5.57;  $p < 0.01$  in both comparisons). Compared to NTG mice, cTnT ran a shorter distance (201.33m  $\pm$  6.40 vs 253.81m  $\pm$  8.78;  $p < 0.0001$ ) and for less time (13.25min  $\pm$  0.25 vs 15.22min  $\pm$  0.31;  $p < 0.0001$ ). Respiratory exchange ratio and mean body weights were not different between cTnT and NTG mice. **CONCLUSION:** This is the first report of reduced peak  $\dot{V}O_2$  in a pre-clinical HCM model. These findings mirror reductions in peak  $\dot{V}O_2$  observed in HCM patients, the magnitude of which is a strong predictor of adverse outcomes. Our observation validates the model as one in which the effects of an exercise intervention on phenotypic conversion and progression can be assessed. Support by UM

3403 Board #: 272 June 2 9:30 AM - 11:00 AM  
**The Influence of EMG-based Maximal Voluntary Contraction ( $MVC_{EMG}$ ) Intensity on Middle Cerebral Artery Velocity**

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 (No relevant relationships reported)

It has been established that cerebral blood flow velocity (CBFV) might elevate due to the increase of exercise intensity determined by % $\dot{V}O_{2max}$  during a cardiorespiratory exercise test. But, the response of CBFV to EMG-based maximal voluntary contraction ( $MVC_{EMG}$ ) during Isometric muscle contraction remains unclear. **PURPOSE:** To evaluate the influence and adaptability as the intensity index of  $MVC_{EMG}$  on middle cerebral artery velocity (MCA  $V_{mean}$ ) during isometric strength type exercise.

**METHODS:** Fourteen healthy male (24.1 $\pm$ 1.4yrs) were asked to perform the 45° knee extension isometric contraction during 60 seconds. All participants performed three times in random order the isometric exercise of 100%, 80% and 60% MVC determined by root mean square (RMS) of EMG at right rectus femoris m. with a week interval. Each participant was asked to conduct and maintain the predetermined exact intensity of %MVC confirming the figures on a monitor. MCA  $V_{mean}$  was measured at rest, during exercise, immediately after exercise, 30 seconds recovery, 60 seconds recovery and 2 minutes recovery using transcranial-Doppler sonography. All data were analyzed using two-way ANOVA (3 intensities x 6 times) with repeated measures.

**RESULTS:** MCA  $V_{mean}$  in 80%  $MVC_{EMG}$  was significantly higher than MCA  $V_{mean}$  in 60%  $MVC_{EMG}$  (110 $\pm$ 19 vs. 89 $\pm$ 19 cm/s,  $p < 0.05$ ) immediately after exercise. MCA  $V_{mean}$  in 100%  $MVC_{EMG}$  was significantly higher than MCA  $V_{mean}$  at 60%  $MVC_{EMG}$  in 30 second recovery (97 $\pm$ 14 vs. 77 $\pm$ 10 cm/s,  $p < 0.05$ ) and 60 seconds recovery (97 $\pm$ 16 vs. 73 $\pm$ 12 cm/s,  $p < 0.05$ ). Heart rate in 100%  $MVC_{EMG}$  was significantly higher than in 80%, 60%  $MVC_{EMG}$  at immediately after exercise (128 $\pm$ 26 vs. 106 $\pm$ 15, 97 $\pm$ 10 beats/

min,  $p < 0.01$ ) and at 30 seconds recovery (102 $\pm$ 18 vs. 87 $\pm$ 12, 80 $\pm$ 9 beats/min,  $p < 0.05$ ).

**CONCLUSIONS:** These results suggest that the increase of isometric exercise intensity up to ~80% of  $MVC_{EMG}$  might induce the elevation of MCA  $V_{mean}$ .

3404 Board #: 273 June 2 9:30 AM - 11:00 AM  
**Muscle Afferent Blockade Improves Endurance Exercise Performance When O<sub>2</sub> Transport To Locomotor Muscles Is Preserved**

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(No relevant relationships reported)

**PURPOSE:** During high intensity whole body endurance exercise, feedback from group III/IV locomotor muscle afferents restricts neural drive to the legs while, simultaneously, optimizing peripheral O<sub>2</sub> transport. We attenuated feedback from these sensory neurons to investigate their limiting effects on endurance exercise performance while controlling for locomotor muscle O<sub>2</sub> transport.

