

## D-03 Highlighted Symposium - The Aging Neuromuscular System and the Protective Effects of Physical Activity

Thursday, May 28, 2020, 1:30 PM - 3:30 PM  
Room: CC-3012

**1786** **Chair:** Sandra K. Hunter, FACSM. *Marquette University, Milwaukee, WI.*  
(No relevant relationships reported)

**1787** May 28 1:40 PM - 2:10 PM  
**Keynote - The Aging Neuromuscular System and Fatigability of Limb Muscles**

Sandra K. Hunter, FACSM. *Marquette University, Milwaukee, WI.*  
(No relevant relationships reported)

**1788** May 28 2:10 PM - 2:25 PM  
**Neural Control of Movement with Aging and Effects of Activity**

Ashleigh E. Smith. *University of South Australia, Adelaide, Australia.*  
(No relevant relationships reported)

Aging is associated with reduced neuromuscular function, which may be due to central nervous system changes in corticospinal excitability and a reduced capacity of the human brain to re-organize the strength of its connections (neuroplasticity). **PURPOSE:** This symposium presentation will highlight two complementary studies that determined the influence of aging and physical activity (PA) on motor cortical excitability and neuroplasticity, elicited with Transcranial Magnetic Stimulation (TMS). **METHODS:** In study one, corticospinal excitability was assessed in 28 young (22.4 ± 2.2 yr; 14 women) and 50 old adults (70.2 ± 6.1 yr; 22 women) by measuring motor evoked potentials (MEPs) elicited in motor cortical areas and targeting the vastus lateralis (VL) muscle of the quadriceps. In the second study, the response to a continuous theta burst stimulation paradigm (cTBS) was assessed in 27 old adults (66.5 ± 4.5, 13 women) by measuring MEPs in the first dorsal interosseous (FDI) muscle elicited after a single and paired cTBS paradigm- targeting the primary motor cortex. PA was measured in both studies using accelerometry (Actigraph GT-3x or GENEActiv, respectively). **RESULTS:** In study 1, irrespective of age and sex, individuals who achieved >10,000 steps/day had reduced corticospinal excitability of the VL muscles ( $F[1.61, 85.6] = 3.49, p = 0.04$ ). In study 2, when accounting for age and sex, more time engaging in PA was associated with a greater neuroplasticity response to the cTBS paradigm ( $r = -0.51, p = 0.007$ ). **CONCLUSION:** These studies provide evidence that PA in both young and old adults is associated with lower corticospinal excitability in the lower limb and an enhanced capacity of the motor cortex to re-organize the strength of its connections. Together these results suggest regular PA may protect against age-related movement decline through preservation of the inhibitory and excitatory networks within the primary motor cortex, resulting in maintenance of an optimal environment for neuroplasticity. Supported by NHMRC-ARC Dementia Research development fellowship awarded to Dr Ashleigh Smith (GNT 1097397) and NIH Grant R01 awarded to Dr Sandra K. Hunter.

**1789** May 28 2:25 PM - 2:40 PM  
**Limits of Muscle Power with Aging: Evidence from the Whole-Limb to the Single Cell**  
Christopher W. Sundberg. *Marquette University, Milwaukee, WI.*  
(No relevant relationships reported)

Advanced age is accompanied by a decreased ability to generate the power necessary to perform daily activities, which can be exacerbated by the increased fatigability when old adults perform dynamic contractions. **Purpose:** This symposium presentation will highlight a sequence of studies that integrate measures of whole muscle function with single cell contractile mechanics to identify the mechanisms for the age-related loss in muscle power and increased fatigability. **Methods:** Studies on the sites limiting power of the whole limb incorporated measures of transcranial magnetic stimulation, electrical stimulation, electromyography and <sup>31</sup>P phosphorus magnetic resonance spectroscopy. To test if impairments in cross-bridge function could explain age-related decrements in power and increased fatigability, studies also included biopsies of the vastus lateralis and investigated single cell contractile mechanics in maximal

and submaximal Ca<sup>2+</sup> and across a range of elevated hydrogen (H<sup>+</sup>) and inorganic phosphate (Pi). **Results:** Age-related increases in power loss during a fatiguing dynamic knee extension exercise were closely associated with greater changes in involuntary contractile properties ( $r = 0.75$ ) and intramuscular accumulation of H<sup>+</sup> ( $r = -0.84$ ) and Pi ( $r = 0.92$ ), but not associated with the ability of the nervous system to activate the muscle. Elevated H<sup>+</sup> and Pi, as well as submaximal Ca<sup>2+</sup>, caused marked reductions in cross-bridge function. However, other than severe atrophy (>40%) of fast fibers in old men and women, single cell contractile function was well-preserved in all conditions with aging. **Conclusion:** These data suggest that the age-related loss in power is determined primarily by atrophy of fast fibers, while the increased fatigability is explained by a greater accumulation of H<sup>+</sup> and Pi. The data also suggest that the ideal exercise intervention to improve power with aging should target increasing fast fiber size and decreasing metabolite accumulation.

These studies were supported by a National Institute of Aging Ruth L. Kirschstein predoctoral fellowship (AG052313) and an American Heart Association postdoctoral fellowship (19POST34380411) to Christopher Sundberg and a National Institute of Aging R01 (AG048262) to Robert Fitts and Sandra Hunter.

**1790** May 28 2:40 PM - 3:10 PM  
**Keynote - Skeletal Muscle with Aging, and Physical Activity**  
Russell S. Richardson. *University of Utah, Salt Lake City, UT.*  
(No relevant relationships reported)

## D-10 Thematic Poster - Bone and Integrative Physiology

Thursday, May 28, 2020, 1:30 PM - 3:30 PM  
Room: CC-2007

**1820** **Chair:** Shannon L. Mathis. *University of Alabama Huntsville, Huntsville, AL.*  
(No relevant relationships reported)

**1821** Board #1 May 28 1:30 PM - 3:30 PM  
**Associations Between Sedentary Behaviors And Visceral Adiposity On Bone Mineral Density In Women**  
Jose Rocha-Rangel<sup>1</sup>, Alexandra Auslander<sup>2</sup>, Desiree N. Caballero<sup>2</sup>, Amanda M. Kirk<sup>2</sup>, Kristin M. Merki<sup>2</sup>, Archie D. Bayacal<sup>2</sup>, Michael T. Liang, FACSM<sup>1</sup>. <sup>1</sup>California State Polytechnic University, Pomona, Pomona, CA. <sup>2</sup>California State Polytechnic University, Pomona, Diamond Bar, CA. (Sponsor: Michael T Liang, FACSM)  
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(No relevant relationships reported)

American society has become increasingly sedentary putting this population at higher risks of developing chronic disease such as osteoporosis. One potential link between sedentary behaviors and risk of chronic disease progression is obesity. Studies comparing fracture incidence in obese and non-obese women have demonstrated that obesity is associated with increased risk of fracture at some skeletal sites but seems to be protective at others. Researchers have suggested that certain types of obesity may be a strong predictor of risk of osteoporosis-related non-spine fractures. **PURPOSE:** The purpose of this study is to examine the relationships between physical activity levels (PA), obesity and bone mineral density (BMD) in adult sedentary women. **METHODS:** Twenty-three women, aged 45-65, were instructed to wear an accelerometer for one week, and participate in a Dual energy X-ray absorptiometry (DXA) scan for determining BMD of the whole body (WBBMD), lumbar spine (L1-L4), femoral neck (FN) and forearm as well as body fat mass and lean mass. Participants were divided based on obesity status into two groups, high and low BMI. A one-way ANOVA analysis was used to detect differences in BMD and PA levels by group. Multiple linear regression was used to analyze the effect of PA measures and body composition on BMD. **RESULTS:** Light PA decreased whole body BMD (WBBMD) ( $\beta = -13.5, p = .012$ ) while body fat percentage (BF%) and fat free mass (FFM) increased it ( $\beta = 1754.7, p = .041$  and  $\beta = 3.558, p = .001$ ). Light PA, BF% and FFM all yielded a higher L1-L4 lumbar spine BMD ( $\beta = -.003, p = .05, \beta = 0.641, p = .037$  and  $\beta = .001, p = .017$ , respectively). The higher the total amount and the longer the length of sedentary bouts increased arm BMD ( $\beta = .052, p = .038$  and  $\beta = .016, p = .000$ ). In addition, greater MET values yielded higher forearm BMD ( $\beta = 6.085, p = .020$ ). **CONCLUSIONS:** These results demonstrate that PA levels and fat mass have a significant effect on sedentary adult women's bone density levels. Further investigation of causal mechanisms underlying these associations is warranted.

1822 Board #2 May 28 1:30 PM - 3:30 PM

**Sex-specific Associations Between Muscle Performance And Bone Mineral Density During Adolescence And Young Adulthood**

Fátima Baptista<sup>1</sup>, Diana Luís<sup>1</sup>, Vera L. Zymbal<sup>1</sup>, Kathleen F. Janz, FACSM<sup>2</sup>. <sup>1</sup>University of Lisbon, Lisboa, Portugal. <sup>2</sup>University of Iowa, Iowa, IA. (Sponsor: Kathleen F Janz, FACSM)  
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(No relevant relationships reported)

Measures of muscle size are considered the best predictors of areal bone mineral density (aBMD). However, the role of muscle function may be particularly important for public health since muscle function can be improved via the modifiable factor of physical activity; whereas, muscle size is heavily influenced by the non-modifiable factor of genetics. **Purpose:** The aim of this study was to analyze the contribution of muscle mass in the relationship between muscle function and aBMD (g/cm<sup>2</sup>) of the whole body, hip, and right arm. **Methods:** The sample included 462 participants from 9 to 20 yrs (212 girls:13.7±2.3yrs; 250 boys:13.8±2.4yrs) without clinical conditions affecting muscle or bone. Bone variables were assessed by DXA. Muscle function was operationalized as the maximum power per body mass (W/kg) measured during a vertical counter movement jump on a force platform and the maximum handgrip strength (kg) assessed with a dynamometer. Muscle size (kg) was operationalized as appendicular lean soft tissue (aLST) from the total DXA body scan. Mediation model effects were estimated using the PROCESS macro, and 95% bootstrap confidence intervals were constructed to examine the indirect (mediated by muscle size) effects of muscle function on bone outcomes. Body height and maturity offset were used as covariates. **Results:** The mediation analyses indicated an indirect effect of vertical jump power on aBMD of WBLH and total hip through aLST in both boys and girls (p<0.001). In boys, aLST explained 59.0% (β=0.001 95%CI [0.001, 0.002]) and 33.7% (β=0.002 95%CI [0.001, 0.003]) of the total effects of vertical jump power on aBMD of WBLH and total hip, respectively. In girls, the percentages of the total effects of vertical jump power on aBMD explained by aLST were 69.3% (β=0.001 95% CI [0.001, 0.002]) at the WBLH and 51.9% (β=0.002 95%CI [0.001, 0.003]) at the total hip. Associations between handgrip strength and aBMD of the right arm were also partially explained by aLST, specifically 31.6% (β=0.001 95%CI[0.001, 0.002]) in boys (p<0.001) and 55.2% (β=0.002 95%CI[0.001, 0.003]) in girls. **Conclusion:** The higher proportion of explained variability due to muscle size that we report in girls (when compared to boys) suggests that girls may be missing out of the “value added” osteogenic effect of muscle function associated with physical activity.

1823 Board #3 May 28 1:30 PM - 3:30 PM

**Circulating Bone Biomarkers Are Altered Following A Single Bout Of Strenuous Load Carriage Exercise**

Jeffery S. Staab, Laura J. Lutz, Stephen A. Foulis, Julie M. Hughes, Erin Gaffney-Stomberg. *US Army Research Institute of Environmental Medicine, Natick, MA.*  
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(No relevant relationships reported)

Military training creates a multi-stressor environment which has been associated with risk of stress fracture. Understanding the acute bone biomarker responses to exercise can provide a model to study how various stressors or interventions affect bone and its adaptation to physical training. **Purpose:** To characterize the effects of a militarily relevant exercise on circulating bone biomarkers. **Methods:** 20 Soldiers (18 male, 2 female); age 21.2±0.9 y, performed a 60 min self-paced treadmill time trial at 1% grade while wearing 30% of body weight vest (EX) and a resting control trial (CON) in a randomized, crossover design. Fasted blood samples were collected at 0630 h (AM) and EX or CON trials commenced ~0900 h. Blood samples were collected before (PRE) and after (POST) exercise, and at +1, +2, and +4 h after EX or time-matched during CON. Additionally, fasted samples were collected for the next 3 mornings at 0630 h (AM Day +1 to +3). Parathyroid hormone (PTH), ionized calcium (iCa), osteocalcin (OCN), sclerostin (SOST), C terminal propeptide of type 1 collagen (CTX), N-terminal propeptide of type 1 collagen (PINP), bone alkaline phosphatase (BAP), and tartrate resistant acid phosphatase (TRAP5b) were assayed and all samples except AM were adjusted for changes in plasma volume from PRE. Data were analyzed using repeated measured ANOVA. Data are mean ± SE. **RESULTS:** Compared to PRE, PTH was significantly higher (104±32%, p<0.01) and iCa was lower (-2.5±0.8%, p<0.01) at POST during EX but not during CON. OCN was higher at +1 through +4 h than PRE by 15.9±13.0-20.5±12.0% (p<0.01) during EX but unchanged during CON. SOST was elevated by 29.1±14.2% (p<0.01) at POST vs PRE EX but later time points were not different than CON. CTX was elevated vs PRE at +1 h (43.6±22.2%, p<0.01) in EX condition only; later time points were higher (p<0.01) than PRE under both conditions. PINP, BAP, and TRAP5b were not different from PRE during EX or CON. There were no changes in the AM Day 1-3 samples except OCN was lower than CON on Day +2 and +3.

**CONCLUSIONS:** Consistent with prior reports, iCa decreased and PTH increased immediately post EX. Some markers of bone resorption and OCN were increased post EX. In sum, the temporal pattern of these biomarkers suggest a transient post exercise increase in resorption, but these changes disappear within 24 h after exercise.

1824 Board #4 May 28 1:30 PM - 3:30 PM

**EFFECTS OF DIET ALTERATIONS, WITH OR WITHOUT FECAL MICROBIAL TRANSPLANTS, ON BONE INTEGRITY**

Sarah E. Little, Ayland C. Letsinger, Jon P. Elizondo, Harry A. Hogan, J Timothy Lightfoot, FACSM, Susan A. Bloomfield, FACSM. *Texas A&M University, College Station, TX.* (Sponsor: Susan Bloomfield, FACSM)  
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(No relevant relationships reported)

High fat feeding exerts a negative impact on bone quality and strength. Gut microbiota have been strongly linked to bone outcomes in several models, though a clear mechanism linking alterations in gut microbiota, diet composition, and bone has not yet been elucidated.

**PURPOSE:** To determine if alterations in diet, with or without fecal microbial transplants (FMT) can rescue bone integrity in diet-induced obesity. **METHODS:** 6-wk old male C57BL/6 mice (n=10/group) were randomized to a low-fat (LF) or high fat, high sugar (HFS) diet *ad libitum* for 13 wks. HFS mice were randomized to one of three groups for 4 wks: LF diet with FMT from the LF mice (HFS/LF+), LF diet with sham FMT using PBS (HFS/LF), or HFS diet with FMT from the LF mice (HFS/HFS+) to simulate the impact of combined diet alteration and addition of “healthy” microbes, diet alterations only, and addition of “healthy” microbes only, respectively. Animals had free access to a running wheel until terminated at 23 wks of age. Statistical analyses were performed using a two-way ANOVA and Tukey’s *post-hoc* test. **RESULTS:** HFS/HFS+ mice showed greater absolute femoral neck (FN) strength versus HFS/LF and HFS/LF+ mice (p<0.003), while LF/LF mice had the greatest relative FN strength versus all groups (p<0.016). Whole femur bone mineral density (BMD, g/cm<sup>3</sup>) was greater in HFS/HFS+ versus all groups (p<0.023); LF/LF mice had the highest BMD when normalized to body weight (p<0.029). Immunostaining for tumor necrosis factor alpha, sclerostin, insulin-like growth factor 1, and interferon gamma in cortical and cancellous bone revealed no differences between groups. Despite no difference in marrow adipocyte number (#/mm<sup>2</sup>) between groups, HFS/HFS+ mice had greater marrow adipocyte size (μm<sup>2</sup>) versus LF/LF mice; diet alteration, with and without transplanted “healthy” microbes, was able to partially attenuate increased marrow adipocyte size. **CONCLUSIONS:** A change in diet from HFS to LF led to reduced absolute FN strength compared to HFS/HFS+ and LF/LF mice, with no apparent effect from transplanted “healthy” gut microbes. LF/LF mice had greater relative femoral neck strength. Altering diet, with and without FMT’s, was sufficient to partially rescue the detrimental impacts of high fat, high sugar feeding on bone integrity.

1825 Board #5 May 28 1:30 PM - 3:30 PM

**IMPACT OF MATERNAL EXERCISE ON CORTICAL GEOMETRY AND TRABECULAR MICROARCHITECTURE IN MOUSE OFFSPRING**

Rebecca K. Dirkes, Ethan D. Weiss, Rebecca J. Welly, Jiude Mao, Jessica Kinkade, Victoria J. Vieira-Potter, Cheryl S. Rosenfeld, Pamela S. Bruzina. *University of Missouri Columbia, Columbia, MO.*  
(No relevant relationships reported)

Exercise during gestation is safe and has many positive effects on the offspring, such as improved cardiovascular health and nervous system development. However, whether gestational exercise positively impacts skeletal development is unknown.

**PURPOSE:** To determine whether maternal exercise throughout gestation and lactation positively impacts cortical geometry and trabecular microarchitecture of the femur in mouse male and female offspring. **METHODS:** In this longitudinal study, sexually mature C57BL/6 female mice were given *ad lib* access to a standard rodent chow. Two weeks before mating, females were randomized into two groups: voluntary wheel running treatment (EX) or sedentary control (SED). Females were mated to C57BL/6 males and continued treatment or control through both gestation and lactation. One male and one female offspring from each dam (n=7/group/sex) were selected and given *ad lib* access to a high-fat diet until 16 weeks of age, when final body weight was measured and femora collected. Cortical geometry of the mid-diaphysis and trabecular microarchitecture of the distal right femur were assessed via micro-computed tomography (μCT) with a voxel size of 12 μm. ANOVA or ANCOVA with final body weight (BW) as a covariate was used to determine the effects of maternal exercise on trabecular and cortical bone outcomes, respectively. **RESULTS:** There were no differences in BW between SED and EX male offspring. EX male offspring had smaller total area (Tr.Ar, p=0.075) and marrow area (Ma.

Ar,  $p=0.025$ ), and a higher cortical-to-total area ratio (Ct.Ar/Tt.Ar,  $p=0.017$ ) compared to SED males. EX males had lesser trabecular thickness ( $p=0.049$ ) but higher connectivity density ( $p=0.029$ ) compared to SED. EX female offspring had greater BW than SED offspring ( $p=0.064$ ). EX females had smaller Tt.Ar ( $p=0.017$ ), Ma.Ar ( $p=0.033$ ), and Ct.Ar ( $p=0.063$ ) versus SED. EX female offspring had greater trabecular spacing ( $p=0.046$ ) and degree of anisotropy ( $p=0.040$ ), and lower trabecular number ( $p=0.034$ ) compared to SED.

**CONCLUSION:** Maternal exercise during gestation and lactation decreased cortical bone area independent of body weight and negatively impacted trabecular microarchitecture in both male and female offspring.

**1826** Board #6 May 28 1:30 PM - 3:30 PM  
**C-mirna Expression Responses To Whole-body Vibration And Resistance Exercise In Postmenopausal Women**

Samuel R. Buchanan, Hoang V. Nguyen, Ryan Miller, J. Mikhail Kellawan, Christopher Black, FACSM, Michael Bembem, FACSM, Debra Bembem, FACSM. *The University of Oklahoma, Norman, OK.* (Sponsor: Dr. Debra Bembem, FACSM)  
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 (No relevant relationships reported)

Circulating microRNAs (c-miRNA, miR) are potential biomarkers for age-related changes in musculoskeletal function. There is a paucity of data on c-miRNA responses to exercise, especially in postmenopausal women (PMW). Evaluating alterations in the expression of c-miRNA may provide deeper insight into the benefits of exercise for bone health in aging populations. **PURPOSE:** The purpose of this study was to characterize the effects of acute bouts of resistance exercise (RE) and whole-body vibration (WBV) on selected c-miRNAs that regulate bone metabolism (miR-21-5p, -23a-3p, -133a-3p, -148a-3p) in PMW ( $n=10$ ). **METHODS:** Subjects performed a high intensity RE condition and a WBV condition in random order. RE consisted of 3 sets, 10 reps, 70% 1RM for leg press, shoulder press, lat pulldown, leg extension, and hip adduction isotonic exercises. For WBV, 5-1 min bouts were performed (20 Hz, 3.38 mm peak-to-peak displacement) each separate by 1 min rest on a Galileo vibration platform. Morning blood samples after an overnight fast were collected pre, immediately-post (IP), 60 min, 24 hrs, and 48 hrs after exercise to measure c-miRNA and TRAP5b. C-miRNA expression was corrected for plasma volume (PV) shifts using the equation:  $\% \Delta PV = (\log(100)/(\log(100) - \log(\text{Hct Pre})) * \log(100) * (\log(\text{Hct Pre}) - \log(\text{Hct Post}))/\log(\text{Hct Post}))$ . The correction factor was subtracted from the Cq values for each exercise sample. **RESULTS:** PV significantly decreased for both conditions at IP ( $p=0.04$ ), thus serum variables were corrected for PV shifts. There was a significant condition  $\times$  time interaction for miR-21 ( $p=0.019$ ), which decreased in relative expression from 60p ( $1.61 \pm 0.31$ ) to 24h ( $0.80 \pm 0.16$ ) after WBV but not after RE. MiR-23a-3p, -133a-3p, -148a-3p showed no significant expression changes for either exercise condition. TRAP5b concentrations significantly decreased 24h (WBV  $-7.56\% \pm 5.27$ , RE  $-3.44\% \pm 4.33$ ) after exercise ( $p<0.01$ ) even after correcting for PV shifts ( $p<0.01$ ). **CONCLUSION:** C-miR-21-5p was downregulated at 24 hrs in response to an acute bout of WBV. Both types of exercise also decreased serum TRAP5b 24 hrs post-exercise, indicating decreased bone resorption. This is the first known study to correct c-miRNA expression for PV shifts.

**1827** Board #7 May 28 1:30 PM - 3:30 PM  
**EFFICACY OF ORAL VITAMIN D SUPPLEMENTATION OR SIMULATED SUNLIGHT ON BONE DURING MILITARY TRAINING**

Thomas J. O'Leary<sup>1</sup>, Rachel M. Izard<sup>2</sup>, Neil P. Walsh, FACSM<sup>3</sup>, Jonathan CY Tang<sup>4</sup>, William D. Fraser<sup>4</sup>, Julie P. Greeves<sup>1</sup>. <sup>1</sup>Army Headquarters, Andover, United Kingdom. <sup>2</sup>Army Recruiting and Initial Training Command, Upavon, United Kingdom. <sup>3</sup>Liverpool John Moores University, Liverpool, United Kingdom. <sup>4</sup>University of East Anglia, Norwich, United Kingdom. (Sponsor: Professor Neil Walsh, FACSM)  
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 (No relevant relationships reported)

25-hydroxyvitamin D (25(OH)D)  $\geq 50$  nmol·L<sup>-1</sup> is essential for bone health. Vitamin D deficiency during arduous training has implications for increased stress fracture risk. Vitamin D is mainly synthesised from skin exposure to the sun; around 20% of vitamin D is obtained from the diet. **PURPOSE:** This study compared the efficacy of vitamin D supplementation by oral pill *versus* simulated sunlight on bone macro- and micro-architecture during a 13-week military training course in winter. **METHODS:** Eighty male infantry recruits (mean  $\pm$  SD, age  $22 \pm 3$  years, height  $1.78 \pm 0.07$  m, body mass  $77.9 \pm 10.7$  kg) received oral vitamin D<sub>3</sub> (1,000 IU·D<sup>-1</sup> for 4 weeks and then 400 IU·d<sup>-1</sup> for 8 weeks,  $n = 21$ ), an oral placebo ( $n = 19$ ), solar-simulated radiation (SSR,  $1.3 \times$  standard erythemal dose in T-shirt and shorts,  $3 \text{ d}\cdot\text{wk}^{-1}$  for 4 weeks and  $1 \text{ d}\cdot\text{wk}^{-1}$  for 8 weeks,  $n = 22$ ), or placebo SSR ( $n = 18$ ). Total 25(OH)D was measured by LC-MS/

MS in week 1, 5 and 13, and bone density and structure was assessed at the ultra-distal dominant tibia by HR-pQCT (Xtreme CTI, Scanco) in week 1 and 13. **RESULTS:** Oral vitamin D<sub>3</sub> and SSR increased 25(OH)D from week 1 ( $51 \pm 22$  and  $43 \pm 21$  nmol·L<sup>-1</sup>) to week 5 ( $78 \pm 23$  and  $79 \pm 15$  nmol·L<sup>-1</sup>) and week 13 ( $75 \pm 15$  and  $76 \pm 12$  nmol·L<sup>-1</sup>,  $P < 0.001$ ). The oral and SSR placebos did not change 25(OH)D from week 1 ( $51 \pm 40$  and  $41 \pm 17$  nmol·L<sup>-1</sup>) to week 5 ( $45 \pm 4$  and  $41 \pm 16$  nmol·L<sup>-1</sup>), but 25(OH)D increased in both groups by week 13 ( $60 \pm 4$  and  $65 \pm 15$  nmol·L<sup>-1</sup>,  $P \leq 0.010$ ). Supplementation and training did not affect total, trabecular or cortical volumetric bone mineral density, cortical area, trabecular volume, number or thickness, or cortical pore diameter (main effects of time,  $P \geq 0.105$ ; group  $\times$  time interactions,  $P \geq 0.258$ ). Training increased cortical thickness ( $1.30 \pm 0.25$  to  $1.32 \pm 0.25$  mm), and reduced trabecular area ( $682 \pm 133$  to  $680 \pm 133$  mm<sup>2</sup>) and spacing ( $360 \pm 58$  to  $345 \pm 71$   $\mu\text{m}$ , main effects of time,  $P \leq 0.041$ ), but supplementation had no effect (group  $\times$  time interactions,  $P \geq 0.181$ ). There was a significant group  $\times$  time interaction for cortical perimeter ( $P = 0.033$ ) and porosity ( $P = 0.049$ ); training had no effect on either measure for any group ( $P \geq 0.068$ ). **CONCLUSION:** Vitamin D supplementation in winter, using strategies to increase total 25(OH)D above  $50 \text{ nmol}\cdot\text{L}^{-1}$ , exerted no effect on bone macro- or micro-architecture beyond the osteogenic effects of exercise training.

**1828** Board #8 May 28 1:30 PM - 3:30 PM  
**Predictors And Prevalence Of Low Bone Mineral Density And Bone Stress Injuries In Ultramarathon Runners**

Tracy B. Høeg<sup>1</sup>, Michael Fredericson, FACSM<sup>2</sup>, Kristin L. Sainani<sup>2</sup>, Kira F. Skaggs<sup>2</sup>, Megan D. Roche<sup>2</sup>, Emily Miller<sup>2</sup>, Emily Kraus<sup>2</sup>. <sup>1</sup>University of California-Davis, Sacramento, CA. <sup>2</sup>Stanford University, Palo Alto, CA.  
 Email: exophoria@gmail.com  
 Reported Relationships: T.B. Høeg: Salary; Napa Medical Research Foundation. Other (please describe): Personal laboratory testing from InsideTracker.

**BACKGROUND:** Low bone mineral density (BMD) and bone stress injuries (BSI) are highly prevalent among collegiate runners due to risk factors that have been well elucidated. Though initial data suggest ultramarathon runners are at high risk for low BMD and BSI, the prevalence of and risk factors for low BMD and BSI among this older population of long-distance runners has not been thoroughly investigated. **PURPOSE:** To determine the prevalence of and risk factors for low BMD and history of BSI in male and female ultramarathon runners **METHODS:** 123 ultramarathon runners who qualified for a 161km endurance race were recruited via pre-race email invitation in 2018 and 2019. Pre-race assessments included a survey on BSI history, dietary habits, body mass index and menstrual history in females; dual energy x-ray absorptiometry (DXA) scan; and, in 2019, serum evaluation for ferritin, total testosterone, free testosterone and estradiol. Poisson regression was used to evaluate risk factors for BSI; and linear regression or Pearson's correlation coefficients when evaluating correlates of BMD. **RESULTS:** 40 women and 83 men (mean age 41.8 and 46.2 years, respectively) were enrolled and completed the survey with 36 women and 72 men completing DXA's and 19 women and 32 men completing serum evaluation. 79.5% of men and 37.5% of women reported history of at least one BSI. 15% of women and 28.9% of men had low BMD (Z-score  $< -1.0$ ). Low BMD was significantly or near-significantly associated with history of BSI: the age-adjusted risk ratio per BMD risk point was 1.86 ( $p=.036$ ) for men and 2.03 ( $p=.056$ ) for women. Oligomenorrhea was correlated with lower BMD values in women (beta coefficient =  $-.39$  SD per risk point for total hip BMD,  $p=.038$ ; and beta coefficient =  $-.35$  SD per risk point for femoral BMD,  $p=.054$ ). Of the blood markers, higher testosterone correlated with higher hip ( $r=.40$ ,  $p=.022$ ); and femoral ( $r=.39$ ;  $p=.027$ ) BMD in males and higher estradiol correlated with higher spine BMD ( $r=.47$ ;  $p=.043$ ) in females. **CONCLUSIONS:** BSI history and low BMD were highly prevalent among male ultramarathon runners and less so among females. Low BMD was associated with a history of BSI. Higher levels of sex hormones were correlated with higher BMD in both men and women. Oligomenorrhea was correlated with lower BMD in women.

**D-11 Thematic Poster - Hydration Strategies and Assessment**

Thursday, May 28, 2020, 1:30 PM - 3:30 PM  
 Room: CC-2010

**1829 Chair:** William M. Adams. *University of North Carolina at Greensboro, Greensboro, NC.*  
*(No relevant relationships reported)*

**1830 Board #1** May 28 1:30 PM - 3:30 PM  
**A Urine Color Chart Is An Accurate Tool For Self-identification Of High Urine Concentration In Athletes**  
 Floris C. Wardenaar, Daniel Thompsett, Kathryn Pesek, Abigail T. Colburn, Kaila Vento, Dean Bacalzo, Stavros Kavouras, FACSM. *ARIZONA STATE UNIVERSITY, Phoenix, AZ.*  
 (Sponsor: Barbara Ainsworth, FACSM)  
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**PURPOSE:** Urine color ( $U_c$ ) charts can be a reliable field tool to assess urine concentration, but no self-reporting athlete data is available. This study compares  $U_c$  scores from athletes against research team scores and urine osmolality values. **METHODS:** Urine samples were collected from college athletes ( $n=173$ , 68% male, median age 20). To standardize  $U_c$  scoring, a box was constructed with a set distance (14 inch) towards the 30 ml sample and placed behind a 1.2x1.2 inch opening against a white backdrop. Athletes and two research members independently scored  $U_c$  using the chart described by Armstrong in 1994. Differences in researcher  $U_c$  were discussed until consensus was established. To control for lighting, two 28-Watt white LED lights were placed aside of the box and the  $U_c$  chart. Samples were measured for urine osmolality in duplicate via freezing point depression. **RESULTS:** Median athlete and researcher scores for  $U_c$  values were 2 with an interquartile range (IQR) 1-3 and urine concentration of 744 (474-940)  $\text{mmol}\cdot\text{kg}^{-1}$ . A significant lower number of samples with  $U_c < 2$  was reported by athletes ( $n=60$ ) vs. researchers ( $n=44$ ),  $P=0.02$ . Correlations for  $U_c$  against urine osmolality were similar for athlete and researcher scores indicated by a similar  $r: 0.56$ ,  $P<0.001$ . Based on athlete score receiver operating characteristics (ROC),  $U_c$  has a fair diagnostic capability for identifying urine with an osmolality  $\geq 800 \text{ mmol}\cdot\text{kg}^{-1}$  based on an area under the curve (AUC) of 0.71. Contingency tables, based on the ROC optimal threshold for  $U_c \geq 2$  (with sensitivity 0.89% and specificity 0.53%) showed 68% among athletes vs. 60% among researchers' correct classification for being euhydrated or underhydrated. Of the athletes 27% misclassified themselves as being underhydrated ( $U_c \geq 2$ ) with urine concentration below  $800 \text{ mmol}\cdot\text{kg}^{-1}$ , but only 5% of samples were misclassified suggesting proper hydration while osmolality values indicated underhydration. **CONCLUSIONS:** Validity of reporting  $U_c$  by athletes was similar to researchers. Although accuracy could be justified as fair, the  $U_c$  misclassification for athletes with high urine osmolality values was minimal. Indicating that  $U_c$  can help athletes to self-identify urine concentrations above  $\geq 800 \text{ mmol}\cdot\text{kg}^{-1}$  that may predict underhydration. Funded by a Global Sport Institute award at ASU.

**1831 Board #2** May 28 1:30 PM - 3:30 PM  
**Comparison Of Different Methods For Urine Hydration Assessment**  
 Anthony F. Ludwig, Chandler B. Rudolph, Hunter D. Evans, Noah J. Erb, Cory L. Butts. *Weber State University, Ogden, UT.*  
 (Sponsor: Dr. Brendon P. McDermott, FACSM)  
*(No relevant relationships reported)*

Several instruments and techniques to assess hydration via urine exist; but which is used for evaluation depends on diagnostic accuracy, reliability, cost, and convenience. Urine specific gravity assessed via refractometry is a common field technique for urine assessment; however, previous comparisons of different refractometers have provided contradicting reports of bias. **PURPOSE:** To identify agreement between different refractometers (manual and digital) to measure urine specific gravity, as well as assess the diagnostic accuracy of urine specific gravity compared to osmolality. **METHODS:** Free-living participants ( $n = 39$ , 27 males, 12 females, age  $25 \pm 5$  y, ht  $1.76 \pm 0.09$  m, wt  $81.1 \pm 15.2$  kg, BMI  $26.2 \pm 4.1$ ) volunteered to provide a spot urine sample. Each sample was evaluated in duplicate with an osmometer (Osmo1 Single-Sample Micro-Osmometer), manual refractometer (Atago MASTER-SUR/Na), and digital refractometer (Atago PAL-10S). Bland-Altman analysis was performed to assess agreement between manual and digital refractometers. Diagnostic accuracy of refractometers to identify concentrated samples ( $\geq 1.025$ ) was conducted using receiver operating characteristic curves with osmolality ( $\geq 850 \text{ mOsm/kg}$ ) as the standard. **RESULTS:** Samples evaluated with the digital ( $1.018 \pm 0.008$ ) and manual ( $1.018 \pm 0.007$ ) refractometers were highly correlated ( $r = 0.998$ ,  $P < 0.001$ ). Bland-Altman

analysis demonstrated high agreement between manual and digital refractometers (mean difference:  $0.0002 \pm 0.0004$ ). Compared with osmolality, the digital refractometer identified concentrated samples with an area-under-the curve (AUC) of 0.86, sensitivity of 0.71, and specificity of 1.00. The manual refractometer identified concentrated samples with an AUC of 0.89, sensitivity of 0.79, and specificity of 1.00. **CONCLUSION:** This study demonstrated a high agreement between manual and digital refractometers, suggesting either instrument would be acceptable for use. When compared to osmolality, both instruments provided excellent specificity for identifying diluted samples, but moderate sensitivity for identifying concentrated samples.

**1832 Board #3** May 28 1:30 PM - 3:30 PM  
**Optimizing Baseline Body Mass Measurements To Determine Hydration Status**  
 Courtney L. Benjamin, Yasuki Sekiguchi, Erica M. Filep, Cody R. Butler, Margaret C. Morrissey, Rebecca L. Stearns, Douglas J. Casa, FACSM. *University of Connecticut, Storrs, CT.* (Sponsor: Douglas J. Casa, FACSM)  
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*(No relevant relationships reported)*

Baseline hydration status is typically determined through collecting 3 consecutive days of free-living nude body mass (BM). However, this method might not capture individuals in their euhydrated state. **PURPOSE:** To determine differences between euhydrated and free-living 3, 5, and 7 day hydration measures. **METHODS:** 27 males and 25 females (male age,  $21 \pm 1$  years; female age,  $20 \pm 1$  years; male BM,  $79.38 \pm 13.31$  kg; female BM,  $65.52 \pm 11.80$  kg) participated in this study. First morning nude BM, urine specific gravity (USG), urine color ( $U_{col}$ ), and urine osmolality ( $U_{osmo}$ ) were assessed for 10 consecutive days. Participants arrived euhydrated the first 3 days ( $USG < 1.020$ ). The average of days 1-3 (euhydrated baseline), 4-6 (free-living 3 day baseline), 4-8 (free-living 5 day baseline), and 4-10 (free-living 7 day baseline) were calculated. Repeated measures ANOVA with LSD post-hoc comparisons were performed. Data are reported as mean  $\pm$  standard deviation ( $M \pm SD$ ) and 95% confidence intervals (95%CI),  $p < 0.05$ . **RESULTS:** Euhydrated baseline USG was lower ( $M \pm SD$  [95%CI],  $1.009 \pm 0.003$  [1.008, 1.009]) than free-living 3 day ( $M \pm SD$  [95%CI],  $1.017 \pm 0.005$  [1.016, 1.019]), 5 day ( $M \pm SD$  [95%CI],  $1.018 \pm 0.005$  [1.016, 1.019]), and 7 day ( $M \pm SD$  [95%CI],  $1.018 \pm 0.005$  [1.016, 1.019]),  $p < 0.05$ . Euhydrated baseline  $U_{col}$  was lower ( $M \pm SD$  [95%CI],  $2 \pm [2, 3]$ ) than free-living 3 day ( $M \pm SD$  [95%CI],  $5 \pm 1$  [4, 5]), 5 day ( $M \pm SD$  [95%CI],  $5 \pm 1$  [1.016, 1.019]), and 7 day ( $M \pm SD$  [95%CI],  $5 \pm 1$  [4, 5]),  $p < 0.05$ . Euhydrated baseline  $U_{osmo}$  was lower ( $M \pm SD$  [95%CI],  $381.87 \pm 102.95$  [353.21, 410.53] mOsmol) than free-living 3 day ( $M \pm SD$  [95%CI],  $651.84 \pm 191.77$  [598.45, 705.23] mOsmol), 5 day ( $M \pm SD$  [95%CI],  $652.88 \pm 187.46$  [600.69, 705.07] mOsmol), and 7 day ( $M \pm SD$  [95%CI],  $659.24 \pm 182.33$  [608.48, 710.00] mOsmol),  $p < 0.05$ . Euhydrated baseline BM was lower ( $M \pm SD$  [95%CI],  $72.60 \pm 14.32$  [68.61, 76.59] kg) than free-living 3 day ( $M \pm SD$  [95%CI],  $71.72 \pm 14.67$  [67.64, 75.81] kg) but not different than 5 day ( $M \pm SD$  [95%CI],  $72.24 \pm 2.02$  [68.19, 76.28] kg) or 7 day ( $M \pm SD$  [95%CI],  $72.05 \pm 2.02$  [68.00, 76.09] kg),  $p < 0.05$ . **CONCLUSIONS:** A free-living 3 day baseline is 1.21% lower than a euhydrated 3 day baseline BM. Therefore, a three-day euhydrated, 5 or 7 day free-living baseline BM may be useful to define a true hydration baseline, which is important when dehydration level is described by %BM loss.

**1833 Board #4** May 28 1:30 PM - 3:30 PM  
**Characterizing Seven Day 24-hour Urinary Hydration Markers In College-aged Men And Women**  
 William M. Adams, Travis Anderson, Mitchell E. Zaplatosh, Eleni M. Karras, Stacey L. Walton. *University of North Carolina at Greensboro, Greensboro, NC.*  
 Email: wmadams@uncg.edu  
*Reported Relationships: W.M. Adams: Royalty; Springer. Industry contracted research; Statim Technologies, LLC, QCK, LLC.*

Maintaining a day-to-day state of euhydration is advantageous for acute and long-term health. However, little data exists examining 24h hydration status in free-living emerging adults (18 – 25y). **PURPOSE:** Thus, the purpose of this study was to assess 24h urinary hydration markers across 7 days in male and female college students. **METHODS:** Eighteen participants (male,  $n=11$ ; female,  $n=7$ ; mean  $\pm$  SD; age,  $23 \pm 3$  y; height,  $164.6 \pm 15.3$  cm, body mass,  $73.48 \pm 15.86$  kg; body fat,  $19.4 \pm 9.4$ %) provided a 24-hour urine sample on 7 consecutive days. Measures of 24h urine volume ( $U_{vol}$ ), urine osmolality ( $U_{osm}$ ), urine specific gravity ( $U_{sg}$ ), and urine color ( $U_{col}$ ) were assessed each day. Differences in 24h urinary hydration markers between weekdays and weekend days were assessed. **RESULTS:** Across 7 days, mean  $U_{vol}$ ,  $U_{osm}$ ,  $U_{sg}$ , and  $U_{col}$  was  $1.59 \pm 0.89$  L,  $628 \pm 284 \text{ mOsm}\cdot\text{kg}^{-1}$ ,  $1.020 \pm 0.007$ ,  $3.8 \pm 1.6$ , respectively. There were no differences (all  $p > 0.05$ ) between weekday and weekend days for mean  $U_{vol}$  ( $1.61 \pm 0.82$  vs.  $1.56 \pm 0.72$  L),  $U_{osm}$  ( $626 \pm 270$  vs.  $627 \pm 235 \text{ mOsm}\cdot\text{kg}^{-1}$ ),  $U_{sg}$  ( $1.020 \pm 0.007$  vs.  $1.020 \pm 0.006$ ), and  $U_{col}$  ( $3.8 \pm 1.4$  vs.  $3.8 \pm 1.5$ ), respectively. Mean weekend day measures of  $U_{vol}$  (adj  $R^2 = 0.507$ ,  $p = 0.001$ ),  $U_{osm}$  (adj  $R^2 = 0.547$ ,  $p < 0.001$ ),  $U_{sg}$  (adj  $R^2 = 0.551$ ,  $p < 0.001$ ), and  $U_{col}$  (adj  $R^2 = 0.608$ ,  $p < 0.001$ ) were

all significantly associated with mean weekday measures. **CONCLUSION:** Our results suggest that, in this sample population of college students, individuals tended to have stable 24-hour urinary hydration measures across weekdays and weekend days. Despite finding relative stability in 24 hour urinary hydration markers across a week, we are unable to discuss factors associated with day-to-day variation in these measures. Integrating other factors such as previous personal and family medical history, physical activity, dietary intake, body composition, racial/ethnic background, and socioeconomic status may further elucidate variations in day-to-day hydration status and the role hydration plays in emerging adults on health.