**METHODS:** Eight healthy men ( $\dot{V}O_{2max}$ : 55 $\pm$ 6 ml/min/kg) performed 5 km cycling time trials (TT) under control conditions and with lumbar intrathecal fentanyl impairing neural feedback from the lower limbs. To assure similar arterial oxygenation, O<sub>2</sub> content (C<sub>a</sub>O<sub>2</sub>) was raised by breathing 100% O<sub>2</sub> during the control (HYP<sub>c</sub>) and the fentanyl (HYP<sub>f</sub>) TT. The TT was also performed in normoxia with intact afferent feedback (NORM). After each TT, subjects performed a short, constant-load cycling bout at the mean power output achieved during the preceding TT while common femoral artery blood flow (Q<sub>f</sub>) was quantified using Doppler ultrasound. Leg O<sub>2</sub> transport was calculated as the product of C<sub>a</sub>O<sub>2</sub> and Q<sub>f</sub>. Using supramaximal electrical femoral nerve stimulation, peripheral and central fatigue were quantified via pre- to post-exercise changes in quadriceps twitch force ( $\Delta Q_{tw}$ ) and voluntary activation ( $\Delta VA$ ).

**RESULTS:** Both Q<sub>f</sub> (~16 ml/W/min) and C<sub>a</sub>O<sub>2</sub> (~24 ml O<sub>2</sub>/dl) were similar at the mean power output achieved during HYP<sub>c</sub> and HYP<sub>f</sub> ( $P > 0.6$ ), but significantly different from NORM (18  $\pm$  4 ml/W/min and 22  $\pm$  1 ml O<sub>2</sub>/dl). Importantly, leg O<sub>2</sub> transport was similar between HYP<sub>c</sub> and HYP<sub>f</sub> (~0.36 ml O<sub>2</sub>/W/min;  $P = 0.6$ ) and significantly greater than NORM (0.33  $\pm$  0.05 ml O<sub>2</sub>/W/min). Although mean power output was augmented during HYP<sub>c</sub> compared to NORM (287  $\pm$  57 W and 261  $\pm$  38 W,  $P < 0.05$ ),  $\Delta Q_{tw}$  was similar between trials (~40%). Interestingly, HYP<sub>f</sub> further increased mean power output (309  $\pm$  17 W) and improved time trial performance (3.3  $\pm$  0.9%) compared to HYP<sub>c</sub> ( $P < 0.05$ ). This was associated with a greater  $\Delta Q_{tw}$  (54  $\pm$  9%), but a similar  $\Delta VA$  (~4%) in HYP<sub>f</sub> compared to HYP<sub>c</sub>.

**CONCLUSIONS:** Group III/IV muscle afferent feedback restricts endurance exercise performance and limits the development of peripheral fatigue. However, to expose the performance limiting aspect of these sensory neurons during whole body exercise, their impact on convective O<sub>2</sub> transport needs to be controlled.

3405 Board #: 274 June 2 9:30 AM - 11:00 AM  
**Highly Cushioned Shoes Increase Leg Stiffness And Amplify Impact Loads During Running**

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(No relevant relationships reported)

Shoe cushioning represents a standard way to manage impact loading and consequent injuries due to running. However, although modern shoes have become increasingly cushioned, running injuries have not decreased. The probable, but poorly understood explanation for this counterintuitive is that shoes with additional cushion have only limited ability to attenuate impacts during running, even though they can significantly reduce impact loads *in vitro* mechanical tests.

**PURPOSE:** The aim of this study was to investigate why shoes with additional cushion provide little or no reduction to the impact loads during running.