**1834 Board #5 May 28 1:30 PM - 3:30 PM**  
**The Effects Of Mode Of Rehydration On Stress Hormone Response To Subsequent Maximal Intensity Exercise In The Heat.**

Linda M. Yamamoto<sup>1</sup>, Elaine C. Lee<sup>2</sup>, Brendon P. McDermott<sup>3</sup>, Kathleen N. Beasley<sup>2</sup>, Holly Emmanuel<sup>2</sup>, Jeff S. Volek<sup>4</sup>, Douglas J. Casa, FACSM<sup>2</sup>, Lawrence E. Armstrong, FACSM<sup>2</sup>, William J. Kraemer, FACSM<sup>4</sup>, Carl M. Maresh, FACSM<sup>4</sup>. <sup>1</sup>Central Connecticut State University, New Britain, CT. <sup>2</sup>University of Connecticut, Storrs, CT. <sup>3</sup>University of Arkansas, Fayetteville, AR. <sup>4</sup>The Ohio State University, Columbus, OH. (Sponsor: Carl M. Maresh, FACSM)  
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 (No relevant relationships reported)

**PURPOSE:** Endocrine response to strenuous exercise in the heat can serve as an indicator of the amount of strain the body is experiencing. Previous intravenous (IV) versus oral rehydration studies found no difference cortisol (CORT) response between modes of rehydration, but mixed norepinephrine (NOR) response with ORAL during an exercise-heat challenge (EHC). The purpose of this study was to examine the effects of mode of rehydration on the stress-hormone response to a subsequent EHC that more closely mimics a real-life athletic situation utilizing three traditional modes of rehydration *ad libitum* (ADL), IV and ORAL and combined half IV and half ORAL (I+O) fluids of identical volume.

**METHODS:** Ten healthy, non-smoking, active men (age 23.3 ± 1.1 y; height, 177.8 ± 2.8 cm; body mass, 81.4 ± 1.3 kg; body fat, 11.0 ± 1.0%;  $O_{2max}$ , 58.8 ± 1.3 ml·kg<sup>-1</sup>·min<sup>-1</sup>) completed four trials consisting of dehydration by -4% body mass, rehydration to -2% body mass, and an EHC comprised of 25 min of running at 60%  $O_{2max}$ , a maximal effort 0.5 mile run, five minutes of rest and five min of self-paced repetitive box lifting (RBL). Plasma catecholamines [epinephrine (EPI) and NOR] and CORT were analyzed at baseline, post-exercise dehydration, immediately before EHC (EHCPRE), immediately-post 0.5 mile run (EHC30), immediately-post RBL (EHCIP), and 15 minutes post-RBL. Data was analyzed with a two-way repeated measures ANOVA or Student's t-test, p < 0.05.

**RESULTS:** Catecholamine response was not significantly different between modes of rehydration, but significantly increased during EHC (EHCPRE - EPI 0.52±0.44 pmol·L<sup>-1</sup>, NOR 2.64±0.89 nmol·L<sup>-1</sup>; EHC30 - EPI 3.59±1.89 pmol·L<sup>-1</sup>, NOR 21.66±7.42 nmol·L<sup>-1</sup>; EHCIP - EPI 1.31±0.84 pmol·L<sup>-1</sup>, NOR 15.45±6.63 nmol·L<sup>-1</sup>). CORT response was significantly lower during I+O (EHCPRE: 451.8±118.5 nmol·L<sup>-1</sup>, EHCIP 505.4±237.9 nmol·L<sup>-1</sup>) compared to all other trials (EHCPRE 567.1±240.5 nmol·L<sup>-1</sup>, EHCIP - 603.6±270.1 nmol·L<sup>-1</sup>).

**CONCLUSIONS:** These results suggest a synergistic effect of I+O on plasma CORT concentration resulting in reduced adreno-cortical response. It is possible the I+O treatment resulted in reduced hormonal response or increased removal rate due to a combination of oropharyngeal response and rapid plasma volume restoration since stress was controlled across conditions.

**1835 Board #6 May 28 1:30 PM - 3:30 PM**  
**Hydration Status Response To Bolus Frequency And Volume Intake During Exercise In Heat**

Jonathan R. Larson<sup>1</sup>, Nate E. Bartman<sup>1</sup>, Zachary J. Schlader, FACSM<sup>2</sup>, Blair D. Johnson, FACSM<sup>1</sup>, David Hostler, FACSM<sup>1</sup>, Riana R. Pryor<sup>1</sup>. <sup>1</sup>University at Buffalo, Buffalo, NY. <sup>2</sup>Indiana University, Bloomington, IN.  
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Workplace hydration recommendations suggest consuming 237mL of fluid every 15-20 min during physical work in the heat. It is unknown if these recommendations promote hydration during work and if consuming larger boluses of water less frequently maintains hydration better than smaller boluses of water consumed more frequently.

**PURPOSE:** Examine if consuming 500mL water every 40 min maintains hydration better than 237mL water every 20 min during work in the heat.

**METHODS:** Seven healthy adults completed 2 trials while fasted, either consuming 237mL water every 20 min (237) or 500mL water every 40 min (500). Subjects performed 2 h of treadmill exercise at 6.4kph, 1.0% grade in 34°C, 30% relative humidity wearing shorts and a t-shirt, followed by 2 h of rest in a temperate room.

Heart rate (HR), rectal temperature ( $T_{rec}$ ), skin temperature ( $T_{skin}$ ), were measured throughout exercise and recovery. Gastrointestinal (GI) symptoms were measured during exercise. Nude body mass was measured pre- and post-exercise. Blood and urine samples were collected pre- and post-exercise, and after recovery.

**RESULTS:** HR,  $T_{rec}$ , and  $T_{skin}$  increased from pre- (58±10, 62±9 bpm; 36.8±0.3, 36.7±0.3°C; 32.3±0.4, 32.3±0.9°C) to post- (132±29, 136±33 bpm, p=0.01; 38.1±0.6, 38.0±0.7°C, p=0.01; 35.5±0.6, 35.6±1.1°C, p<0.01) exercise and returned to baseline (62±10, 68±15 bpm, p=0.88; 36.7±0.2, 36.7±0.2°C, p=1.00; 32.9±0.7, 32.6±1.0°C, p=0.89) following recovery, in 237 and 500, respectively. GI symptoms were similar among trials and times (p=0.38). In 500, urine specific gravity was lowest following recovery (1.005±0.003) compared to pre- (1.015±0.002, p<0.01) and post- (1.011±0.006, p=0.02) exercise. Plasma osmolality was not different between post-exercise (282±3, 281±4 mOsm/L) and recovery (283±1, 284±2 mOsm/L) compared to pre-exercise (287±6, 286±3 mOsm/L, p=0.96) in 237 and 500, respectively. Changes in plasma volume were similar among trials and times (p=0.78). Post-exercise body mass loss (-0.1±0.5, 0.0±0.5 kg, p=0.28) and sweat rate (0.7±0.2, 0.6±0.5 L/h, p=0.41) were similar, in 237 and 500, respectively. **CONCLUSIONS:** Hydration status was similar between drinking larger, less frequent water boluses and smaller, more frequent boluses. These findings provide flexibility for workers to take less frequent hydration breaks.

**D-12 Thematic Poster - Muscle Damage and Injury**

Thursday, May 28, 2020, 1:30 PM - 3:30 PM  
 Room: CC-2009

**1836 Chair: Cory W. Baumann. University of Minnesota, Twin Cities, MN.**  
 (No relevant relationships reported)

**1837 Board #1 May 28 1:30 PM - 3:30 PM**  
**Muscle Damage Increases Autophagy Activation In Untrained Young Men**

Travis Raif<sup>1</sup>, Casey Appell<sup>1</sup>, Matthew T. Stratton<sup>1</sup>, Mohamed Fokar<sup>2</sup>, Jakob Vingren, FACSM<sup>3</sup>, Hui-Ying Luk<sup>1</sup>. <sup>1</sup>Texas Tech University, Lubbock, TX. <sup>2</sup>Center for Biotechnology and Genomics, Texas Tech University, Lubbock, TX. <sup>3</sup>University of North Texas, Denton, TX. (Sponsor: Jakob Vingren, FACSM)  
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**Introduction:** The autophagic process is a key regulator of muscle repair and steroid hormones have been shown to alter this autophagic response. To date, no study has determined the effects of the acute resistance exercise (RE)-induced hormonal response on the autophagic process during muscle regeneration.

**Purpose:** To examine the effect of the acute RE-induced hormone response on the autophagic process in untrained young men.

**Methods:** Untrained young men (n=8, 22 ± 3y; height: 180 ± 5.7cm; weight: 80 ± 15kg) completed two sessions of 80 unilateral maximal eccentric knee extensions. Immediately after knee extensions, participants completed either 20-min of rest (CON) or upper body resistance exercise (EX). Muscle samples were collected from the vastus lateralis before exercise (BL), and 12-hr and 24-hr after exercise sessions. Real-time PCR was used to determine the gene expression for autophagic initiation signaling markers (i.e. FOXO3, MTOR, and AKT) and autophagic markers (i.e., ATG5, ATG7, LC3A, LC3B, ULK1, and p62).

**Results:** A significant (p<0.05) time effect was found for AKT, FOXO3A, ATG5, and p62 expression. AKT expression increased from BL to 12-hr (1.97 ± 0.34-fold) and 24-hr (1.33 ± 0.12-fold) and FOXO3A expression decreased from BL at 12-hr (3.15 × 10<sup>-4</sup> ± 2.94 × 10<sup>-4</sup>-fold) and 24-hr (1.43 × 10<sup>-5</sup> ± 3.02 × 10<sup>-6</sup>-fold). Additionally, p62 increased from BL at 12-hr (4.11 ± 1.26-fold) and ATG-5 expressions increased from BL at 12-hr (1.62 ± 0.30-fold). A trend was found for MTOR towards an increase from BL at 12-hr.

**Conclusion:** In response to muscle damage, the autophagic response increased from baseline in untrained young men; however, our data suggest that exercise-induced circulatory factors did not affect the autophagic process in untrained men.

1838 Board #2 May 28 1:30 PM - 3:30 PM

**Curcumin Supplementation Suppresses Ubiquitin Proteasome System Activity Following Exercise-Induced Muscle Damage In Humans**

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(No relevant relationships reported)

**PURPOSE:** Curcumin is a natural polyphenolic compound with profound antioxidant and anti-inflammatory properties. Moreover, combined curcumin and piperine supplementation has shown improved curcumin bioavailability by 2000%. Multiple studies have demonstrated that exposure to curcumin leads to dysregulation of the ubiquitin-proteasome system (UPS) in cell culture. However, to date, no data has investigated curcumin's ability to influence UPS activity in a human model. Therefore, the purpose of this study was to investigate the effects of curcumin and piperine supplementation on markers of UPS activity following exercise-induced muscle damage in human skeletal muscle. **METHODS:** Twenty-three recreationally active male and female participants were randomized into a curcumin + piperine (CUR; n=11); or placebo + piperine (PLA; n=12). Both groups were instructed to consume 2g of their respective supplement and 20mg of piperine for 11 consecutive days. Following 8 consecutive days of supplementation, participants performed a 45-min eccentrically-biased muscle damaging treadmill protocol at 60%  $\dot{V}O_{2max}$ . Muscle Biopsies and delayed muscle soreness (DOMS) analyses were performed 30 minutes prior and 3-, 24-, 48-, and 72-hours post exercise-induced muscle damage. Muscle ubiquitin, MAFbx, ubiquitin specific peptidase 19 (USP19), and chymotrypsin-like protease (CLP) concentrations were measured using ELISA kits. A 2x5 repeated measures ANOVA with pairwise comparisons was conducted with significance set at  $p < 0.05$ . **RESULTS:** Both groups had a significant time effect for DOMS ( $p < .001$ ). Pairwise comparisons indicated DOMS was significantly greater from baseline at all time points except 72 hours post muscle damage. No significant differences were found for CLP or USP19 across any time points. Regardless of time, there was a significant group effect for ubiquitin ( $p = .012$ ) and MAFbx ( $p = .016$ ) where CUR was significantly lower than PLA. **CONCLUSION:** Curcumin appears to attenuate muscle ubiquitin and MAFbx in response to a muscle damaging protocol. As key markers of protein degradation, this implies decreased ubiquitination and a subsequent reduction in proteasomal activity. Therefore, curcumin supplementation potentially plays a role in preserving skeletal muscle mass through decreased muscle breakdown.

1839 Board #3 May 28 1:30 PM - 3:30 PM

**Numb And Numb-like Responses To Exercise Induced Muscle Damage In Human Skeletal Muscle**

Matthew P. Buback<sup>1</sup>, Kevan W. Stout<sup>1</sup>, Julia E. Tomtschik<sup>1</sup>, Ethan E. Peterson<sup>1</sup>, Melissa L. Hipp<sup>1</sup>, Zach A. Grahm<sup>2</sup>, Christopher P. Cardozo<sup>3</sup>. <sup>1</sup>The University of Kansas, Lawrence, KS. <sup>2</sup>Birmingham VAMC; University of Alabama at Birmingham, Birmingham, AL. <sup>3</sup>Center for the Medical Consequences of Spinal Cord Injury; Medical Service, James J. Peters VAMC; Icahn School of Medicine at Mount Sinai, Bronx, NY. (Sponsor: Philip Gallagher, FACSM)  
(No relevant relationships reported)

Numb and Numb-Like (NumbL) are adaptor proteins. Among their functions is control of cell fate determination and progression of cell differentiation. While no role for NumbL has been found in cells of the myogenic lineage, Numb promotes myogenic differentiation of satellite cells. The roles these proteins in human skeletal muscle in response to exercise-induced muscle damage have yet to be examined. **PURPOSE:** The purpose of this investigation is to examine changes in the expression of Numb and NumbL in human skeletal muscle after a bout of muscle damage via eccentric exercise. **METHODS:** Twelve male subjects signed an informed consent approved by The University of Kansas's Institutional Review Board and were randomly assigned to one of two groups: a control group (n = 6) or an damage group (n = 6). Subjects completed a one repetition maximum (1RM) in leg extension followed by seven sets of ten repetitions of eccentric leg extension at 120% of 1RM with a two minutes of rest period between sets. Three muscle biopsies of the *vastus lateralis* were collected at baseline, two days post-, and five days post-muscle damage and analyzed utilizing Western blot and quantitative reverse transcription polymerase chain reaction analyses. The results were analyzed using a 2 X 3 (Group X Time) repeated-measures ANOVA. **RESULTS:** No significant differences in mRNA expression were observed for *Numb* between groups two days post- and five days post-damage ( $p = 0.37$  and  $p = 0.29$ , respectively). There was no significant difference in *NumbL* for the exercise group ( $3.101 \pm 1.763$ ) in comparison to the control group ( $0.838 \pm 0.234$ ) two days post-exercise induced muscle damage ( $p = 0.27$ ). However, there was a significant increase in *NumbL* at five days post-exercise between the exercise group ( $1.773 \pm 0.358$ ) and the control group ( $0.726 \pm 0.087$ ) from baseline measures ( $p = 0.04$ ). No significant

differences in Numb or NumbL proteins were observed at any time point or between the control group and exercise group ( $p > 0.05$ ). **CONCLUSION:** Numb expression was unaltered post-muscle damage, while NumbL mRNA expression was increased after muscle damage. These results indicate that NumbL may have a greater role in muscle repair after strenuous exercise in humans than previously thought. Funding provided by NIA grant 5R01AG060341-02 to CPC and the CSACSM Doctoral Grant.

1840 Board #4 May 28 1:30 PM - 3:30 PM

**Exosomes Isolated From Platelet-rich Plasma And Mesenchymal Stem Cells Promote Functional Recovery After Muscle Injury**

Shama R. Iyer, Amanda L. Scheiber, Paul Yarowsky, R. Frank Henn III, Satoru Otsuru, Richard M. Lovering. *University of Maryland School of Medicine, Baltimore, MD.* (Sponsor: Edward McFarland, FACSM)  
(No relevant relationships reported)

**PURPOSE:** Clinical use of platelet-rich plasma (PRP) and mesenchymal stem cells (MSCs) have gained momentum as viable treatment options for muscle injuries. Exosomes, or small cell-derived vesicles, could be helpful if they could deliver the same or better physiological effect without cell transplantation into the muscle. The purpose of this work was to determine if local delivery of exosomes derived from PRP (PRP-exos) or MSCs (MSC-exos) to injured muscles hastens recovery of contractile function. **METHODS:** Using Sprague-Dawley rats, platelets were isolated from blood and MSCs were isolated from bone marrow and expanded in culture; exosomes from both were isolated through ultracentrifugation. The tibialis anterior muscles were injured *in vivo* by maximal lengthening contractions. Muscles were injected with PRP-exos or MSC-exos (immediately after injury, and days 5 and 10 after injury); shams received an equal volume of saline. In addition, histological and biochemical analysis was performed on tissues for all groups. **RESULTS:** Injury resulted in a significant loss of maximal isometric torque ( $66 \pm 3\%$ ) that gradually recovered over 2 weeks. Both PRP-exos and MSC-exos accelerated recovery, with similar improved recovery of contractile function over the saline treated group at days 5, 10, and 15 ( $P < 0.05$ ). A significant increase in centrally nucleated fibers was seen with both exos groups by day 15 ( $P < 0.05$ ). Muscles treated with PRP-exos had increased expression of *Myogenin* gene expression ( $P < 0.05$ ), whereas muscles treated with MSC-exos had reduced expression of *TGF- $\beta$*  ten days after muscle injury. **CONCLUSIONS:** Exosomes derived from PRP or MSCs can facilitate recovery after a muscle strain injury in a small-animal model, likely due to factors that can modulate inflammation, fibrosis and myogenesis. With their small size, low immunogenicity, and ease with which they can be obtained, exosomes could represent a novel therapy for many orthopedic ailments.

1841 Board #5 May 28 1:30 PM - 3:30 PM

**Recovery From Eccentric Injury Is Maintained In Aging Sarcopenic Muscle**

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**PURPOSE:** The progressive loss of muscle function and mass with age, known as sarcopenia, is a leading cause for falls and reduced quality of life in the elderly. Eccentric contractions have been known to induce muscle damage, and it has been suggested that eccentric induced muscle damage (EIMD) contributes to sarcopenia. More recently, however, eccentric training has gained attention as means to improve muscle function in the elderly. These differing views highlight the need for clarification on how EIMD affects sarcopenic muscle performance, particularly force frequency, fatigue, and kinetics of muscle contraction. **METHODS:** Male CB6F1 mice were used at 7-9 mo (adult) and 29-31 mo (old) of age. *In vivo* measurement of plantarflexor function was assessed in anesthetized mice using an Aurora Scientific 305C servomotor by stimulating the tibial nerve. Force-frequency and fatigue were assessed at baseline and 3 days following EIMD. EIMD was induced by 20 eccentric contractions of the plantarflexors by forcing dorsiflexion during a maximal contraction. **RESULTS:** At baseline old mice had lower force ( $12 \pm 1.8$  vs  $15.2 \pm 0.8$  mN-m) and were more fatigue resistant compared to adult mice. During the EIMD protocol, old mice lost significantly more force compared to adult mice ( $34.8\% \pm 11.5$  vs  $26.3\% \pm 4.2$  respectively). Surprisingly, old mice recovered most of their force ( $96.4\% \pm 2.0$  vs  $90.6\% \pm 6.5$  adult) and contraction kinetics 3 days after EIMD. Rates of muscle fatigue did not significantly change 3 days after EIMD compared to baseline in either age group. **CONCLUSIONS:** The plantarflexors of old mice were more susceptible to injury by maximal eccentric contractions compared to adult. However, old mice did not differ from adult mice in their ability to recover muscle function 3 days after EIMD. The impaired regenerative capacity often reported for sarcopenic muscle was not evident under these conditions. The similar recovery in adult and old mice could be due to nature of the EIMD protocol, the muscles tested, and the use of muscle performance rather than molecular and structural markers of damage. These results

indicate that mild EIMD may not have a long-term deleterious effect on sarcopenic muscle performance. Further research is needed to determine if EIMD can improve function of sarcopenic muscle.

**1842** Board #6 May 28 1:30 PM - 3:30 PM  
**Effects Of Exercise-induced Muscle Injury On Quadriceps Muscle EMG During Locomotion**

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*(No relevant relationships reported)*

Exercise-induced muscle injury is characterized by long-lasting muscle strength deficits and soreness but whether these changes alter quadriceps muscle activation and knee pain development during subsequent locomotor activity is unclear. **PURPOSE:** To determine the effects of downhill running-induced muscle injury on quadriceps muscle torque and soreness, knee pain, and muscle activation during a standardized run. **METHODS:** 12 recreationally active males, 18-35 years old were randomly assigned to either a downhill running group (DR; n = 6) or level running control group (CON; n = 6). Quadriceps muscle maximum isometric torque at 20°, 45° and 90° of knee flexion, and muscle and knee pain were measured before, immediately following and 24 hours after either DR (45 min at -12% grade) or level running (10 min) protocols. Vastus medialis (VM), rectus femoris (RF), and vastus lateralis (VL) muscle activation were measured bilaterally via surface EMG during level running at 75% of heart rate maximum. Bilateral muscle and knee pain were measured using a visual analog scale (100 mm). **RESULTS:** CON group experienced no significant (p>0.05) decreases in maximal isometric torque of quadriceps muscles, or changes in muscle and knee pain, or normalized integrated EMG (niEMG) during running. DR group produced significantly (p<0.05) less peak torque at all joint angles immediately following (14.1±5.0-21.4±4.6%) and 1-day (15.4±5.3-23.9±5.1%) after DR. Compared to pre-injury (2.5±1.9 mm), quadriceps muscle soreness increased (p<0.008) immediately after (31±9 mm) and at 1-day (46±6 mm) after DR, whereas knee pain increased (p=0.003) at 1-day (Pre 4±3 mm vs. 1 d 27±6 mm). niEMG in the left VM was 131±16%-142±23% (p=0.06) and right VL was 131±16-144±22% (p=0.07) of pre-injury values immediately after and 1-day after DR. **CONCLUSIONS:** Exercise-induced muscle injury increases quadriceps muscle strength deficits and soreness, and knee pain that appear to alter activation of certain quadriceps muscles during subsequent locomotion.

**1843** Board #7 May 28 1:30 PM - 3:30 PM  
**Eccentric And Concentric Resistance Training Alterations In Muscle Z-line Proteins**

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*(No relevant relationships reported)*

Few studies are available on the alterations of resistance training on muscle Z-lines. Thus, it is of great importance to understand long time effects of resistance training on the mechano-stability and mechano response on muscle Z-lines proteins. **Purpose:** The present study was conducted to ascertain how Z-lines proteins (myopodin/SYNPO 2 and  $\alpha$ -actinin) are altered by eccentric and concentric resistance training leading to possible alterations in mechano-stability and mechano-response. **Methods:** Ten (10) healthy male subjects with age (25.3 ± 1.4 years), height (1.87 ± 0.09 m), weight (73.2 ± 11.6 kg) and BMI (24.4 ± 3.3 kg·m<sup>-2</sup>) were grouped into eccentric resistance (n= 5) and concentric resistance (n=5) training. Subjects underwent twelve (12) weeks of resistance training intervention on the dominate leg. Muscle biopsies were taken in five time points (T0,T1,T2,T3,T4) on the forelimb of the vastus lateralis muscle and immunohistochemistry double staining protocol were implemented. Images were taken using confocal laser scanning microscope and protein distribution was morphometrically analysed by line scanning to find-out the alterations of myopodin/SYNPO2 and  $\alpha$ -actinin on muscle Z- lines. Paired student's t-test was used for analysis to compare a given time point to the basal value (T0), whilst an unpaired student's t-test was used for between groups analysis. **Results:** We observed a significant value (0.44 ± 0.07, p < 0.007) for between group (eccentric and concentric) for myopodin/SYNPO 2 for time (T4), as well as significant value (0.50 ± 0.25, p < 0.034) between time (T0 and T4) for eccentric training on myopodin/SYNPO 2. Also, we observed a significant value (0.69 ± 0.09, p < 0.013) between group (eccentric and concentric) for Z-line for time (T3). The results show that myopodin/SYNPO 2 is more restricted or distributed in the Z-line region. Also, it could be that the compression of Z-line at time (T3) led to a higher signal at the reducing ratio of  $\alpha$ -actinin for both eccentric and concentric training, which depends on the time and type of training in a dose-response manner.

**Conclusion:** Long-term exposure of resistance training, especially eccentric type, affects Z-lines (myopodin/SYNPO 2 and  $\alpha$ -actinin) proteins functional architecture and structure against myofibrillar stress.

**1844** Board #8 May 28 1:30 PM - 3:30 PM  
**Characterization Of Muscle Damage And Inflammation Following Repeated Maximal Eccentric Loading Of The Trunk**

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*(No relevant relationships reported)*

Eccentric exercises (ECC) induce reversible muscle damage, delayed-onset muscle soreness and an inflammatory reaction that is often followed by a systemic anti-inflammatory response. Thus, ECC might be beneficial for treatment of metabolic disorders which are frequently accompanied by a low-grade systemic inflammation. However, extent and time course of a systemic immune response after repeated ECC bouts are poorly characterized. **PURPOSE:** To analyze the (anti-)inflammatory response after repeated ECC loading of the trunk. **METHODS:** Ten healthy participants (33 ± 6 y; 173 ± 14 cm; 74 ± 16 kg) performed three isokinetic strength measurements of the trunk (concentric (CON), ECC1, ECC2, each 2 wks apart; flexion/extension, velocity 60°/s, 120s MVC). Pre- and 4, 24, 48, 72, 168h post-exercise, muscle soreness (numeric rating scale, NRS) was assessed and blood samples were taken and analyzed [Creatine kinase (CK), C-reactive protein (CRP), Interleukin-6 (IL-6), IL-10, Tumor necrosis factor- $\alpha$  (TNF- $\alpha$ )]. Statistics were done by Friedman's test with Dunn's post hoc test ( $\alpha$ =.05). **RESULTS:** Mean peak torque was higher during ECC1 (319 ± 142 Nm) than during CON (268 ± 108 Nm; p<.05) and not different between ECC1 and ECC2 (297 ± 126 Nm; p>.05). Markers of muscle damage (peaks post-ECC1: NRS 48h, 4.4±2.9; CK 72h, 14407 ± 19991 U/l) were higher after ECC1 than after CON and ECC2 (p<.05). The responses over 72h (stated as Area under the Curve, AUC) were abolished after ECC2 compared to ECC1 (p<.05) indicating the presence of the repeated bout effect. CRP levels were not changed. IL-6 levels increased 2-fold post-ECC1 (pre: 0.5 ± 0.4 vs. 72h: 1.0 ± 0.8 pg/ml). The IL-6 response was enhanced after ECC1 (AUC 61 ± 37 pg/ml\*72h) compared to CON (AUC 33 ± 31 pg/ml\*72h; p<.05). After ECC2, the IL-6 response (AUC 43 ± 25 pg/ml\*72h) remained lower than post-ECC1, but the difference was not statistically significant. Serum levels of TNF- $\alpha$  and of the anti-inflammatory cytokine IL-10 were below detection limits. Overall, markers of muscle damage and immune response showed high inter-individual variability. **CONCLUSION:** Despite maximal ECC loading of a large muscle group, no anti-inflammatory and just weak inflammatory responses were detected in healthy adults. Whether ECC elicits a different reaction in inflammatory clinical conditions is unclear.

**D-13** Thematic Poster - RPE, Pain and Fatigue

Thursday, May 28, 2020, 1:30 PM - 3:30 PM  
**Room:** CC-2011

**1845** **Chair:** Aaron J. Stegner. *Univ. of Wisconsin, Madison, WI.*  
*(No relevant relationships reported)*

**1846** Board #1 May 28 1:30 PM - 3:30 PM  
**Perceived Exertion Is Elevated In Chronic Fatigue Syndrome And Fibromyalgia: A Meta-analysis Of Case-control Studies**

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*(No relevant relationships reported)*

Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS) and fibromyalgia (FM) are two debilitating, medically unexplained illnesses primarily characterized by fatigue and widespread musculoskeletal pain, respectively. Prior case-control studies suggest that perceived exertion (RPE) is elevated in ME/CFS and FM, however, other studies have found that RPE responses to exercise do not differ between patients and healthy controls. We used a meta-analytic approach to quantify the effect of exercise on RPE in ME/CFS and FM. **Purpose:** Quantify the population effect of acute aerobic exercise on RPE in ME/CFS and FM. **Methods:** We conducted a meta-analysis of case-control studies involving ME/CFS and FM patients that reported RPE responses

to acute aerobic exercise. Articles published prior to June, 2018 were located with searches of PubMed, Scopus/Embase, CINAHL, and CENTRAL. To be included in the final analysis, studies also had to report data on heart rate (HR) responses to exercise for patients and controls. Hedges' *d* effect sizes for RPE and HR were calculated and aggregated using random effects models. **Results:** Forty effects were extracted from 36 studies involving 971 patients (age = 42.2±6.1; BMI = 25.2±1.8; percent female = 77.8±23.1) and 762 healthy controls (age = 40±6.3; BMI = 24.7±1.4; percent female = 74.4±25). We observed a large ( $d=0.84$ ; 95% CI: 0.61, 1.07), significant ( $p<0.001$ ), and heterogenous ( $I^2=78.8$ ) effect indicating that RPE responses to exercise were higher in patients than controls. We also found a small ( $d=-0.42$ ; 95% CI: -0.58, -0.26), but significant ( $p<0.001$ ) effect indicating lower HR responses in patients than controls. **Conclusion:** RPE is elevated in ME/CFS and FM despite potentially lower physical exertion than healthy controls during exercise. This finding warrants further investigation to determine if RPE responses to exercise can provide insight into pathophysiological mechanisms of these illnesses. Future work may include exploring the strength of association between exercised-induced changes in RPE and physiological outcomes as well as experimentally manipulating RPE responses to exercise using methods such as pharmacological blockade or transcranial magnetic stimulation. **Jacob Lindheimer was supported by Department of Veterans Affairs grant: IK2-CX001679**

**1847 Board #2 May 28 1:30 PM - 3:30 PM**  
**A Novel Role Of ASICs In Immediate Exercise-Induced Pain And Exercise Performance**

Tahsin Khataei<sup>1</sup>, Anne S. Harding<sup>1</sup>, Mahyar Janahmadi<sup>2</sup>, Maram El-Geneidy<sup>1</sup>, Hamid Rajabi<sup>3</sup>, Peter M. Snyder<sup>1</sup>, Kathleen A. Sluka<sup>1</sup>, Christopher Benson<sup>1</sup>. <sup>1</sup>University of Iowa, Iowa city, IA. <sup>2</sup>Shahid Beheshti University of Medical Sciences, Tehran, Iran, Islamic Republic of. <sup>3</sup>Kharazmi University, Tehran, Iran, Islamic Republic of. (Sponsor: Thorsten Rudroff, FACS) Email: tahsin-khataei@uiowa.edu  
 (No relevant relationships reported)

**INTRODUCTION:** Exercise training is an effective therapy for many pain-related conditions, and there is a difference in pain perception between athletes and unconditioned people. The mechanisms by which exercise modulates pain are poorly understood. Painful conditions can be associated with elevated levels of protons, metabolites and inflammatory factors, which can activate receptors and/or ion channels on nociceptive sensory neurons including acid sensing ion channels (ASICs) and transient receptor potential cation channel subfamily V member 1 (TRPV1). Additionally, strenuous exercise also causes the release of similar chemical signals, and ASICs within muscle afferents may mediate immediate exercise-induced pain (IEP) and fatigue, as well as reflex hemodynamic changes. We hypothesized that ASICs and TRPV1 have role in IEP and maximal exercise performance. **METHOD:** First, C57BL/6 mice were divided into sedentary (SED), low-intensity continuous training (LICT) and high-intensity interval training (HIIT) groups. Mice were trained on a treadmill every other day for 4 weeks. SED mice were placed on a non-moving treadmill for similar periods of time. After 4 weeks, exercise performance, ASICs and TRPV1 mRNA levels within lumbar dorsal root ganglion (DRG) were measured. In a separate group, we measured IEP at baseline and following exhaustive exercise before and after HIIT. In a third study, we compared the IEP and exercise performance in ASIC3<sup>-/-</sup> versus wild type (WT) mice. **RESULTS:** We found HIIT improved exercise performance compared to LICT and sedentary groups, diminished ASICs and TRPV1 mRNA levels in lumbar DRG, and reduced IEP. We also found a negative relationship between mRNA levels of ASICs and TRPV1 and exercise performance ( $r = -0.59$ ,  $p < 0.001$ ). In addition, ASIC3<sup>-/-</sup> showed a significant lower IEP compared to WT mice, while there was no difference in maximal exercise performance between groups. **CONCLUSION:** In summary, ASIC3 is required for IEP following exhaustive exercise, and exercise training downregulates ASICs and TRPV1 in muscle afferents and diminishes IEP. These findings suggest a possible role of ASICs in benefits of exercise training for many pain and fatigue conditions such as fibromyalgia and chronic fatigue syndrome conditions. Supported by Department of Veteran Affairs.

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**1848 Board #3 May 28 1:30 PM - 3:30 PM**  
**Pain Modulation Is Associated With Moderate Physical Activity In Gulf War Veterans With Chronic Pain**

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 (No relevant relationships reported)

Veterans of the Persian Gulf War (GV) suffer unresolved widespread chronic musculoskeletal pain (CMP) that significantly impacts their functional ability and quality of life. Pain modulation is impaired in some groups with CMP and can be augmented with acute exercise. Further, we have shown that physical activity behaviors in women with fibromyalgia are positively associated with pain modulation. Whether this relationship occurs in GV with CMP is unknown. **PURPOSE:** To examine the relationships between self-reported and accelerometer measures of physical activity and pain modulation in GV with CMP. **METHODS:** Sixty-eight GV with CMP were recruited and 55 completed physical activity assessments that included completing the International Physical Activity Questionnaire and wearing an Actigraph accelerometer for one week. Psychophysical pain testing was used to assess pain modulation. Painful heat stimuli were delivered alone and during completion of a distracting cognitive task, the Stroop Color and Word Test. Participants rated pain intensity and unpleasantness using Gracely Box Scales (0-20). Multiple linear regression analyses were used to determine whether physical activity significantly predicted pain responses during the distracting cognitive task while controlling for age (years), body mass index (BMI), pain symptom severity (McGill Pain Questionnaire), and mood (Profile of Mood States). **RESULTS:** Forty-three GV with CMP were included in the analyses (age = 50.0 (SD 6.7) years; weight = 100.7 (SD 37.2) kg; height = 1.7 meters (SD 8.3); Average Widespread Pain Index scores = 7.0 (SD 3.3)). Moderate physical activity ( $\beta=-0.45$ ), based on accelerometer measurements, was a significant predictor of pain responses during distraction ( $F(5, 37) = 2.572$ ,  $p < 0.05$ ); adjusted  $R^2 = 0.16$ . Relevant covariates (age, BMI, mood and pain symptom severity) were not significant predictors of pain ratings. Self-reported physical activity ( $\beta=-0.08$ ) was not a significant predictor of pain responses during distraction ( $F(5, 45) = 1.298$ ,  $p > 0.05$ ). **CONCLUSION:** These results suggest that being physically active may help to maintain pain regulatory mechanisms in GV with CMP, but the strength of the relationship was weak and requires further research. Supported by US Department of Veterans Affairs grant #01CX000383.

**1849 Board #4 May 28 1:30 PM - 3:30 PM**  
**Acute Exercise Increases Pain Threshold And Subjective Psychoactive Mood State**

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 (No relevant relationships reported)

Prescription pain medication can be addictive and have long-term health consequences. Alternative pain-relieving strategies are becoming increasingly sought after. Exercise is known to have a pain-relieving effect which is thought to be mediated through the dopaminergic system. **PURPOSE:** To examine the relationships between minimum pain threshold (MPT), exercise blood lactate (EBL), and the self-reported psychoactive effects of exercise based on questions from the Morphine-Benzedrine Group, Morphine and Excitement subscales of the Addiction Research Center Inventory (ARCI) following acute exercise in college aged students. **METHODS:** Twelve college aged students (age = 20.9 ± 0.5yr) underwent 5 minutes of light leg cycling as a warmup. Following the warmup, they cycled for 20 minutes at 8 METS with an additional 5-minute cooldown. Measurements were taken prior to exercise and just before the cool down. EBL was collected as a measure of relative exercise intensity. The MPT was measured using a Wagner "Pain Test" algometer on the extensor carpi radialis. Results were assessed using a Student's T-Test. **RESULTS:** Following exercise the MPT was increased by 62.1% ± 2.8 ( $P<0.001$ ). Women had a greater increase in MPT (25.7 ± 9.1%) relative to men (15.8 ± 9.4%;  $P<0.05$ ). EBL increased from an average of 1.8 ± 0.6 mmol/L at baseline to 4.1 ± 0.7 mmol/L following exercise ( $P<0.01$ ). There was a positive linear correlation between MPT and EBL ( $r^2=0.59$ ;  $P<0.05$ ). Indicating greater EBL levels were related to increased MPT. Positive responses from the ARCI subscale increased by 27 ± 3.3% following exercise ( $P<0.05$ ). There was no effect of sex nor EBL on positive responses on the ARCI. **CONCLUSIONS:** These data suggest moderate intensity exercise can increase MPT and to a greater extent in women. Further, MPT correlated with increased EBL indicating that greater relative exercise intensity may modulate a greater increase

MPT. Moderate intensity exercise increased positive responses on the ARCI providing evidence that the dopaminergic system may drive changes to MPT. However, positive responses did not correlate to EBL which may suggest another variable may augment pain reduction with increased exercise intensity.

**1850** Board #5 May 28 1:30 PM - 3:30 PM  
**Towards Standardized Instructions For Measuring Perception Of Effort And Muscle Pain During Physical Exercise**

Benjamin Pageaux<sup>1</sup>, Pierre Clos<sup>2</sup>, Franco Impellizzeri<sup>3</sup>, Michel Audiffren<sup>4</sup>, Paul Stapley<sup>5</sup>, Vincent Grémeaux<sup>6</sup>, Stéphane Perrey<sup>7</sup>, Patrick J. O'Connor, FACSM<sup>8</sup>, Samuele M. Marcora<sup>9</sup>, Romuald Lepers<sup>2</sup>, Davy Laroche<sup>10</sup>. <sup>1</sup>Université de Montréal, Montreal, QC, Canada. <sup>2</sup>Université de Bourgogne, Dijon, France. <sup>3</sup>University of Technology Sydney, Sydney, Australia. <sup>4</sup>Université de Poitiers, Poitiers, France. <sup>5</sup>University of Wollongong, Wollongong, Australia. <sup>6</sup>Université de Lausanne, Lausanne, Switzerland. <sup>7</sup>Université de Montpellier, Montpellier, France. <sup>8</sup>University of Georgia, Athens, GA. <sup>9</sup>University of Bologna, Bologna, Italy. <sup>10</sup>CHU Dijon-Bourgogne, Dijon, France. (Sponsor: Patrick J O'Connor, FACSM) Email: benjamin.pageaux@umontreal.ca (No relevant relationships reported)

**PURPOSE:** Perceptions of effort (PE) and muscle pain (MP) influence performance and engagement in regular physical exercise. Literature-based standardized instructions describe PE as resulting from multiple sensory cues including "aches". This description of PE creates a possible confound when PE and MP are being considered separately. This project uses standardised, confound-free instructions and tests their validity during cycling exercise.

**METHODS:** After removing confounding factors from PE's instructions (Borg, 1998), we used The Borg CR Scales® Folder (Borg, 2008) to adapt these instructions to the CR100 scale®. MP was measured with instructions available from Cook et al. 1997 and adapted to the CR100 scale®. For availability in English and French, the instructions were translated and back-translated following standardised procedure. Semantic validity was confirmed by bilingual participants (N = 8) during pilot testing. Then, twenty-two participants visited the laboratory thrice. During the first visit, participants performed an incremental test to exhaustion to determine their cycling peak power output (PPO). During both visits 2 and 3 (randomized order), subjects performed four 1 min cycling bouts at 4 workloads (40, 60, 80, 100% PPO) twice. The bouts were separated by either 15 min of rest or a time to exhaustion test at 80% PPO. PE and quadriceps MP intensity were assessed during each exercise. Differences were tested using Friedman tests on the values reported at each workload and the change scores between workloads.

**RESULTS:** During the incremental test, changes in PE and MP in response to changes in workloads were dissociated only for power outputs below 50% PPO (P < 0.001). During the 1 min cycling bouts, changes in PE and MP in response to changes in workloads were dissociated (P < 0.001). Following completion of the time to exhaustion test, PE and MP increased (P < 0.001). During each exercise, PE was higher than MP (~10 a.u., P < 0.001).

**CONCLUSION:** The observed difference in the intensity of PE and MP, as well as their response to changes in workload provide experimental support in favour of the use of confound-free instructions to monitor PE and MP during cycling exercise. Future studies should test this possibility for other exercise modalities involving similar and other muscle groups.

**1851** Board #6 May 28 1:30 PM - 3:30 PM  
**SEX DIFFERENCES IN PAIN SENSITIVITY ARE ELIMINATED WHEN NORMALIZED TO LIMB SPECIFIC LEAN MASS**

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Women are more sensitive to pressure pain threshold testing compared to men, however the underlying mechanism(s) that explain these differences have not been fully elucidated. Pain sensitivity has been shown to be influenced by BMI, but less is understood when examining the role of limb specific fat and lean mass on pain sensitivity. **PURPOSE:** To examine how fat mass and lean mass influence pressure pain sensitivity in men and women. **METHODS:** Pressure pain thresholds (PPT) of 102 participants (50 female) were assessed in the vastus lateralis (VL) and brachioradialis (BR) using a pressure algometer on the left (L) and right (R) sides of the body. Whole body and limb specific fat and lean tissue were assessed via DXA scan. **RESULTS:** Women had higher percent body fat (32.3% ± 9.2 vs 20.1% ± 9.2,

P<0.001), absolute total body fat (21.4kg ± 9.9 vs 16.9kg ± 9.9, P=0.02), and had less lean mass (41.1kg ± 5.5 vs 62.4kg ± 8.9; P<0.001) than their male counterparts. Limb specific sex differences were also seen in both fat mass and lean mass in the R-BR (fat: 199.7g ± 125.6 vs 148.1g ± 100.4, P=0.02; lean: 770.1g ± 180.5 vs 1355.4 ± 319.5; P<0.001), L-BR(fat: 202.3g ± 110.4 vs 150.9g ± 113.6, P=0.02; lean: 736.1g ± 180.6 vs 1308.9 ± 318.2; P<0.001), R-VL (fat: 3732.3 ± 1600.5 vs 2601.9 ± 1360.2, P<0.001; lean: 4755.9 ± 839.0 vs 7261.4g ± 1243.8; P<0.001), and L-VL (fat: 3595g ± 1505.3 vs 2379.6g ± 1156.6, P<0.001; lean: 4574.5g ± 1000.3 vs 7154.8g ± 1239.1; P<0.001). Women had lower PPT's in the R-BR (321.9 ± 128.9 vs 466.2 ± 220.3, P<0.001), L-BR (308.6 ± 114.1 vs 444.5 ± 229.9, P<0.001), R-VL (460.4 ± 166.2 vs 677.5 ± 254.9, P<0.001) and L-VL (433.5 ± 156.6 vs 646.1 ± 262.5, P<0.001) when compared to men. When normalized to site specific lean mass PPT's, no differences were seen in any of the measured sites (R- BR; P = 0.15, L-BR; P = 0.15, R-VL; P=0.55, L-VL; P=0.31). However, when normalized to fat mass, the sex differences remained (R-BR; P<0.001, L-BR; P<0.001, R-VL; P<0.001, L-VL; P<0.001). **CONCLUSION:** When PPT's were normalized to lean mass, sex differences disappeared; however the sex differences remained when PPT's were normalized to fat mass. This finding suggests that having less lean mass may play a role in increased pain sensitivity and could indicate why women are more sensitive to pain compared to males.

**1852** Board #7 May 28 1:30 PM - 3:30 PM  
**Effects Of Pre-induced Fatigue Vs. Concurrent Pain On Neuromuscular Performance Of Locomotor Muscles**

Jenny Zhang<sup>1</sup>, Danilo Iannetta<sup>1</sup>, Giorio Varesco<sup>2</sup>, Guillaume Y. Millet<sup>2</sup>, Saied J. Aboodarda<sup>1</sup>. <sup>1</sup>University of Calgary, Calgary, AB, Canada. <sup>2</sup>Jean Monnet University, Saint-Étienne, France. Email: mu.zhang@ucalgary.ca (No relevant relationships reported)

Fatigue and muscle pain perceived during high-intensity exercise has long been implicated in attenuation of exercise tolerance, but the influence of these perceptual responses on regulation of neuromuscular performance during exercise is unknown.

**PURPOSE:** To examine the effects of pre-induced fatigue and concurrent rising pain (evoked by muscle ischemia) in one leg on motor fatigability and corticospinal excitability and inhibition of the contralateral leg. **METHODS:** Twelve healthy males(mean±SD; age: 27±4 yrs) undertook four experimental protocols including unilateral cycling to task failure at 80% of peak power output with i) the right-leg (RL), ii) the left-leg (LL), iii) RL immediately preceded by LL protocol (FAT-RL), and (iv) RL while blood flow was occluded in the contralateral (left) leg (PAIN-RL). The single-leg cycling exercise and neuromuscular assessments were carried out on a validated custom-built recumbent cycle ergometer that facilitates post-fatigue assessments within 1 second. Participants performed maximal and submaximal 5-s right-leg knee extensions, during which transcranial magnetic and femoral nerve electrical stimuli were delivered to elicit motor evoked potentials (MEP) and compound muscle action potentials (Mmax), respectively. **RESULTS:** Pre-induced fatigue reduced the right leg cycling time-to-task failure (332±137 s) to a greater extent than concurrent pain (460±158 s), compared to RL (580±226 s) (p<0.001). The maximal voluntary contraction (MVC) force declined less following FAT-RL (p<0.019) and PAIN-RL (p<0.032), compared to the RL. Voluntary activation declined, and the corticospinal excitability recorded from knee extensors increased similarly following the three conditions(p<0.05). However, the pre-induced fatigue, but not concurrent rising pain, reduced corticospinal inhibition compared to RL (p<0.05). **CONCLUSIONS:** These findings suggest that regardless of the origin or mechanisms modulating sensory group III/IV afferents (i.e. pre-induced fatigue vs. concurrent rising pain), the limit of exercise tolerance remains the same and exercise will be terminated upon achievement of sensory tolerance limit. The inhibitory neural feedback evoked by the two interventions however may have distinctive effects on corticospinal inhibition.

**1853** Board #8 May 28 1:30 PM - 3:30 PM  
**The Influence Of Physical Activity On Pain Sensitivity In Gulf War Veterans With Chronic Pain**

Jacob V. Ninneman<sup>1</sup>, Aaron J. Stegner<sup>1</sup>, Jacob B. Lindheimer<sup>1</sup>, Neda E. Almassi<sup>1</sup>, Stephanie M. Van Riper<sup>1</sup>, Nicholas P. Gretzon<sup>1</sup>, Alex E. Boruch<sup>1</sup>, Ryan J. Dougherty<sup>1</sup>, Laura B. Ellingson, FACSM<sup>2</sup>, Patrick J. O'Connor, FACSM<sup>3</sup>, Dane B. Cook, FACSM<sup>4</sup>. <sup>1</sup>UW-Madison, Madison, WI. <sup>2</sup>Western Oregon University, Monmouth, OR. <sup>3</sup>University of Georgia, Athens, GA. <sup>4</sup>William S. Middleton Memorial Veterans Hospital, Madison, WI. (Sponsor: Dane B. Cook, FACSM) Email: jninneman@wisc.edu (No relevant relationships reported)

Physical activity improves quality of life and decreases symptoms in chronic pain. Data from our lab and others have demonstrated increases in pain sensitivity following acute exercise in chronic pain. Conversely, regular physical activity is associated with lower pain sensitivity and greater pain modulation in civilians with chronic pain. Whether this same relationship occurs in Gulf War Veterans (GV) with chronic

widespread musculoskeletal pain (CMP) is unknown. **PURPOSE:** To determine the relationship between physical activity and pain sensitivity in GV with CMP. **METHOD:** GV (n=68) were recruited from south central WI as part of a 16-week exercise training trial and 55 completed baseline assessments that included physical activity and pain sensitivity measurements. Physical activity was measured using both self-report (International Physical Activity Questionnaire) and accelerometer (ActiGraph GTX) methods. Experimental pain testing consisted of three levels of noxious heat (45, 47, and 48.9°C), each presented five times. Ratings of pain intensity and unpleasantness were obtained following each stimulus using Gracely Box Scales (0-20). Multiple linear regression was used to determine whether self-reported and/or accelerometer measures of physical activity predicted pain ratings controlling for age (years), body mass index, and disease severity (Widespread Pain Index (WPI)). **RESULTS:** Forty-two GV with CMP were included in the analyses (age = 50.5 (SD 6.9) years; weight = 101.6 (SD 40.9) kg; height = 1.74 meters (SD 8); Average WPI = 7.5 (SD 3.2)). Neither self-reported ( $\beta = 0$ ) nor accelerometer-based ( $\beta = -0.02$ ) measures of moderate-to-vigorous physical activity (IPAQ: 505.25 (559.1); GTX: 70.6 (40.9)) significantly ( $p > 0.05$ ) predicted either pain intensity or unpleasantness. Disease severity ( $\beta = 0.46$ ), and age ( $\beta = 0.23$ ) were significant ( $p < 0.05$ ) predictors of unpleasantness but not intensity (Model  $p = 0.02$ , adjusted  $R^2 = 0.19$ ). **CONCLUSION:** These results suggest that physical activity does not affect the sensitivity of the nociceptive system to painful heat in GV with CMP. Future research examining different pain modalities and/or physical activity interventions may better clarify the associations between physical activity and CMP. Supported by Dept. of Veterans Affairs grant: IO1-CX000383.

**D-14 Thematic Poster - Sleep**

Thursday, May 28, 2020, 1:30 PM - 3:30 PM  
**Room:** CC-2000

**1854 Chair:** Scott R. Collier, FACSM. *Appalachian State University, Boone, NC.*  
*(No relevant relationships reported)*

**1855 Board #1** May 28 1:30 PM - 3:30 PM  
**The Relationship Between Changes In Sleep, Inflammatory Biomarkers, And Energy Expenditure In Female Soccer Players**  
 Brittany N. Bozzini, Bridget A. McFadden, Harry P. Cintineo, Alexa J. Chandler, Michelle A. Arent, Shawn M. Arent, FACSM. *University of South Carolina, Columbia, SC.*  
*Email: bbozzini@mailbox.sc.edu*  
*(No relevant relationships reported)*

The chronic stress of training and frequent travel during the competitive soccer season may adversely affect sleep and thus, recovery in collegiate athletes. **PURPOSE:** To examine the relationship between changes in sleep, inflammatory biomarkers, and exercise energy expenditure (EEE) throughout the season. **METHODS:** DI female soccer players (N=24) were monitored throughout the competitive season. During all training and games, EEE (kcal/kg) was evaluated using an integrative GPS and heart rate monitoring system, which was individualized based on pre-season performance testing. Pittsburgh Sleep Quality Index (PSQI) questionnaires, weight assessments, and blood draws were completed prior to pre-season and at weeks 2, 4, 8, & 12 of the season. Total cortisol (TCORT), free cortisol (FCORT), c-reactive protein (CRP), IL-6, and TNF $\alpha$  were analyzed. Change scores were calculated between timepoints for each biomarker, GlobalPSQI, Sleep Duration (SD), and Sleep Quality (SQ) scores. Pearson product correlations were conducted between change scores as well as EEE<sub>AVG</sub> between timepoints with significance set at  $p < .05$ . **RESULTS:**  $\Delta$ GlobalPSQI was not related to any measures, except  $\Delta$ SD and  $\Delta$ SQ ( $r = .39, r = .51; p < .05$ ).  $\Delta$ SD and  $\Delta$ SQ were both significantly correlated to  $\Delta$ IL-6 ( $r = -.21, r = -.23; p < .05$ ).  $\Delta$ IL-6 was positively correlated to  $\Delta$ CRP ( $r = .32, p < .05$ ),  $\Delta$ TNF $\alpha$  ( $r = .43, p < .05$ ), and  $\Delta$ FCORT ( $r = .26, p < .05$ ).  $\Delta$ CRP was also significantly related to  $\Delta$ TCORT ( $r = .24, p < .05$ ). EEE<sub>AVG</sub> was not associated with any measures ( $p > .05$ ). **CONCLUSIONS:** There appears to be a relationship, albeit weak, between sleep measures and IL-6, with increased SD and SQ (i.e. decreased PSQI score) related to increases in IL-6. Additionally, increased IL-6 was associated with increases in other proinflammatory and stress markers, potentially indicative of fuel mobilization and physiological repair responses. The cumulative load of the competitive season could indicate an increased need for recovery, thus yielding compensatory increases in SD and perceived SQ. Further research is warranted using objective sleep measures to examine the observed relationship in soccer players. Funding provided by Quest Diagnostics

**1856 Board #2** May 28 1:30 PM - 3:30 PM  
**Exploration Of Sleep Quality And Mood States During Varied Training Period In Collegiate Triathletes**  
 Mu-Tsung Chen<sup>1</sup>, Chih-Kai Hsu<sup>2</sup>, Tsung-Liang Lin<sup>3</sup>, Su-Ming Huang<sup>3</sup>, Meen-Tsai Wu<sup>3</sup>. <sup>1</sup>*Shih Chien University, Taipei, Taiwan.* <sup>2</sup>*National Taipei University of Nursing and Health Sciences, Taipei, Taiwan.* <sup>3</sup>*Tatung Institute of Technology, Chiayi, Taiwan.*  
*(No relevant relationships reported)*

**PURPOSE:** To evaluate the periodic changes in fatigue state, sleep quality, and mood states in response to different training periods in collegiate triathletes. **METHODS:** Thirteen collegiate triathletes with supervised regular periodic training program (age: 18-25 yrs) voluntarily participated in this study. During the period of study, the standardized training logs and diary were provided by their coach, and the training load/volume, Profile of Mood Sates questionnaire (POMS), Epworth Sleepiness Scale (ESS), and Pittsburgh Sleep Quality Index (PSQI) were used to periodically to measure and record the changes of our outcome measurements from 3 months in prior to the primary national triathlon competition (total investigating duration: 3.5 months). **RESULTS:** The monthly training volume gradually increased from 825 to 1176 min in one-month (peaked value) before competition and decreased to 786 min in 2-weeks before the competition. However, the sleep quality (PSQI and ESS) did not show any difference among different training periods. The overall PMOS score exhibited no difference across varied training periods. However, the sub-elements of POMS in depression/dejection and fatigue/inertia were peaked in one-month before the national competition ( $p < .05$ ), and the tension/anxiety element was significantly increased by 4-folds above baseline in 2-weeks before the competition ( $p < .05$ ). **CONCLUSIONS:** We demonstrate that the sleep quality was not affected during different training period. However, the depression/dejection, fatigue/inertia, and tension/anxiety appear to react differently in different timing patterns in response to varied training periods in these collegiate athletes. Our study may provide the evidence primarily focusing on the student collegiate triathletes, which would be important for coaches to closely monitor the timing of mood states changing across different training periods to achieve better training outcomes.

**1857 Board #3** May 28 1:30 PM - 3:30 PM  
**Self-reported, Sleep Behaviors And Barriers Of Adolescent Athletes**  
 Melissa L. Anderson, Khalil A. Lee, Timothy J. Roberts, Reid J. Reale, Justina L. Bonsignore. *Gatorade Sports Science Institute, PepsiCo, Inc., Bradenton, FL.*  
*Email: melissa.anderson1@pepsico.com*  
*Reported Relationships: M.L. Anderson: Salary; Gatorade Sports Science Institute, 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..*

**BACKGROUND:** Many adolescent athletes fail to meet sleep duration recommendations, however little is known about self-reported barriers preventing adequate sleep. **PURPOSE:** To investigate current and ideal sleep behaviors, as well as barriers to sleep in a group of adolescent athletes. **METHODS:** Adolescent athletes (n = 258, 16.3 ± 1.4 y; 196 male, 62 female) from 8 sports completed a standardized electronic survey regarding sleep behaviors and perceived barriers to sleep. The survey assessed current and ideal sleep onset, offset, and duration. Athletes were presented a list of common pre-bed activities and asked if they ever engaged in each activity in the hour prior to bed. Similarly, a list of potential barriers to falling asleep once in bed were presented. Frequency of all barriers (nights per week) was assessed. Comparisons between ideal and current behaviors were made using ANOVA and t-tests as appropriate. Barriers were ranked to identify which were most responsible for impacting sleep behaviors. Normally and non-normally distributed data are presented as mean ± SD, and mean with associated 95% confidence interval [95% CI], respectively. **RESULTS:** Significant differences were found between ideal (9:24 ± 1:18 (h:min)) and school night (8:14 ± 1:43), ideal and non-school night (9:56 ± 1:57), and school and non-school night sleep durations ( $p < 0.05$ ). The most frequent pre-bed activities were: engaging in social media (5.6 nights per week, 95% CI [5.3,5.9]), communication with others using technology (4.9 [4.6,5.2]), and socializing (4.9 [4.6,5.2]). School work (3.0 [2.7,3.2]) was the most cited barrier to getting into bed at the desired time, followed by engaging with social media (2.6 [2.2,2.9]) and communicating using technology (2.1 [1.8,2.4]). Once in bed, worrying about school work (1.5 [1.2,1.7]) and worrying about sport (1.4 [1.1,1.7]) were the two most cited barriers to falling asleep. **CONCLUSION:** Discrepancies exist between actual and desired sleep duration with athletes preferring to obtain more sleep on school nights. School work as well as the use of technology are top barriers preventing adolescent athletes from achieving their ideal bedtime. Focus should be placed on behavior change strategies, including time management, to overcome these known barriers to sleep.

**1858** Board #4 May 28 1:30 PM - 3:30 PM  
**The Effect Of Nap Duration On Sleep Inertia, Muscle Strength, And 3-km Cycling Time Trial Performance**

Angela Petretta, Nicholas Thomas, Michael Saunders, FACSM, Trent Hargens, FACSM, Nicholas Luden. *James Madison University, Harrisonburg, VA.* (Sponsor: Michael Saunders, FACSM)

(No relevant relationships reported)

**PURPOSE:** To determine the impact of napping (15-min and 30-min) on sleep inertia, peak muscle strength, and 3-km cycling time trial performance. **METHODS:** Six recreationally-trained college-aged participants (Age,  $22 \pm 1$  y;  $VO_{2max}$ ,  $43 \pm 12$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) completed a familiarization- and 3 experimental trials in the afternoon. Following a night of modest sleep restriction (range: 4.6-5.8 h), participants underwent exercise testing without a nap and following 15-min (Nap15) and 30-min (Nap30) naps. Peak isokinetic leg extension force (120 deg·sec<sup>-1</sup>) and computer-simulated 3-km cycling time trial (TT) performance were assessed 30 min after napping. Sleep inertia was quantified using the Karolinska Sleepiness Scale and the Tower of London cognitive task before and after each nap. Repeated measures ANOVAs were used to assess differences in peak strength and 3-km TT performance between conditions, while a 3 x 2 (nap condition by time) repeated measures ANOVA was used to assess sleep inertia. **RESULTS:** 3-km TT power output was similar across conditions (no-nap =  $212 \pm 84$  W, Nap15 =  $208 \pm 95$  W; Nap30 =  $213 \pm 95$  W). Though peak strength following Nap30 was not statistically lower than no-nap ( $p = 0.12$ ), peak strength was  $8.0 \pm 0.8\%$  lower in Nap30 compared to Nap15 ( $p < 0.05$ ). Sleep inertia was similar across conditions. **CONCLUSION:** These data suggest that napping prior to competition will not improve performance but rather may impair peak power-oriented activities. Data should be gathered to assess the impact of longer duration napping and the potential performance benefits of napping following more severe sleep restriction.

**1859** Board #5 May 28 1:30 PM - 3:30 PM  
**Sleep And Prior Exercise Influence Wingate Performance - Should These Be Controlled When Assessing Anaerobic Performance?**

Ryan W. Jeremic, Courtney D. Jensen, J. Mark VanNess. *University of the Pacific, Stockton, CA.*

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(No relevant relationships reported)

A variety of factors can influence anaerobic performance, including time of day, training status, fatigue, sleep duration and quality, psychological state, hydration, and food intake. These variables may interact to influence performance. **PURPOSE:** To compare anaerobic performance in individuals across three time periods of the day (morning, afternoon, and evening), and determine if sleep and/or prior exercise influence performance. **METHODS:** Ten healthy, physically active adults were recruited to do three 30-second Wingate tests: Morning (6:00am to 11:59am), afternoon (12:00pm to 4:59pm), and evening (5:00pm to 9:00pm). The order of tests was randomized and all testing was completed over one week. Prior to each test, subjects were provided similar instructions, and they completed pre-test questionnaires evaluating the duration of sleep the previous night and whether they abstained from strenuous exercise during the past 24 hours. Standard 30-second Wingate parameters were collected during each trial. Repeated measures ANOVA examined performance across each time period. **RESULTS:** All subjects completed the three testing protocols. There was no main effect of time of day on peak power ( $p=0.989$ ). When subjects were grouped based on prior strenuous exercise there was a trend for significance in peak power ( $p=0.070$ ) and a significant change in maximum speed ( $p=0.039$ ). Those who abstained from strenuous exercise had higher peak power (32.7% improvement) and maximum speed (21.5% improvement). When subjects were grouped based on sleep, similar results were observed: those who slept at least seven hours had higher peak power (17.6% improvement;  $p=0.055$ ) and higher maximum speed (15.7% improvement;  $p=0.036$ ). **CONCLUSION:** Pre-screening questions or guidelines for sleep and activity may be important to control when examining anaerobic performance. When subjects abstain from strenuous exercise and get adequate sleep they demonstrate improved Wingate performance.

**1860** Board #6 May 28 1:30 PM - 3:30 PM  
**Stretching And Meditation Improve Heart Rate Variability, Positive Feelings, And Quality Sleep In Active Adults.**

Jinger S. Gottschall<sup>1</sup>, Zane Smite<sup>2</sup>, Bryce Hastings<sup>3</sup>. <sup>1</sup>The Pennsylvania State University, University Park, PA. <sup>2</sup>University of Latvia, Riga, Latvia. <sup>3</sup>Les Mills International, Auckland, New Zealand. (Sponsor: W. Larry Kenney, FACSM)

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(No relevant relationships reported)

Physical and mental health is a prevailing research topic as adults balance the demands of daily life. One strategy to maintain wellbeing is to adhere to a physical activity routine. Countless studies have demonstrated that regular exercise increases fitness and decreases depression. Therefore, recent investigations focus on protocols to easily measure the effectiveness of specific programs to maximize benefits. Heart rate variability (HRV) is an example of a noninvasive variable that provides insight about cardiovascular health and recovery. Stretching and meditation are two practices that past research has demonstrated increase HRV. **PURPOSE:** To evaluate if a fusion of stretching and meditation improves heart rate variability, positive feelings, and quality sleep in active adults. Our hypothesis is that performing a sequence of stretches (20-30 minutes) with subsequent meditation (10 minutes) three nights per week will enhance recovery (higher HRV) in addition to induce positive feelings and quality sleep. **METHODS:** Sixty-six adults between 24-67 years who regularly exercised at least five hours per week, without stretching or meditation, collected their morning heart rate and exercise heart rate with a chest transmitter for two weeks. Next, we assigned (age and activity matched) half the participants to an experimental stretching and meditation protocol three nights per week. Both groups continued the heart rate collection for another two weeks. Each participant also completed a weekly survey with questions addressing their satisfaction with life, physical as well as mental feelings, and quality of sleep. **RESULTS:** In the experimental group, heart rate variability, positive feelings (confidence, motivation), and quality sleep were significantly greater during the second two weeks while resting heart rate and negative feelings (sadness, anxiety) were significantly less (all comparisons  $p \leq 0.02$ ). To contrast, in the control group, there were no significant differences between the measurement weeks. **CONCLUSIONS:** Our data demonstrate that 30-40 minutes of stretching and meditation three nights per week can be an effective routine to enhance both physical and mental health in active adults.

**1861** Board #7 May 28 1:30 PM - 3:30 PM  
**Differences In Sleep Quality In Elite Youth Athletes During And After The Competitive Season**

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(No relevant relationships reported)

**PURPOSE:** Our study investigated the differences in sleep architecture and health in and out of a competitive season. **METHODS:** Nine competitive youth athletes between the ages of 12 and 16 who compete for either the tumbling and trampoline team or the diving team were recruited for this study. Data was collected for 3 consecutive nights during the competition and for 3 consecutive nights during post season. Data was then analyzed using the Sleep Profiler™ scoring software. All data is expressed as Mean +/- SEM. **RESULTS:** Mean nocturnal pulse was statistically different from in season versus post season ( $p = 0.049$ , +/- ;  $66.8 \pm 9.6$  bpm in season versus  $61.7 \pm 6.3$  bpm post season). Sleep efficiency, WASO, and spindle duration were all not statistically different from in season to post season. Sleep latency, REM, and NREM sleep though not statistically different from in season to post season have a strong correlation. **CONCLUSION:** These data demonstrate a significant decline in mean heart rate when an athlete moves from competition season to the non-competitive season. These data show that gymnastic training in addition to competition training may lead to deleterious cardiovascular changes. Future studies should elucidate the impact and volume of training a youth athlete undertakes and the benefits and risks on physiological and psychological well-being.

**1862** Board #8 May 28 1:30 PM - 3:30 PM  
**Increased Sleep Is Associated With Higher Maximal Aerobic Capacity In NCAA Division 1 Athletes**  
 Kristin Haraldsdottir, Jennifer Sanfilippo, Andrew Watson.  
*University of Wisconsin- Madison, Madison, WI.*  
*Email: kristin.haraldsdottir@wisc.edu*  
 (No relevant relationships reported)

Prior research regarding sleep and endurance performance has primarily focused on sleep deprivation or sleep restriction among sedentary or recreationally active individuals. Little is known about the effect of real-world sleep fluctuations on aerobic capacity and performance in elite athletes. **PURPOSE:** To determine the impact of sleep duration acutely and chronically on maximal aerobic capacity ( $\dot{V}O_{2max}$ ) and ventilatory threshold (VT) in NCAA division 1 athletes.

**METHODS:** Over 2 years, 254 collegiate Division I varsity athletes from multiple sports (17-23 years old) performed incremental maximal exercise testing to determine  $\dot{V}O_{2max}$  and VT. On the day of testing, participants reported sleep duration for the prior night and the average sleep duration for the prior month. Acute:chronic sleep was calculated as the ratio of prior night to prior month sleep. Variables were grouped by prior night and prior month sleep duration (<8 hours or  $\geq$ 8 hours/night) as well as acute:chronic (<1,  $\geq$ 1).  $\dot{V}O_{2max}$  and VT were compared between groups using independent t-tests. Separate linear mixed effect models were used to evaluate the relationship between acute and acute:chronic sleep on  $\dot{V}O_{2max}$  and VT, while adjusting for age and individual repeated measures.

**RESULTS:** Athletes who slept  $\geq$ 8 hours the night before the test had significantly higher  $\dot{V}O_{2max}$  than those who slept <8 hours ( $53 \pm 5.1$  v  $51.1 \pm 6.8$  ml/kg/min,  $p=0.02$ ). Athletes who slept more than usual before the test (acute:chronic sleep  $\geq$ 1) had higher  $\dot{V}O_{2max}$  ( $53 \pm 5.9$  v  $50.8 \pm 6.6$  ml/kg/min,  $p=0.01$ ) and VT ( $43.1 \pm 5.4$  v  $39.4 \pm 7$  ml/kg/min,  $p<0.01$ ) than those who slept less than usual. In the multivariable models, prior night sleep duration was predictive of  $\dot{V}O_{2max}$  ( $1.0 \pm 0.31$ ,  $p<0.01$ ) and VT ( $0.91 \pm 0.33$ ,  $p=0.01$ ), and acute:chronic sleep was predictive of  $\dot{V}O_{2max}$  ( $6.8 \pm 2.2$ ,  $p<0.01$ ) and VT ( $8.6 \pm 2.3$ ,  $p<0.01$ ).

**CONCLUSIONS:** Among collegiate NCAA division 1 athletes, increased sleep duration is associated with significantly greater  $\dot{V}O_{2max}$  and VT, both of which are important predictors of athletic performance. In addition to the well-known and wide-ranging physical and mental benefits of sleep, interventions to increase sleep duration among elite athletes may improve endurance performance, and would support the NCAA's mission to promote the well-being and lifelong success of college athletes.

## D-15 Free Communication/Slide - Exercise Training, Intensity and Fitness

Thursday, May 28, 2020, 1:30 PM - 3:30 PM  
 Room: CC-3014

**1863** **Chair:** Rachel A. Tinius. *Western Kentucky University, Bowling Green, KY.*  
 (No relevant relationships reported)

**1864** May 28 1:30 PM - 1:45 PM  
**Muscular Strength Cut-points For Detection Of Type 2 Diabetes Risk In Apparently Healthy Adults**  
 Elise C. Brown<sup>1</sup>, Duncan S. Buchan<sup>2</sup>, Samar Madi<sup>1</sup>, Breanne Gordon<sup>1</sup>, Dorin Drignei<sup>1</sup>. <sup>1</sup>*Oakland University, Rochester, MI.* <sup>2</sup>*University of the West of Scotland, Lanarkshire, United Kingdom.*  
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 (No relevant relationships reported)

In the early stages of type 2 diabetes, patients are often asymptomatic. More screening tools are needed for early detection of diabetes in this increasing patient population. Low muscular strength is associated with increased diabetes risk, and use of handgrip dynamometers to determine normalized grip strength (NGS) may serve as a cost-effective diabetes screening tool for clinical and community settings.

**PURPOSE:** To establish sex- and age-specific NGS cut-points for estimating diabetes risk in apparently healthy adults.

**METHODS:** Publicly available National Health and Nutrition Examination Survey 2011-2012 and 2013-2014 data were used, and informed consent was obtained from all participants. Those aged 20-80 years who were free of underlying health conditions such as stroke, cardiovascular diseases, and cancer were retained ( $n=4,451$  participants; 67.9% aged 20-50 years; young males,  $n=1,609$ , mean age= $33.39$  [95% CI= $32.5, 34.3$ ] years; young females,  $n=1,412$ , mean age= $33.27$  [95% CI= $32.3, 34.2$ ] years). Grip strength was assessed using a handgrip dynamometer, and normalized

by adjusting for body mass. Risk for diabetes was determined using the American Diabetes Association diagnostic criteria. A logistic regression for survey data controlling for sociodemographic, anthropometric, and lifestyle covariates was used to determine NGS cut-points.

**RESULTS:** NGS was a significant predictor for diabetes ( $p=0.0472$ ), and the established cut-points for estimating diabetes risk was 0.76 (young men), 0.59 (young women), 0.62 (older men), and 0.47 (older women). When comparing estimated rates and actual diabetes risk, the risk percentages reported for all subgroups were similar. The risk percentages included 1.59 [95% CI= $0.76, 2.42$ ] (young men), 2.58 [95% CI= $1.64, 3.53$ ] (young women), 3.01 [95% CI= $0.44, 5.57$ ] (older men) and 2.03 [95% CI= $0.34, 3.73$ ] (older women).

**CONCLUSIONS:** NGS cut-points presented in this study may be a useful screening tool for estimating diabetes risk in apparently healthy adults, and these cut-points could be implemented in community and clinical settings for early diabetes detection.

**1865** May 28 1:45 PM - 2:00 PM  
**Utilizing Causal Pathway Analysis To Predict Change In Cardiorespiratory Fitness In The STRRIDE Randomized Trials**

Leanna M. Ross<sup>1</sup>, Roshan Tourani<sup>2</sup>, Sisi Ma<sup>2</sup>, Steven Shen<sup>2</sup>, Daniel C. Parker<sup>1</sup>, Kim M. Huffman<sup>1</sup>, Virginia B. Kraus<sup>1</sup>, Constantin F. Aliferis<sup>2</sup>, William E. Kraus, FACSM<sup>1</sup>. <sup>1</sup>*Duke University School of Medicine, Durham, NC.* <sup>2</sup>*University of Minnesota, Minneapolis, MN.*

(No relevant relationships reported)

Exploring high-throughput data in a causal pathway framework facilitates accurate and parsimonious multivariable predictive models for clinical outcomes. Developing these models elucidates mechanisms by which regular exercise elicits health benefits.

**Purpose** As a proof-of-concept, we tested the utility of causal pathway discovery for predicting changes in  $\dot{V}O_{2peak}$  across the STRRIDE trials.

**Methods** A total of 532 adults from three STRRIDE studies were randomized to one of 7 exercise interventions, ranging from doses of 8-22 kcal/kg/week; intensities of 50-75%  $\dot{V}O_{2peak}$ ; and durations of 6-9 months. Six groups included aerobic exercise, two included resistance training, and one included dietary intervention. Graded maximal exercise treadmill testing with expired gas analysis determined Absolute  $\dot{V}O_{2peak}$ . The Fast Causal Inference algorithm was applied to discover the mechanistic relationship among 231 clinical and transcriptomic variables with 200 bootstrap resamples to assess the stability of the discovered causal graph. To estimate effect sizes,  $\dot{V}O_{2peak}$  was regressed on variables in its local causal neighborhood.

**Results** Forty-four variables were identified in the causal vicinity (within three edges away) of  $\dot{V}O_{2peak}$  following exercise intervention in more than 50% of bootstrap resampling runs. Exercise intensity, age, and pre-training  $\dot{V}O_{2peak}$  were identified as the direct causes of post-training  $\dot{V}O_{2peak}$ . Among the studied variables, none mediated the effect of exercise dose. The following exercise combinations were the most effective in changing  $\dot{V}O_{2peak}$ : high amount/vigorous intensity aerobic training ( $\beta=0.39$  L/min); low amount/vigorous intensity aerobic plus resistance training ( $\beta=0.33$  L/min); low amount/vigorous intensity aerobic training ( $\beta=0.27$  L/min); high amount/moderate intensity aerobic training ( $\beta=0.26$  L/min); low amount/moderate intensity aerobic training ( $\beta=0.19$  L/min); and resistance training ( $\beta=0.18$  L/min).

**Conclusions** Multivariable causal graph-based inference confirmed an exercise dose-response for  $\dot{V}O_{2peak}$ . As we develop and incorporate additional molecular data, our future research will use this approach to maximize predictive ability for other clinical phenotypes to help make personalized lifestyle medicine a functional reality.

**1866** May 28 2:00 PM - 2:15 PM  
**Evaluating Individual Training Adaptations With Heart Rate Variability Following High Intensity Functional Training**

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(No relevant relationships reported)

Structured training programs fail to accommodate low and high responders. Training monitoring allows program changes to optimize outcomes. Monitoring heart rate variability (HRV) and its variance are thought to reflect the degree of individual adaptation and recovery to exercise training programs. However, it is unclear if HRV responses are indicative of change in aerobic capacity ( $\dot{V}O_{2max}$ ) and strength in high intensity functional training (HIFT).

**PURPOSE:** To evaluate if increases in  $\dot{V}O_{2max}$  and strength are related to differential changes in HRV following 6-weeks of HIFT. **METHODS:** Active men ( $n=26$ ; age =  $22.6 \pm 4.3$  years) and women ( $n=29$ ; age =  $23.7 \pm 4.3$  years) participated in six weeks ( $5$  d  $\cdot$  week<sup>-1</sup>) of HIFT. At baseline and posttest,  $\dot{V}O_{2max}$  and one-repetition

maximum for squat, deadlift and overhead press were totaled (CFT) to serve as training outcomes. Daily HRV was measured upon waking via a smartphone photoplethysmography application throughout. **RESULTS:**  $VO_{2max}$  increased in two HRV response profiles while CFT increases occurred regardless of profile. There was a main effect for time in CFT ( $p < .05$ ) but not for  $VO_{2max}$  ( $p > .05$ ). There was a significant inverse relationship between  $\Delta HRV$  and  $\Delta$ coefficient of variance ( $r = -0.46$ ,  $p < .05$ ). No significant relationships between baseline HRV and  $\Delta HRV$  ( $r = -0.12$ ,  $p > .05$ ),  $\Delta CV$  ( $r = 0.03$ ,  $p > .05$ ),  $\Delta VO_{2max}$  ( $r = 0.21$ ,  $p > .05$ ), or  $\Delta CFT$  ( $r = -0.01$ ,  $p > .05$ ) were identified. The relationship scatterplot between  $\Delta HRV$  and  $\Delta CV$  was used to classify participants into four unique HRV response profiles,  $HRV_{up}/CV_{up}$ ,  $HRV_{up}/CV_{dn}$ ,  $HRV_{dn}/CV_{dn}$ , and  $HRV_{dn}/CV_{up}$ . One-way MANOVA with a Tukey post-hoc test revealed significant differences in  $\Delta VO_{2max}$  ( $F_{3,70.3} = 2.5$ ,  $p < .05$ ) between HRV response profiles.  $HRV_{up}/CV_{dn}$  profile increased  $VO_{2max}$  compared to the  $HRV_{dn}/CV_{dn}$  profile (mean difference = 7.5%, 1.0-14.1%;  $p < .05$ ). Further,  $VO_{2max}$  decreased in the  $HRV_{dn}/CV_{dn}$  profile compared to the  $HRV_{up}/CV_{up}$  profile (mean difference = -7.8%, -15.0-0.50%;  $p < .05$ ). No significant difference was found for  $\Delta CFT$  between HRV profiles ( $p > .05$ ); all HRV profiles significantly increased CFT (mean difference = 32.78  $\pm$  6.97,  $p < .05$ ). **CONCLUSION:** Improving multiple training outcomes is desired in HIFT, so a  $HRV_{dn}/CV_{dn}$  profile may indicate a decline in  $VO_{2max}$ . Thus, training should be altered to optimize aerobic adaptations.

**1867** May 28 2:15 PM - 2:30 PM  
**Effects Of Amount, Intensity, And Mode Of Exercise Training On HOMA - The STRIDE Clinical Trials**

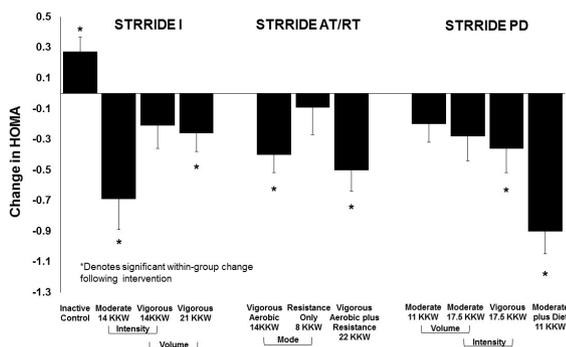
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 (No relevant relationships reported)

**Purpose.** To examine the effects of amount, intensity, and mode of exercise training on HOMA (a marker of fasting insulin resistance) across 10 exercise-only interventions from the three STRIDE (Studies of Targeted Risk Reduction Interventions through Defined Exercise) clinical trials.

**Methods.** A total of 518 subjects completed the three trials with pre and post intervention HOMA values. Subjects with dyslipidemia [STRIDE I (n=224) and STRIDE AT/RT (n=144)] or prediabetes [STRIDE-PD (n=150)] were randomized to either control group or one of 10 interventions, ranging from doses of 8-22 kcal/kg/week (KKW); intensities of 50-75%  $VO_{2peak}$ ; and durations of 6-9 months. Two groups included resistance training and one group included diet intervention (weight loss of 7%). Fasting blood samples were obtained at baseline and 16-24 h after the final exercise bout. Paired t-tests determined within group change score significance ( $p < .05$ ).

**Results.** In the inactive controls. HOMA increased significantly —became more insulin resistant. After training, all intervention groups became more insulin sensitive; 6 of these 10 groups had significant improvements in HOMA. In non-statistical comparisons across the trials, the diet + exercise group had the greatest improvement (-0.90  $\pm$  0.9); resistance training alone experienced the least improvement in HOMA. The 14 KKW moderate intensity (STRIDE I) and the aerobic + resistance training (STRIDE AT/RT) groups obtained 77% and 55% of the improvement observed in the diet + exercise group from STRIDE-PD. Only 4 of the 7 aerobic exercise groups had significant improvements.

**Conclusion.** On average, STRIDE interventions improved fasting insulin resistance. Adding resistance to aerobic training elicits an additive training effect on insulin resistance. In individuals with prediabetes, incorporating dietary intervention with aerobic training results in the most robust improvement in fasting insulin resistance.



**1868** May 28 2:30 PM - 2:45 PM  
**Non-metabolic VCO<sub>2</sub> Recovery Off-kinetics, And Performance Fatigability Following Chronic Exercise**

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 (No relevant relationships reported)

**Purpose:** This study characterized the role of non-metabolic expired carbon dioxide (nm-VCO<sub>2</sub>) in the relationship between recovery and performance fatigability (PF). **Methods:** Twenty adults (men, n=9, age=44.7 $\pm$ 13.9 years; women, n=11, age=50.3 $\pm$ 11.1 years) completed peak cardiopulmonary exercise tests (CPET) and submaximal constant work rate tests (CWRT) on the cycle ergometer on separate days before and after a vigorous, 4-week aerobic exercise training (AET) regimen. Each test was followed by a 10-minute passive recovery and endurance test at 70% of peak watts attained during CPET. PF was indexed by endurance test duration following both peak CPET (End1) and CWRT (End2), peak CPET time (pk-Time) and watts (pk-Watts). Metabolic indices were total VCO<sub>2</sub> (tVCO<sub>2</sub>), metabolic VCO<sub>2</sub> (m-VCO<sub>2</sub>), nm-VCO<sub>2</sub>, and recovery VO<sub>2</sub> and VCO<sub>2</sub> off-kinetics response indices (ORI). Data were analyzed using paired t-tests and correlations and compared before and after AET. **Results:** Significant improvements in recovery and PF measures were observed after AET, along with significant increases in tVCO<sub>2</sub> and nm-VCO<sub>2</sub>. No significant change in m-VCO<sub>2</sub> was observed.

VO <sub>2</sub> -off ORI (ml/min/s)	VCO <sub>2</sub> -off ORI (ml/min/s)	End1 (s)	End2 (s)	pk-Time (s)	pk-Watts	tVCO <sub>2</sub> (ml)	m-VCO <sub>2</sub> (ml)	nm-VCO <sub>2</sub> (ml)
7.48 $\pm$ 7.52 p<0.001*	4.11 $\pm$ 5.05 p<0.001*	265 $\pm$ 337 p<0.01*	321 $\pm$ 392 p<0.01*	63 $\pm$ 40 p<0.001*	24 $\pm$ 19 p<0.001*	1512 $\pm$ 2225 p<0.01*	904 $\pm$ 2255 p=0.089	608 $\pm$ 666 p<0.001*

Relationships between measures of recovery and PF were observed, though the strength of the relationships were diminished (pk-Time, pk-Watts) or became non-significant (End1, End2) after controlling analyses for the effect of nm-VCO<sub>2</sub>.

	End1	End2	pk-Time	pk-Watts
VO <sub>2</sub> -off ORI	-0.307 (p=0.058)	-0.300 (p=0.067)	-0.714 (p<0.001*)	-0.755 (p<0.001*)
VCO <sub>2</sub> -off ORI	-0.236 (p=0.149)	-0.151 (p=0.365)	-0.647 (p<0.001*)	-0.698 (p<0.001*)

**Conclusion:** The current study suggests nm-VCO<sub>2</sub> may moderate the relationship between recovery and PF and may have implications regarding AET induced buffering dynamics and its role in fatigue resistance during activity above moderate intensities.

**1869** May 28 2:45 PM - 3:00 PM  
**Non-exercise Equations For Determining Change In Cardiorespiratory Fitness**

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 (No relevant relationships reported)

CRF is a strong and independent predictor of morbidity and all-cause mortality beyond traditional risk factors. However, CRF is not routinely measured in clinical settings where cost, time, training, and discomfort on behalf of the patient have all been cited as barriers to routine integration. An alternative to measuring CRF is to estimate it using a non-exercise CRF equation. It is currently unknown whether eCRF can be used to estimate change in mCRF following the adoption of regular exercise. **Purpose:** To determine whether change in estimated cardiorespiratory fitness (eCRF) is associated with change in measured CRF (mCRF) independent of exercise amount and intensity over 24 weeks. **Methods:** Participants were 163 sedentary adults with abdominal obesity (waist circumference: mean 109.9 (SD; 11.5) cm) randomly assigned to: i) no-exercise control (n=42), ii) low-amount, low-intensity exercise (LALI; n=39), iii) high-amount, low-intensity exercise (HALI; n=51), iv) high-amount, high-intensity exercise (HAHI; n=31). mCRF was measured using a maximal treadmill test at baseline, 8, 16 and 24 weeks. eCRF was calculated using a published non-exercise equation with the following variables: sex, age, waist circumference, resting heart rate, self-selected physical activity.

**Results:** Participants attended 115 of 120 exercise sessions prescribed (96.0 (4.0) % adherence). eCRF change from baseline to 8, 16 and 24 weeks was not different from mCRF change for control, LALI or HALI (P=.03). In HAHI, eCRF change was significantly greater than mCRF change at all time points (P<.001). Change in mCRF and eCRF at 24 weeks were separated into tertiles to determine whether there were systematic differences between the two measures. Tertile scores revealed that for LALI and HALI, eCRF change significantly overestimated the lowest mCRF tertile (P=.001) and underestimated the highest mCRF tertile (P=.003). For HAHI, eCRF change overestimated mCRF within both the lowest and middle tertile (P=.005).