**METHODS:** Ground reaction forces (GRF) and the spring-like leg mechanics were examined among 12 healthy men while running at 4.0 m/s with a rearfoot striking pattern using normal (NORM, Brooks Ghost 6) and maximalist (MAX) cushion shoes (Hoka One One). We determined and compared vertical GRF impact peak (VIP) and average vertical loading rate (AVLR), as well as leg stiffness and leg compression between shoe conditions. **RESULTS:** GRF parameters illustrating the hardness of the impact showed significantly greater values when running with MAX shoes, as compared to running with NORM shoes (VIP ( $p = 0.001$ ) and AVLR ( $p = 0.038$ ) were 10.7% and 12.3% greater in the MAX shoe, respectively). The analysis of the spring-like leg function revealed that during running with MAX shoes runner's leg became stiffer ( $p = 0.012$ ) and compresses less ( $p = 0.006$ ) when compared to running with NORM shoes.

**CONCLUSIONS:** The present findings suggest that increased landing stiffness may

be responsible for opposing the impact attenuation effect of extra shoe cushioning during running. In fact, highly cushioned MAX shoes can even amplify impact loading during running, which thus may increase the risk of impact-related running injuries.

Mean (SD) data for the normal (NORM) and maximalist (MAX) shoe.

	NORM shoe	MAX shoe	t-test
<i>Spring-like leg mechanics</i>			
Leg stiffness (kN/m <sup>3</sup> )	26.1 (7.1)	27.9 (8.2)	0.012*
Leg compression (cm)	8.3 (1.3)	8.0 (1.4)	0.006**
<i>Impact loading</i>			
Vertical GRF impact peak (BW)	2.01 (0.32)	2.25 (0.32)	0.001***
Vertical GRF loading rate (BW/s)	59.0 (15.2)	67.3 (14.6)	0.038*

3406 Board #: 275 June 2 9:30 AM - 11:00 AM  
**Quantifying Head Impact Dynamics In Community Level Australian Rules Football**

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Reported Relationships: **A. Pearce: Contracted Research - Including Principle Investigator; Research funded by Impact Technologies, Australia.**

Research from elite contact sports is suggesting an athlete may incur hundreds of repetitive head impacts over one season. However, the majority of studies to date have focused on elite level athletes. To date, little investigation has focussed on non-elite sports, particularly in Australia where the majority of sport is played at the community level where little attention is given to those players who may experience significant head trauma. This is the first study to present head impact data in community level football. **PURPOSE:** To quantify head impact data over a season of Australian Rules football (ARF) played at the community club level. **METHODS:** Twenty-five male players (mean age  $24.9 \pm 5.2$  years) from one ARF club participated in 20 home and away matches in the regular season. During matches, head impact data was collected using individually fitted instrumented mouth guards (Nexus A9, Impact Technologies, Australia). Data was sampled at 1000 Hz, with a 500 Hz bandwidth. If the mouthguard exceeded the pre-determined 10 g linear acceleration threshold 100 milliseconds (ms) of data (10 ms pre-trigger and 90 ms post-trigger) were recorded to the on-board memory for later downloading. Outcome measures included mean impact number, mean peak linear and peak rotational acceleration, and injury severity profiles for linear (ISP<sub>linear</sub>) and rotational (ISP<sub>rotational</sub>) accelerations. **RESULTS:** A total of 2810 impacts were recorded. Individual players experienced an average of  $162 \pm 40.5$  impacts over the course of the season resulting in mean of  $8 \pm 11$  impacts per-player per match. Linear accelerations ranged from 10 g to a peak of 176 g; with a mean, media and 95<sup>th</sup> percentile value of 33 g, 25 g, and 76 g respectively. Rotational accelerations ranged from 87 rad/s<sup>2</sup> to a peak of 19831 rad/s<sup>2</sup>; with a mean, median, and 95<sup>th</sup> percentile value of 4004 rad/s<sup>2</sup>, 3109 rad/s<sup>2</sup>, and 9593 rad/s<sup>2</sup> respectively. The ISP<sub>linear</sub> profiles showed 86.6% were mild severity, 12.7% were moderate severity, and 0.7% were severe. The ISP<sub>rotational</sub> profiles showed 69%, 19.8%, and 11.2% were mild, moderate and severe respectively. **CONCLUSIONS:** This novel study provides data to better inform medical personnel in the identification and evaluation of at-risk players for concussion at non-elite community level ARF.