**Conclusion:** eCRF change was associated with mCRF change at 24 weeks independent of exercise amount but not intensity. Systematic variation between eCRF

and mCRF highlights a possible limitation when using eCRF to follow change in mCRF, specifically, that eCRF does not capture the individual variability of the mCRF response.

1870 May 28 3:00 PM - 3:15 PM

### Relationship Of Blood Lactate And Sweat Lactate To Exercise Intensity

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(No relevant relationships reported)

Typical procedures for measuring blood lactate involve either finger stick blood samples or venous blood draws. The literature is equivocal regarding whether sweat lactate values change with exercise intensity. Recently, wearable technology devices have been developed to measure sweat lactate. **PURPOSE:** To examine the relationship between sweat lactate and blood lactate values during incremental exercise. **METHODS:** This study consisted of 12 (8 male, 4 female) healthy recreationally active individuals ( $VO_{2peak}$   $35.5 \pm 7.6$  ml/kg/min) between the ages of 18 and 25 ( $22 \pm 2$  yrs) who volunteered for the study. Participants performed an exercise test on a cycle ergometer to volitional fatigue to determine blood lactate, lactate threshold,  $VO_{2peak}$ , and peak heart rate (HR). Blood lactate was collected via finger stick at each 3-min stage of exercise. Participants performed a subsequent exercise session at 40, 60, and 80% heart rate reserve (HRR). During the 20-min stages of this test, blood and sweat lactate were collected during each intensity level. Sweat lactate was collected in a sweat "pouch" at each state of exercise. Sweat lactate samples were analyzed via the lactate oxidase method on a Chemwell 2910 chemistry analyzer. Blood lactate samples were analyzed using a Lactate Plus analyzer. Whole body sweat rate was calculated from pre- and post-exercise body weight at each intensity, factoring in water consumed and urine voided. **RESULTS:** Sweat rate increased with increasing intensity (40%:  $9.66 \pm 7.58$ ; 60%:  $18.10 \pm 12.51$ ; 80%:  $24.32 \pm 15.44$  ml/min). Sweat lactate significantly differed between 60 and 80% intensities ( $15.66 \pm 5.73$ ,  $12.52 \pm 4.44$  mmol/L, respectively),  $P = 0.03$ . Blood lactate levels at 40, 60, and 80% intensities were  $2.67 \pm 1.15$ ,  $3.60 \pm 1.90$ , and  $4.83 \pm 1.52$ , respectively ( $P < 0.001$ ). **CONCLUSIONS:** These findings agree with Buono, Lee, & Miller, 2010 who found sweat lactate decreases as sweat rate increases. It is likely that sweat lactate decreases with increasing exercise intensity due to dilution as sweat rate increases. From this data, it appears that sweat lactate does not demonstrate a relationship with blood lactate that warrants replacing blood lactate in exercise testing with sweat lactate. This may be due to the lactate in sweat originating from eccrine glands and thus is not reflective of muscle metabolism.

1871 May 28 3:15 PM - 3:30 PM

### Heat Training Improves Cardiovascular Responses And Briefly Blunts Sprint Performance In Elite Sprint Track Cyclists

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(No relevant relationships reported)

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<sup>1</sup>Auckland University of Technology - Sport Performance Research Institute NZ, <sup>2</sup>High Performance Sport New Zealand, <sup>3</sup>Paralympics New Zealand, <sup>4</sup>University of Otago  
**PURPOSE:** To investigate the effects of short-term heat training on sprint performance and cardiovascular function in elite sprint track cyclists. **METHODS:** Five elite male sprint cyclists ( $23.8 \pm 2.0$  years; peak power output =  $22.8 \pm 1.3$  W·kg<sup>-1</sup>) completed 5 d of training for ~60 min in hot conditions (30-35°C, 40-60% relative humidity (RH)) consisting of sprint-interval training and resistance training. Sprint performance was assessed using an inertial load ergometer in temperate conditions (~20°C, 50% RH) on day 1 and 5 of heat training, and 72 h post. Cardiovascular responses were assessed (~20°C, 50% RH) pre and 24 h post heat training and included a submaximal cycling test and resting plasma volume measurement. During the first (heat training day 1 = HT1) and last (HT5) resistance training session thermoregulatory measurements were recorded. **RESULTS:** There was a transient decrement in performance as observed by a small very likely decrease in sprint peak power output (-4.3% (90% CL -6.1, -2.5)) and small possible decrease [-2.0 rpm (-5.1, 1.2)] at 24 h post heat training. This decrement recovered to baseline within 72 h for both sprint performance (trivial change [0.2% (-3.4, 3.9)]) and optimal cadence (trivial change [-0.8% (-3.5, 2.0)]).

Core temperature during HT5 was lower (-0.29-0.36°C from 10 to 40 min; small possible decrease) during exercise but there was no effect of heat training on skin temperature or sweat rate compared with baseline values. Following heat training, heart rate during submaximal exercise decreased [-10 bpm (-18, -2); large very likely] and recovery heart rate increased [11 bpm (9, 14); large most likely], compared with baseline values. There was a small likely increase in plasma volume [6.3% (2.7-10.0)] immediate post 5 d HT, compared with baseline values. **CONCLUSION:** Our findings indicate that markers of cardiovascular stability improved with short-term heat training, and that sprint performance was suppressed at 24 h but rebounded at 72 h post.

### D-16 Free Communication/Slide - Protein Metabolism

Thursday, May 28, 2020, 1:30 PM - 3:15 PM  
Room: CC-3020

1872 **Chair:** Stefan M. Pasiakos, FACSM. *USARIEM, Natick, MA.*  
(No relevant relationships reported)

1873 May 28 1:30 PM - 1:45 PM

### Hot-water Immersion Does Not Increase Post-exercise Muscle Protein Synthesis Rates

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(No relevant relationships reported)

Protein ingestion and heating are strategies employed by athletes to improve post-exercise recovery and, as such, to facilitate muscle reconditioning following exercise. However, whether post-exercise heating affects post-prandial protein handling and subsequent muscle protein synthesis rates during recovery from exercise has not been assessed.

**Purpose:** To assess the impact of post-exercise heating on post-prandial myofibrillar protein synthesis rates during recovery from a single bout of resistance-type exercise in healthy, young males.

**Methods:** Twelve healthy, male adults (age:  $23 \pm 1$  y) performed a single bout of resistance-type exercise followed by 20 min water immersion of both legs. One leg was immersed in hot water (46°C: HWI) while the other leg was immersed in thermoneutral water (30°C: CON). After water immersion, a beverage was ingested containing 20 g intrinsically L-[1-<sup>13</sup>C]-phenylalanine and L-[1-<sup>13</sup>C]-leucine labelled milk protein with 45 g of carbohydrates. In addition, primed continuous L-[ring-<sup>2</sup>H<sub>3</sub>]-phenylalanine and L-[1-<sup>13</sup>C]-leucine infusions were applied, with frequent collection of blood and muscle samples to assess myofibrillar protein synthesis rates *in vivo* over a 5 h recovery period.

**Results:** Muscle temperature immediately after water immersion was higher in the HWI compared to the CON leg ( $37.5 \pm 0.1$  vs  $35.2 \pm 0.2$  °C;  $P < 0.001$ ). Incorporation of dietary protein-derived L-[1-<sup>13</sup>C]-phenylalanine into myofibrillar protein did not differ significantly between the HWI and CON leg during the 5 h recovery period ( $0.025 \pm 0.003$  vs  $0.024 \pm 0.002$  MPE;  $P = 0.953$ ). Post-exercise myofibrillar protein synthesis rates did not differ between the HWI and the CON leg based upon L-[1-<sup>13</sup>C]-leucine ( $0.050 \pm 0.005$  vs  $0.049 \pm 0.002$  %·h<sup>-1</sup>, respectively;  $P = 0.815$ ) as well as L-[ring-<sup>2</sup>H<sub>3</sub>]-phenylalanine ( $0.048 \pm 0.002$  vs  $0.047 \pm 0.003$  %·h<sup>-1</sup>, respectively;  $P = 0.877$ ).

**Conclusions:** Hot-water immersion during recovery from resistance-type exercise does not increase the post-prandial rise in myofibrillar protein synthesis rates. In addition, post-exercise heating does not increase the capacity of the muscle to use dietary protein derived amino acids for *de novo* muscle protein accretion during subsequent recovery.

1874 May 28 1:45 PM - 2:00 PM

**High Compared To Standard Essential Amino Acid Intakes Enhance Whole-Body Protein Balance During Energy Deficit**

David D. Church<sup>1</sup>, Jess A. Gwin<sup>2</sup>, Adrienne Hatch-McChesney<sup>2</sup>, Emily E. Howard<sup>2</sup>, Chris T. Carrigan<sup>2</sup>, Nancy E. Murphy<sup>2</sup>, Marques A. Wilson<sup>2</sup>, Lee A. Margolis<sup>2</sup>, John W. Carbone<sup>3</sup>, Robert R. Wolfe<sup>1</sup>, Stefan M. Pasiakos, FACSM<sup>2</sup>, Army A. Ferrando<sup>1</sup>. <sup>1</sup>University of Arkansas for Medical Sciences, Little Rock, AR. <sup>2</sup>U.S. Army Research Institute of Environmental Medicine, Natick, MA. <sup>3</sup>Eastern Michigan University, Ypsilanti, MI. (Sponsor: Stefan M. Pasiakos, FACSM)

(No relevant relationships reported)

**BACKGROUND:** The effects of energy deficit on postabsorptive, postprandial, and post-resistance exercise muscle protein synthesis are generally well described. However, few studies have assessed whole-body protein turnover responses to energy deficit and concomitant protein feeding after exercise, particularly after ingesting varying amounts of essential amino acids (EAA). Assessing the post-exercise whole-body protein kinetic response to EAA feeding during energy deficit may provide a critical indication of the potential protein requirements needed to prevent disruptions in whole-body protein balance induced by the metabolic stress of underfeeding. **PURPOSE:** Determine the effects of consuming varying EAA intakes on integrated whole-body protein turnover during energy deficit. **METHODS:** Nineteen males (mean  $\pm$  SD; 23  $\pm$  5y; 25.4  $\pm$  2.7 kg/m<sup>2</sup>) completed a randomized, double-blind crossover study consisting of two, 5d periods of controlled energy deficit (30  $\pm$  4%), separated by a 14d washout. Whole-body protein synthesis (PS), breakdown (PB), and net protein balance (NET) were determined at rest and post-resistance exercise at the end of each energy deficit period using primed, constant infusions of <sup>2</sup>H<sub>2</sub>-phenylalanine and <sup>3</sup>H<sub>2</sub>-tyrosine. Drinks providing standard (0.10g/kg/meal, 7.87  $\pm$  0.87 g) and high (0.30g/kg/meal, 23.5  $\pm$  2.54 g) EAA amounts were consumed post-exercise. Whole-body protein turnover (g protein/180min) is expressed as the change between the postabsorptive, resting period and the postprandial, post-resistance exercise period. **RESULTS:** Stimulation of PS (3.6  $\pm$  0.6 vs. 0.2  $\pm$  0.5) and suppression of PB (-25.5  $\pm$  1.2 vs. -9.8  $\pm$  0.7) was greater for high than standard EAA (P < 0.05). The resulting NET was more positive for high (29.0  $\pm$  0.9) than standard (10.0  $\pm$  0.4) EAA (P < 0.05). **CONCLUSION:** These data demonstrate that higher EAA intake enhances net protein balance in response to the combined stress of exercise and energy deficit, largely by attenuating protein breakdown, suggesting higher protein meals are necessary to support whole-body protein balance during the metabolic stress of underfeeding. Supported by USAMRDC; authors' views not official U.S. Army or DoD policy.

1875 May 28 2:00 PM - 2:15 PM

**Energy Deficit Attenuates Muscle Protein Synthetic Responses To Essential Amino Acids**

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(No relevant relationships reported)

**BACKGROUND:** Peripheral essential amino acid (EAA) concentrations regulate muscle protein synthesis (MPS). During energy balance, consuming ~9 g EAA doubles postprandial peripheral EAA concentrations and increases resting MPS by nearly 50%. During energy deficit, EAA requirements may be elevated due to a greater carbon skeleton requirement for energy metabolism. We examined if similar or greater increases in peripheral EAA concentrations during energy deficit stimulate the same magnitude increase in MPS as in energy balance.

**PURPOSE:** Determine the effects of peripheral increases in EAA concentrations and the stimulation of MPS during energy balance and deficit.

**METHODS:** Data were derived from two independent controlled studies assessing the effects of consuming high and low doses of EAA on peripheral EAA concentrations and MPS (<sup>2</sup>H<sub>2</sub>-phenylalanine, direct incorporation method) during energy balance (BAL HIGH/LOW) and energy deficit (DEF HIGH/LOW). In BAL, measures were determined in 8 healthy adults (mean  $\pm$  SD; 21.4  $\pm$  2 y, 24.6  $\pm$  3.2 kg/m<sup>2</sup>), ingesting in random order, either 4.3  $\pm$  0.0 g or 8.6  $\pm$  0.0 g EAA, separated by 7 d. In DEF, measures followed 5 days of controlled energy deficit (30  $\pm$  4 %) in 19 healthy adults (22.9  $\pm$  5 y, 25.4  $\pm$  2.7 kg/m<sup>2</sup>), ingesting either 7.8  $\pm$  0.9 g or 23.5  $\pm$  2.6 g EAA, in random order, separated by 14 d.

**RESULTS:** Peak EAA concentrations were 36% higher in DEF HIGH compared to BAL HIGH (2219  $\pm$  470 vs. 1634  $\pm$  320  $\mu$ mol/L; p<0.05), but not for the low doses. Peak EAA concentrations were higher (p<0.05) in HIGH doses for both energy states compared to LOW doses. Independent of EAA dose, postprandial MPS

for BAL (0.78  $\pm$  0.36 %/h) and DEF (0.58  $\pm$  0.15 %/h) were 81% and 26% greater than postabsorptive MPS for BAL (0.43  $\pm$  0.18 %/h) and DEF (0.46  $\pm$  0.24 %/h), respectively (energy-by-fed state, p<0.05). Postprandial MPS was 25% lower in DEF than BAL (energy-by-state, p<0.05).

**CONCLUSION:** Ingesting roughly triple the dose of EAA in DEF than BAL (23.5 g vs. 8.6 g) resulted in marked differences in peripheral concentrations; yet the anabolic stimulus was similar. The reduction in postprandial MPS during DEF, despite ingesting 2-3 times the amount

of EAA compared to BAL, suggests that muscle is not the primary target for the greater rise in peripheral EAA.

Supported by USAMRDC; authors' views not official U.S. Army or DoD policy.

1876 May 28 2:15 PM - 2:30 PM

**Leucine Supplementation Does Not Attenuate Metabolic Or Functional Declines Following 7-days Of Unilateral Lower-limb Immobilisation.**

Sophie Edwards<sup>1</sup>, Benoit Smeuninx<sup>1</sup>, James McKendry<sup>2</sup>, Yusuke Nishimura<sup>1</sup>, Molly Perkins<sup>3</sup>, Jill Ramsay<sup>1</sup>, Sophie Joannis<sup>2</sup>, Andrew Philp<sup>4</sup>, Leigh Breen<sup>1</sup>. <sup>1</sup>University of Birmingham, Birmingham, United Kingdom. <sup>2</sup>McMaster University, Hamilton, ON, Canada. <sup>3</sup>University of Exeter, Exeter, United Kingdom. <sup>4</sup>Garvan Institute of Medical Research, Darlinghurst, Australia. (Sponsor: Janice Thompson, FACSM)

(No relevant relationships reported)

Unavoidable periods of physical inactivity (i.e. illness/injury) lead to muscle atrophy and functional declines, which likely stem from alterations in both anabolic signaling processes and oxidative metabolism. Preventing such declines is important to reduce the risk of re-injury and preserve musculoskeletal health across the lifespan.

**PURPOSE:** To determine the effectiveness of high-dose leucine supplementation to preserve muscle mass, strength, and morphology following 7-days of unilateral knee immobilisation.

**METHODS:** Sixteen healthy, recreationally active males (23 $\pm$ 1yrs) underwent 7-days of unilateral knee immobilisation, with (LEU; n=8) or without (PLA; n=8) thrice daily leucine supplementation (15g/d). Strength and compartmental tissue composition were assessed prior to and following immobilisation. Muscle biopsy samples obtained immediately following immobilisation were used to determine muscle fibre morphology as well as key indicators of mitochondrial function between the control (CTL) and immobilised (IMB) limbs.

**RESULTS:** Leg fat-free mass was reduced in the IMB leg following immobilisation (-3.6 $\pm$ 0.5%; P<0.05) in both the LEU and PLA conditions (P>0.05), with no such alterations noted in the CTL leg (-0.6 $\pm$ 0.5%; P>0.05). Isometric knee extensor strength declined following immobilisation (P<0.01), with a greater (P<0.05) and equivocal decline in the IMB (-27.9 $\pm$ 4.4%) vs. CTL (-14.3 $\pm$ 4.4%) leg in both the LEU and PLA group (P>0.05). Following immobilisation, type II fibre cross sectional area was significantly lower in the IMB vs. CTL limb (5561.49 $\pm$ 465.97 vs. 6319.9 $\pm$ 412.9 $\mu$ m<sup>2</sup>; P<0.05) but not in type I fibre cross sectional area (4805.5 $\pm$ 324.3 vs. 5424.95 $\pm$ 323.63 $\mu$ m<sup>2</sup>; P>0.05), with no differences between treatment groups (P>0.05).

A significant Group\*Leg interaction was identified for mitochondrial complex I phosphorylating respiration (Pi; P<0.05). However, post-hoc analysis revealed no differences in Pi in the IMB vs. CTL limb in either the PLA (FC=1.20 $\pm$ 0.19, P=0.06) or LEU (FC=0.87 $\pm$ 0.27, P=0.87) group.

**CONCLUSION:** Leucine supplementation, even at a high-dose (15g/d), does not appear to attenuate declines in leg fat-free mass, strength, muscle morphology or mitochondrial respiration following 7-days of unilateral knee immobilisation.

1877 May 28 2:30 PM - 2:45 PM

**Efficacy Of A <sup>13</sup>C 'Breath Test' To Determine Protein Anabolism After Physiological Feeding And Exercise**

Michael Mazzulla, Nathan Hodson, Daniel W.D. West, Carolyn Adams, Hugo J.W. Fung, Maksym N.H. Holowaty, Daniel R. Moore. University of Toronto, Toronto, ON, Canada.

(No relevant relationships reported)

Dietary amino acids that are not oxidized are retained in the body to support net protein anabolism, which is important for individuals aiming to maintain or enhance lean body mass. There are limited methodologies with which to measure protein anabolism noninvasively in response to physiological stimuli (e.g. single meal feeding and exercise), which represents a challenge for research in vulnerable populations.

**PURPOSE:** To determine the efficacy of a novel, noninvasive stable isotope 'breath test' to measure differences in anabolism in response to a physiological anabolic stimulus. **METHODS:** Fifteen healthy men were randomized to a rested (FED; n=7; 23 $\pm$ 5y; 77 $\pm$ 4kg; 14 $\pm$ 3% body fat; mean $\pm$ SD) or post-resistance exercise (EX-FED; n=8; 22 $\pm$ 2y; 78 $\pm$ 10kg; 13 $\pm$ 5% body fat) condition. Participants consumed a mixed carbohydrate (0.75g/kg body weight) complete amino acid (0.25g/kg) beverage modeled on the composition of egg protein, with a leucine content of 20mg/kg enriched to 5% with L-[1-<sup>13</sup>C]leucine, which is primarily metabolized within skeletal

muscle. CO<sub>2</sub> production was measured hourly via indirect calorimetry, and breath samples were collected every 20-30min during the 5h postprandial period to determine <sup>13</sup>C<sub>2</sub> enrichment via isotope-ratio mass spectrometry. Dietary leucine kinetics are expressed as the cumulative percentage of <sup>13</sup>C excreted (%LEU) and total exogenous leucine oxidation (OX) over 5h. Dietary net leucine balance (BAL) was determined by the difference between leucine intake and OX. **RESULTS:** %LEU was lower ( $P=0.03$ ) in EX-FED (14.2±1.9%) vs. FED (16.3±1.2%). Similarly, OX was lower ( $P<0.01$ ) in EX-FED (60.8±6.5μmol/kg/5h) vs. FED (70.2±5.3μmol/kg/5h), which resulted in a greater ( $P<0.01$ ) BAL in EX-FED (90.5±6.5μmol/kg) vs. FED (81.1±5.3μmol/kg). **CONCLUSION:** We demonstrate that a novel, noninvasive breath test based on oral [<sup>13</sup>C]leucine ingestion can detect greater anabolism with resistance exercise in young men. Muscle protein enrichment analysis is ongoing to determine the extent to which these whole-body outcomes reflect those within skeletal muscle. Further validation will enhance the applicability of this new technique to a variety of populations experiencing growth (e.g. children) and/or atrophy (e.g. clinical populations).

1878 May 28 2:45 PM - 3:00 PM

### Acute And Chronic Resistance Exercise Differentially Modulates The Skeletal Muscle Metabolome

Sebastian Gehlert<sup>1</sup>, Werner-Römisch Margl<sup>2</sup>, Thorben Aussiecker<sup>3</sup>, Patrick Dreher<sup>4</sup>, Daniel Jacko<sup>3</sup>, Wilhelm Bloch<sup>3</sup>, Gabi Kastenmüller<sup>2</sup>, Henning Wackerhage<sup>5</sup>. <sup>1</sup>University of Hildesheim, Institute of Sports Sciences, Hildesheim, Germany. <sup>2</sup>Institute of Bioinformatics and Systems Biology, Neuherberg, Germany. <sup>3</sup>German Sports University Cologne, Cologne, Germany. <sup>4</sup>Helmholtz Zentrum München-German Research Center for Environmental Health, Neuherberg, Germany. <sup>5</sup>Technical University of Munich, München, Germany. Email: gehlert@uni-hildesheim.de (No relevant relationships reported)

Acute resistance exercise (RE) is associated with acutely increased protein synthesis while repeated resistance training (RT) increases muscle growth. Although the molecular events that initiate these events are well described there is a lack of knowledge concerning the involvement of skeletal muscle metabolic pathways in the adaptive response towards RE. Yet, skeletal muscle metabolomic studies have not analysed differences in the metabolomic signature between acute RE and repeated loading of skeletal muscle by RT. **PURPOSE:** To determine myofiber diameter and the skeletal muscle metabolome after acute and prolonged RE in humans. **METHODS:** 7 male subjects (Age: 24±4 years; Height: 180±8 cm; Weight: 81±10 kg) conducted 13 RE sessions over 5 weeks. Muscle biopsies from vastus lateralis muscle were taken at rest (Rest), 45 min after the first and the last (13th) RE session. Muscle samples were analysed for changes in myofiber diameter via immunohistochemistry and metabolites by conducting untargeted metabolomics analysis on an LC-MS platform.

**RESULTS:** 645 metabolites were detected after RE and RT comprising different clusters of skeletal muscle metabolites. From these, 508 metabolites could be assigned to amino acids, nucleotides, lipids, carbohydrates, energy metabolism, vitamins and co-factors as well as anti oxidants. Five weeks of RT significantly increased the size of slow type I and fast/intermediate type II muscle fibres by 9+4% and 10+3% respectively. Fatty acid metabolites decreased significantly ( $p<0.05$ ) after RT. After RE, metabolites associated with amino acid metabolism significantly increased ( $p<0.05$ ). Specifically 3-methylhistidine increased acutely after RE likely associated with increased degradation of myofibrillar proteins after unaccustomed RE. Antioxidant metabolites were decreased ( $p<0.05$ ) while Metabolites derived from purine nucleotide cycle were partly increased or decreased ( $p<0.05$ ) after RE.

**CONCLUSIONS:** Acute unaccustomed RE and prolonged RT, associated with hypertrophy induce significant but different changes of the skeletal muscle metabolome likely reflecting the functional and structural adaptation of the skeletal muscle environment. Supported by Grant from Federal Institute of Sports Science: ZMVI4-2516B10106

1879 May 28 3:00 PM - 3:15 PM

### Mtorc1 Sensitivity To Amino Acids In Skeletal Muscle And Myotubes Derived From Young And Older Men

Stephanie D. Gagnon, Carl J. Hulston, Neil R.W. Martin. Loughborough University, Loughborough, United Kingdom. Email: S.Gagnon@lboro.ac.uk (No relevant relationships reported)

Ageing is associated with a progressive loss of muscle mass termed sarcopenia, increasing morbidity and mortality. Although multifactorial in nature, dysregulated sensing of amino acids (AAs) after nutrient ingestion, coupled with blunted mTORC1 activation and muscle protein synthesis (MPS), is undoubtedly a major contributing factor in the development and progression of sarcopenia. However, it is unknown whether this is a result of poor AA delivery to the muscle or diminished AA sensing intrinsic to aged muscle cells. Exercise has been shown to increase the sensitivity of

muscle to AAs, and conversely, reductions in physical activity appear to drastically impair this response. Since there is typically a reduction in habitual physical activity in the elderly, the impaired muscle growth response to AAs may be a consequence of a lack of physical activity rather than ageing. **PURPOSE:** To determine the roles that age and physical activity levels play in the activation of anabolic pathways within skeletal muscle and myotube cultures in response to AAs. **METHODS:** A cross-sectional study was used to compare mTORC1 signaling in response to ingestion of whey protein in 7 young active (Y, 23±2 yrs), 8 older active (OA, 71±4 yrs) and 3 older inactive (OI, 71±5 yrs) men. To determine if mTORC1 sensitivity is intrinsically regulated and remembered by skeletal muscle cells, myoblasts were isolated from biopsies from these participants and differentiated to form myotubes. Myotube cultures were then deprived of serum and AAs, re-stimulated with AAs, and subsequently lysed temporally for mTORC1 analysis. **RESULTS:** Our preliminary data indicates that phosphorylation of ribosomal protein s6 (RPS6), a downstream mTORC1 substrate, was increased in myotube cultures from Y and OA men with a reduced response in OI men ( $Y=7.2+7.3$ ,  $AO=9.8+4.5$ ,  $IO=6.0+5.6$ -fold). We are currently analysing muscle tissue from these same individuals to understand if mTORC1 signaling is comparable between biopsy tissue and myotube cultures. **CONCLUSION:** Sustained physical activity levels in older individuals and regular structured exercise may diminish age-related mTORC1 desensitisation of skeletal muscle in response to AA ingestion in cultured myotubes.

## D-17 Clinical Case Slide - Medical Issues I

Thursday, May 28, 2020, 1:30 PM - 3:30 PM  
Room: CC-2005

1880 **Chair:** Pierre L. Viviers, FACSM. Stellenbosch University, Stellenbosch, South Africa. (No relevant relationships reported)

1881 **Discussant:** Rebecca G. Breslow. Brigham and Women's Hospital, Boston, MA. (No relevant relationships reported)

1882 **Discussant:** Heather Gillespie, FACSM. Maine Medical Partners Orthopedics and Sports Medicine, South Portland, ME. (No relevant relationships reported)

1883 May 28 1:30 PM - 1:50 PM  
**Abdominal Pain- Non-athlete**  
Gary James Duncan, Megan Zaworski. OhioHealth Riverside Family Practice Center, Columbus, OH. (No relevant relationships reported)

**HISTORY:** A 48-year-old former pizza shop worker presents with >2 years of intermittent abdominal pain with extensive GI work up. Patient reports that pain is worse with bowel movements, tying shoes, bending over, and reaching with arms. Significant history of alcohol and cigarette use. He feels as if he is bruised or experienced a "Charlie horse" after these ~1 minute episodes occur.

**PHYSICAL EXAMINATION:** Tenderness of right lower chest wall and right upper quadrant without guarding or rebound. Negative McBurney's point and Murphy's sign. Intermittent abdominal distention over the course of disease. Patient brought video showing abnormal chest wall movement to more recent appointment.

**DIFFERENTIAL DIAGNOSIS:** 1. Slipping Rib Syndrome 2. GERD 3. Intercostal/Oblique muscle spasm **TEST AND RESULTS:** CT abdomen pelvis 9/30/19 No bowel obstruction or acute renal pathology. Mild fluid and air to distention of small-bowel loops without obstruction. The stomach is underdistended. Gastric wall thickening cannot be excluded. US Abdomen 1/24/17 Normal right upper quadrant ultrasound. EGD 7/2019 - Esophageal mucosal changes suspicious for short-segment Barrett's esophagus. Biopsied. - Normal antrum. Biopsied. - Granular gastric mucosa. Biopsied. - Normal duodenum. **FINAL WORKING DIAGNOSIS:** Slipping rib syndrome of right side **TREATMENT AND OUTCOMES:** Patient still seeing GI for possible GERD related causes. Awaiting follow up for referral to OMT clinic for manipulation. Diclofenac gel prescription for pain relief. If OMT and analgesic treatment unsuccessful, referral for surgical resection or intercostal nerve block

1884 May 28 1:50 PM - 2:10 PM

**Pulmonary Embolism - Rowing**

Richard Ma<sup>1</sup>, Jordan C. Genece<sup>2</sup>, Freedom Salas<sup>3</sup>, Isabella M. Cipillone<sup>4</sup>, Answorth A. Allen<sup>5</sup>, Victor Lopez, Jr.<sup>6</sup>. <sup>1</sup>Missouri Orthopedic Institute, Columbia, MO. <sup>2</sup>Rugby Research and Injury Prevention Group, Hospital for Special Surgery, New York, NY. <sup>3</sup>Pennsylvania State University, Schuylkill, PA. <sup>4</sup>University of Connecticut, Storrs, CT. <sup>5</sup>Sports Medicine Institute, Hospital for Special Surgery, New York, NY. <sup>6</sup>Rugby Research and Injury Prevention Group, Inc, Hospital for Special Surgery, New York, NY. (Sponsor: Nialah Coleman, MD, FACSM)

Email: richardmam@gmail.com

(No relevant relationships reported)

**HISTORY:** A 17-year-old male club rower sustained a chest injury 2-3 weeks post-season. He presented with shortness of breath (SOB), sharp chest pain and coughing up blood. Campus urgent care Heli ported to a Trauma I ED. He was admitted, had labs drawn and a chest CT. No significant medical history. He did note over the past year, episodic lower leg/foot muscle cramping and lower back pain, exacerbated with rowing. Three-months post initial event, patient presented again coughing up blood. He self-ambulated to a local ED, was admitted and observed for 3-days. **PHYSICAL EXAM:** Urgent care examination revealed young male with SOB and hemoptysis with need for higher care evaluation. ED exam revealed, Heli ported stabilized young alert male with SOB, hemoptysis and constant 10/10, non-radiating localized chest pain. He was tachypneic/bradycardic, RR=28, O2=84% room air, HR=124, and BP=118/89. Chest auscultation unremarkable. No thigh or calf swelling. No tenderness on palpation of lower extremities. **DIFFERENTIAL DIAGNOSIS:** 1. Pulmonary emboli 2. Pneumothorax 3. Asthma 4. Acute bronchitis 5. Emphysema 6. Early onset cardiac diseases **TEST AND RESULTS:** EKG: Sinus bradycardia with sinus arrhythmia, ST elevation indicating early repolarization, pericarditis, or injury. Venous duplex US: Upper bilateral extremities was unremarkable. Chest CT w/contrast: - Right and Left lower lobe infarcts - Right pulmonary artery filling defect into right middle and lower lobes Repeat CT w/contrast: - Segmental and subsegmental right lower lobe PE. No new PE. - Decreased right lower lobe infarct. D-dimer=0.32 mcg/ml, Factor VIII clotting assay=314%, PT - 15 sec; INR - 1.15 sec **FINAL/WORKING DIAGNOSIS:** Bilateral pulmonary emboli secondary to effort thrombosis **TREATMENT AND OUTCOMES:** 1. Emergency. Urgent care IV resuscitation for blood loss and immediate Heli port to Trauma I center. In-flight resuscitation and EKG monitoring. 2. Trauma I ED with immediate IV anticoagulation, serial lab work and chest CT. Observed for 8-10 days, with improvement, sent home on percutaneous anticoagulants. 3. Second Trauma I ED presentation started on IV anticoagulation and chest CT-reflecting no changes, and observed for 3-days. Discharged and continued percutaneous anticoagulants. 4. Currently stable, on anticoagulants with no return to sport planned.

1885 May 28 2:10 PM - 2:30 PM

**Acute Kidney Injury From Heat Illness - Rugby Union (7-players-a-side)**

Victor Lopez Jr<sup>1</sup>, Jordan C. Genece<sup>2</sup>, Austin Prewitt<sup>3</sup>, Liliana Tasovac<sup>4</sup>, Freedom Salas<sup>5</sup>, Answorth A. Allen<sup>6</sup>. <sup>1</sup>Rugby Research and Injury Prevention Group, Inc., Hospital for Special Surgery, New York, NY. <sup>2</sup>Rugby Research and Injury Prevention Group, Inc, Hospital for Special Surgery, New York, NY. <sup>3</sup>Oregon Health & Science University, Portland State University School of Public Health, Portland, OR. <sup>4</sup>SUNY Binghamton University, NY, Binghamton, NY. <sup>5</sup>Pennsylvania State University, Schuylkill, PA. <sup>6</sup>Sports Medicine Institute, Hospital for Special Surgery, New York, NY. (Sponsor: Nialah Coleman, MD, FACSM)

Email: drvictorlopezjr@gmail.com

(No relevant relationships reported)

**HISTORY:** A 30-year-old men's club Division I Rugby-7s winger sustained abdominal cramping and profuse sweating at tournament end. Player reported these symptoms from exertional demands of the sport. Player noted, he aided hydration throughout the tournament (Local Temp=91F) with water and electrolyte supplementation with "sports drinks." Diet included fruits, candy, and meats during tournament. Player denies difficulty urinating, yet described urine to be dark in color. No significant medical history, but noted comparable cramping events that occurred approximately 2½ months prior, as well as, 2-years ago with no medical intervention. Six National Championship tournament matches (each match lasted 14 minutes) later he advised the team doctor. **PHYSICAL EXAM:** Examination post tournament, reflected profuse diaphoresis and abdominal muscle cramping at end of tournament. Patient transferred to local ED, where exam revealed an alert player in no acute distress, mild Temp=98.3F, BP=136/89, Pulse=66, PO2=98, cool to touch and mildly diaphoretic. Player had

generalized abdominal muscle cramping. No lower or upper extremity muscle presentation. Blood was drawn and urine collected. Post-IV infusion patient noted cessation of abdominal cramping and tolerated perioral ingestion. Repeated blood labs.

**DIFFERENTIAL DIAGNOSIS:**

1. Acute kidney injury
2. Exertional rhabdomyolysis
3. Heat illness

**TEST AND RESULTS:**

Urinalysis: Yellow, +protein, +hyaline casts, +ketones, +RBC's, +UA crystals. Preliminary Blood test: BUN=29, creatinine =2.3, AST=42 and CK=1581 Repeat Blood test (post IV Fluids): BUN=27, creatinine=1.7, Glucose=42 and CK=1617

**FINAL WORKING DIAGNOSIS:**

Acute kidney injury (Stage 2) with rhabdomyolysis 2ndry to Heat Exhaustion

**TREATMENT AND OUTCOMES:**

1. Emergency. Immediate removal from play to avoid progression and transfer to ED for rapid IV bolus.
2. Serial blood work, noting elevated BUN, creatinine and CK of stage 2 AKI, with decrease post IVF, urinalysis reflected of dehydration, and monitoring
3. Discharged to self-care and advised to return if necessary, to ED with complaints of fever, inability to urinate, back pain, discolored/blood in urine, or other new symptoms.
4. Returned to sport 3-weeks post-injury with no sequelae and able to meet the demands of his sport.

1886 May 28 2:30 PM - 2:50 PM

**Right Arm Numbness In An Adolescent**

Rebecca King, Nathan Bucks. *WellSpan, York, PA.* (Sponsor: Mark Lavalley, FACSM)

(No relevant relationships reported)

**HISTORY:** A 14-year-old high school student presented to Orthopedics Urgent Care for right arm numbness and discoloration. Four days prior had noticed that her right arm would turn a dusky purple or blue color from the shoulder to her fingers with associated numbness and tingling in the entire arm. Episodes lasted only a few seconds to a minute. She would have multiple episodes a day. No specific pattern or time of day, however she thinks it may occur more frequently while wearing a backpack or if her arm is in an elevated position. Episodes resolve on their own. ROS otherwise negative.

**PHYSICAL EXAMINATION:** Right upper extremity without dusky appearance, appears similar to left upper extremity. Full ROM and strength at the shoulder, elbow, wrist, and fingers. Decreased sensation in the ulnar distribution of the right hand compared to the left. Strong radial pulse when right hand is lowered. Positive Adson for loss of radial pulse, positive Roos for numbness and tingling.

**DIFFERENTIAL DIAGNOSIS:** 1. Right upper extremity DVT 2. Thoracic outlet syndrome 3. Pancoast tumor

**TEST AND RESULTS:** Right upper extremity venous ultrasound normal. Right upper extremity arterial ultrasound with normal triphasic arterial waveforms with arm at patient's side and at 90 degrees abducted in the subclavian, axial, brachial, radial, and ulnar arteries. With arm raised above patient's head, abnormal monophasic waveform in the right subclavian artery.

**FINAL WORKING DIAGNOSIS:** Arterial thoracic outlet syndrome.**TREATMENT AND OUTCOMES:** 1. Referred to pediatric vascular surgery.

2. Was referred to physical therapy, will follow up in 6 months.

1887 May 28 2:50 PM - 3:10 PM

**Sudden Collapse - Field Hockey**

Jill S. Moschelli. *Michigan State University, East Lansing, MI.* (Sponsor: James Dunlap, FACSM)

Email: jssadoski@gmail.com

(No relevant relationships reported)

**HISTORY:** 19-year-old female DI field hockey player with PMH of fainting episodes presented to the training room after having a syncope episode at the end of a game over the weekend and again at practice the day prior to presentation. In both cases, she describes having no warning before suddenly passing out. Both events were witnessed by her ATC who described her being unconscious for one minute, and then having horizontal nystagmus and a pulse of 100-130 bpm once conscious. She described lightheadedness, headache, and palpitations after each episode. She also felt groggy for one day after each event. She stated that it was very warm the day of the initial event with aggressive play, and eval by the sideline provider suggested dehydration. However, the second event occurred on a cool cloudy day during practice. Denied fever, chills, nausea, vomiting, tongue biting, bowel or bladder incontinence, visual or olfactory disturbances.

**PMH**

Fainting episodes that started at the age of 13.

**ADHD****FH** Father has narcolepsy with cataplexy**Surgeries** Tonsillectomy and adenoidectomy

Meds Ritalin 10mg BID, Concerta 36 mg QD, and Trazadone 150mg QHS

**PHYSICAL EXAMINATION:**

Gen: alert, NAD  
 Cardio: RRR, no murmurs  
 Pulm: CTAB  
 Abd: soft, non-TTP, no masses  
 Ext: gait normal, moving all extremities symmetrically  
 Neuro: CN II-XII intact, No focal deficits  
 Skin: warm, dry, no rashes

**DIFFERENTIAL DIAGNOSIS:**

Vasovagal Syncope  
 Epilepsy  
 Electrolyte Abnormalities  
 Cardiac etiology  
 Narcolepsy

**TEST AND RESULTS:**

CBC w/ diff: WNL  
 CMP: Glucose 110  
 2H Glucose Tolerance Test: Neg  
 Sed Rate: WNL  
 Anti-nuclear Ab: Neg  
 CRP: 1.1  
 EEG: No epileptiform discharges identified  
 ECG: NSR  
 Echo: Mild regurgitation  
 14 Day Event Monitor:  
 HR range: 62-178 bpm  
 Sinus rhythm and sinus tachycardia  
 MRI Brain: No acute ischemia or mass  
 CTA Head/Neck: No high-grade stenosis, dissection, or pseudoaneurysm.  
 Cardiac Stress Test: Neg  
 Loop Recorder placed

**FINAL WORKING DIAGNOSIS:** Narcolepsy with Cataplexy

**TREATMENT AND OUTCOMES:** Due to the extensive negative work up, athlete has been allowed to return to activity with a slow progression and monitoring.

Psychiatry is confident that narcolepsy is the likely diagnosis. Sleep study ordered to aid diagnosis, and results are currently pending.

**1888** May 28 3:10 PM - 3:30 PM

**Post-Operative Chest Pain - Men's Rugby**

Jeffrey Wisinski. *Penn State Health, State College, PA.* (Sponsor: Peter Seidenberg, FACSM)  
 Email: jwisinski@pennstatehealth.psu.edu  
 (No relevant relationships reported)

**HISTORY:** A 20 year old male collegiate rugby athlete suffered a noncontact left lower extremity injury during practice. An MRI was obtained and showed a complete tear of the ACL, central free edge tear of the lateral meniscal body, subchondral fracture of the posterior medial tibial plateau and lateral femoral condyle, and a small loose body in the suprapatellar pouch. 19 days after the injury, patient underwent Left Knee Arthroscopy, ACL reconstruction with bone-patellar tendon-bone autograft, lateral meniscus repair, and loose body removal. Patient was discharged home on the same day after being successfully weaned off general anesthesia without difficulty. On post-op day number 1, he presented for initial physical therapy session and admitted to retrosternal chest pain with deep inspiration. He was referred to the Emergency Room.

**PHYSICAL EXAMINATION:** Pulse Ox: 98% on room air, BP 158/93, HR 80, Temp 36.7 C, RR 20 General: No acute distress, well appearing Cardiac: Regular Rate and rhythm, no murmurs, rubs, or gallops Chest: No tenderness with Palpation of chest wall, lungs clear to auscultation bilaterally, no wheezes, crackles, or rhonchi Lower Extremity: No pitting edema, no calf tenderness, no erythema, no warmth, Negative Homan's, incisions clean, dry, and intact, neurovascularly intact

**DIFFERENTIAL DIAGNOSIS:** 1. Pulmonary Embolism 2. Pneumonia with Pleurisy 3. Pericarditis 4. Myocarditis 5. Costochondritis 6. Asthma

**TEST AND RESULTS:** Portable CXR: Faint Parenchymal infiltrate right pulmonary apex D-Dimer: >450 CT Angiogram Chest: no pulmonary embolism, extensive infiltrate in posterior segment of right upper lobe, concerning for Pneumonia CBC: WBC 11.49, Hgb 14.4, Hct 42.6, Platelet Count 267, Lymphocytes 10.7 % CMP: Unremarkable Troponin: Negative

**FINAL WORKING DIAGNOSIS:** Right Upper Lobe Pneumonia

**TREATMENT AND OUTCOMES:** Initially placed on Augmentin 875/125 mg PO Q12H for 7 days. On post-op day number 4, pt admitted to ongoing retrosternal chest pain along with dyspnea with exertion. Evaluated by urgent care, found to be hemodynamically stable with unremarkable physical examination. Augmentin discontinued, started on Doxycycline 100 mg PO BID for 10 days and Prednisone 60 mg po daily for 7 days. Seen for follow up post-op day number 8, symptoms significantly improved

**D-18 Clinical Case Slide - Running II**

Thursday, May 28, 2020, 1:30 PM - 3:30 PM  
 Room: CC-2016

**1889** **Chair:** Kevin R. Vincent, FACSM. *University of Florida, Gainesville, FL.*  
 (No relevant relationships reported)

**1890** **Discussant:** Emily Kraus. *Stanford Hospital and Clinics, Woodside, CA.*  
 (No relevant relationships reported)

**1891** **Discussant:** Hallie Labrador. *NorthShore University HealthSystem, Gurnee, IL.*  
 (No relevant relationships reported)

**1892** May 28 1:30 PM - 1:50 PM

**Anterior Knee Pain In A Runner**

Keri L. Denay, FACSM, Vivek Kalia. *University of Michigan Medical School, Ann Arbor, MI.*  
 Email: kschwide@med.umich.edu  
 (No relevant relationships reported)

**HISTORY:** 40 yo F runner with bilateral, right, anterior, aching, intermittent, 3-10/10 knee pain. Wakes at night. Worse with going down stairs, running, fast walking. Better with rest and ibuprofen. ROS negative. PMHx: DVT, PE, depression, endometriosis, sleep apnea. PSHx: C-section, IVC filter. Meds: ibuprofen prn, citalopram, fluticasone nasal spray, Coumadin. FHx: DVT in father. SocHx: +tobacco, no alcohol or drug use; desk job; recreational runner. No recent immobilization/long travel.

**PHYSICAL EXAMINATION:**

BMI 38, vitals stable. Knee Exam: No malalignment, bruising, erythema, or obvious swelling; gait normal. Full AROM without pain; + patellar j sign; + patellar crepitus; 5/5 strength without pain; Neurovascularly intact. Negative patellar apprehension; equivocal patellar inhibition. positive patellar grind bilaterally. Full AROM. Negative bounce test, McMurray. Minimal tenderness of medial joint line. Palpable, firm 4cm mass in the right popliteal fossa that is mildly tender to palpation. No overlying skin changes. No ligamentous instability, calf pain, swelling, tenderness, warmth, erythema. Negative Homan's sign.

**DIFFERENTIAL DIAGNOSIS:**

For mass: synovial/baker's cyst, ganglionic cyst, meniscal cyst, DVT, aneurysm, muscular deformity, soft tissue mass

**TEST AND RESULTS:**

-2-view knee x-ray: ill-defined soft tissue sclerosis in the postero-medial right knee which could be a bone forming soft-tissue tumor, Moderate bilateral tricompartmental knee OA.

-Knee MRI: Round, lobular mass measuring 3 x 3 x 3.6 cm adjacent to the distal semimembranosus myotendinous junction. Central ossification and a thin rim of peripheral enhancement. A bone forming tumor, benign or malignant, is a possibility.

-Bone tumor surgeon notified and patient seen. Felt unrelated to symptoms and likely secondary to prior trauma. CT knee and CXR. CXR normal.

-CT without contrast: Soft tissue calcified lesion medial to the patient's small Baker's cyst partially surrounds the semitendinosus tendon. Tissue sampling is recommended to exclude a matrix forming neoplasm. Knee OA.

-Sarcoma Tumor Board: benign; treat underlying knee pain.

**FINAL WORKING DIAGNOSIS:** Benign soft tissue calcified lesion of the knee

**TREATMENT:** symptomatic treatment, quit smoking, weight loss

**OUTCOME:** asymptomatic at 2-months

**1893** May 28 1:50 PM - 2:10 PM

**Left Hip Pain In A Runner**

Shelby E. Johnson, Brittany J. Moore, Jay Smith. *Mayo Clinic, Rochester, MN.* (Sponsor: Karen L. Newcomer, FACSM)  
 Email: johnson.shelby@mayo.edu  
 (No relevant relationships reported)

**HISTORY**

A 44 year-old female runner presented with four weeks of migrating left anteromedial and posterolateral hip pain. Pain was gradual in onset but worsened after a 20 mile run three weeks prior. Pain was worse with running and weight-bearing activities. She tried a run the day prior to her visit but stopped at five miles due to pain. Ibuprofen

improved her symptoms. She denied weakness, paresthesias, night pain, pain with lying on her left side, or mechanical symptoms. She hoped to run in the Boston Marathon, which was 13 days after her initial visit.

#### PHYSICAL EXAMINATION

Patient was tender to palpation over the gluteal musculature and greater trochanteric region however this was not her typical pain. Hip range of motion and strength were full. Resisted hip abduction was painful. Stinchfield reproduced posterior buttock pain. Log roll, labral scour, FABER, FADIR, and ischiofemoral impingement maneuvers were negative. Reflexes and sensation were intact.

#### DIFFERENTIAL DIAGNOSIS

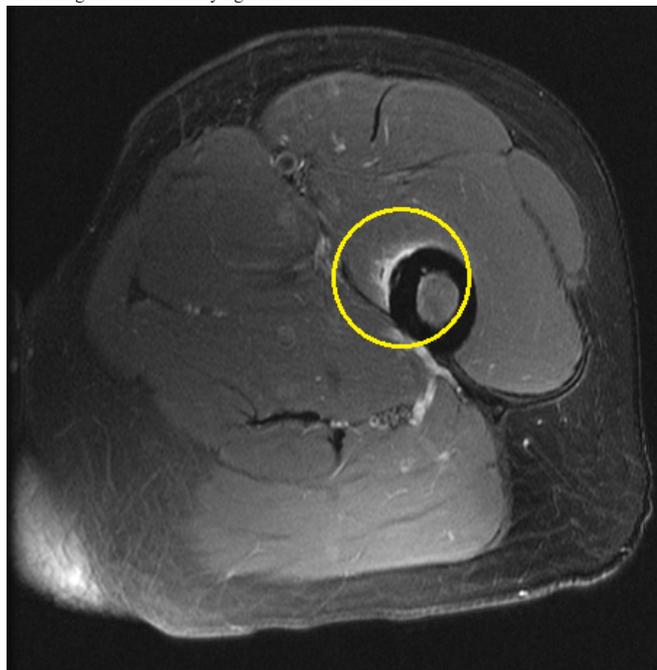
1. Greater trochanteric pain syndrome
2. Femoral acetabular impingement
3. Myofascial pain
4. Piriformis syndrome
5. Stress fracture

#### TESTS AND RESULTS

Hip X-ray: Mild degenerative change of bilateral hips. No fracture.

Hip MRI: Evidence of left gluteal tendinopathy and associated greater trochanteric bursitis. Increased T2 signal along the proximal femoral diaphysis. No femoral neck stress fracture.

Femur MRI: Periosteal edema along the medial proximal femoral shaft with periosteal thickening and trace underlying bone marrow edema.



#### FINAL WORKING DIAGNOSIS

Adductor insertion avulsion syndrome (thigh splints)

#### TREATMENT AND OUTCOMES

1. Partial weight-bearing with crutches with progression to full weight-bearing over two weeks as pain with walking improved.
2. Physical therapy with a return to running program and running analysis.
3. Discussed the risks of stress fracture or complete fracture if continued to run.
4. Patient ran in the Boston Marathon and finished in just over four hours.

1894 May 28 2:10 PM - 2:30 PM

#### Left Forefoot Pain And Discoloration- Runner

Joshua I. Pacious, Scott A. Annett. *Prisma Health–Upstate/ University of South Carolina School of Medicine Greenville, GREENVILLE, SC.* (Sponsor: Kyle J. Cassas, FACSM)

(No relevant relationships reported)

**HISTORY:** A 24-year-old female recreational runner with a past medical history of ADHD on Vyvanse presented to clinic for worsening left forefoot pain and great-toe numbness without antecedent trauma. She also noted blue color changes to the great toe. She presented on crutches due to an inability to bear weight on the forefoot.

**PHYSICAL EXAMINATION:** On inspection of the ankle and foot, there was a bluish-hue to the great toe; no swelling was evident in the foot. She was most tender over the plantar second and third metatarsal heads. Range of motion and strength were preserved. PT pulses were symmetric bilaterally, DP pulses were difficult to appreciate. The foot was cool to the touch with hyperalgesia.

**DIFFERENTIAL DIAGNOSIS:** 1. Vasospastic disease 2. Arterial embolization 3. Chronic regional pain syndrome

**TEST AND RESULTS:** Left foot AP, lateral, and oblique radiographs: --Normal. Vascular physiological ABI with maneuvers, arterial ultrasound of the bilateral legs: -No arterial disease noted except for flat toe waveforms in toes of BOTH feet. Left great toe is worse. However, pulsatility returns with toe warming implying vasospastic component. Plantar flexion and dorsiflexion did not change popliteal flow velocity. Normal ABIs. No evidence of popliteal artery disease. Left foot MRI without contrast: -Inflammatory changes in the soft tissue deep to the second MTP joint. There is an associated ganglion of the plantar plate measuring 4x2mm- although no discrete plantar plate injury is identified, ganglia can be associated with a small tear. ESR: 5. ANA: neg. RF: <15. Centromere B Ab: neg.

**FINAL WORKING DIAGNOSIS:** Digital vasospasm and possible second metatarsal plantar plate injury

**TREATMENT AND OUTCOMES:** From clinic she was immediately referred to vascular surgery, who noted that although the patient's toe waveforms were dampened in multiple digits she did show improvement with warming. This suggested vasospastic disease, and given Vyvanse's association with the same, it was discontinued. Her vasculopathic symptoms improved. Due to ongoing metatarsal head discomfort with ambulation, an MRI was obtained to for further evaluation. Results suggested a plantar plate injury, and taping was used to offload the plate. She was eventually transitioned out of the boot and into a carbon plate insole with eventual return to running.

1895 May 28 2:30 PM - 2:50 PM

#### Distal Thigh Pain-Running

Stephanie C. Clark, Marissa L. Dombovy-Johnson, Karen L. Newcomer, FACSM. *Mayo Clinic, Rochester, MN.*

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(No relevant relationships reported)

**HISTORY:** A 29-year-old female presented with progressive right distal thigh pain. Her pain began gradually after increasing her mileage jogging approximately three months prior to presentation. Her pain was dull, non-radiating and worse at night as well as with running. She had no recent weight loss. There was no associated numbness or tingling. Her past medical history is significant for multiple miscarriages and infertility.

**PHYSICAL EXAMINATION:** She had a non-antalgic gait. Inspection was negative for edema, masses, adenopathy or skin changes. There was pain with palpation of the supracondylar region of her medial right femur. Range of motion of bilateral hips and knees were full and pain free. Lower extremity strength was normal and symmetric. There was no laxity appreciated with varus/valgus stressing. Lachman and posterior drawer tests were negative.

#### DIFFERENTIAL DIAGNOSIS:

- Distal adductor tendinopathy
- Femoral epicondyle stress fracture
- MCL strain
- Plica syndrome
- Osteosarcoma

#### TEST AND RESULTS:

*Knee Radiographs*

•Small eccentric lytic lesion in the distal right femoral diaphysis medially with associated indolent periosteal new bone formation and minimal surrounding sclerosis

*Femur MRI*

- Eccentric, T1 hypointense, T2 hyperintense 1.2 x 1.3 x 2.4 cm lytic mass right femoral with a thin rim of peripheral sclerosis and faint rim of T1 hyperintensity
- Thinning of the lateral femoral cortex without definitive cortical breakthrough
- Moderate surrounding marrow and periosteal edema
- Mildly heterogeneous mass with peripherally located enhancement

*CT Guided Biopsy*

- Pathology positive for Langerhans cell histiocytosis

#### FINAL/WORKING DIAGNOSIS:

- Langerhans cell histiocytosis

#### TREATMENT AND OUTCOMES:

- Extended intralesional curettage for gross total resection with synthetic bone graft
- Discharged home the next day with weight bearing as tolerated, walker and Aspirin 325mg BID for 4 weeks for DVT prophylaxis
- Recovery complicated by soleal DVT and hematoma requiring aspiration
- 6 week post-op started full weight bearing and nonathletic activities
- 4 month follow up with stable x-rays, pain free and cleared to resume full activities
- Plan for one year follow up with repeat radiographs and baseline MRI

1896 May 28 2:50 PM - 3:10 PM

#### HIP INJURY- CROSS COUNTRY

SARAH DECKER<sup>1</sup>, GEORGE MATIC<sup>2</sup>, RICHARD OKRAGLY<sup>1</sup>. <sup>1</sup>TRIHEALTH, Cincinnati, OH. <sup>2</sup>BEACON, Cincinnati, OH. (Sponsor: HENRY STIENE, FACSM)

(No relevant relationships reported)

**HISTORY** 18-year-old high school female cross-country runner presented with one week of left anterior hip pain. Denied a specific injury. Pain started during a late season

meet causing her to finish at a slower pace. Pain progressively worsened requiring crutches to ambulate, despite no further activity. Max mileage was 40 miles/week, had tapered to 20 miles/week prior to injury. History of stress fracture 4 years prior. Initial x-ray of left hip revealed open epiphyseal plates, no other osseous abnormalities. Inquiring about menstrual history, she had yet to reach menarche. Per the patient's mother, she had been trialed on growth hormone and is currently on estradiol patches. She has a known eating disorder for which she is not actively receiving help, despite multiple hospitalizations. PMHX Primary amenorrhea, followed by endocrinology. Lab work revealed low estradiol, LH, FSH with high alkaline phosphatase. Normal labs were thyroid studies, BMP, LFT, vitamin D and prolactin. Genetics showed 46XX. Multiple XR for bone age showed that of an 11-year-old. Cardiac work up showed sinus bradycardia on EKG and normal echo. Brain/pituitary MRI revealed normal pituitary and mild enlargement of ventricles, sulci, cerebellar folia. **PHYSICAL EXAMINATION** Patient stands 55 inches tall, weighing 61 pounds with a BMI of 14. She appears much younger than stated age. Hair is full, though fine. Breast tissue is not appreciated. On left hip exam, there is TTP along flexor tendon, lateral hip, and piriformis. She has pain with external rotation, weakness and pain with hip flexion, abduction, and adduction against resistance. She is unable to do a single leg hop due to groin pain. She is neurovascularly intact. **DIFFERENTIAL DIAGNOSIS** 1. Femoral neck stress fracture 2. Primary amenorrhea 3. Hip flexor strain 4. Relative Energy Deficiency in Sports syndrome 5. ASIS avulsion fracture **TESTS/RESULTS** MRI left hip 1. Partial thickness tear at attachment of left iliopsoas tendon to lesser trochanter with intramuscular hematoma 2. Minimal partial thickness tear of the left common hamstring origin **FINAL DIAGNOSIS** 1. Partial tear of left iliopsoas tendon and hamstring 2. RED-S **TREATMENT/OUTCOMES** 1. Shut down from all activities 2. Weightbearing as tolerated 3. Referral to gynecology for transvaginal ultrasound 4. Referral to Eating Recovery Center

**1897** May 28 3:10 PM - 3:30 PM  
**Hip Injury - Distance Runner**  
 Jaimi Weber. *University of Minnesota, Minneapolis, MN.*  
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 (No relevant relationships reported)

**HISTORY:** 17yo F cross-country runner with hx of 2 bone stress injuries (BSI) of L femoral neck, presents with continued deep anterior L hip pain since 4/2019. No back or radicular pain. Initial BSI (11/2018) was inferomedial femoral neck and was treated with limiting impact activities & PT. Second BSI (4/2019) was superolateral femoral neck. Training volumes at that time were an avg of 35-40 mi/wk. No disordered eating or restrictions. Adequate calcium intake from dietary sources. Taking calcium supplement, and recently stopped vitamin D supplement.  
**PMH:** Menarche at 15 yo and regular until 2 months prior to initial visit. They remained regular but were lighter. No other significant PMH.  
**FHX:** Mother- Hashimoto's & osteopenia. MGM- osteoporosis  
**PHYSICAL EXAM:** BMI 22. Well developed. No thyromegaly. Heart RRR. Lungs CTAB. L hip: NTTP over ant or lat hip. jt line. FROM and strength. Neg FADIR, FABER and single leg hop.  
**DIFFERENTIAL DIAGNOSIS:**  
 1. Recurrent or delayed healing BSI of L femoral neck  
 2. L femoral neck fracture  
 3. Femoral Acetabular Impingement with hip labral tear  
**TESTS/RESULTS:** Normal TSH, CMP, Mg, Phos, & Ca. Celiac screen negative. FT3 2.8 pg/mL. DEXA: Total body less head Z-score = Total body less head -0.9. L hip XR: Normal. MRI 9/2019- grade 2 femoral neck BSI wo significant change compared to MRI obtained 5 weeks prior.  
**FINAL DIAGNOSIS:** Inferomedial femoral neck (Grade 2 BSI) with delayed healing  
**TREATMENT/OUTCOMES:**  
 1. NWB x 4 wks and then partial WB  
 2. No impact activities  
 3. PT  
 4. Bone stimulator  
 5. Ortho consult re: surgical intervention  
 6. Repeat imaging to monitor healing  
 7. Sports psych consult, initiated by mom & pt  
 8. Nutrition counseling to assess for underfueling.

**D-19 Clinical Case Slide - Upper Extremity**

Thursday, May 28, 2020, 1:30 PM - 3:10 PM  
 Room: CC-2022

**1898** **Chair:** George Guntur Pujalte, FACSM. *Mayo Clinic, Jacksonville, FL.*  
 (No relevant relationships reported)

**1899** **Discussant:** Jason L. Zaremski, FACSM. *University of Florida, Gainesville, FL.*  
 (No relevant relationships reported)

**1900** **Discussant:** Erik S. Adams, FACSM. *Midwest Sports Medicine Institute, Bozeman, MT.*  
 (No relevant relationships reported)

**1901** May 28 1:30 PM - 1:50 PM  
**Shoulder Pain In A High School Football Player**  
 George Ghata, Brian Coleman, Jim Barrett. *University of Oklahoma Health Science Center, Oklahoma City, OK.*  
 Email: george.ghata@gmail.com  
 (No relevant relationships reported)

**HISTORY:**  
 15 year old presents to clinic accompanied by father with right anterior shoulder pain for 6 days. He injured it during football practice doing contact drills. He lowered his head and got hit in the anterior aspect of his right shoulder by an opponent's helmet. Initially he couldn't even raise his arm up. He states that his motion has mildly improved but continues to have pain and points anterior and lateral when describing his pain. Denies significant swelling, bruising, paralysis, or paresthesias, or previous injuries to his shoulder. Pain is 4/10. Describes it as a shooting type pain worse with movement and better with ice and holding his arm still. No feelings of instability.  
**PHYSICAL EXAMINATION:**  
 On examination of his right shoulder there is slight fullness appreciated over the proximal arm. He has mild tenderness over the coracoid anteriorly as well as over his lateral deltoid. Actively he will flex to 130 degrees, external rotation 0 degrees, shoulder adduction 30 degrees and internal rotation just past his iliac crest all of which give him some pain. He does have some mild pain with resisted elbow flexion anteriorly. 5-/5 strength on external rotation, internal rotation and Jobe's.  
**DIFFERENTIAL DIAGNOSIS:**  
 - Subacromial Impingement  
 - Rotator Cuff Tear  
 - Scapular Fracture  
**TEST AND RESULTS:** AP External Rotation and Axillary views were obtained which showed lucency over the base of the coracoid process consistent with fracture.  
**FINAL WORKING DIAGNOSIS:**  
 Fracture of the base of the right coracoid process  
**TREATMENT AND OUTCOMES:**  
 1. Placed in a shoulder sling and was instructed to not do any lifting with that arm.  
 2. Seen 2 weeks later with significant improvement in pain and was able to move arm with still some mild discomfort over the anterior shoulder.  
 3. Followed up 6 weeks post injury and had no pain with range of motion and had symmetrical strength.  
 4. Blue Theraband with Jobe's exercises started and was allowed back to play in a graded RTP fashion with follow up as needed.

**1902** May 28 1:50 PM - 2:10 PM  
**Elbow Pain - CrossFit**  
 Ahmad Al-Awadi, Daniel P. Montero, George G.A. Pujalte, FACSM. *Mayo Clinic, Jacksonville, FL.* (Sponsor: George G.A. Pujalte, FACSM)  
 Email: al-awadi.ahmad@mayo.edu  
 (No relevant relationships reported)

**HISTORY:** A 29-year-old male CrossFit and surfing instructor with a history of left ulnar shaft fracture treated nonoperatively presented with a 9 month duration of chronic, intermittent, left, sharp and burning elbow pain since injuring himself weight lifting. Bicep flexion and thumb rotation caused pain radiating to the elbow. He endorsed numbness of the left hand that led to an ER visit 9 months ago. His tingling

THURSDAY, MAY 28, 2020

resolved prior to our visit and he denied shoulder or neck pain. He has been seen previously by a Hand Specialist, was offered a steroid injection, and presented to us for further evaluation.

**PHYSICAL EXAMINATION:** The patient exhibited no obvious atrophy of the forearm, but trace atrophy at the left medial triceps. He had full flexion and extension equal bilaterally, with slightly decreased supination on the left as compared to the right side. He was tender to palpation over the distal biceps, but nontender in the antecubital fossa. There was mild crepitus with resisted supination and pronation on the lateral epicondylar region. Radial head was minimally tender to palpation. He had elbow pain with resisted elbow flexion in neutral and supination more so than pronation. No skin changes were appreciated and no obvious elbow effusion. Distal neurovascular exam was grossly intact.

**DIFFERENTIAL DIAGNOSIS:**

1. Distal biceps tear
2. Bicipitoradial bursitis
3. Ulnar shaft fracture
4. Radial head fracture
5. Osteochondritis dissecans of the capitulum

**TEST AND RESULTS:** Elbow MR arthrogram (obtained 3 weeks ago) demonstrated a very small partial thickness tear of the ulnar collateral ligament, minimal radial cartilage loss, and a partial thickness tear of the distal biceps with prominent bicipitoradial bursitis.

**FINAL/WORKING DIAGNOSIS:**

Left partial thickness distal biceps tear AND associated bicipitoradial bursitis

**TREATMENT AND OUTCOMES:**

1. Patient elected to avoid steroid injections and pursue conservative management involving physical therapy and topical NSAIDs
2. Pain continued intermittently. Further work up 1 year later included CT elbow showing mild left ulnohumeral joint osteoarthritis with small ossific joint loose bodies and healed proximal left ulna shaft and coronoid process fractures
3. Elbow pain may be subsequent to malalignment from an old Monteggia fracture

**1903** May 28 2:10 PM - 2:30 PM

**Left Elbow Pain In An Elite Basketball Player**

Ryan Robin<sup>1</sup>, Elena J. Jelsing<sup>2</sup>, Nancy M. Cummings<sup>2</sup>, <sup>1</sup>Mayo Clinic, Rochester, MN. <sup>2</sup>Mayo Clinic, Minneapolis, MN.  
(No relevant relationships reported)

**HISTORY:** A 32 year old, right handed, female professional basketball player presented two weeks following injury to the left elbow. Her history is significant for various lower extremity musculoskeletal injuries but no previous elbow or shoulder complaints. She presented two weeks following an in-game injury, in which she was "tied up" with another player and felt a hyperextension and valgus movement at the elbow. She felt immediate pain at the medial elbow. Initially there were paresthesias in the ulnar distribution but these resolved shortly. She continued playing through the discomfort for two weeks.

**PHYSICAL EXAMINATION:** On inspection, there was a trace effusion about the left elbow. There was tenderness to palpation over the flexor pronator mass, medial epicondyle, and sublime tubercle. Extension lacked 5 degrees of range of motion. Flexion was normal at 130 degrees. Strength testing was normal, although there was pain with resisted wrist flexion and pronation. There was no pain with wrist or finger extension or elbow supination. A moving valgus stress test reproduced pain. There was no obvious laxity. Tinel's test over the ulnar nerve was negative.

**DIFFERENTIAL DIAGNOSIS:** 1. Medial epicondylitis 2. Ulnar collateral ligament sprain or tear 3. Ulnar neuropathy 4. Valgus extension overload syndrome

**TEST AND RESULTS:** Left elbow X-ray: Unremarkable; Left elbow ultrasound: Full-thickness proximal UCL tear with significant (2.7mm) humeroulnar joint space opening with valgus stress test; Left elbow MRI: Full-thickness tear of the UCL at its humeral attachment with associated edema and inflammation extending into the adjacent flexor digitorum superficialis muscle and partially encasing the ulnar nerve within the cubital tunnel

**FINAL WORKING DIAGNOSIS:** Left ulnar collateral ligament full thickness tear

**TREATMENT AND OUTCOMES:** 1. The patient underwent PRP to the UCL tear 2. Post injection rehabilitation started with 6 weeks of rest, protection and range of motion. Pain resolved. 3. Follow up ultrasound at 6 weeks demonstrated interval healing of the full-thickness proximal UCL tear with no significant humeroulnar joint opening on valgus stress testing (0.7mm). 4. Continued PT through 16 weeks post injection and remained pain free with a normal elbow examination throughout the following season without limitation.

**1904** May 28 2:30 PM - 2:50 PM

**Pediatric Elbow Pain - Baseball**

Marcus I. Ng, North Shore University Hospital, Manhasset, NY.  
(No relevant relationships reported)

**HISTORY:**

A 12-year-old RHD developed sudden onset right elbow pain after pitching in a game in the Dominican Republic. He did not have any associated numbness, tingling, or

weakness of the affected extremity. Patient states that he plays primarily as pitcher for his team, and had a sudden sharp pain with a "pop." During the baseball season, patient plays 3 games a week, usually all on the same day. He estimates that he throws at least 100 pitches per game, including warm-up pitches, but is not completely sure because his coaches do not keep strict pitch counts.

**PHYSICAL EXAMINATION:**

Right elbows without gross deformities, no ecchymosis or crepitus. There is TTP of the medial epicondyle with none in lateral epicondyle, olecranon process, RC joint, or flexor/extensor insertions. Pain with resisted flexion and pronation. Elbow ROM 20-110 degrees, with supination and pronation of 80 degrees. Milking test was positive. Moving valgus stress test was positive, though no varus or valgus laxity appreciated. Sensation was grossly intact to touch along median, ulnar, radial, and axillary distribution. 2+ radial and brachial pulse. Strength was full.

**DIFFERENTIAL DIAGNOSIS:**

1. Medial epicondylitis
2. Fracture of medial epicondyle
3. UCL injury / Little League Elbow Syndrome

**TEST AND RESULTS:**

3 views of the right elbow:

— Widening of the medial apophysis to 4.5mm.

— Small ossific fragment at the inferior aspect of the right medial epicondyle apophysis compatible with avulsion injury.

**FINAL/WORKING DIAGNOSIS:**

Avulsion fracture of the medial epicondyle with apophysitis

**TREATMENT AND OUTCOMES:**

1. Immobilization with forearm sugar tong splint for 1 week.
  2. Patient returned to Dominican Republic and was placed in long-arm cast by his doctor for 4 weeks.
  3. Cast removed 6 weeks after injury with no pain elicited on exam. Repeat XR of the elbow showed near resolution of apophyseal widening and healed avulsion fracture.
  4. Started PT with emphasis on ROM and joint stabilization with graduated progression to overhead thrower's program.
  5. Re-evaluated after 6 weeks of PT with no pain even with overhead throwing.
- Patient cleared to return to regular baseball activity with strict adherence to pitch count restrictions per Andrews Institute.

**1905** May 28 2:50 PM - 3:10 PM

**Wrist Injury - Track**

Kelly Estes, Washington University, St. Louis, MO.  
Email: drkellyestes@gmail.com  
(No relevant relationships reported)

**History:**

A 19 yo M division II decathlete presented to an orthopedic injury clinic with left wrist pain. Just prior to arrival, he had tripped while hurdling, fell, and landed to somehow injure his wrist. He was uncertain of the exact positioning of his wrist to cause the injury. He complained of ulnar-sided wrist pain. His pain was worse with wrist movement. He had concerns about limitations in his range of motion. He denied numbness, tingling, or prior wrist injuries.

**Physical Exam:**

A focused exam of the left wrist was done. There was no swelling, bruising, or deformity. His active range of motion of the wrist was full in flexion, extension, and pronation. His supination was restricted to zero. Normal motion at the hand and fingers. Normal composite with hand grip. Tenderness at the fovea, triquetrum, ECU. Passive compression of the carpus against the head of the ulna with the wrist in ulnar deviation caused pain. Intact radial, ulnar, and median nerve. 2+ radial pulse. Sensation was intact to light touch.

**Differential Diagnosis:**

- 1 Acute Fracture - Triquetrum, Lunate, Pisiform
- 2 Bone Contusion
- 3 TFCC injury
- 4 Lunotriquetral Ligament Injury
- 5 Ulnocarpal Impaction Syndrome

**Test and Results:**

Three view XR of the left wrist: normal alignment, no fracture.

**Treatment and Outcomes:**

Patient was placed in a cock-up wrist brace, instructed to rest from left upper extremity weight-bearing, and return in 1-2 weeks for repeat exam and XR. At that time his exam was unchanged, continued with ulnar-sided pain and mechanical restriction with supination to zero. MRA of the left wrist was done that showed a displaced, bucket handle tear of the left triangular fibrocartilage disc with flipped fragment within the volar recess of the distal radioulnar joint. Bone contusions were also present in the triquetrum and the lunate. The patient was referred for hand surgery. There is currently plans for arthroscopic assessment and TFCC repair. Possible debridement. Possible fovea repair.

**Final/working diagnosis:**

Displaced, bucket handle TFCC tear

**D-20 Rapid Fire Platform - Wearables**

Thursday, May 28, 2020, 1:30 PM - 2:50 PM  
Room: CC-Exhibit Hall

**1906** **Chair:** Scott E. Crouter, FACSM. *The University of Tennessee Knoxville, Knoxville, TN.*  
(No relevant relationships reported)

**1907** May 28 1:30 PM - 1:40 PM

**Tracking Calories: Validity Of Wearable Activity Monitors**

Jessica M. Wade, Kayla M. Kowalczyk, Victoria Lynch, Bianca De Lucia, Jonathan Hudak, Alicja B. Stannard. *Sacred Heart University, Fairfield, CT.*  
(No relevant relationships reported)

The use of commercially accessible activity monitors has increased over the past few years. Assessing the accuracy of these devices is necessary to inform recreational consumers about the validity of these products. **PURPOSE:** To assess the validity of four activity monitors (Monitor 1, Monitor 2, Monitor 3, and Monitor 4) for energy expenditure (EE) data. **METHODS:** Twenty-one subjects (8 male and 13 female), with an average age of 20.2 years performed three exercise protocols: walking at 3.0 mph, running at 6.0 mph, and a HIIT workout for ten minutes each. Each exercise bout was followed by a seated rest period until subjects returned to pre-exercise  $\text{VO}_2$  values. EE measured in kcal was collected from the Parvo metabolic cart and compared with the EE from four activity monitors. EE from activity monitors was recorded from apps in kilocalories (kcal) upon completion of the testing. Descriptive statistics were performed for all variables. Coefficient of determination ( $R^2$ ) was used to assess the validity of EE in kcal for all devices. **RESULTS:** Monitor 3 was the most accurate device with an  $R^2$  of 0.68 for walking, 0.62 for HIIT and 0.59 for running. Monitor 1 showed the weakest correlations for the running (0.27), and the HIIT (0.34) protocols but was comparable to Monitor 3 for walking (0.64). Monitor 2 was the least accurate for walking ( $R^2 = 0.246$ ) and showed low validity for running and HIIT (0.36 and 0.47 respectively). Monitor 4 was most accurate for higher intensity activities such as running (0.68) and HIIT (0.67). **CONCLUSION:** Monitor 3 was consistently the most accurate out of tested devices. However, results of this study demonstrate inaccurate assessment of EE by all wearable devices. None of the activity monitors met the correlational standard of 0.7. Future research should continue to assess the validity of these devices to provide accurate information on various modalities and exercise intensities to recreational consumers.

**1908** May 28 1:40 PM - 1:50 PM

**Validity Of Wrist-worn Activity Trackers**

Bianca J. De Lucia, Victoria E. Lynch, Kayla M. Kowalczyk, Jessica M. Wade, Jonathan R. Hudak, Alicja B. Stannard. *Sacred Heart University, Fairfield, CT.*  
(No relevant relationships reported)

The use of physical activity monitors has increased dramatically in the past decade. Wrist-worn activity monitors are often used to monitor heart rate (HR) for exercise intensity. Assessing the validity of these devices is essential for accurate exercise prescription and user safety. **PURPOSE:** The objective of this study was to assess the validity of three common wrist-worn physical activity monitors for measuring HR during three modes of exercise. **METHODS:** Twenty-one participants (seven males, fourteen females) completed the study. Inclusion criteria for participation were:  $\geq 18$  years of age, have no history of cardiovascular or chronic disease (assessed by PAR-Q+), and have the ability to run for 10 minutes at 6mph. HR data was recorded for three common physical activity monitors (AM1, AM2, AM3) during 10 minutes of walking at 3mph, running at 6mph, and High Intensity Interval Training (HIIT) session consisting of a body weight series of exercises. HR data was collected every minute and compared against gold standard chest strap HR monitor to assess validity. Descriptive statistics were performed for all variables.  $R^2$  values were calculated for each device and each mode of exercise. **RESULTS:** AM1 was the most accurate device with  $R^2$  of 0.733 for running and 0.678 for walking. AM2 data showed moderate  $R^2$  for running (0.54) and walking (0.44). AM3 HR data was unreliable. HIIT condition was the least accurate for each monitor ( $R^2$  range 0.098-0.124). **CONCLUSION:** These results demonstrate that the accuracy of the devices for tracking HR increases with increasing intensity of steady-state activities. HR data during HIIT was unreliable possibly due to excessive movements. Assessed physical activity monitors in this study are not accurate for tracking HR during walking, running, and HIIT particularly if used for patient monitoring. The cheapest monitor (AM3) had a very weak correlation; consumers should consider more expensive monitors for more accurate HR readings during steady-state activities. More research needs to be done to further explore the accuracy of activity monitors for a wider range of modalities and intensities.

**1909** May 28 1:50 PM - 2:00 PM

**Validation Of A Wrist-mounted Heart Rate Monitor During Maximal Graded Exercise Testing**

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(No relevant relationships reported)

The electrocardiogram (ECG) serves as the gold standard of heart rate (HR) monitoring but is rarely used outside of a clinical environment. Newly developed wearable technology is more usable outside of a clinical setting, but has not been validated against this gold standard. **PURPOSE:** The purpose of this study is to determine the validity of a wrist-mounted photoplethysmography (PPM) device used for measuring HR during incremental treadmill exercise using ECG as the criterion HR measurement. **METHODS:** Twenty-two subjects (13 men, 9 women;  $35.8 \pm 6.3$  yr,  $14.6 \pm 7.5$  % body fat,  $\text{VO}_{2\text{max}} = 55.5 \pm 0.49$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) performed a Bruce treadmill protocol graded exercise test. HR was recorded at rest and at the end of each minute with the Mio Alpha PPM device and ECG simultaneously. HR was compared between methods across the entire testing session (rest and exercise values) and separately for each exercise test stage using paired-samples *t*-tests and the Bonferroni correction. Validity coefficients were determined using the Pearson correlation. **RESULTS:** HR across the entire intensity range (rest to maximal exercise) exhibited a significant correlation between methods ( $r = 0.97$ ,  $p < 0.001$ ) and was similar between ECG and Mio after the Bonferroni correction was applied, requiring  $p < 0.008$  (overall mean HR: ECG =  $124 \pm 39$  b·min<sup>-1</sup>, Mio =  $123 \pm 37$  b·min<sup>-1</sup>,  $t_{339} = -2.504$ ,  $p = 0.013$ ). Significant correlations were observed at rest and each exercise test stage, with *r* values ranging from 0.67 to 0.96 (all  $p < 0.001$ ). HR was similar between methods at rest and each exercise test stage except for stage 4 (ECG =  $168 \pm 13$  b·min<sup>-1</sup>, Mio =  $164 \pm 14$  b·min<sup>-1</sup>,  $p = 0.004$ ). **CONCLUSIONS:** Correlational analyses indicated a strong agreement between HR methods overall, as well as individually at rest and during each exercise test stage. However, mean comparisons observed a significant difference between methods at stage 4 and mean differences between methods became larger as intensity increased. From a practical standpoint, the mean difference between methods did not exceed 3 b·min<sup>-1</sup> except for stage 5. Therefore, a PPM device seems valid for HR monitoring during low-to-moderate-intensity but not high-intensity treadmill exercise.

**1910** May 28 2:00 PM - 2:10 PM

**Validation Of Player Tracking Sensors For Measuring Sprint Speed With Collegiate Ice Hockey Players**

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(No relevant relationships reported)

Commercially available player tracking sensors (PTS) have been used to monitor athlete player metrics during practices and games in a variety of sports. Specifically, PTS have been used to monitor athlete performance during ice hockey practices and games. Internal metrics stemming from heart rate values appeared plausible and valid, but external metrics (distance, speed, acceleration) were sporadic and counterintuitive. For instance, goalie distances were greater than skaters, and sprint values did not appear to register in real time. This could be due to the mechanics of skating differing from common bipedal locomotion. **PURPOSE:** To determine the validity of a PTS for measuring sprint speed with male collegiate hockey players. **METHODS:** A total of 15 NCAA Division I male hockey players ( $21.86 \pm 1.04$ yr,  $175.86 \pm 6.78$ cm,  $80.58 \pm 4.44$ kg) participated in the study. Each participant had a player profile created in the PTS system, which included each player's height, body mass, date of birth, and level of training. Participants then wore a PTS strap, at the level of the xiphoid process, with an attached sensor that corresponded to their individual player profile. Participants performed two sprints of 15.24 meters and two sprints of 35.05m with five minutes of rest between each sprint. Sprints were performed in three conditions: indoor running, outdoor running, on-ice skating. The 15.24m (blue line to blue line) and 35.50m (red line to the far blue line) distances were chosen to simulate common landmarks on a hockey rink. Wireless infrared photocell timing gates (TG) were used to determine sprint times and allow for manual calculation of speed. Speed values from the PTS and TG were compared using paired samples *t*-tests, and an alpha level of 0.05, 2-sided was set *a priori* as a significance level. **RESULTS:** For indoor and outdoor sprinting, the PTS overestimated speed at both distances ( $p < .001$ ). However, on-ice sprints resulted in PTS underestimating speed at both distances compared to TG ( $p \leq .001$ ). **CONCLUSIONS:** The PTS is not accurate for measuring sprint speed during indoor running, outdoor running, or on-ice

skating. The inconsistency in speed values needs to be taken into consideration when using the system for player monitoring, because the speed values could also affect other external performance metrics provided by PTS.

**1911** May 28 2:10 PM - 2:20 PM  
**ESTIMATING ENERGY EXPENDITURE USING ACCELEROMETERS DURING HIGH INTENSITY INTERVAL TRAINING.**

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 (No relevant relationships reported)

Accelerometers are objective monitors that can be used to estimate energy expenditure (EE) during steady state exercise. However, high intensity interval training (HIIT) has received increasing attention because of its similar benefits to longer duration, steady state, less intense exercise. The accuracy of accelerometer-estimated EE during HIIT has yet to be examined. **PURPOSE:** The purpose of this study was to discern the differences between criterion-measured EE and accelerometer-estimated EE (kCals) during a HIIT session. **METHODS:** Nine participants (mean age=20.4 yrs, Body Mass Index=24.7 kg/m<sup>2</sup>, males=8), completed a preliminary session, to determine treadmill speed at 95% HR max, and a HIIT session within 2 weeks of each other. For the HIIT session, each participant wore an ActiGraph GT3X+ accelerometer on their right hip while EE was measured using portable indirect calorimetry (Oxycon Mobile). The HIIT session comprised of 5 bouts: each bout included a 45-second exercise event and 90-second rest event. Data analysis was conducted using custom R scripts and paired T-tests to determine significant differences between criterion measure and accelerometer estimates of EE during the HIIT session. **RESULTS:** On average, the accelerometer underestimated total EE (92.76±0.33 kCals) compared with the criterion measure (108.73±3.99 kCals) for the entire HIIT session by 15% (p=0.0507). During exercise events, accelerometer estimated EE (8.99±1.99 kCals) was greater than criterion measured EE (7.10±1.82 kCals; p<0.001). During rest events, accelerometer estimated EE (9.56±2.86 kCals) was less than criterion measured EE (14.64±2.81; p<0.001). **CONCLUSION:** Compared with the criterion measure of indirect calorimetry, the accelerometer underestimated total EE for the HIIT session due to the underestimation of EE during rest events. Future studies should further investigate the accelerometer's underestimation in larger more diverse samples to develop an algorithm that better predicts total EE during interval training.

**1912** May 28 2:20 PM - 2:30 PM  
**Estimates Of Exercise Energy Expenditure From Two Optical Heart Rate Bands**

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 (No relevant relationships reported)

**Introduction:** There are many watches on the market today that use optical sensors to measure heart rate (HR) in order to estimate exercise energy expenditure (ExEE). It has been shown that wrist movements can interfere with the HR measurements obtained from these watch based sensors which in turn may alter ExEE estimates. The Polar OH1 (OH1) and the Wahoo TICKR FIT (TICKR) eliminate interference by using an elastic armband to hold the sensor in place on the either the forearm or just below the elbow. **PURPOSE:** The purpose of the study was to compare the ExEE values from the OH1 and the TICKR to actual ExEE as measured by indirect calorimetry (IDC) during specific bouts of exercise.

**METHODS:** Eleven females and 9 males (26.1 ± 7.0 and 23.8 ± 3.2 yrs old, respectively) were fitted with each armband. The sensors were placed on the forearms according to the manufacturer instructions. The exercise bouts consisted of 5 min walking stages (3.5 mph at 0% and 5% grade) and 5 min running stages (5.5 mph at 0% and 5% grade). There was a 3 min of rest between each bout. Actual ExEE was measured via IDC.

**RESULTS:** There were no significant differences between devices during the walking stage at 0% grade. There were significant differences between devices for the walk with 5% grade, with the OH1 overestimating compared to the TICKR and IDC (11.2 ± 3.6 and 11.7 ± 3.4 kcal, respectively). There were significant differences between devices for the run at 0% grade, with the OH1 overestimating compared to the TICKR and IDC (14.6 ± 4.0 and 16.2 ± 3.9 kcal, respectively). There were significant differences between devices for the run at 5% grade with the OH1 overestimating compared to the TICKR and IDC (18.3 ± 3.8 and 15.0 ± 3.7 kcal, respectively).

**CONCLUSIONS:** The Polar OH1 overestimates ExEE as exercise intensity increases when compared to IDC. The ExEE estimates from the Wahoo TICKR FIT are similar to ExEE as measured by IDC at all intensity levels. Caution should be used when tracking ExEE when using the OH1 at higher exercise intensities.

**1913** May 28 2:30 PM - 2:40 PM  
**Validation Of Two Wearable Chest Straps For Heart Rate Monitoring During Mountain Biking**

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 (No relevant relationships reported)

The Suunto chest strap claims to "monitor [HR] with precision" and "send accurate [HR] information to your compatible Suunto [product]". Previous research has shown the HR feature of the Suunto to be valid during running. However, there appears to be little, if any, research determining whether the Suunto is a valid measure of HR during mountain biking. **PURPOSE:** This study aimed to determine the validity of the HR feature of the Suunto chest strap during mounting biking activity as compared to the criterion, the Polar H7. **METHODS:** Sixteen apparently healthy volunteers (males = 8, females = 8, 24.69 ± 4.44 yrs, 171.45 ± 8.9 cm, 74.23 ± 21.07 kg) rode mountain bikes on a beginner-level mountain biking trail at the McCullough Hills Trailhead in Henderson, NV. Participants concurrently wore both HR monitors on the chest while biking one mile away from the trailhead and one mile to return to the trailhead. The Polar H7 and Suunto second-by-second HR data were compared using mean absolute percent error (MAPE), a Bland-Altman analysis with limits of agreement (LoA), and an intraclass correlation (ICC). Prior to testing, the benchmark for validity was established as a MAPE < 10% and an ICC > 0.7 (p < 0.05), with the lower limit of the ICC 95% confidence interval (CI) set at > 0.7. **RESULTS:** The lower and upper LoA were -13.89 and 13.08, respectively. The MAPE value from the Suunto produced a forecast of 3.944. The Suunto demonstrated an ICC = 0.973 (95% CI = 0.972, 0.974, p < 0.001). **CONCLUSIONS:** The data indicate that there is a good level of agreement between the Polar H7 and the Suunto, suggesting that the Suunto is a valid measurement of HR during mountain biking.

**1914** May 28 2:40 PM - 2:50 PM  
**Generational Differences Of Consumer Wearable Devices For Estimating Physical Activity Outcomes**

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 (No relevant relationships reported)

Consumer activity monitors (CAMs) are commonly validated for estimating physical activity outcomes [e.g. energy expenditure (EE)] when a new model is released. It is unclear if this is a needed practice and if prediction algorithms change when a new device generation is released. **Purpose:** To compare step and EE estimates for different generations of wrist-worn CAMs from the same manufacturer [Apple Watch Series 2 (AW2) and 4 (AW4), Fitbit Charge 2 (FC2) and 3 (FC3), and Garmin Vivofit (VF) and Vivofit 4 (VF4)]. **Methods:** Nineteen participants (mean±SD; age, 25.1±5.0 y) completed seven structured activities (six min each) that ranged from sedentary to vigorous intensities. Each participant wore four CAMs (two different models from the same brand on each wrist) and a Cosmed K5 for measured EE. The devices were randomized by combination (e.g. Fitbit-Garmin), placement (proximal vs. distal), and side (left vs. right). Total EE was obtained for the entire activity protocol, including transitions (average total time, 48 min). The primary analysis included the comparison of the estimates of steps and EE between generations within a brand. A secondary analysis included comparing the EE estimates from each device against the K5. Paired t-tests were used to compare steps and EE between different generations within a brand. Repeated measures ANOVAs were used to compare estimated gross EE from devices and measured EE from the K5. **Results:** There was no significant placement effect (proximal versus distal), thus, data from both placement locations was pooled together for each device for analysis. Table 1 shows the overall findings.

**Conclusion:** It is not recommended to interchange EE estimates from different CAM brand generations. However, the step estimates had an acceptable difference of ≤5% and could be interchanged across CAM generations. Future studies should explore if the observed differences are due to changes in hardware or software between generations.

Table 1. Mean ± standard deviation for total Kcals and steps for each device.

Device	Steps	Total Kcals	Total K5 Kcals
AW4	3001.4±525.1	242.6±72.0**	298.6±77.7
AW2	3074.7±563.6	223.6±62.2*	
FC3	3577.1±525.4*	296.6±135.6	292.3±72.4
FC2	3450.9±292.4	272.9±56.7	
VF4	3288.9±380.4*	161.1±33.2**	280.0±65.9
VF	3144.8±368.0	303.6±141.1	

\*Statistically significant generational difference, p<0.05.

\*\*Statistically significant difference between the device and K5, p<0.05.

**D-37 Thematic Poster - Genetic Predictors of Performance Across the Globe**

Thursday, May 28, 2020, 3:45 PM - 5:45 PM  
Room: CC-2000

**1968 Chair:** Brian A. Irving, FACSM. Louisiana State University, Baton Rouge, LA.

(No relevant relationships reported)

**1969 Board #1 May 28 3:45 PM - 5:45 PM  
Nomograms For Predicting And Identifying Polygenetics Models Of Power Performance In Chinese Elite Athletes**

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Based on the single nucleotide polymorphism(SNP) of elite power performance athletes, combined with other related phenotypic indicators, models for predicting and identifying the power performance of Chinese elite athletes was established, and the models were visualized by the method of nomogram.

**PURPOSE:** To explore the relationship between power performance and SNP of Chinese elite athletes and to create polygenic models for predicting and identifying elite power performance. **METHODS:** 103 elite athletes (age=24.3±3.2years; height=174.9±8.4cm; body mass=66.3±14.0kg; body mass index (BMI)=21.5±3.4) which were all Chinese were divided into power group(n=60) and endurance group(n=43) by their sport event. Best standing long jump (SLJ) and standing vertical jump (SVJ) were collected. Saliva samples were collected to test and 20 SNPs were genotyped by SNaPshot. test was used to compare the genotype distribution and allele frequency between groups. Predicting and identifying models were established by multivariate logistic regression analysis. Nomograms were created to visualize.

**RESULTS:** ACTN3(rs1815739),ADRB3(rs4994) and PPARGC1A(rs8192678) were significant both in genotype distribution and allele frequency between groups(P<0.05). The predicting model was consisted of ACTN3(rs1815739) (OR=2.448, 95% CI: 1.277-4.693), ADRB3(rs4994) (OR=3.546, 95% CI: 1.360-9.245) and PPARGC1A(rs8192678) (OR=2.159, 95% CI: 1.109-4.207), the AUC of which was 0.736. The identifying model was consisted of BMI(OR=1.217, 95% CI: 1.005-1.473), SVJ(OR=1.092, 95% CI: 1.040-1.146), ACTN3(OR=2.127, 95% CI: 1.006-4.497), ADRB3(OR=5.029, 95% CI: 1.451-17.427) and PPARGC1A(OR=2.370, 95% CI: 1.070-5.250), the AUC of which was 0.854. Based on the two models, nomograms were created to visualize the results. **CONCLUSION:** Two models can be both used for talent identification in Chinese athletes, among which the predicting one can be used in adolescent athletes to predict the development potential of power performance and the identifying one can be used in elite athletes to distinguish and evaluate power athletic status. It can be applied quickly and visually by using the method of nomogram.

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**1970 Board #2 May 28 3:45 PM - 5:45 PM  
Kcnj11 Gene Polymorphism And Endurance Performance Status In Hispanics: A Replication Study**

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(No relevant relationships reported)

Previous reports from our laboratory had shown significant associations between the potassium inwardly-rectifying channel, subfamily J, member 11 (KCNJ11) gene Glu23Lys variant and cardiorespiratory endurance performance (CRE) phenotypes (Padró et al. (2003), MSSE, 35(S1), 377; González et al. (2003), MSSE 35(S1), 378; Ortiz et al. 2005, MSSE 37(S1), 165). The KCNJ11 gene, is expressed in several tissues, including cardiac and skeletal muscle, where it is involved in the coupling of cell metabolism to cell electrical activity. **PURPOSE:** To replicate the study Ortiz et al. 2005, MSSE 37(S1), 165) and validate the findings of Padró et al. (2003), MSSE, 35(S1), 377; González et al. (2003), MSSE 35(S1), 378, by testing the association between the KCNJ11 gene Glu23Lys variant and CRE performance level in Hispanic male marathon runners (MR) using a good-sized sample size. **METHODS:** The subjects (n=1778) were adult Hispanic male MR that completed a 42-km road race. Fast-MR (cases; n=884) were finishers in the top third percentile. Slow MR (controls; n=894) were finishers in the lowest third percentile of their respective ages. A whole blood sample provided for the extraction of genomic DNA. The polymerase chain reaction was used to amplify the KCNJ11 gene Glu23Lys variant. Both case and control groups observed genotype frequencies met Hardy-Weinberg equilibrium expectations (X<sup>2</sup>, P≥0.05). **RESULTS:** The main finding showed a statistically significant (p ≤0.05) association between the KCNJ11 gene Glu23Lys variant and CRE performance level. Fast-MR (cases) showed a significant over-representation of the KCNJ11 gene Glu23Lys variant compared to slow-MR (controls), 67.4% vs. 51.5%, (p ≤0.05). **CONCLUSION:** The study replicated and validated previous findings of an association between the KCNJ11 gene Glu23Lys variant and cardiorespiratory endurance.

**1971 Board #3 May 28 3:45 PM - 5:45 PM  
Association Between The Mct1 T1470a Polymorphism And Athletic Status In Asian And European Climbers**

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(No relevant relationships reported)

**PURPOSE:** To investigate the association between the MCT1 T1470A polymorphism and athletic status in Asian and European climbers.

**METHODS:** One-hundred and ninety climbers (93 Asian: 93 Japanese; 97 European: 94 Polish, 1Ukrainian, 1Russian, 1French) and 825 controls (204 Asian and 621 European) were genotyped for the MCT1T1470A genotype (rs1049434) polymorphism using the TaqMan<sup>®</sup> Assay. Sports climbing included some discipline in the form of bouldering and lead climbing. Therefore, we assigned them to bouldering or lead climbing groups within each ethnic group based on self-reported achievement. We assigned 72 boulderers and 21 lead climbers among the Asian climbers and 65 boulderers and 32 lead climbers among the European climbers.

**RESULTS:** There were no significant differences in theMCT1 genotype and allele frequency between Asian climbers and controls (genotype: p=0.192, allele frequency: p=0.246).Meanwhile,the frequency of the T allele was significantly higher in climbers than in controls among the European subjects (p=0.029).In addition, the frequency of the TT genotype tended to be higher in climbers than in controls among the European subjects (p=0.073).The odds ratios of the T allele were 1.24 (95% confidence interval (CI): 0.86-1.80) and 1.47 (95% CI: 1.07-2.00) in Asian and European climbers, respectively. The frequency of the T allele tended to be higher in boulderers than in lead climbers among the Asian subjects (p=0.083). Conversely, the frequency of the T allele tended to be higher in lead climbers than in boulderers among the European subjects (p=0.089).

**CONCLUSIONS:** Our results suggest that climbers have a greater frequency of the T allele of the MCT1 T1470A polymorphism compared with that in controls among Asianand European individuals, respectively. The MCT1 genotype is associated with climbing status in European individuals, and the same trend is observed in an Asian cohort. We need a greater sample size to confirm the association between gene polymorphisms and athletic status in climbers.

1972 Board #4 May 28 3:45 PM - 5:45 PM

**Cmv Serostatus Has A Negative Effect On Cardiorespiratory Fitness And Insulin Sensitivity In Sedentary African-americans**

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(No relevant relationships reported)

**PURPOSE:** Investigate the effects of Cytomegalovirus (CMV) serostatus on measures of physical (VO<sub>2</sub>max) and metabolic (Insulin Sensitivity) fitness in healthy adults before and after a 20-week exercise intervention.

**METHODS:** Serum samples from a subsample (n=120) of the HERITAGE study (Bouchard et al., MSSE 1995) were analyzed for CMV serostatus. This subset was selected from the 60 men and 60 women with the greatest VO<sub>2</sub> max increase in response to the 20 week intervention and included Caucasians (n=82) and African Americans (n=38). Baseline VO<sub>2</sub>max was assessed using a stationary cycle ergometer test and insulin sensitivity was measured using a 3-hour intravenous glucose tolerance test before and after the training program.

**RESULTS:** Caucasians had a lower prevalence of CMV seropositive status than African-American (33% vs. 68%, p<0.01). In Caucasians, CMV serostatus was not associated with baseline aerobic capacity or insulin sensitivity. In African-Americans, CMV seropositive status was associated with impaired aerobic capacity pre- (2.39 ± .53 L/min vs 1.84 ± .67 L/min; p=.020; CMV seropositive vs CMV seronegative) and post-intervention (2.44 ± .75 L/min vs 3.03 ± .59 L/min; p=.028). Significant effects of CMV serostatus persisted after controlling for age, sex, body weight, and body fat percentage (p=.047, p=.047; pre- and post-intervention resp.). African-American CMV seropositive participants also had higher insulin responses to an IVGTT both pre- (1971.64 ± 1173.31 10 min.mU<sup>-1</sup>mL<sup>-1</sup> vs 849.16 ± 456.67 min.mU<sup>-1</sup>mL<sup>-1</sup>; p=.014) and post-intervention (1873.88 ± 1212.65 min.mU<sup>-1</sup>mL<sup>-1</sup> vs 909.18 ± 432.38 min.mU<sup>-1</sup>mL<sup>-1</sup>; p=.038). CMV serostatus still had significant effects on insulin sensitivity after controlling for age, sex, and aerobic capacity (p=.011, p=.016; pre- and post-intervention, resp.).

**CONCLUSIONS:** In sedentary African American adults, CMV serostatus is significantly associated with lower VO<sub>2</sub>max and insulin sensitivity even while controlling for variables known to mediate fitness and glucose sensitivity, and the associations persisted after exposure to 20 weeks of a standardized exercise program. We conclude that CMV status is another personal characteristic that needs to be taken into account in the assessment of cardiorespiratory fitness and insulin sensitivity in this population.

1973 Board #5 May 28 3:45 PM - 5:45 PM

**ASSOCIATION BETWEEN POLYMORPHISMS IN THE CARNOSINASE GENES AND THE PERSONAL BEST TIME OF BRAZILIAN SPRINTERS**

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Naturally found in some meats, carnosine is a physico-chemical buffering agent that has been shown to have positive effects on high intensity exercises. Because carnosine is readily degraded by highly active carnosinase enzymes, it has been postulated that only individuals with a low carnosinase activity and protein content could show the presence of carnosine in plasma (carnosinemia), which may be beneficial for athletes engaged in high intensity activities. Of note, two carnosinases have been identified: the serum carnosinase (CNDP1) and the tissue carnosinase (CNDP2).

**PURPOSE:** Explore whether the presence of polymorphisms in the *CNDP1* and *CNDP2* genes is associated with the performance of short (100 m), medium (200 m) and long (400 m) running sprints.

**METHODS:** A cohort of top-level Brazilian sprinters (men) had their genotypes determined for the *CNDP1* rs2887 and *CNDP2* rs3764509 polymorphisms, and the personal best times for the 100 m (n = 31), 200 m (n = 35) and 400 m (n = 39) compared between genotypes. Based on previous studies, the A/A genotype instead of G/G and G/A genotypes (*CNDP1* rs2887) and the G/G genotype instead of C/C and C/G genotypes (*CNDP2* rs3764509) were considered optimal for power performance. Athlete's personal records were acquired using the International Association of Athletics Federations database, available online at <https://www.iaaf.org/>. Genotyping of both polymorphisms was conducted using a pre-designed specific TaqMan® SNP Genotyping Assay according to the manufacturer's instructions. Student's t-test was used to compare the personal best times between genotypes. The significance level was established at P < 0.05.

**RESULTS:** No differences were found between polymorphisms and personal best times for the 100 m (overall mean ± SD: 10.66 ± 0.38 s, P > 0.930). However, athletes with the *CNDP1* A/A genotype (21.12 ± 0.41 s versus 21.78 ± 0.72 s, P = 0.027) or

*CNDP2* G/G genotype (21.19 ± 0.80 s versus 21.78 ± 0.67 s, P = 0.044) had faster personal times for the 200 m. In addition, athletes with the *CNDP2* G/G genotype showed a trend of faster personal times for the 400 m (47.19 ± 1.29 s versus 48.39 ± 1.55 s, P = 0.051).

**CONCLUSION:** The homozygous genotype for the mutant allele in both polymorphisms (*CNDP1* rs2887 and *CNDP2* rs3764509) was associated with 200m sprinting performance in elite athletes.

1974 Board #6 May 28 3:45 PM - 5:45 PM

**Vegf Rs2010963 Genotype And Performance Of Elite Middle-long Distance Swimmers In China**

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(No relevant relationships reported)

Vascular endothelial growth factor is essential to induce the full spectrum of VEGF angiogenic responses to aerobic training.

**PURPOSE:** The study aimed to examine the association of the VEGF rs2010963 genotype with the performance of elite middle-long distance swimmers.

**METHODS:** The distributions of the VEGF rs2010963 genotype and allele were examined in a general population (122) and a group of elite middle-long distance swimmers (120) in China by using PCR-RFLP and TOF.

**RESULTS:** Compared with the general population, the elite middle-long distance swimmers had a higher frequency of the GG genotype (Total: 42.37% VS 29.51%, P<0.05). The middle-long distance swimmers had a higher frequency of the G allele than the general population (64.83% VS 52.46%, P<0.05). The elite MLD swimmers had a lower frequency of the CC + CG genotype compared with the general population (57.62% VS 70.49%).

**CONCLUSIONS:** The VEGF rs2010963 polymorphism was associated with the performance of elite middle-long distance swimmers in China. The SNP rs2010963 could be used as a biomarker for selecting middle-long distance swimmers in China.

**D-38 Thematic Poster - Implementation Science in Exercise Oncology**

Thursday, May 28, 2020, 3:45 PM - 5:45 PM  
Room: CC-2007

1975 Chair: Heather J. Leach. Colorado State University, Fort Collins, CO.

(No relevant relationships reported)

1976 Board #1 May 28 3:45 PM - 5:45 PM

**A Qualitative Investigation Of Fitness Professionals' Perceived Barriers And Enablers To Community-based Cancer Exercise Programming**

Victoria R. DeScenza, Zachary L. Chaplow, Jessica Bowman, Marcy Haynam, Kathryn Dispenette, Stephanie Hohn, Xiaochen Zhang, Sue Sutherland, Brian C. Focht, FACSM. *The Ohio State University, Columbus, OH.* (Sponsor: Brian C. Focht, FACSM)  
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Access to community-based interventions is valuable for promoting regular exercise participation in cancer survivors. Although cancer survivors perceived exercise barriers have been consistently investigated, fitness professionals' perceptions of the barriers and enablers to offering community-based exercise programming targeting cancer survivors has yet to be systematically explored. **PURPOSE:** The primary purpose of this study is to qualitatively investigate health and fitness professionals' perceptions of barriers and enablers to offering community-based exercise programs targeting cancer survivors at their fitness and/or community centers. **METHODS:** A mixed-method qualitative case study approach incorporating web-based survey and semi-structured interview components was used to evaluate the fitness professionals' programming perceptions. A total of 82 community-based health and fitness professionals were contacted about the web-based survey. A total of 7 subjects volunteered to participate in a follow-up semi-structured interview based on their consent to participate in the further interview as indicated on the initial survey. **RESULTS:** A total 12 survey responses (14.6%) were completed online and 7 of 12 (58.3%) of the individuals completed the semi structured interviews. Data analysis using content analysis

and the constant comparative method process revealed 3 primary domains with 11 underlying themes: 1. Program Barriers: a. Education and Awareness; b. Physician Referral; c. Cost, and d. Care Along the Cancer Continuum; 2. Program Enablers a. Champion Advocacy, b. Sponsor/Funding, c. Personnel, and d. Propositional Solutions; and 3. Program Perceptions a. Social Support, b. Gym Atmosphere, and c. Cancer Specific Modifications. **CONCLUSIONS:** Findings from this mixed method, qualitative study identified multiple domains and themes articulating health and fitness professionals' perceptions of key barriers, enablers, and programmatic aspects in offering community-based exercise cancer programming. These results have important implications for guiding the design and delivery of community-based exercise programs for cancer survivors and represent a meaningful advance in developing a clinic-to-community translational model of exercise-based supportive cancer care.

**1977** Board #2 May 28 3:45 PM - 5:45 PM  
**Seven-day Exercise-based Prehabilitation For People With Non-small Cell Lung Cancer: A Systematic Review And Meta-analysis**

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 (No relevant relationships reported)

**PURPOSE:** Exercise based prehabilitation (EBPP) for people with non-small cell lung cancer (NSCLC) can reduce postoperative complications, however the four-week intervention period may negatively affect tumour growth, condition deterioration and programme adherence. It is unclear whether shorter 7-day EBPP can improve fitness to reduce postoperative complications. Therefore, the aim was to determine whether 7-day EBPP can increase six-minute walk distance (6MWD), improve peak expiratory flow (PEF) and improve postoperative outcomes. **METHOD:** Electronic databases (PubMed, Scopus, Medline, Web of Science and Cochrane Library), were systematically searched. Reference lists of relevant papers were also searched. Study selection was performed independently in a non-blinded manner. Only randomised controlled trials (RCTs) were included, with people with NSCLC undergoing 7-day EBPP, including at least one of pre- to post-EBPP change in 6MWD or PEF and at least one of: pulmonary complications (PC), length of stay (LoS) or length of antibiotic use. Review Manager was used to analyse risk of bias (RoB), risk ratio (RR) and mean difference (MD). **RESULTS:** 6 studies, with 346 participants, were included and presented a high RoB. Reporting of exercise performed, progression and adherence were limited. All studies used combined leg and arm ergometry aerobic training for 15-30 minutes, at a perceived exertion of "somewhat hard", 1-2 times daily. One study implemented resistance training. All studies included respiratory muscle training (20 min or 12-30 breaths). Pooled data suggested that compared to standard care, 7-day EBPP significantly increased 6MWD (20.6 m; 95% CI: 13.6 to 27.6;  $p < 0.00001$ ) and PEF (20.8 L·min<sup>-1</sup>; 95% CI: 15.5 to 26.0;  $p < 0.00001$ ) in three studies and significantly reduced LoS (-2.7 days; 95% CI: -3.6 to -1.1;  $p < 0.00001$ ) in four studies, significantly reduced the risk of developing a PC (RR 0.39; 95% CI: 0.25 to 0.62;  $P < 0.0001$ ) in all studies and significantly reduced antibiotic use (1.2 days; 95% CI: -2.1 to 0.3;  $p < 0.01$ ) in two studies. **CONCLUSION:** Low quality evidence suggests that 7-day EBPP may significantly increase 6MWD & PEF and significantly reduce PPC, LoS & antibiotic use. Future RCTs should apply greater methodological quality and record and report details of their intervention.

**1978** Board #3 May 28 3:45 PM - 5:45 PM  
**Integrated Knowledge Translation To Inform Implementation Of Exercise Counselling And Referral Of Cancer Survivors**

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 (No relevant relationships reported)

There is limited evidence supporting successful implementation of exercise-programming for cancer survivors into cancer clinical care pathways. We designed and launched a five-year hybrid effectiveness and implementation study to evaluate the relative benefit from an Alberta wide clinic-to-community based cancer and exercise model of care - the Alberta Cancer Exercise (ACE) program, and to evaluate the implementation of ACE into clinical cancer care. **PURPOSE:** To determine Health Care Provider (HCP) preferences, barriers and facilitators towards exercise counselling and referral of survivors to ACE at the Cross Cancer Institute (CCI), Edmonton, Alberta, and to test the feasibility of in-clinic, HCP-informed implementation tools. **METHODS: Stage I:** A theory-informed electronic questionnaire was distributed to HCPs at the CCI, of which N=47 responded (Aug-Oct 2017). A subsequent focus group N= 7 (May 2018) of CCI HCPs was held to probe into questionnaire findings and to determine actionable strategies. **Stage II:** Responses were mapped to the Capability Opportunity Motivation Behavior model. Tools were developed to specifically target the needs of HCPs in the head and neck cancer (HNC) tumor

group. Tool packages were distributed to HCPs (N=9) for in-clinic use for 4 weeks, corresponding to ACE recruitment for Spring programming (March-April 2019). Referral of HNC survivors to ACE programming was tracked. **RESULTS: Stage I:** Across all disciplines, only 17% of HCPs reported performing exercise counselling with survivors. The most common HCP identified barrier to exercise counselling was time, followed by a lack of knowledge regarding appropriate exercise. The most common facilitator was the 'interdisciplinary team', including access to physical therapy services. **Stage II:** Tool-based implementation strategies were developed and involved an educational package and exercise screening algorithm that was distributed to HCPs. A total of N=14 HNC survivors were referred, representing more than double the average number of previous HNC referrals (N=6) per session. HCPs reported the implementation tools to be 'somewhat' to 'very helpful'. **CONCLUSIONS:** HCP-identified implementation tools can enhance exercise-counselling and referral practices, and improve referral to community-based exercise programming.

**1979** Board #4 May 28 3:45 PM - 5:45 PM  
**Tailoring Exercise Programming To Optimize Recruitment, Adherence And Completion Among Survivors With Brain Tumours**

Ryan Alexander Szychka, Paula A. Ospina, Graeme M. Purdy, Jacob Easaw, Margaret L. McNeely. *University of Alberta, Edmonton, AB, Canada.*  
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 (No relevant relationships reported)

The Alberta Cancer Exercise (ACE) study is a 5-year study evaluating the benefit from, and implementation of, an Alberta wide clinic-to-community-based cancer and exercise model of care. The ACE program uses an integrated knowledge translation approach engaging survivors and clinicians as active participants in the research project. Shared decision-making is used to adapt the ACE program to the local context and tailor programming to meet the needs of survivors within specific tumor groups. **PURPOSE:** To demonstrate how an integrated knowledge translation approach can identify the need for tailored exercise programming to optimize adherence and outcomes. **METHODS:** The results of 52 patients with brain tumours enrolled in ACE from January 2017 to March 2019 were explored. Survivor and clinician feedback was obtained to inform strategies to optimize adherence and completion outcomes. **RESULTS:** Findings show that completion (69%) and adherence rates (47%) were lower in the brain tumor group when compared with overall ACE rates (91% and 79% respectively). The primary reason reported for non-completion of the program was related to disease progression. Participant reported reasons for missed sessions included medical appointments and symptoms (feeling too ill or fatigued). Survivors with brain tumors (n=36) who were able to complete the 12-week program realized fitness benefits similar to ACE participants from other tumour groups. Statistically and clinically significant improvements were seen in 6MWT (59 metres; 13%;  $p = 0.004$ ), upper body strength (25 lbs; 30%;  $p < 0.005$ ) and lower body strength (38 lbs; 27%;  $p = 0.04$ ). Of note, attendance to sessions was higher (70%) in sites offering tailored programming and flexibility in scheduling. Clinicians identified the need for earlier introduction of ACE programming as a means to attenuate declines in function during adjuvant cancer treatments. **CONCLUSIONS:** An integrated knowledge translation approach was used to identify strategies to improve study completion, exercise adherence and survivor outcomes. A sub-study is currently underway to evaluate the benefit of early intervention, tailored exercise programming and flexible scheduling for survivors with brain tumors. Supported by: Alberta Innovates and Alberta Cancer Foundation

**1980** Board #5 May 28 3:45 PM - 5:45 PM  
**Exercise Counselling To Promote Exercise Behaviour Change In Individuals With Prostate Cancer**

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 (No relevant relationships reported)

Exercise is an effective strategy to enhance survivorship, quality of life and physical function in individuals with prostate cancer. However, the majority of men with prostate cancer are not sufficiently active. To assist in the adoption and maintenance of recommended exercise behaviours, the Prostate Cancer Supportive Care (PCSC) program implemented an exercise clinic using a standardized delivery protocol that included group education and individualized exercise counselling delivered by an exercise physiologist. **PURPOSE:** The primary aim of this study was to evaluate the feasibility of the delivery of the exercise clinic and to understand the preliminary effect of this clinic in changing exercise behaviours at 3-months. **METHODS:** A retrospective chart review was performed on data collected from attendees of the Vancouver PCSC Program Exercise Clinic (version 2.0 protocol) from June 11 2018 to April 10 2019 at four appointments, namely education session, exercise clinic

session 1 (in-person), exercise clinic session 2 (telephone follow-up) and exercise clinic session 3 (3-month in-person follow-up session). Feasibility was defined a priori as >60% attendance, <30% attrition, and >75% session timing, intervention delivery fidelity and intervention component fidelity. Self-reported aerobic and resistance exercise levels were evaluated at each session. **RESULTS:** A total of 34 individuals were evaluated. Feasibility targets were met for attendance (81%), attrition (19%), intervention fidelity (90%) and in-person session timing (90%). There was intervention component fidelity in 38 of 39 components. Weekly moderate-to-vigorous aerobic exercise levels increased at 3-months by 83±198 mins to a mean of 202.6±147.3 mins with a moderate effect (ES 0.54, 95% CI 0.3-0.5). Resistance exercise increased by 2.0±3.1 sessions to a mean of 3.2±2.9 sessions with a large effect (ES 0.77, 95% CI 0.3-1.3). **CONCLUSION:** This intervention was feasible to deliver to individuals with prostate cancer in a real-world clinical setting by exercise physiologists. The exercise counselling intervention elicited a moderate effect, showing improvements in aerobic and resistance exercise levels at 3-months. Future work should explore if this behaviour change can be sustained longer-term.

**1981** Board #6 May 28 3:45 PM - 5:45 PM  
**Community-based Exercise For Health Promotion And Secondary Cancer Prevention: A Hybrid Effectiveness-implementation Study**

Margaret L. McNeely<sup>1</sup>, Christopher Sellar<sup>1</sup>, Tanya Williamson<sup>2</sup>, Elaine Gobeil<sup>1</sup>, Anil Abraham Joy<sup>1</sup>, S Nicole Culos-Reed<sup>2</sup>.  
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**PURPOSE:** Cancer care has expanded from a disease-focused, survival-oriented model to an approach that now considers how survivors can live well in the aftermath of intensive therapy. Research evidence supports the benefit of exercise during and following cancer treatments for cancer-related symptoms, physical fitness, and health-related quality of life. To move efficacy evidence into practice, we designed and launched the Alberta Cancer Exercise (ACE) program, a 5-year study to evaluate the relative benefit from implementing a clinic-to-community-based exercise and cancer model of care.

**METHODS:** A hybrid effectiveness and implementation trial design is evaluating the effectiveness of community-based exercise, and collecting data on implementation of the program. ACE opened in January 2017 and is now offered across seven cities (18 sites) in Alberta, Canada. Participants are adult survivors from all tumour groups and stages, at any time point since diagnosis, up to 3 years post treatment completion. Survivors take part in a minimum of 60 minutes of mild-to-moderate intensity full body exercise twice weekly for a 12-week period. The primary effectiveness outcome is the proportion of participants meeting physical activity guidelines at 1-year follow-up. The Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework is being used to capture individual-level and organizational-level impact of ACE.

**RESULTS:** 1506 Albertan survivors have entered ACE and 1109 have completed the 12-week intervention. Completion rates for 12, 24 and 1-year follow-ups are 91%, 84% and 79% respectively. Post-intervention, statistically significant benefits were found for fitness and patient-reported outcomes such as the 6 minute-walk test distance (+36m; p<0.001), lower leg strength (+34 lbs; p<0.001) and symptoms of fatigue (+2.56 points; p<0.01). Of the 631 participants who have completed the 1-year follow-up, the number of participants meeting 150 minutes of moderate intensity exercise per week increased from 28.4% to 35.5% (p<0.01).

**CONCLUSIONS:** Results support high interest in, and benefit from ACE among Albertan survivors. While statistically and clinically significant benefits were found short-term, further efforts are needed to support long-term exercise behaviour change.

**1982** Board #7 May 28 3:45 PM - 5:45 PM  
**Community-based Exercise Programs For Cancer Survivors: Using The Consolidated Framework For Implementation Research To Identify Barriers And Facilitators To Program Implementation**

Sarah Neil-Sztramko<sup>1</sup>, Jenna Smith-Turchyn<sup>2</sup>, Angela Fong<sup>3</sup>, Kaitlin Kauffeldt<sup>4</sup>, Jennifer Tomason<sup>4</sup>.  
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 (No relevant relationships reported)

**PURPOSE:** Exercise is recommended as an intervention to reduce the side effects of cancer treatment both during treatment and beyond. New ACSM guidelines for cancer survivors have been recently published, alongside a recommendation for all oncology clinicians to 'Ask, Advise and Refer' to appropriate exercise programs. Based on

this, there is a need to understand how to best translate exercise oncology programs from research into community-based settings. The purpose of this scoping review is to describe the characteristics of existing exercise programs for cancer survivors conducted outside of a research laboratory (i.e., home- or community-based settings) mapped to a common implementation science framework in order to identify potential strategies for future implementation interventions.

**METHODS:** A systematic search of published literature was conducted for exercise programs or interventions including individuals diagnosed with cancer either undergoing treatment or who have completed treatment in which participants exercise at home, or in a community-based setting. Data were extracted using the Oxford Implementation Index and coded under the five domains of the Consolidated Framework for Implementation Research.

**RESULTS:** A total of 46 publications describing 30 individual programs from around the world were identified. Only 11 publications had the specific goal of reporting on program implementation and development. Most programs included both aerobic and resistance exercise, targeting either breast cancer survivors, or any cancer. A variety of intervention and individual characteristics were described. Reporting of implementation factors related to the inner and outer setting and implementation process were minimal. Partnerships with oncology clinicians appears to be a key facilitator to implementation success.

**CONCLUSIONS:** This scoping review summarizes the implementation characteristics of existing programs that have been reported in the literature and can serve as a resource for those developing future community-based exercise oncology programs. Findings support the need for implementation science to inform best practices for program implementation.

**D-39** Thematic Poster - Physical Activity and Aging

Thursday, May 28, 2020, 3:45 PM - 5:45 PM  
 Room: CC-2009

**1983** Chair: David X. Marquez, FACSM. University of Illinois at Chicago, Chicago, IL.

(No relevant relationships reported)

**1984** Board #1 May 28 3:45 PM - 5:45 PM  
**Effect Of High Intensity Power Training On Blood Pressure In Type 2 Diabetes: Great2Do Trial**

Maria Fiatarone Singh<sup>1</sup>, Pinak Sharma<sup>1</sup>, Matthew Hollings<sup>1</sup>, Yorgi Mavros<sup>1</sup>, Shelley Kay<sup>1</sup>, Kylie A. Anderberg<sup>1</sup>, Michael K. Baker<sup>2</sup>, Yi Wang<sup>3</sup>, Ren Ru Zhao<sup>4</sup>, Jacinda Meiklejohn<sup>1</sup>, Mike Climstein, FACSM<sup>5</sup>, Anthony O'Sullivan<sup>6</sup>, Nathan De Vos<sup>7</sup>, Bernhard T. Baune<sup>8</sup>, David Simar<sup>9</sup>, Nalin Singh<sup>1</sup>, Steven N. Blair, FACSM<sup>9</sup>.  
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 (No relevant relationships reported)

Hypertension is a cardiovascular disease risk factor which can be modified by exercise. The effect of high intensity power training on ambulatory blood pressure (ABP) in older adults with type 2 diabetes (T2D) has never been studied. **PURPOSE:** To determine if high intensity power training (PRT) can reduce ABP in older adults with T2D. **METHODS:** One hundred three participants (51% male, 67.9±5.5 yrs, 100% T2D, 24hr SBP: 132±13 mmHg, 24hr DBP: 73±7 mmHg, 55% ABP hypertensive (141/83 mmHg)) were randomized into 3 times/week of PRT or low-intensity, non-progressive sham exercise (SHAM) for 12 months. Ambulatory blood pressure monitors were fitted to the non-dominant arm and worn continuously for 24 hours at baseline, 6- and 12-month timepoints. Sleep and waking times were logged by participants and used for analyses. Systolic (SBP) and diastolic (DBP) blood pressures during awake, asleep and overall 24-hr period were similar for both groups.

**RESULTS:** There was no significant effect of time or group on any measure of ABP in older adults with T2D over 12 months. However, a fully adjusted model including baseline ABP hypertensive status (defined as baseline 24hr ABP of SBP ≥ 130 or DBP ≥ 80) revealed significant reductions in ABP domains over time in hypertensive vs. normotensive participants regardless of group assignment [mean difference (p-value): 24hr SBP, -4.1 vs 4.2 (p<0.01); 24hr DBP, -5.0 vs 0.9 (p<0.01); Awake SBP, -7.9 vs 5.8 (p<0.001); Awake DBP, -5.8 vs 1.3 (p<0.01); Sleep SBP, -3.5 vs 6.2 (p<0.05); Sleep DBP, -2.6 vs 2.5 (p=0.09)]. **CONCLUSION:** Overall, there was no change in ABP following 12 months of high or low intensity exercise training in older adults with

T2D. However, in those with hypertension at baseline, both PRT and SHAM exercise were associated with clinically meaningful and significant reductions in ABP domains over 12 months. The mean difference of -8 mmHg in Awake SBP after 12 months of exercise in hypertensive individuals with T2D is particularly noteworthy. Extrapolating from meta-analyses of anti-hypertensive medication effects, a difference of this magnitude may be associated with major cardiovascular disease risk reduction.

**1985** Board #2 May 28 3:45 PM - 5:45 PM  
**Neuromotor Characteristics Of Older Men With Sarcopenia**

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Reported Relationships: S.A. Horan: Other (please describe); Supported by a Physiotherapy Research Fellowship from the Health Innovation, Investment, and Research Office, Queensland Health.

Skeletal muscle mass increases over the first three decades of life, declines steadily through middle age, and more rapidly in older age. Sarcopenia describes a condition of significant loss of muscle mass in conjunction with reduced strength and function. While the changes in mass, strength and function across the lifespan are well-documented, little is known of the underlying neuromotor changes. **PURPOSE:** To examine the neuromotor mechanisms that underpin changes in muscles mass and function in older men with sarcopenia. **METHODS:** Twenty four older men (74.4 ± 5.0yrs) were recruited for testing. Muscle and fat mass were determined by DXA (Norland XR-800, USA). Functional performance was assessed via isometric knee extension strength, timed-up-and-go (TUG), 5-times sit-to-stand (5TSTS), self-selected gait speed, and hand grip strength. Neuromotor function was assessed using electrical stimulation of the tibial nerve (Digitimer D57AH, UK) and recording of EMG activity and torque during a graded plantar flexion contraction protocol. Measures included Level of Voluntary Activation (LoVA; 20%, 40%, 60% 80%, and 100% of MVC), resting and superimposed twitch (SIT), ankle torque, and EMG activity of the plantar and dorsi flexor muscles. **RESULTS:** Six older men were classified as sarcopenic based on DXA-derived measures of appendicular lean mass and height (<7.25kg/m<sup>2</sup>). Differences in LoVA and SIT were observed between older men and sarcopenic men at the 60% (LoVA: OM=85.5 ± 5.5% SM=77.3 ± 11.7%, p<0.05; SIT: OM=2.0 ± 1.0% SM=3.6 ± 2.8%, p<0.05) and 80% (LoVA: OM=95.8 ± 2.4% SM=92.4 ± 3.3%, p<0.05; SIT: OM=0.5 ± 0.3% SM=1.2 ± 0.8%, p<0.05) contraction intensities. Significant differences in knee extension strength were observed between older men and sarcopenic men (OM=512.2 ± 125.2N SM=328.6 ± 74.4N, p=0.03), however no other differences in functional performance measures were observed. **CONCLUSIONS:** These preliminary findings suggest that there are underlying neuromotor changes in men with sarcopenia, particularly during submaximal muscle contractions. Interestingly, men with sarcopenia were still able to maintain a similar level of functional ability compared to older healthy men. Future work will examine neuromotor characteristics in response to fatigue.

**1986** Board #3 May 28 3:45 PM - 5:45 PM  
**The Effect Of Muscle Quality On Isokinetic Acceleration Time In Obese Older Men**

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 (No relevant relationships reported)

Recent modeling studies have suggested that increases in intramuscular fat may have a deleterious effect on skeletal muscle function. An increase in intramuscular fat is characteristic of aging, which is exacerbated with obesity. **PURPOSE:** The purpose of this study was to determine the influence of obesity-altered muscle quality on isokinetic acceleration time (AT) during a fast velocity in older men. **METHODS:** Twenty-two normal weight healthy older men (ONW) (age: 69.4 ± 2.1 yrs; BMI: 23.3 ± 1.5 kg/m<sup>2</sup>) and 20 age-matched obese older men (OB) (age: 69.0 ± 2.4 yrs; BMI: 34.0 ± 3.8 kg/m<sup>2</sup>) completed one visit. Body fat percentage (%BF) was assessed with a dual energy X-ray absorptiometry scan (ONW: 24.4 ± 6.3 %; OB: 37.0 ± 3.9 %). Panoramic B-mode US imaging was used to determine subcutaneous fat corrected echo intensity (EI) as a surrogate for intramuscular fat infiltration. The EI values included the average of all superficial quadriceps muscles (vastus lateralis, vastus medialis, and rectus femoris) at 50% of femur length. Each participant performed three maximal concentric isokinetic contractions at 240 deg · sec<sup>-1</sup> on a calibrated isokinetic dynamometer. The trial with the shortest AT from the onset of the contraction to the target velocity (load range) was used for all analyses. Independent samples *t*-tests were used to determine differences between the groups for age, BMI, %BF, EI, and AT. **RESULTS:** There was no group differences in age (*P*=0.586) or AT (ONW: 133.8 ± 26.4 ms vs. OB 130.8 ± 40.0 ms, *P*=0.774). However, BMI (*P*≤0.001), %BF (*P*≤0.001), and EI (ONW: 95.2 ± 13.3 AU vs. OB: 115.4 ± 15.8 AU, *P*≤0.001)

were different between groups. **CONCLUSIONS:** Quadriceps muscle quality was poorer in the OB older men, however there were no differences in AT between groups. These data may suggest that obesity-altered muscle quality does not influence limb acceleration in older men, however future studies are needed to examine more functional measures of rapid movement performance.

**1987** Board #4 May 28 3:45 PM - 5:45 PM  
**Additional Parameters In Discriminating Classifications Of Sarcopenia For An Elderly Population In Taiwan**

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(No relevant relationships reported)

Sarcopenia is an age-related degenerative loss of muscle mass and muscular function. Other than classification criteria from the European Working Group on Sarcopenia in Older People (EWGSOP) and Asian Working Group for Sarcopenia (AWGS), such as skeletal muscle index (SMI), handgrips strength (HGS), and 6-m normal walking speed (NWS), many other sarcopenic-related parameters have also been studied in the literature. **PURPOSE:** To discriminate classification of sarcopenia using related sarcopenic parameters. **METHODS:** This was a cross-sectional investigation. Subjects were above the age of 65 in Taoyuan, Taiwan. Measurement data of SMI, HGS, 6-m NWS, thigh circumferences and calf circumferences, muscular strength in knee extension and flexion, 30-s and 5 times sit-to-stand, and 8-inch timed-up-and-go were collected. Discriminant analysis was employed to detect related parameters that differentiated classification of sarcopenia using EWGSOP criteria. Significant level was at  $\alpha = .05$ . **RESULTS:** A total 384 cases were included with averaged age of 71.2 ± 5.4 (male: *N*=135; female: *N*=249). Using the EWGSOP criteria, the prevalence of pre-sarcopenia and sarcopenia were 35.42% and 22.66% respectively. SMI and HGS contributed commonly to discriminate sarcopenia classification in male, female, and all subjects, but not 6-m NWS in male (*p*=.331). However, additionally, thigh circumference, calf circumference, and 8-inch timed-up-and-go could discriminate classification of sarcopenia for all subjects with correct prediction rate of 95.6% for male and 92.0% for female subjects. **CONCLUSIONS:** In addition to SMI and HGS, a brief thigh and calf circumference measurements in anthropometry, and the 8-inch timed-up-and-go in physical performance may seem appropriate in promotion of sarcopenia prevention for older adults in the community in Taiwan. Supported by Chang Gung Memorial Hospital Grant CORPG3G0022.

**1988** Board #5 May 28 3:45 PM - 5:45 PM  
**Plasma Uric Acid Is Positively Associated With Muscle Strength In Older Adults - NHANES 2001-2002**

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**PURPOSE:** To associate plasma UA with muscle strength in individuals over 50 years. **METHODS:** A cross-sectional study was performed evaluating 1,433 individuals (731 men and 702 women) from National Health and Nutrition Examination Survey (NHANES) 2001-2002. The analyses included men and women aged 50-85 years who presented complete sociodemographic, anthropometric, body composition, strength, biochemical parameters, food intake, medical conditions and lifestyle data. Plasma UA was measured by colorimetric method; kinetic communicator isokinetic dynamometer was used to evaluate voluntary peak isokinetic knee extensor strength. The outcome measurement was the peak force (Newton) of the quadriceps. Six muscle strength measurements were performed: three initial measurements were considered warm-up/learning measurements and three final measurements were considered valid, the highest peak force value was used. Lean mass was evaluated by dual-energy X-ray absorptiometry. Participants were characterized by UA tercile and sex. To assess the association between UA tercile and strength, multiple linear regression models were performed. The analysis were adjusted for age, race, education level, smoke status, alcohol intake, body mass index, physical activity, protein and energy intake, diabetes, hypertension, glomerular filtration rate and total lean mass. All analyses were performed using Stata 14.0 software. **RESULTS:** Individuals with higher UA were older, had higher weight, height, lean mass, fat mass, strength, higher proportion of smokers and alcohol users (*p*<0.05). In addition, they had lower glomerular filtration rate and consumed less protein (*p*<0.05). Linear regression showed that UA levels were positively associated with muscle strength for men ( $\beta$  of third tercile = 24.8 [1.75;47.9] *p*-trend=0.028) and women ( $\beta$  of third tercile = 22.2 [1.03;43.3] *p*-trend = 0.028). **CONCLUSIONS:** Uric acid was positively associated with muscle strength in older adults.

1989 Board #6 May 28 3:45 PM - 5:45 PM  
**Six-year Effects Of Power Training On Physical Activity In Older Adults With Type 2 Diabetes**

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**PURPOSE:** We examined the effect of power training on long-term changes in physical activity (PA) in older adults with type 2 diabetes (T2D) during a 5-year follow-up of the GREAT2DO randomized control trial. **METHODS:** 103 participants with T2D and metabolic syndrome (51% male, 67.9 ± 5.5 yrs) were randomized to receive power or sham exercise training, 3 times/week for 12 months and followed for another 5 years. During follow-up, the power group was supported to continue, and controls were crossed over to training, but neither group exercised under direct supervision. Total PA was assessed using the Physical Activity Scale for the Elderly and the Homeostasis model assessment: insulin resistance (HOMA2-IR) and glycosylated hemoglobin (HbA1c) were used as indices of IR and glucose homeostasis, respectively. **RESULTS:** Total PA decreased significantly during the follow-up period ( $p=0.0001$ ), driven by reductions between 12 and 24 months when full supervision of exercise was withdrawn, followed by relative stability over the next 4 years. Engagement in resistance training (PRT) declined from 76% at 12 months in the original power training group to 43% of those assessed at the 6-year follow-up. Notably, 43% of the original sham group also reported engaging in PRT at 6 years. HbA1c, adjusted for total PA level over the 5 years, and diabetes medication usage were significantly lower at 72 vs. 12 months ( $p=0.04$ ), without any effect of original group assignment. However, there was no significant change over the follow-up period for HOMA2-IR, adjusted for PA and medication usage ( $p=0.23$ ). **CONCLUSION:** 5 years after withdrawal of fully supervised power training or sham exercise in initially inactive older adults with T2D, 43% of both groups were engaged in minimally-supervised resistance training in community sites. Although both groups reduced participation in structured exercise after withdrawal of direct supervision at 12 months, stability in Total PA level from 24-72 months along with persistence of PRT in 43% of older adults with diabetes and many progressive co-morbidities is notable and unexpected. We are unaware of any other study of unsupervised PRT in an older clinical cohort in which adherence rates of 43% have been achieved 6 years after initial randomization, accompanied by significant improvements in glucose control.

1990 Board #7 May 28 3:45 PM - 5:45 PM  
**Operationalisation Of Older Adults' Lifetime Physical Activity Data**

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 (No relevant relationships reported)

Despite the broad knowledge about general positive health effects of regular exercise, physical activity recommendations are mostly not fulfilled. Accompanying our ageing society, research often focuses on health status and activity habits at older age. Here, knowledge about triggers on and effects of very long-term physical activity (PA) is needed. **PURPOSE:** To investigate the relationship of PA during the lifespan and at old age.

**METHODS:** Overall 47 nursing home residents ( $n=47$ ) aged  $81.7 \pm 3.6$  years participated. The Lifetime Leisure Physical Activity Questionnaire (LLPAQ) and accelerometers (4 out of 7 days; MyWellnessKey ©) were used. LLPAQ captured lifetime leisure, housekeeping and occupational activity levels across 7 lifetime episodes. The LLPAQ retest data was gained from a subcohort ( $n=14$ ) six weeks after the first elicitation. Individual questionnaire and accelerometer data was converted to METs (Metabolic equivalent of task) and used for further data analysis. Individual estimation inaccuracies were computed as the ratio of self-reported to objectively measured current PA.

**RESULTS:** A linear association between accelerometer and LLPAQ data ( $r=.31$ ,  $p=.033$ ) for last year's PA was found. Test-retest reliability (ICC) was .7 ( $CV=118\%$ ,  $SEM=6.8$ , / 63.7%). Internal consistency was (Cronbachs  $\alpha$ ) 0.8. The average inaccuracy (overestimation) in self-reported data was 176% (CI-95% 120-232%).

Adjusted for individual inaccuracy, PA at old age significantly correlated with three age episodes ( $r=.354$ ;  $r=.336$ ;  $r=.323$ ;  $p<.05$ ). Likewise, inaccuracy-adjusted self-report data was sufficient to distinguish between individuals grouped as inactive or active (PA guidelines) in lifetime and current PA (Hotelling's  $t^2=45-164$ ;  $p \leq .002$ ).

**CONCLUSIONS:**

The observed inaccuracy (overestimation) in self-reported data aligns with findings in the literature (Sallis & Saelens, 2000; Tucker et al., 2011). The findings in individually processed data indicate a relationship of lifetime and old age PA. Future studies might enhance the applicability of methods for self-report PA data handling. Valid lifetime PA data might enhance further research on the relationship of old age PA and disease occurrence.

1991 Board #8 May 28 3:45 PM - 5:45 PM  
**Factors Influencing Sedentary Behavior And Physical Activity In Assisted Living Residents**

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 (No relevant relationships reported)

Older adults in assisted living who engage in prolonged bouts of sedentary behavior and spend little time in physical activity are at risk for frailty, physical disablement and other health problems.

**PURPOSE:** To describe sedentary behavior and physical activity behaviors in assisted living residents and examine factors related to those behaviors.

**METHODS:** Sedentary behavior and physical activity were objectively measured for seven consecutive days, 24-hours a day, with a continuous-wear accelerometer taped to the participant's thigh. Survey questionnaires were administered via one-on-one interviews and included measures of depression, social isolation, sleep disturbance, pain interference and fatigue. Data were analyzed with descriptive statistics and bivariate correlations.

**RESULTS:** Forty-six older adults (M/F=20/26) from 7 assisted living facilities participated (M=82.0 years, SD=10.95; BMI, M=29.4, SD= 5.6). Approximately 20 hours/day (awake and sleeping) were spent in accumulated sedentary behavior (M=19.8 hours, SD=2.1, range 13.8-22.9). Mean sitting bouts/day of >30 minutes were 10.3 (SD=2.1). Mean sitting bouts/day of >60 minutes were 4.8 (SD=2.7). Less than one hour/day was spent in stepping activity (M= 50.6 minutes, SD=29.0, range 13.1-179.7). Most stepping activity occurred during stepping bouts of one minute or less (M=38.2 minutes, SD=22.6). Three participants (6%) engaged in stepping bouts >10 minutes duration. Significant negative correlations were noted between number of sitting bouts >60 minutes and stepping duration >5 minutes <10 minutes ( $r=-.375$ ,  $p=.010$ ). Age negatively correlated with time spent stepping per day ( $r=-.411$ ,  $p=.005$ ). Positive correlations were observed between fatigue and number of hours in sitting bouts of 60 minutes or less ( $r=.356$ ,  $p=0.015$ ) and between BMI and number of hours spent in sitting bouts of 60 minutes or less ( $r=.349$ ,  $p=0.034$ ). There were no other significant correlations.

**CONCLUSION:** Assisted living residents spend most of their time in prolonged bouts of sedentary behavior. Interventions aimed at breaking up bouts of sedentary behavior with light intensity stepping bouts may be useful in improving the overall sedentary profile and impart health benefits.

Supported by Research Creative Activity Award University of Michigan-Flint

**D-40 Thematic Poster - Physiological Responses to Heat Acclimation**

Thursday, May 28, 2020, 3:45 PM - 5:45 PM  
 Room: CC-2010

**1992 Chair:** Matthew Cramer. *Defence Research and Development Canada, Toronto, ON, Canada.*  
 (No relevant relationships reported)

**1993 Board #1 May 28 3:45 PM - 5:45 PM**  
**Inter-individual Variability In Rate Of Heat Acclimation Using A Standard, Fixed Intensity Protocol**  
 Michelle M. Saillant, Nisha Charkoudian, FACSM, Katherine M. Mitchell, Karleigh E. Bradbury, Adam J. Luippold, Beau R. Yurkevicius, Billie K. Alba, Adam C. Nixon, Robert Kenefick, FACSM, Roy M. Salgado. *USARIEM, Natick, MA.*  
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In combination with increases in core temperature ( $T_{re}$ ) during acute exercise in the heat, progressive increases in heart rate (HR) contribute to increased cardiovascular strain as compared to the same exercise performed in cooler conditions. It is well-established that heat acclimation (HA), defined by both thermal and cardiovascular adaptations (lower  $T_{re}$  and HR), is achieved within ~7 to 10 days of repeated exercise for 60-120 min or more in the heat. More recent research indicates that HA can be achieved in <7 days, also referred to as short-term heat acclimation (STHA). **PURPOSE:** To quantify the occurrence and magnitude of STHA in a group of young healthy males participating in a standard, 8-day military HA protocol. We hypothesized that some but not all volunteers would achieve STHA. **METHODS:** Thirteen healthy male volunteers (age  $21 \pm 3$  yrs, ht:  $173 \pm 8$  cm, wt:  $75.1 \pm 12.2$  kg) participated in an 8 day exercise-heat acclimation protocol (120 minutes of treadmill walking:  $3.1$  mi·hr<sup>-1</sup>, 2% grade, in 40°C, 40% RH).  $T_{re}$  and HR were recorded every 5 minutes. Pre- and post-exercise nude body-weight (corrected for urine output) were used to calculate total body sweat rate (SR). Individual and group mean (ANOVA) changes in final  $T_{re}$ , HR, and SR were compared across Days 1, 5, and 8 of HA. The criteria for achievement of HA were  $\Delta T_{re}$  during exercise  $\leq 0.9$  °C and  $\Delta HR \leq 33$  bpm, which were based on average values attained at Day 8. **RESULTS:** Group mean  $T_{re}$  (Day 1:  $38.1 \pm 0.34$  vs. Day 5:  $37.9 \pm 0.3$  vs. Day 8:  $37.8 \pm 0.3$ °C) and HR (Day 1:  $134 \pm 17$  vs. Day 5:  $122 \pm 13$  vs. Day 8:  $121 \pm 13$  bpm) were significantly decreased by Day 5 ( $p < 0.05$ ) and did not decrease further by Day 8 ( $p > 0.05$ ). Using our criteria for achieving HA, 31% (4/13) of the volunteers achieved HA on Day 5. SR was not different across time points (Day 1:  $860 \pm 148$  vs. Day 5:  $908 \pm 210$  vs. Day 8:  $873 \pm 203$  ml·hr<sup>-1</sup>;  $p > 0.05$ ). **CONCLUSIONS:** These data suggest that during a standard fixed-intensity heat acclimation protocol, about one third of the volunteers will achieve STHA with no further change in  $T_{re}$  or HR responses beyond Day 5. Future research should evaluate the mechanisms contributing to the variability of achieving STHA. Supported by USAMRDC; author views not official US Army or DoD policy.

**1994 Board #2 May 28 3:45 PM - 5:45 PM**  
**Physiological Changes During Five Days Of Heat Acclimation**  
 Candi D. Ashley, Priscilla Lamadrid, Rebecca M. Lopez. *University of South Florida, Tampa, FL.* (Sponsor: Douglas J. Casa, FACSM)  
 (No relevant relationships reported)

The process of acclimation is imperative to ensure worker safety in hot environments. Most industry acclimation protocols prescribe 5 days of increasing heat exposure before working in the heat while research suggests 10-14 days for full acclimation. **PURPOSE:** To determine if 5 days of acclimation can induce meaningful physiological changes for worker safety. **METHODS:** Data collected from previous heat stress studies were used. A convenience sample of 15 female and 20 male participants (age =  $28 \pm 6$  yr, ht =  $171 \pm 7.6$  cm, wt =  $76.7 \pm 16.4$  kg) walked on a treadmill at a moderate metabolic rate ( $160$  W/m<sup>2</sup>) in a hot environment (50°C and 20% RH; WBGT =  $35.71$ °C) while wearing shorts, t-shirt and athletic shoes. Rectal temperature ( $T_{re}$ ) and heart rate (HR) were monitored continuously throughout all trials. Trials lasted approximately 120 minutes or upon attainment of sustained HR greater than 90% of age-predicted HR<sub>max</sub>,  $T_{re} \geq 39$ °C, or participant wished to stop. Paired samples t-tests were used to assess changes in ending HR and  $T_{re}$  over the last 2 days of acclimation. Repeated measures ANOVA were used to determine differences in  $T_{re}$  and HR over the acclimation period. Significance was set at  $p \leq 0.05$ . **RESULTS:** There was no significant difference in ending HR or ending  $T_{re}$  over the last 2 days of acclimation ( $p \geq 0.05$ ), suggesting participants were acclimated. Trial duration

increased significantly from day 1 to day 5 (Time =  $97 \pm 23$  and  $115 \pm 11$  min,  $p = 0.004$ ). During the first trial, 18 participants (51.4%) were able to complete 120 min, and 25 participants (71.4%) were able to complete 120 min by the end of acclimation. Beginning  $T_{re}$  was not significantly different from Day 1 to Day 5 ( $p = 0.106$ ), however Day 1 ending  $T_{re}$  ( $38.35 \pm 0.51$ °C) was significantly higher than Day 5 ( $38.10 \pm 0.66$ °C;  $P = 0.039$ ). Beginning HR was significantly greater for Day 1 than Day 5 (HR =  $103 \pm 16$  and  $93 \pm 13$  bpm;  $p = 0.024$ ), but there was no significant difference in ending HR from day 1 to day 5 ( $p = 0.056$ ). **CONCLUSION:** Five days of acclimation can induce physiological changes in HR and  $T_{re}$ ; specifically in resting HR and ending  $T_{re}$ . As such, industry acclimation protocols are adequate to induce physiological changes to help reduce heat illness.

**1995 Board #3 May 28 3:45 PM - 5:45 PM**  
**No Effect Of 8 Days Of Heat Acclimation On VO<sub>2peak</sub> Peak Power Output, Or Ventilatory Threshold**  
 Karleigh E. Bradbury, Katherine M. Mitchell, Beau R. Yurkevicius, Adam J. Luippold, Kirsten E. Coffman, Roy M. Salgado. *United States Army Research Institute of Environmental Medicine, Natick, MA.*  
 (No relevant relationships reported)

Adaptations from heat acclimation (HA) have been suggested to alter physiological responses during a maximal exercise test in trained individuals. These responses include a decreased oxygen cost for a given workload (improved exercise economy), or an increase in the power output at which the ventilatory threshold (VT) occurs; both factors that predict endurance performance. However, these findings are inconsistent in the literature, particularly in untrained individuals, therefore the effects of HA on maximal exercise responses remain unclear. **PURPOSE:** To examine any differences in VO<sub>2peak</sub>, peak power output (PPO), and VT pre- and post-HA in untrained individuals. **METHODS:** Thirteen healthy men (mean  $\pm$  SD; age:  $21 \pm 3$  yr; ht:  $172 \pm 8$  cm; wt:  $76 \pm 13$  kg) participated in the study. Subjects completed two peak oxygen consumption tests (VO<sub>2peak</sub>; on a cycle ergometer) that were separated by an 8-day exercise-HA protocol (treadmill walking:  $5$  km·hr<sup>-1</sup>, 2% grade; 40°C, and 40% RH). The VO<sub>2peak</sub> test workload started at 50-75 watts (W), and increased by 25 W every min until volitional exhaustion. Metabolic data were collected continuously over the course of the test. VT was determined using the ventilatory equivalence method (an increase in VE/VO<sub>2</sub> with no change in VE/VCO<sub>2</sub>). The percent change in plasma volume (% $\Delta$ VPV) was calculated from blood draws pre- and post-HA. A paired t-test was used to assess differences in physiological responses during the VO<sub>2peak</sub> test and from the HA protocol. Significance was set at an alpha level of  $P < 0.05$ . **RESULTS:** HA was achieved as indicated by a lower core temperature (Day 1:  $38.1 \pm 0.3$  vs Day 8:  $37.8 \pm 0.3$  °C;  $P < 0.01$ ) and HR (Day 1:  $134 \pm 17$  vs Day 8:  $121 \pm 13$  bpm;  $P < 0.01$ ) on Day 8 compared to Day 1. The % $\Delta$ VPV from pre- to post HA was  $22.8 \pm 7.6$  % over the course of the HA period. VO<sub>2peak</sub> ( $3.2 \pm 0.4$  vs  $3.1 \pm 0.5$  L/min) and PPO ( $253 \pm 37$  vs  $257 \pm 38$  W,  $P > 0.05$  for both) were not different after 8 days of HA. There were no differences pre- to post-HA in VO<sub>2</sub> ( $2.2 \pm 0.4$  vs  $2.1 \pm 0.4$  L/min), power output ( $169 \pm 27$  vs  $167 \pm 31$  W), VE ( $53.4 \pm 9.6$  vs  $53.6 \pm 10.8$  L/min), or the RER ( $0.94 \pm 0.05$  vs  $0.95 \pm 0.06$ ,  $P > 0.05$  for all) at which VT occurred. **CONCLUSION:** An 8-day HA protocol did not lead to changes in VO<sub>2peak</sub>, PPO, or in the VO<sub>2</sub> and PO at which the VT occurred during a peak oxygen consumption test. Supported by USAMRDC; authors views not official US Army or DoD policy.

**1996 Board #4 May 28 3:45 PM - 5:45 PM**  
**The Impact Of Short-Term Hot Water Immersion On Heat Acclimation And Thermotolerance**  
 Andrew Greenfield, Felipe G. Pereira, Trevor Gillum. *California Baptist University, Riverside, CA.*  
 (No relevant relationships reported)

**BACKGROUND:** Environmental heat stress increases physiological strain during exercise in non-acclimated individuals. Heat acclimation (HA) protocols are often used as countermeasures to preserve physiological function during exercise in the heat. Passive heat strategies could be a potential method of HA that reduces excess physical exertion prior to activity or relocation. **PURPOSE:** To determine the effect of hot water immersion (HWI) on heat acclimation and thermotolerance. **METHODS:** 6 males (Age:  $23.8 \pm 1.5$ ; VO<sub>2max</sub>:  $45.0 \pm 7.5$  mL/kg/min.) participated in a crossover, counterbalanced study with a four-week washout between conditions. Heat stress tests (HST) were performed PRE and POST acclimation sessions and consisted of 45 min of cycling at 50% of VO<sub>2max</sub> in 40 °C, 40% RH. Acclimation sessions were either three consecutive bouts of HWI or traditional heat-exercise training (TRAD). HWI sessions consisted of 40 min of submersion at 40 °C. TRAD sessions consisted of 40 min of cycling at 50% VO<sub>2max</sub> in 40 °C, 40% RH. Core body temperature ( $T_{core}$ ), heart rate (HR), rate of perceived exertion (RPE), and thermal sensation (TSS) were recorded during HSTs. Blood was drawn PRE and POST HST to determine change

in plasma volume. Nude body mass was recorded before and after HSTs to calculate whole body sweat loss (WBSL).  $T_{core}$  and HR were used to calculate physiological strain index (PSI).

**RESULTS:** HWI decreased average HR (PRE:  $158 \pm 7$ ; POST:  $149 \pm 7$ ;  $p < 0.05$ ), peak HR ( $176 \pm 7$ ;  $164 \pm 5$ ;  $p < 0.05$ ), and end exercise RPE ( $15.3 \pm 1.8$ ;  $13.2 \pm 1.9$ ;  $p < 0.05$ ). HWI had no significant effect on resting  $T_{core}$  ( $37.2 \pm 0.4$ ;  $36.8 \pm 0.3$ ;  $p = 0.66$ ), end exercise  $T_{core}$  ( $38.7 \pm 0.4$ ;  $38.4 \pm 0.3$ ;  $p = 0.20$ ), PSI ( $7.8 \pm 1.1$ ;  $7.0 \pm 0.8$ ;  $p = 0.56$ ), or TSS ( $10.8 \pm 1.0$ ;  $9.5 \pm 1.2$ ;  $p = 0.09$ ). TRAD resulted in no significant changes in average HR (PRE:  $153 \pm 11$ ; POST:  $149 \pm 11$ ;  $p = 0.82$ ), peak HR ( $170 \pm 9$ ;  $165 \pm 10$ ;  $p = 0.51$ ), end exercise RPE ( $15.1 \pm 1.2$ ;  $13.3 \pm 2.0$ ;  $p = 0.87$ ), PSI ( $9.3 \pm 2.1$ ;  $8.6 \pm 1.4$ ;  $p = 0.73$ ), or TSS ( $10.5 \pm 0.8$ ;  $10.7 \pm 1.5$ ;  $p = 0.77$ ). Plasma volume expansion (%) was observed in both groups (HWI:  $6.6 \pm 6.4$ ; TRAD:  $4.3 \pm 2.0$ ;  $p = 0.41$ ).

**CONCLUSION:** Three consecutive HWI sessions are effective in lowering HR during submaximal exercise in the heat. Compared to heat-exercise exposures, HWI is a method in which to more rapidly elicit a HA phenotype.

**1997 Board #5 May 28 3:45 PM - 5:45 PM**  
**Acute Kidney Injury Biomarker Responses To Short Term Heat Acclimation**

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 (No relevant relationships reported)

The combination of hyperthermia, dehydration, and strenuous exercise can result in severe reductions in kidney function leading to an increased risk of developing acute kidney injury (AKI). **PURPOSE:** We sought to determine if short term heat acclimation (SHTA) mitigates the rise in AKI biomarkers during strenuous exercise in heat. **METHODS:** Twenty men completed two 2-hour bouts of high-intensity interval exercise before (Pre-SHTA) and after (Post-SHTA) 4 days of 90-120 minutes of exercise in either hot ( $n=12$ ,  $40^\circ\text{C}$ , 40% relative humidity; HEAT) or temperate ( $n=8$ ,  $24^\circ\text{C}$ , 40% relative humidity; CON) conditions. Men drank water ad libitum throughout exercise. Blood was drawn before and after exercise Pre-SHTA and Post-SHTA. AKI was defined as a serum creatinine increase  $\geq 0.3$  mg/dL or estimated glomerular filtration rate (eGFR) reduction  $>25\%$ . **RESULTS:** HEAT had a similar creatinine increase during exercise Pre-SHTA ( $0.35 \pm 0.23$  mg/dL) and Post-SHTA ( $0.39 \pm 0.20$  mg/dL), with creatinine in HEAT increasing more than CON at both time points ( $0.11 \pm 0.07$  mg/dL,  $0.08 \pm 0.06$  mg/dL,  $p \leq 0.001$ ), respectively. HEAT had a greater reduction in percent change eGFR than CON ( $p \leq 0.001$ ) independent of heat acclimation status (Pre-SHTA, HEAT:  $-30.2 \pm 9.7\%$ , CON:  $-10.5 \pm 8.5\%$ ; Post-SHTA, HEAT:  $-26.4 \pm 12.4\%$ , CON:  $-8.4 \pm 5.9\%$ ). Biomarkers reached the threshold for AKI in HEAT Pre-SHTA ( $n=9$ , 75%), with fewer participants reaching the AKI threshold Post-SHTA ( $n=7$ , 58%,  $p=0.007$ ). Biomarkers indicated AKI did not occur in CON at either time point. Hydration and body temperatures were similar between HEAT participants with and without biomarkers reaching the threshold of AKI both Pre-SHTA and Post-SHTA. Change in serum creatinine was related to percent of fluid replaced Pre-SHTA ( $r=0.60$ ,  $p=0.039$ ), while Post-SHTA was related to percent change in plasma volume ( $r=0.732$ ,  $p=0.007$ ). **CONCLUSION:** SHTA did not mitigate reductions in eGFR nor increases in serum creatinine during high-intensity exercise in the heat, although the number of participants reaching the threshold for AKI was reduced Post-SHTA. This suggests that SHTA may reduce the risk of developing AKI during exercise in the heat.

Supported by the National Athletic Trainers' Association Research and Education Foundation Doctoral Grant 14DGP012.

**1998 Board #6 May 28 3:45 PM - 5:45 PM**  
**Does Heat Acclimation Upregulate Skeletal Muscle Markers Of Oxidative Metabolism And Mitochondrial Biogenesis?**

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 (No relevant relationships reported)

Heat acclimation (HA) increases tolerance to exercise performed in the heat and may improve aerobic fitness and performance in highly trained individuals. However, it is unknown if HA effects the expression of proteins related to mitochondrial biogenesis and oxidative capacity in skeletal muscle in active young individuals. **PURPOSE:** To investigate the effect of HA on the expression of oxidative and mitochondrial proteins in the skeletal muscle of healthy, active young-adult males and females. **METHODS:**

In a quasi-experimental design, thirteen (7 males, 6 females) aerobically fit ( $VO_{2max} > 75$ th percentile) individuals underwent 10-days of HA over 14-days. Participants performed two 45-minute bouts of exercise (walking at 30-40% maximal velocity) with 10 minutes rest per session in a hot environment (dry temperature  $\sim 42^\circ\text{C}$ , relative humidity 30-50%). Pre- and post-HA  $VO_{2max}$  (room temperature), second ventilatory threshold (VT), protein expression of PGC-1 $\alpha$ , TFAM, CaMK, Cytochromes I-IV, and HSP72 were measured pre-HA and post-HA. Heat acclimation was determined comparing heart rate (HR), core temperature (CT), sweat rate, and ratings of perceived exertion (RPE) on days 1 and 10. **RESULTS:** Participants were acclimated as indicated by pre- and post-HA resting-CT ( $37.3 \pm 0.38$  vs.  $37.1 \pm 0.28^\circ\text{C}$ ;  $p = 0.04$ ), maximal-CT ( $38.8 \pm 0.35$  vs.  $38.2 \pm 0.38^\circ\text{C}$ ;  $p < 0.0001$ ), mean-HR ( $138.5 \pm 17.7$  vs.  $125.9 \pm 14.0$  bpm;  $p=0.03$ ), maximal-HR ( $170.2 \pm 26.4$  vs.  $149.4 \pm 24.5$  bpm;  $p=0.003$ ), mean-RPE ( $12.4 \pm 1.2$  vs.  $9.8 \pm 1.1$ ;  $p < 0.0001$ ), and maximal-RPE ( $15.0 \pm 1.6$  vs.  $12.2 \pm 1.9$ ;  $p=0.002$ ). Pre- to Post-HA  $VO_{2max}$  ( $50.2 \pm 8.6$  vs.  $51.7 \pm 11.2$  mL/kg/min;  $p=0.08$ ) and VT ( $31.2 \pm 7.0$  vs.  $33.9 \pm 8.7$ ;  $p=0.19$ ) were unchanged. Protein expression was unchanged pre- to post-HA; (PGC-1 $\alpha$   $p=0.21$ , TFAM  $p=0.34$ , CaMK  $0-0.19$ , Cytochromes I  $p=0.73$ ; II  $p=0.85$ , III  $p=0.62$ , IV  $p=0.70$ , Hsp72  $p=0.27$ ). **CONCLUSIONS:** 10-days of low intensity exercise in the heat resulted in HA, but did not increase aerobic fitness or markers of mitochondrial biogenesis and oxidative metabolism in physically active individuals. Supported by a research grant from the College of Education, University of New Mexico.

**1999 Board #7 May 28 3:45 PM - 5:45 PM**  
**Exercise Heat Exposure Induced Changes In Genetic Expression Before And After Heat Acclimation In Humans**

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 University of Wyoming, Laramie, WY.  
 (No relevant relationships reported)

**PURPOSE:** To evaluate changes in genetic expression of proteins that are implicated in physiological adaptation to exercise heat exposure (Hypoxia Inducible Factor -1 $\alpha$  [HIF-1 $\alpha$ ], Erythropoietin [EPO], and Vascular Endothelial Growth Factor [VEGF]) during systemic adaptation related to Heat Acclimation (HA) in humans. **METHODS:** Participants ( $n=18$ , 13 males, 5 females:  $30 \pm 7.34$  y;  $173.1 \pm 7.673$  cm;  $76.25 \pm 14.17$  kg) underwent two Heat Tolerance Tests (HTT 1 & 2; 120 min walking, 5 km/h, 2.0% grade,  $40^\circ\text{C}$ , 40% rh) with 12-14 days between tests. Participants in experimental group (HA) underwent six heat acclimation days between tests, while the control group (CON) avoided exercise heat exposure between HTT's. Blood was drawn pre- and post- each HTT and isolated into Peripheral Blood Mononuclear Cells, then further isolated into RNA. Then, cDNA was synthesized for Quantitative Real-Time Polymerase Chain Reaction to quantify gene expression. The data was then analyzed using the  $\Delta\Delta C_T$  to acquire fold change. **RESULTS:** No statistical difference in resting rectal temperature was observed before HTT2 in HA ( $-0.13 \pm 0.36^\circ\text{C}$ ) vs. CON ( $-0.08 \pm 0.47^\circ\text{C}$ ;  $P=0.80$ ). No significant changes were observed between HTT1 and HTT2 in the control group for HIF-1 $\alpha$ , EPO, or VEGF. However, it was observed that acute EPO fold change increased 10.6x; ( $P=0.14$ ) from pre- to post- in HTT1 for each group. An increased fold change was also observed in both HIF-1 $\alpha$  and EPO between HTT1 and HTT2 (3.24x;  $P=0.04$ ) & (7.19x;  $P=0.03$ ) respectively in the HA group. No significant changes in VEGF were found in either group. **CONCLUSION:** Although the HA protocol utilized in this investigations was not stressful enough to induce observable rectal temperature changes, genetic expression of HIF-1 $\alpha$  and EPO was significantly upregulated in response to chronic exercise heat stress.

**Grant Info:** This publication was supported by the Mountain and Plains - Educational Research Center (MAP-ERC) Pilot Grant & the High Plains Intermountain Center for Agricultural Health & Safety (HICAHS) Pilot Grant.

**D-41 Thematic Poster - Step Right Up! New Insights into Stepping and Health**

Thursday, May 28, 2020, 3:45 PM - 5:45 PM  
Room: CC-2011

**2000 Chair:** Janet Fulton, FACSM. CDC, Atlanta, GA.  
(No relevant relationships reported)

**2001 Board #1 May 28 3:45 PM - 5:45 PM  
Step By Step: Association Of Device-measured Daily Steps With All-cause Mortality - A Prospective Cohort Study**

Bjørge H. Hansen, Knut E. Dalene, Ulf Ekelund, FACSM, Morten W. Fagerland, Elin Kolle, Jostein Steene-Johannessen, Jakob Tarp, Sigmund A. Anderssen. *Norwegian School of Sport Sciences, Oslo, Norway.* (Sponsor: Ulf Ekelund, FACSM)  
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(No relevant relationships reported)

Walking - a basic unit of locomotion - is free, does not require special training, and can be done almost everywhere. Therefore, walking might be a feasible behavior on which to tailor public health messages. There is however insufficient evidence available to determine the magnitude and shape of the relationship between steps taken per day and all-cause mortality, giving current step-based guidelines limited scientific basis. **PURPOSE:** To assess the prospective association and dose-response relationship between device-measured daily walking steps and all-cause mortality in a large population-based cohort of women and men aged 40-85 years. **METHODS:** Daily steps were measured by a waist-mounted accelerometer in 2,180 individuals (53% women) for seven consecutive days at baseline (2008-09). Participants were grouped into quarters (Q) based on their average number of steps per day and followed over a median period of 9.1 years for all-cause mortality determined by linkage with death certificates from the Norwegian Cause of Death Registry. **RESULTS:** Mean (SD) baseline age was 56 (11) years. Median (IQR) steps per day were 4651 (3495, 5325), 6862 (6388, 7350), 8670 (8215, 9186), and 11467 (10556, 13110) in Q1 to Q4, respectively. During follow-up, 119 individuals died (68% men). Higher number of steps per day was associated with lower risk of all-cause mortality with hazard ratios (95% CI) of 0.52 (0.29 to 0.93), 0.50 (0.27 to 0.94), and 0.43 (0.21 to 0.88) across ascending quarters of steps per day compared with Q1 (referent) in the multivariable model ( $p < 0.001$ ). The dose-response association modelled using restricted cubic splines demonstrated a non-linear, inverse association between daily steps taken and all-cause mortality, with no apparent plateauing of risk-reduction within the observed variation in the exposure. **CONCLUSIONS:** We observed a 48% risk reduction for all-cause mortality between the least active and the second quartile, with an absolute difference between Q1 and Q2 of 2200 steps per day. To exemplify, given an average stride length of 0.67 cm for women and 0.76 cm for men, 2200 steps translates to a 1.4 to 1.6 km walk for women and men, respectively. If confirmed, this large gain with modest effort may serve as encouragement to many sedentary individuals.

**2002 Board #2 May 28 3:45 PM - 5:45 PM  
Cadence (steps/min) Associated With Moderate Intensity Walking In Older Adults: The CADENCE-Adults Study**

Catrine Tudor-Locke, FACSM<sup>1</sup>, Christopher Moore<sup>2</sup>, Elroy Aguiar<sup>3</sup>, Marcos A. Amalbert-Birriel<sup>4</sup>, Tiago V. Barreira<sup>5</sup>, Colleen J. Chase<sup>6</sup>, Stuart R. Chipkin<sup>4</sup>, Scott W. Ducharme<sup>6</sup>, Zachary R. Gould<sup>4</sup>, John M. Schuna, Jr.<sup>7</sup>, John Staudenmayer<sup>4</sup>.  
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(No relevant relationships reported)

Cadence (steps/min) is an accessible and understandable metric for communicating physical activity intensity. Studies in younger and middle-aged adults consistently report  $\geq 100$  steps/min associated with walking at an absolutely-defined moderate intensity (i.e., 3 metabolic equivalents [METs]) or higher. However, few studies have quantified the cadence-intensity relationship in older adults.

**PURPOSE:** To identify a reasonable heuristic (i.e., evidence-based, practical, rounded) cadence threshold associated with absolutely-defined moderate intensity in ambulatory older adults.

**METHODS:** Ninety-eight older adults 61-85 years of age (49% women; age=72.6 $\pm$ 6.9 years; BMI=25.9 $\pm$ 3.5 kg/m<sup>2</sup>) completed a series of 5-min treadmill walking bouts. Bouts began at 0.5 mph and increased in 0.5 mph increments until participants: 1) naturally selected to run, 2) reached  $>75\%$  of their age-predicted maximum heart rate (220 - age), or 3) reported a Borg scale rating of perceived exertion (RPE)  $>13$ . Oxygen uptake (VO<sub>2</sub>; ml·kg<sup>-1</sup>·min<sup>-1</sup>) was measured using indirect calorimetry and cadence was derived by dividing directly-observed steps by bout duration. VO<sub>2</sub> was averaged over the last two minutes of each bout and divided by 3.5 ml·kg<sup>-1</sup>·min<sup>-1</sup> to determine METs. Moderate intensity (3 METs) cadence thresholds were identified with two analytic approaches: 1) using Youden's index in a Receiver Operator Characteristic (ROC) curve and 2) by estimating a segmented (i.e., 'hockey-stick') regression model that accounted for repeated measures for the cadence-intensity relationship.

**RESULTS:** Eighty participants (82%) reached 3 METs. The ROC curve displayed an area under the curve (AUC) of 0.93. The segmented regression model indicated that cadence explained 70% of the variance in METs. The cadence thresholds associated with absolutely-defined moderate intensity were 100.3 steps/min in the ROC analysis (accuracy = 85.5%, sensitivity=86.8%, specificity=84.5%) and 103.1 steps/min in the regression analysis (95% prediction interval=70-114 steps/min).

**CONCLUSION:** Consistent with previous evidence collected from younger and middle-aged adults, 100 steps/min serves as a reasonable heuristic threshold to communicate absolutely-defined moderate intensity walking in ambulatory older adults. Funding: NIH NIA 5R01AG049024

**2003 Board #3 May 28 3:45 PM - 5:45 PM  
Device-specific Cadence Thresholds For Moderate And Vigorous Intensity Walking: The CADENCE-Adults Study**

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(Sponsor: Catrine Tudor-Locke, FACSM)  
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(No relevant relationships reported)

**PURPOSE:** To identify device-specific cadence (steps/min) thresholds associated with absolutely-defined moderate and vigorous intensity (3 and 6 metabolic equivalents [METs]) for the Actical (AC), ActiGraph GT9X (AG), activPAL 3 (AP), and StepWatch 3 (SW) accelerometers.

**METHODS:** A sample of 75 young (21-40 years), 80 middle-aged (41-60 years), and 97 older (61-85 years) adults (N = 252, 49.6% women; mean [SD] BMI = 25.6 [3.6] kg/m<sup>2</sup> and height = 169 [9] cm) completed 5-min treadmill walking bouts separated by 2-min rests. Bouts began at 0.5 mph and increased by 0.5 mph until participants: 1) naturally chose to run, 2) reached  $>75\%$  of age-predicted maximum heart rate, or 3) reported a Borg rating of perceived exertion  $>13$ . Participants wore an AC and AG (waist), AP (thigh), and SW (ankle) to assess steps. Oxygen uptake (VO<sub>2</sub>) was measured with indirect calorimetry and converted to METs (VO<sub>2</sub> / 3.5 mL/kg/min). Cadence and METs were averaged over the last 2 min of each bout. Device-specific cadence thresholds were identified for the total sample and each age group by selecting those minimizing Youden index summaries of Receiver Operator Characteristic (ROC) curves.

**RESULTS:** Device-specific cadence thresholds associated with 3 METs were ~100 (range 95-102) steps/min, except those for the AG in young and older adults, and thresholds associated with 6 METs were ~120 (range 118-124) steps/min (Table 1). All area under the ROC curve (AUC) values were  $\geq 0.90$ . Sensitivity and specificity values were  $\geq 80\%$  (Table 1).

**CONCLUSION:** Device-specific cadence thresholds accurately classified moderate and vigorous intensity in adults across the lifespan. However, 3 MET thresholds for the AG were up to 14 steps/min lower (in older adults) than those of the other devices and those reported in studies using the criterion of directly-observed steps (~100 steps/min). Future studies are needed to evaluate the performance of these thresholds in free-living settings.

Funded by NIH NIA Grant 5R01AG049024

**Table 1:** Device-specific cadence (steps/min) thresholds for absolutely-defined moderate and vigorous intensity treadmill walking and their classification accuracies for all participants and by age group

Device	Age Group (years)	Moderate Intensity (3 METs)					Vigorous Intensity (6 METs)*				
		Cadence Threshold (steps/min) <sup>†</sup>	Se (%)	Sp (%)	Ac (%)	AUC <sup>‡</sup>	Cadence Threshold (steps/min) <sup>†</sup>	Se (%)	Sp (%)	Ac (%)	AUC <sup>‡</sup>
Actical	All	96 [94-101]	87.5	89.2	88.3	0.94 [0.93-0.95]	121 [121-126]	98.1	86.9	87.6	0.97 [0.96-0.98]
	21-40	98 [85-103]	87.5	90.7	88.9	0.95 [0.93-0.97]	124 [122-126]	95.4	89.6	90.2	0.97 [0.96-0.98]
	41-60	100 [94-103]	88.0	93.8	90.8	0.96 [0.95-0.98]	121 [115-128]	97.2	86.3	86.9	0.96 [0.94-0.98]
	61-85	95 [76-104]	80.7	88.4	85.3	0.90 [0.87-0.93]	--	--	--	--	--
Acti-Graph GT9X	All	95 [93-98]	84.2	90.7	87.5	0.94 [0.93-0.95]	121 [115-124]	84.3	88.2	88.0	0.92 [0.89-0.95]
	21-40	94 [90-101]	85.1	89.4	86.9	0.94 [0.92-0.95]	122 [116-125]	84.6	89.0	88.6	0.91 [0.87-0.95]
	41-60	96 [94-101]	88.5	91.1	89.8	0.96 [0.94-0.97]	121 [115-128]	86.5	87.1	87.1	0.93 [0.89-0.97]
	61-85	86 [85-97]	84.8	86.5	85.8	0.92 [0.89-0.94]	--	--	--	--	--
activ-PAL 3	All	100 [97-102]	88.3	87.9	88.1	0.95 [0.94-0.96]	119 [119-124]	98.1	85.2	86	0.97 [0.96-0.98]
	21-40	97 [94-102]	89.9	88.9	89.5	0.96 [0.94-0.97]	122 [120-124]	95.2	89.5	90.1	0.97 [0.95-0.98]
	41-60	99 [96-105]	92.0	89.0	90.5	0.97 [0.96-0.98]	119 [119-126]	97.3	84.1	84.9	0.96 [0.93-0.98]
	61-85	102 [96-103]	85.1	86.9	86.1	0.93 [0.91-0.95]	--	--	--	--	--
Step-Watch 3	All	98 [97-104]	90.7	84.6	87.6	0.95 [0.94-0.96]	120 [114-123]	82.4	86.6	86.3	0.92 [0.90-0.94]
	21-40	98 [94-104]	89.1	88.3	88.7	0.95 [0.94-0.97]	120 [115-124]	87.7	86.3	86.4	0.93 [0.91-0.96]
	41-60	99 [95-106]	91.1	88.7	89.9	0.97 [0.96-0.98]	118 [106-126]	83.8	82.0	82.1	0.90 [0.86-0.94]
	61-85	102 [95-104]	84.2	86.2	85.3	0.93 [0.91-0.95]	--	--	--	--	--

METs = metabolic equivalents; Se = Sensitivity; Sp = Specificity; Ac = Accuracy; AUC = area under the ROC curve

Accuracy defined as: (true positives + true negatives) / total bouts

\* Thresholds not provided for 61-85-year-old adults as only 6% of the sample attained 6 METs

† Values presented as point estimate [95% confidence interval]; ‡ 95% confidence intervals determined by bootstrap with 20,000 replicates

defined as  $\text{cfPWV} \geq 10$  m/s, an established risk factor of cardiovascular diseases. Average SCo and SCa over 7 days were measured with Omron accelerometer-based pedometers (HJ-321). Odds ratios (ORs) and 95% confidence intervals (CIs) for high AS were calculated among quintiles of daily SCo and SCa. Participants were dichotomized as fast/slow walkers (obtaining any steps at  $\geq 60$  steps/minute or not) or active/inactive ( $\geq 5,000$  steps/day or not) for a joint analysis. Covariates were sex, age, body mass index, smoking, heavy alcohol intake, diabetes, hypertension, hyperlipidemia, medications, systolic blood pressure, and SCo or SCa in respective analyses. **RESULTS:** Participants walked 5,798 (SD=2,956) steps/day on average. There were 85 (22%) cases of high AS. Compared with the least active SCo quintile, the ORs (95% CIs) were 0.45 (0.19-1.07), 0.42 (0.17-1.03), 0.32 (0.12-0.87), and 0.51 (0.20-1.33) in quintiles 2, 3, 4, and 5 after adjusting for all covariates except SCa. There were no significant associations between SCo quintiles and AS after adjusting for SCa. Compared to the slowest SCa quintile, the ORs (95% CIs) for high AS were 0.29 (0.10-0.88), 0.31 (0.12-0.77), 0.58 (0.23-1.49), and 0.67 (0.21-2.09) after adjustment for covariates including SCo. In a joint analysis, compared to inactive and slow walkers, there were reduced odds of AS among fast walkers, regardless of whether they were inactive (0.35 [0.16-0.80]) or active (0.39 [0.18-0.81]), suggesting benefits of fast walking on AS regardless of daily SCo.

**CONCLUSIONS:** SCa (i.e., intensity of walking) rather than total daily SCo may be associated with reduced odds of high AS among older adults.

## 2004 Board #4 May 28 3:45 PM - 5:45 PM Types Of Social Support And Change In Daily Steps Among Adults

Courtney M. Monroe, Chih-Hsiang Yang, Gabrielle Turner-McGrievy. *University of South Carolina, Columbia, SC.*  
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(No relevant relationships reported)

Evidence has shown a favorable link between social support and leading a physically active lifestyle. Yet, little is known about the types of social support that may be the most influential.

**PURPOSE:** This study examined the association between physical activity (PA) change and the types of social support adults participating in a PA intervention identified as the most helpful for their PA efforts. **METHODS:** Insufficiently active adults were randomized as self-selected teams of 3-8 participants (n=24 teams) to a 12-week technology-mediated, theory-based PA treatment (n=59 participants) or the same intervention plus a real-time PA gamified challenge (n=57 participants). There were no significant differences between conditions in changes in mean daily steps, so analyses collapsed groups and examined participants at 12 weeks (N=116) and 1 year (n=98). Participants completed an online survey at both time points, which asked them to select the most helpful type of social support they received (informational; tangible; emotional; esteem). Configurational Frequency Analysis was used to analyze participants grouped according to their characteristic configurations in terms of meaningful changes in mean daily steps from baseline ( $\geq 1,000$  steps/d) as measured by an accelerometer and reported type of perceived social support. **RESULTS:** Participants averaged  $4853 \pm 1333$  steps/d at baseline and 39% and 36% achieved a  $\geq 1,000$  steps/d increase from baseline at 12 weeks and 1 year, respectively. Esteem support emerged as the most frequently reported most helpful type of support at 12 weeks and 1 year, followed by emotional and tangible support. At 12 weeks, those who achieved a  $\geq 1,000$  steps/d increase and reported emotional support as the most helpful type represented the most notable statistically significant configuration (n=14;  $p < .001$ ). At 1 year, those who achieved a  $\geq 1,000$  steps/d increase and reported tangible support as the most helpful type represented the most notable statistically significant configuration (n=9;  $p = .004$ ). **CONCLUSION:** These findings suggest that different types of support may be especially influential at varying phases of the behavior change process. Future studies should employ designs that allow for the direct comparison of the effectiveness of different types of support on physical activity in adults.

## 2005 Board #5 May 28 3:45 PM - 5:45 PM Associations Between Daily Steps, Stepping Cadence, And Arterial Stiffness In Older Adults

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(No relevant relationships reported)

**PURPOSE:** Higher daily steps counts are associated with lower arterial stiffness (AS). Less is known about the effects of stepping cadence (steps/minutes) on this relationship. We examined the associations between objectively measured steps counts (SCo), stepping cadence (SCa), and AS among older adults. **METHODS:** This cross-sectional analysis included 394 older adults (mean age 72, 59% female) enrolled in the Physical Activity and Aging Study (PAAS). AS was derived from carotid-femoral pulse wave velocity (cfPWV) using the SphygmoCor device (AtCor). High AS was

## 2006 Board #6 May 28 3:45 PM - 5:45 PM Computational Opportunities In The Estimation Of Free-living Temporal Gait Parameters From Wearable Accelerometry Data

JACEK K. URBANEK<sup>1</sup>, Marta Karas<sup>2</sup>, Melody Hsu<sup>1</sup>, Purnima Padmanabhan<sup>1</sup>, Ciprian Crainiceanu<sup>2</sup>, Amy Bastian<sup>1</sup>, Ryan Roemich<sup>1</sup>. <sup>1</sup>Johns Hopkins School of Medicine, BALTIMORE, MD. <sup>2</sup>Johns Hopkins Bloomberg School of Public Health, BALTIMORE, MD.  
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(No relevant relationships reported)

Wearable accelerometers are widely used to monitor free-living physical activity (PA) in the variety of epidemiological and clinical studies. Due to a small size, long battery life and low costs their popularity grew exponentially in recent years. This motivates researchers to seek additional utility of free-living accelerometry outside traditional PA measurements. Arguably, the assessment of mobility and gait parameters is one of the most popular and exciting applications of wearable accelerometers. However, because of the sheer size of free-living, sub-second level accelerometry data, the choice of existing analytical methods and the development of new ones is highly limited by the computational capabilities of modern computers and workstations. In this work, we explore possible solutions to this challenge. Namely, multi-core and graphics processing unit (GPU) computing. As a motivating example, we use the Adaptive Empirical Pattern Transformation (ADEPT), an open-source, dictionary-based pattern recognition method dedicated to the segmentation of walking strides in high-density accelerometry data. **PURPOSE:** We propose to minimize the computational time of the ADEPT algorithm by application of the GPU computing using inexpensive, desktop workstation equipped with the consumer-grade GPU. **METHODS:** We use data collected on 5 healthy participants equipped with the wrist-worn tri-axial Actigraph GT3X monitor over 48-hour period at sampling frequency of 100Hz. Next, we deploy the ADEPT algorithm on single-core Intel I9-900K CPU, 8-core CPU and Nvidia RTX 2080 GPU and measure total computation time. **RESULTS:** Average single-core CPU computation time was equal to 607.70 (sd = 0.3), multicore CPU was 344.40 (sd = 0.8) and GPU was 25.52 (sd = 0.07) seconds. GPU enabled computing allowed for nearly 23 times faster computation with respect to single-core and 14 times with respect to multicore processing. **CONCLUSIONS:** GPU accelerated computing allows for the application of more complex and time-consuming methods in the statistical analysis of high-density accelerometry data collected in free-living settings over multiple days. Additionally, it creates possibilities for scaling-up computationally intensive methods to much larger samples enabling their application in large epidemiological studies.

2007 Board #7 May 28 3:45 PM - 5:45 PM

**Association Of Steps Per Day With Premature Mortality: Results From The Cardia Study**

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 (No relevant relationships reported)

**PURPOSE:** The 2018 Physical Activity Guidelines Advisory Committee Report calls for research to examine associations of step volume with long-term clinical endpoints, including mortality. To date, there are few prospective studies examining accelerometer-measured steps/day with mortality.  
**METHODS:** Data are from 2027 participants from the Coronary Artery Risk Development in Young Adults (CARDIA) study with valid (≥4 days, ≥10 hours/day) accelerometer wear (ActiGraph 7164) at the year 20 exam (2005-2006). Multivariable Cox models calculated hazard ratios (HR) and 95% confidence intervals (CI) for mortality for the total sample and by race and sex.  
**RESULTS:** The sample (45.3±3.6 years; 58% women, 41% black) had mean follow-up time of 10.8±0.9 years, and 67 total deaths occurred. The participants had a median [IQR] of 10004 [8061-12097] steps/day according to the raw output and 6670 [4987-8617] steps/day when applying a censoring equation omitting steps accumulated at low accelerations of <500 counts/minute. Black women accumulated significantly lower step volume vs. all other race-sex groups (p<0.05). Adjusting for demographics, lifestyle characteristics, and comorbidities, every 1000 higher steps/day was associated with a 10% lower risk of mortality (HR:0.90, 95% CI:0.83, 0.99). When stratifying by race or sex, HRs remained statistically significant for women (HR:0.77, 95%CI:0.66, 0.90) and blacks (HR:0.85, 95%CI:0.76, 0.96). Black women had 28% lower risk of mortality for every 1000 higher steps/day (HR:0.72, 95%CI:0.58, 0.88).  
**CONCLUSIONS:** Among this sample of middle-age adults, accumulating a higher volume of steps/day was associated with a lower risk of mortality.

Hazard Ratios of the Association of Steps per Day with Risk of Mortality Overall and by Race and Sex Groups

	Steps/day - Raw* Median [IQR]	Steps/day - Censored <sup>b</sup> Median [IQR]	Deaths/Total (%)	HR (95% CI)
<b>Categorical - Quartiles of Steps/Day among Total Sample</b>				
Q1 (lowest)	6762 [5508-7452]	4244 [3556-4967]	27/506 (5.3%)	1.00
Q2	8959 [8553-9489]	6171 [5523-6743]	10/507 (2.0%)	0.43 (0.20, 0.90)
Q3	10981 [10501-11472]	7942 [7215-8521]	18/507 (3.6%)	0.83 (0.45, 1.56)
Q4 (highest)	14952 [12904-15660]	10950 [8836-13302]	12/507 (2.4%)	0.48 (0.23, 0.99)
<i>p for trend = 0.02</i>				
<b>Continuous - Per 1000 Steps/Day Greater</b>				
Total	10004 [8061-12097]	6670 [4987-8617]	67/2027 (3.3%)	0.90 (0.83, 0.99)
Women	9767 [7944-11734]	6440 [4770-8259]	32/1168 (2.7%)	0.77 (0.66, 0.90)
Men	10434 [8305-12537]	7170 [5287-9061]	35/859 (4.1%)	0.97 (0.87, 1.08)
Black	9483 [7503-11583]	6155 [4591-8110]	36/835 (4.3%)	0.85 (0.76, 0.96)
White	10280 [8440-12309]	7171 [5424-8920]	31/1192 (2.6%)	0.99 (0.87, 1.13)
Black Women	8996 [7224-11015]	5740 [4404-7553]	20/512 (3.9%)	0.72 (0.58, 0.88)
White Women	10342 [8491-12292]	7031 [5126-8752]	12/636 (1.9%)	0.82 (0.64, 1.06)
Black Men	10649 [8962-12964]	6879 [4987-8958]	16/303 (5.3%)	0.88 (0.73, 1.05)
White Men	10208 [8397-12323]	7278 [5542-9128]	19/556 (3.4%)	1.05 (0.91, 1.21)

\*Raw: raw values estimated by the ActiGraph 7164 accelerometer  
<sup>b</sup>Censored: omits steps in minutes at very low intensity accelerations of <500 counts per minute (cpm)  
 Models adjusted for wear time, age, sex, race, max education, center, healthy eating index, smoking status, alcohol intake, history of cardiovascular disease, type 2 diabetes, hypertension, obesity, hypercholesterolemia. All measured at Year 20.  
 Type 2 Diabetes: fasting glucose ≥ 126 mg/dL or 2h GTT ≥ 200 mg/dL or reported diabetes used use  
 Hypertension: SBP≥130 mmHg or DBP ≥80 mmHg or reported antihypertensive med use  
 Hypercholesterolemia: ≥240mg total cholesterol or reported lipid lowering med use  
 Obesity: BMI ≥ 30 kg/m<sup>2</sup>

**D-42 Free Communication/Slide - Clinical Aspects of Thermal Physiology**

Thursday, May 28, 2020, 3:45 PM - 5:15 PM  
 Room: CC-3014

**2008 Chair:** Caroline Smith, FACSM. *Appalachian State University, Boone, NC.*  
 (No relevant relationships reported)

**2009 May 28 3:45 PM - 4:00 PM Voluntary Cooling During Exercise Is Augmented In Heat Sensitive People With Multiple Sclerosis**

Nicole T. Vargas<sup>1</sup>, Alexis Lizzaraga<sup>1</sup>, Nadine M. Fisher<sup>1</sup>, Scott L. Davis<sup>2</sup>, Zachary J. Schlader, FACSM<sup>3</sup>. <sup>1</sup>University at Buffalo, Buffalo, NY. <sup>2</sup>Southern Methodist University, Dallas, TX. <sup>3</sup>Indiana University, Bloomington, IN. (Sponsor: Zachary Schlader, FACSM)  
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**Purpose:** Body cooling improves exercise tolerance in heat sensitive people with Multiple Sclerosis (MS). The effectiveness of cooling modalities in real-world settings requires appropriately engaging in cooling behavior. We tested the hypothesis that people with MS voluntarily engage in cooling behavior during exercise to a greater extent than healthy controls.

**Methods:** In a 27.0±0.2°C, 41±2% RH environment, 7 subjects with relapsing-remitting MS who exhibited heat sensitivity (34±7y, 167±5cm, 72±15kg, EDSS: 1.9±0.8, 1 male) and 7 healthy subjects (CON, 37±7y, 168±7cm, 71±11kg, 1 male) completed two randomized trials cycling for 40 min (EX) at a fixed rate of metabolic heat production (3.5 W/kg) followed by 30 min recovery (REC). In one trial, subjects were restricted from engaging in cooling (NONE). In the other, subjects pressed a button to receive 2 min of ~2°C water perfusing a suit top as often as desired (COOL). Mean skin (T<sub>sk</sub>, 8 site) and core (T<sub>core</sub>, telemetry pill) temperatures and mean skin wettedness (W<sub>sk</sub>, 8 site) were recorded continuously. Total voluntary time in cooling provided an index of cooling behavior. Ratings of perceived exertion (RPE), composite heat sensitivity symptom scores (HSSS, MS only) and subjective fatigue (MS only) were recorded every 10 min.

**Results:** T<sub>core</sub> (+0.5±0.1°C, P<0.01) and W<sub>sk</sub> (+0.52±0.02 a.u., P<0.01) increased in EX and remained elevated in REC (P<0.01) but were not different between trials (P≥0.35) or groups (P≥0.60). T<sub>sk</sub> decreased in MS COOL compared to MS NONE from min 20 EX to 5 REC (P≤0.02). There were no other differences in T<sub>sk</sub> (P≥0.25). MS spent more total time in cooling in EX (MS: 13.4±3.0 min; CON: 7.4±3.6 min, P<0.01) but not REC (MS: 1.7±1.4 min; CON: 0.3±0.7 min, P=0.40). In both trials, RPE was higher in MS vs. CON (P<0.01). HSSS increased in EX (P<0.01) but was not different between trials (P=0.25). Subjective fatigue was not different between trials in EX (P≥0.97) but was lower at 10 and 20 min of REC in COOL (P<0.02).

**Conclusions:** MS engaged in body cooling during EX to a greater extent than CON. While cooling did not affect HSSS or fatigue during EX, MS reported greater reductions in fatigue following exercise when cooling was permitted. Cooling during exercise could improve exercise participation and adherence.  
 Supported by: ACSM Foundation Research Endowment Grant

**2010 May 28 4:00 PM - 4:15 PM Blood Pressure Responses During A Cold Pressor Test Following Ketamine Or Fentanyl Analgesic Administration**

Joseph C. Watso<sup>1</sup>, Mu Huang<sup>1</sup>, Gilbert Morales<sup>1</sup>, Matthew N. Cramer<sup>1</sup>, Joseph M. Hendrix<sup>1</sup>, Frank A. Cimino, III<sup>1</sup>, Luke N. Belval<sup>1</sup>, Carmen Hinojosa-Laborde<sup>2</sup>, Qi Fu<sup>1</sup>, Craig G. Crandall, FACSM<sup>1</sup>. <sup>1</sup>University of Texas Southwestern Medical Center & Institute for Exercise and Environmental Medicine, Texas Health Presbyterian Hospital, Dallas, TX. <sup>2</sup>US Army Institute of Surgical Research, San Antonio, TX. (Sponsor: Craig Crandall, FACSM)  
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 (No relevant relationships reported)

Pain increases arterial blood pressure (BP) in an intensity-dependent manner. US Army Tactical Combat Casualty Care guidelines recommend ketamine (a N-methyl-D-aspartate receptor antagonist) or fentanyl (a μ-opioid receptor agonist) for pain

management in the prehospital setting. It is unclear if pain perception and related BP responses are different between these analgesics. **PURPOSE:** We sought to determine if reductions in pain perception and BP responses during a cold pressor test were different between ketamine or fentanyl administration. **METHODS:** Thirty-four healthy participants (16M/18F; 28±6 y; 26±3 kg·m<sup>-2</sup>, systolic BP 122±12 mmHg, diastolic BP 73±8 mmHg) completed two experimental visits in random crossover fashion, receiving either intravenous drug administration (n=22 with 20 mg ketamine, n=5 with 75 µg fentanyl, n=7 both crossover trials) or placebo (saline). Four minutes post-drug infusion, a cold pressor test was performed by placing the participant's hand in an ice water bath (~0.4°C) for two minutes. Pain perception was assessed using a 10-cm visual analogue scale immediately after the cold pressor test. Peak BP responses were calculated as the increase in BP during the second minute of the cold pressor test relative to BP just before the onset of the cold pressor test (post-infusion). Pain perception and peak mean BP changes were compared between drugs and placebo using one-way ANOVAs and Tukey's post hoc tests. **RESULTS:** Post-infusion, resting mean BP was higher (p<0.01) following ketamine compared to both fentanyl and placebo administrations (Ketamine: 106±13 mmHg; Fentanyl: 91±13 mmHg; Placebo: 93±8 mmHg; main effect: p<0.01). Ketamine and fentanyl similarly (p=0.66) attenuated pain perception to the cold pressor test compared to the placebo conditions (Ketamine: 2±3 cm; Fentanyl: 3±1 cm; Placebo: 7±1 cm; main effect: p<0.01). Consistent with reductions in pain perception, ketamine and fentanyl similarly (p=0.86) attenuated the peak mean BP response during the cold pressor test compared to placebo conditions (Ketamine: Δ 6±7 mmHg; Fentanyl: Δ 6±5; Placebo: 12±8 mmHg; main effect: p<0.01). **CONCLUSIONS:** These preliminary data suggest that ketamine and fentanyl similarly blunt pain perception and the associated BP response to a cold pressor test, despite ketamine raising resting BP.

2011 May 28 4:15 PM - 4:30 PM

### Analgesics In The Pre-hospital Setting: Fentanyl Does Not Alter Tolerance To Simulated Hemorrhage In Humans

Mu Huang<sup>1</sup>, Joseph C. Watso<sup>2</sup>, Gilbert Moralez<sup>1</sup>, Matthew N. Cramer<sup>2</sup>, Joseph M. Hendrix<sup>1</sup>, Mads Fischer<sup>1</sup>, Luke N. Belval<sup>2</sup>, Frank A. Cimino<sup>2</sup>, Carmen Hinojosa-Laborde<sup>3</sup>, Craig G. Crandall, FACSM<sup>2</sup>. <sup>1</sup>UT Southwestern Medical Center, Dallas, TX. <sup>2</sup>Institute for Exercise and Environmental Medicine, Texas Health Presbyterian Hospital Dallas and The University of Texas Southwestern Medical Center, Dallas, TX. <sup>3</sup>US Army Institute of Surgical Research, San Antonio, TX. (Sponsor: Craig Crandall, FACSM)  
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(No relevant relationships reported)

Hemorrhage is the leading cause of battlefield and civilian trauma deaths. Given that a hemorrhagic injury on the battlefield is usually associated with pain, it is paramount that the administered analgesic does not disrupt the physiological mechanisms that are beneficial towards the maintenance of blood pressure and vital organ blood perfusion during that hemorrhagic insult. Current guidelines from the US Army's Committee on Tactical Combat Casualty Care (CoTCCC) for the selection of pain medications administered to a hemorrhaging soldier are based upon limited scientific evidence, with the majority of supporting studies being conducted on anesthetized animals. Specifically, the influence of fentanyl, one of three analgesics employed in the pre-hospital setting by the US Army, on hemorrhagic tolerance in humans is entirely unknown. **PURPOSE:** The aim of this study is to test the hypothesis that fentanyl impairs the capacity for a conscious human to tolerate a simulated hemorrhagic insult. **METHODS:** Fourteen subjects (8 females, 27±7 years old, 173±9 cm, 77±12 kg) participated in this double-blinded, randomized, placebo-controlled crossover investigation. Following intravenous administration of fentanyl (75 µg—consistent with the US Army's CoTCCC guidelines) or placebo (saline), tolerance to a simulated hemorrhage was performed using a progressive lower-body negative pressure (LBNP) protocol to pre-syncope. Tolerance was quantified as a cumulative stress index (CSI), which is the sum of products of the LBNP stage and the duration at that stage [e.g., (40 mmHg·3 min) + (50 mmHg·3 min) ...]. **RESULTS:** Mean tolerance to the simulated hemorrhagic challenge was not different between the fentanyl and placebo trials (CSI: 585±406 mmHg·min and 626±267 mmHg·min respectively, P=0.67). **CONCLUSIONS:** These data, the first to be obtained in conscious humans, demonstrate that administration of the US Army's CoTCCC recommended dose of fentanyl does not compromise tolerance to a simulated hemorrhagic insult. These findings may be insightful in choosing the most suitable analgesic medication in the pre-hospital setting during a hemorrhagic injury.

2012 May 28 4:30 PM - 4:45 PM

### Impact Of Statin Use On Thermoregulatory Outcomes During Submaximal And Maximal Exercise

Rebecca L. Stearns, Rachel K. Katch, Beth A. Parker, John F. Jardine, Douglas J. Casa, FACSM. *Korey Stringer Institute, University of Connecticut, Storrs, CT.* (Sponsor: Douglas Casa, FACSM)  
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(No relevant relationships reported)

Statins are among the most widely prescribed drugs in the US and world. However, many of their side effects and drug mechanisms may impact the users safety during exercise, specifically in the heat.

**PURPOSE:** Perform a preliminary analysis on the thermoregulatory impact of statins during submaximal and maximal exercise in the heat.

**METHODS:** Participants in the 11.26km Falmouth Road Race (Falmouth, MA) were recruited. Statin (S) users were matched by age, sex, VO<sub>2</sub>max, and body surface area (BSA) with an appropriate control (CON). All participants completed a modified heat tolerance test (HTT) (11.26km, 60% VO<sub>2</sub>max, 2% incline; WBGT 23.42±0.77°C) about two-weeks prior to the race. Participants then reported for data collection on race day before and immediately post race. Measures of heart rate (HR), rectal temperature (T<sub>rec</sub>) and race finish time (min) were collected. Paired samples t-tests were conducted to evaluate delta values for variables collected at pre to post HTT and pre to post race day. Significance was set *a priori* at p<0.05.

**RESULTS:** Five S users (3 males, 2 females) were identified. Demographic data for S and 5 same sex CON were: age, 53±8y, 51±10y; height 168±8cm, 178±11cm; VO<sub>2</sub>max 44.46±14.00ml·kg<sup>-1</sup>·min<sup>-1</sup>, 45.66±10.77ml·kg<sup>-1</sup>·min<sup>-1</sup>; and BSA 1.75±0.18m<sup>2</sup>, 1.86±0.18m<sup>2</sup>, respectively. Pre to Post HTT T<sub>rec</sub> delta for S (0.97±0.25°C) and CON (1.24±0.53°C) were similar (p>0.05). Pre to Post race day T<sub>rec</sub> delta for S (2.64±1.30°C) and CON (2.67±1.43°C) were similar (p>0.05). Pre to Post HTT HR delta for S (17±5bpm) and CON (19±15bpm) were similar (p>0.05). Pre to Post race day HR delta for S (38±28bpm) and CON (65±23bpm) were significantly different (p=0.012). Finish time on race day was similar between S (60.9± 11.8) and CON (60.5±10.7min).

**CONCLUSION:** While HR and T<sub>rec</sub> delta values appeared to be similar during submaximal exercise, HR delta was significantly lower in the S group compared to CON during a race scenario, despite similar T<sub>rec</sub> delta values. This may be a result of the known influence statins have on skin blood flow and reflect a potential for changes in cardiovascular regulation during exercise in the heat when individuals regularly use statins. Future research is warranted to determine the source of these potential thermoregulatory responses and impact on risk for heat related illnesses.

2013 May 28 4:45 PM - 5:00 PM

### Interaction Between Exercise Intensity And Burn Size Affects Body Temperature During Exercise In The Heat

Luke N. Belval, Matthew N. Cramer, Mu Huang, Gilberto Moralez, Frank A. Cimino, III, Joseph C. Watso, Craig G. Crandall, FACSM. *Institute for Exercise and Environmental Medicine, Dallas, TX.* (Sponsor: Craig Crandall, FACSM)  
(No relevant relationships reported)

US Army Standards of Medical Fitness exclude personnel who have sustained burn injuries covering 40% or more of their body surface area (BSA). However, this requirement is not specific to different exercise intensities that an individual is expected to perform and therefore does not take metabolic heat generation into account. **PURPOSE:** To test the hypothesis that the magnitude of the elevation in internal body temperature during exercise in a warm environment is influenced by the combination of exercise intensity and percentage BSA burned. **METHODS:** Nine healthy participants (8 males, 1 female; 33±9 y; 176±7 cm, 75.2±12.0 kg) completed eight exercise trials on a cycle ergometer, each with differing combinations of exercise intensities (Low: 4 W/kg and Moderate: 6 W/kg) and simulated BSA burn percentages in a warm environmental chamber (39.8±0.3°C, 20.5±1.5 %rh). Burns were simulated by covering 0%, 20%, 40% or 60% of participants' BSA with a highly absorbent, vapor-impermeable material. Gastrointestinal temperature (TGI) was recorded throughout exercise, with the primary analysis (mixed-model with contrasts and Bonferroni corrections comparing simulated burn trials to 0%, with p<0.017 for significance) being the magnitude of the elevation in TGI after 60 min of exercise. **RESULTS:** The statistical model identified an interaction effect (p=0.005), suggesting that the magnitude of the elevation in TGI was influenced by both exercise intensity and simulated BSA. Regardless of the percentage BSA burn simulated, the increase in TGI was similar across low intensity trials (mean increase: 0.69±0.27°C, p>0.05). However, during moderate intensity exercise the magnitude of the increase in TGI was greater for the 60% (1.76±0.39°C; p<0.001) and 40% (1.23±0.51°C; p=0.0014) BSA coverage trials, relative to the 0% (0.80±0.42°C) BSA coverage trial. There were no differences between 0% and 20% (1.06±0.42°C; p=0.049) BSA coverage trials. **CONCLUSIONS:** These data suggest that exercise intensity influences the relationship between burn injury size and thermoregulatory responses during exercise

in a warm environment. Clinical guidance and US Army Standards for burn survivors should, therefore, consider the intensity of the exercise bout alongside BSA burned when determining limitations to physical activity.

2014 May 28 5:00 PM - 5:15 PM

### The Effect Of Burn Location On Internal Body Temperature Responses During Exercise In The Heat

Frank A. Cimino, III, Matthew N. Cramer, Gilberto Morales, Mu Huang, Luke N. Belval, Joseph C. Watso, Craig G. Crandall, FACSM. *The Institute for Exercise and Environmental Medicine, Dallas, TX.* (Sponsor: Craig Crandall, FACSM)  
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(No relevant relationships reported)

According to the US Army's Standard of Medical Fitness (AR 40-501), extensive burn injuries will disqualify individuals from US Army service, depending in part on the anatomic location of the injury. Specifically, these guidelines state that "extensive burns on the torso will most significantly impair heat dissipation." and that burn injuries could be a disqualifying criteria for continued service. However, the effects of the location of the burn injury on thermoregulation during exercise is currently unknown. **Purpose:** This study tested the hypothesis that a torso burn injury is not any more detrimental to whole-body heat dissipation relative to a similar sized non-torso burn injury. **Methods:** Nine healthy subjects (29±6 years; 72.44±11.29 kg; 1.86±0.17 m<sup>2</sup>) walked on a treadmill (~3.3mph) in the heat (40 °C and 20% relative humidity) for 60 minutes at a fixed rate of metabolic heat generation (5.7±0.5 W/kg). Identical ~25% body surface area (BSA) burn injuries to the torso or non-torso extremities (randomized) were simulated by applying a highly absorbent vapor-impermeable material over those regions. The elevation in internal body temperature assessed via an ingestible telemetry pill, was the primary variable of interest. Additional analyses were performed to assess differences in heart rate and thermal sensation. **Results:** The statistical model (2 way repeated measures ANOVA) identified a main effect of time (p<0.001; 0.94±0.33 °C for torso and 0.91±0.34°C for extremity at end of exercise) on the increase in internal body temperature, with no effect of simulated burn location (p=0.76) or interaction (p=0.10). Heart rate and thermal sensation showed similar responses, with a significant main effect of time (p<0.001) with no effect of burn location (p=0.09) or interaction (p=0.13). **Conclusion:** Contrary to the Army's guidelines, these results suggest that torso burns do not limit heat dissipation and exacerbate thermal strain compared to non-torso burn injuries. Therefore, the Army should not consider torso burns as being more detrimental when determining whether a soldier meets the Standard of Medical Fitness.

Funding: Department of Defense - US Army W81XWH-15-1-0647

### D-43 Free Communication/Slide - Concussion and Movement Performance

Thursday, May 28, 2020, 3:45 PM - 5:45 PM  
Room: CC-3020

2015 **Chair:** James Onate. *Ohio State University, Columbus, OH.*  
(No relevant relationships reported)

2016 May 28 3:45 PM - 4:00 PM

### Effect Of Training Session On Postural Control, Self-reported Concussion Symptoms In Adolescent Female Soccer Athletes

Emily D. Geyer, Maria K. Talarico, Nathan A. Edwards, Matthew P. Brancaleone, Adam M. Culiver, James A. Onate. *Ohio State University, Columbus, OH.*  
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**Reported Relationships:** E.D. Geyer: Other (please describe); The equipment utilized in this experiment was provided by ProtXX Inc. free of cost.

**PURPOSE:** Given the rising emphasis on reducing concussions in sport, it is important to understand the effects of repetitive head impacts on youth athletes and to use this information to optimize the clinical management of concussions. The purpose of this study was to determine the effect of a soccer training session with headers on postural control performance and concussion-like symptoms of healthy adolescent female soccer athletes. **METHODS:** Eighteen female soccer athletes (15±0.725 yrs) from an elite soccer club engaged in a 90-minute soccer training session with headers. Prior to and following the training session, participants completed double-limb postural control assessments with eyes open and closed, as well as a symptom questionnaire (SCAT5). An inertial measurement unit was worn behind the ear which

collected tri-axial accelerations during assessments. Mean sway velocity and sway velocity root-mean-square (RMS) were calculated for each condition. Two-way repeated measures ANOVAs were performed to determine if visual condition (eyes open, eyes closed) and time of testing (pre-, post-training) influenced postural control performance. Wilcoxon Signed Rank tests were performed to determine differences between pre- and post-training symptomology scores. Alpha level was set a priori at P≤0.05. **RESULTS:** A time main effect on sway velocity was observed where participants exhibited faster sway post-training compared to pre-training (mean difference=0.069 cm/s; p=0.004). A vision main effect on RMS was observed where participants exhibited larger RMS with eyes open compared to eyes closed (mean difference=0.038 cm/s; p=0.015). No difference in total symptom scores were observed (Z = -1.729, p=0.084). **CONCLUSIONS:** Soccer training with heading influenced postural control performance of elite adolescent female club soccer athletes, but did not influence overall symptom scores. These findings underscore the importance of incorporating postural control outcomes into clinical assessments to comprehensively evaluate performance. With heightened public concern regarding concussion and the safety of contact sports, it is imperative to assess for potential postural control deficits following training with heading in neurodevelopmentally vulnerable populations such as female adolescents.

2017 May 28 4:00 PM - 4:15 PM

### Influences Of Sleep Disturbances And Mild Traumatic Brain Injury On Gait Performance Among College Students

Tara Bridgeman, Yang Hu, Xiaoyu Zhang, Shih-Feng Chou, Shih-Yu Sylvia Lee, Xuanliang Neil Dong. *The University of Texas at Tyler, Tyler, TX.* (Sponsor: Joyce Ballard, FACSM)  
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(No relevant relationships reported)

Sleep disturbances from stress are common among college students. In addition, student athletes in contact sports (e.g., football and soccer) are at a higher risk of receiving a mild traumatic brain injury (mTBI). Stress-related sleep disturbances and mTBI may provoke cognitive and brain changes associated with gait abnormalities. **PURPOSE:** to examine the association between stress, sleep disturbances, mTBI and gait performance among college students. **METHODS:** The control group included 28 college students (11 males, 17 females, age: 22.6±3.2 yrs) and the mTBI group consisted of 12 NCAA Division II men's and women's soccer players who indicated a history of concussion (3 males, 9 females, age: 19.6±1.3 yrs). Participants were asked to perform gait analysis with an in-shoe pressure measurement system during and after the midterm exam. Cadence, step time, stride time, stance time and swing time were measured. Meanwhile, 14-days consecutive wrist actigraphy data and three sets of questionnaires were collected to assess their stress, sleep and fatigue. A mixed-design ANOVA was used to compare gait and sleep parameters of mTBI and control groups. **RESULTS:** The mTBI group had significantly shorter step time (0.54±0.01 vs. 0.58±0.01 s, p=.011) and stance time (0.66±0.01 vs. 0.70±0.01 s, p=.013) compared to the control group. The control group had significantly longer step time and stance time during the midterm exam than after the midterm exam. However, no significant differences of gait parameters were observed for the mTBI group during and after midterm exam. During the exam week, participants in both control and mTBI groups perceived moderate stress and reported 2-3 nights of sleep disturbances. Meanwhile, stress level was positively associated with sleep disturbances, poor daytime functioning, and poor activity correlation. **CONCLUSION:** Midterm exam as a stressor resulted in sleep disturbances in both mTBI and control groups. This stressor may also cause gait abnormalities of the control group, but not the mTBI group. Another interesting finding is that shorter step time and stance time were observed in the mTBI group. Nevertheless, further studies need to examine whether this is indeed due to mTBI, or the difference between student athletes and non-athletes. Supported by Office of Research and Scholarship at UT Tyler.

2018 May 28 4:15 PM - 4:30 PM

### Upping The Ante: Can Agility Performance Differentiate Previously Concussed From Healthy Controls?

Lucy Parrington<sup>1</sup>, Peter C. Fino<sup>2</sup>, Leland E. Dibble<sup>2</sup>, Margaret M. Weightman<sup>3</sup>, Laurie A. King<sup>1</sup>. <sup>1</sup>Oregon Health & Science University, Portland, OR. <sup>2</sup>University of Utah, Salt Lake City, UT. <sup>3</sup>Oregon Health & Science University, Minneapolis, MN.  
(No relevant relationships reported)

Returning to sport or active duty has the potential to put athletes or service members at risk. Yet, post-concussion assessments primarily rely on subjective reporting or simple clinical tests - tasks that lack ecologic validity in comparison with sport or combat environments. Both environments may require fast-paced movements such as turning, which involves the integration of oculomotor and vestibular information, as well as cognitive control for execution. Testing anticipated and unanticipated turns during agility tasks performed at high speeds may provide a more valid test setting,

and help to quantify differences between previously concussed and healthy persons performing more complex movement tasks. **PURPOSE:** To compare performance on unanticipated and anticipated agility tasks between previously concussed and healthy controls. **METHODS:** We tested agility performance, defined by peak turning velocity (yaw, °/s), in previously concussed and healthy controls in two participant samples: athletes (concussed  $n=5$ , control  $n=5$ ) and a general population (concussed  $n=8$ , controls  $n=10$ ). Athletes completed unanticipated turns cued by a light stimulus, and the general population completed anticipated turns using a modified Illinois Agility task (IAT). Peak turning velocity was extracted from a waist worn inertial sensor. Athlete and general population data were compared separately. Cohen's  $d$  effect size was used to evaluate between-group differences due to small sample sizes. **RESULTS:** The concussed athletes (mean(SD); 239(46) °/s) turned slower than the control athletes (300(37) °/s;  $d = -1.45$ , large effect) completing unanticipated turns. In the general population performing anticipated turns, the concussed group (220(23) °/s) turned slower than the healthy controls (237(33) °/s;  $d = -0.57$ , medium effect). **CONCLUSION:** Findings suggest differences between groups in both samples, despite using different agility tasks. Moving forward, we plan to evaluate anticipated turns performance in an active military duty population. However, unanticipated turn tasks, which require a movement coupled in response to stimulus are an interesting area for future exploration. Supported by the Assistant Secretary of Defense for Health Affairs (#W81XWH-18-2-0049) and the Medical Research Foundation of Oregon.

2019 May 28 4:30 PM - 4:45 PM

### Analyzing Chronic Balance Deficits In A Concussed Population

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(No relevant relationships reported)

**PURPOSE:** Balance impairments have been extensively examined in acutely concussed individuals; however, persistent balance alterations have yet to be conclusively established. The purpose of this study was to examine persistent balance deficits using inertial measurement units (IMU's) in previously concussed participants (CON) compared to non-concussed participants (NC). **METHODS:** Forty participants ( $n=20$  CON: 22.39 ± 3.40 years old, 1.90 ± 1.21 concussions, 5.64 ± 2.72 years from last concussion, sex= 50% female;  $n=20$  NC: 24.81 ± 5.53 years, sex= 50% female) completed the Modified Clinical Test of Sensory Interaction on Balance (mCTSIB) while equipped with six IMU's. All participants completed the trials successfully, thus kinematic balance measures were analyzed. Between-group differences for total and planar (sagittal and coronal) mean velocity and the root mean squared (RMS) of total and planar sway acceleration were evaluated with independent t-tests. Correlations and linear regression models were used to examine the effect of time in years since last diagnosed concussion (TCON) and self-reported strenuous levels of weekly physical activity (PA) on balance variables among the CON participants. **RESULTS:** Independent t-tests produced several significant group differences during the eyes closed on foam surface (ECF) trials for total mean velocity, sagittal mean velocity, total RMS sway, and sagittal RMS sway ( $p < 0.05$ ). Correlations indicated TCON ( $p < 0.05$ ) and PA ( $p < 0.05$ ) were significantly inversely related to all ECF balance variables, except coronal mean velocity and coronal RMS sway. Linear regression of TCON and PA onto balance variables during ECF testing were significant for mean velocity ( $R^2=0.402$ ,  $p=0.013$ ), sagittal mean velocity ( $R^2=0.426$ ,  $p=0.009$ ), and sagittal RMS sway ( $R^2=0.301$ ,  $p=0.047$ ), with total RMS sway trending towards significance ( $R^2=0.297$ ,  $p=0.05$ ). **CONCLUSIONS:** Our study suggests those with a concussion history may present with lingering balance alterations that diminish as time since incidence (TCON) increases and in those who maintain an active lifestyle (PA). Future research should consider using dynamic balance exercises to best evaluate balance in previously concussed participants.

2020 May 28 4:45 PM - 5:00 PM

### Sport-related Concussions Have A More Conservative Stepping Pattern During Instrumented Tandem Gait Performance

Cameron Kissick<sup>1</sup>, Brennan Jordan<sup>1</sup>, Brian Szekely<sup>1</sup>, Sushma Alphonso<sup>1</sup>, Philip Pavilionis<sup>1</sup>, Arthur Islas<sup>1</sup>, Daniel Cipriani<sup>2</sup>, Ryan Moran<sup>3</sup>, Nicholas G. Murray<sup>1</sup>. <sup>1</sup>University of Nevada, Reno, Reno, NV. <sup>2</sup>West Coast University, Los Angeles, CA. <sup>3</sup>University of Alabama, Tuscaloosa, AL.  
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(No relevant relationships reported)

Tandem gait has emerged as a dynamic and clinically viable test of dynamic motor control following sport-related concussion (SRC). A myriad of tools are available to objectively assess gait kinematics. One piece of equipment, the Tekscan Strideway,

uses individual load cells on a series of connected force platform tiles to quantify gait. No data exists that examines the performance of SRC using this device. **PURPOSE:** The purpose of this study was to evaluate the differences in center of pressure (CoP) performance during single-task (ST) and dual-task (DT) tandem gait within 24-48 hours post-SRC. **METHODS:** 18 Division I [SRC (age: 19 ± 1.00 yr. Male=7, Female=11)] and 18 nearly matched controls [CON (age: 19.88 ± 1.05 yr. Male=7, Female=11)] completed the vestibular ocular motor screening test (VOMS) and 3 trials of ST and 1 trial of DT (serial 7s) using the Tekscan Strideway (30Hz, Boston, MA). The raw CoP trajectory for the best tandem gait trial of each condition (fastest overall) was exported and further analyzed using a custom MATLAB code. All turns during the tandem gait trials were removed and each straight path walking was composed together. The raw CoP data in the AP and ML directions were smoothed using empirical mode decomposition and then excursion and velocity data were calculated. T-tests compared the time to complete ST and DT while two multivariate ANOVAs compared CoP in the AP and ML directions. **RESULTS:** SRC took significantly longer to complete the ST trial ( $p=0.006$ ; SRC=14.2±4.4s, CON=10.8±2.1s) but not the DT trial ( $p=0.279$ ). The SRC group had a larger VOMS near-point convergence (NPC) ( $p=0.007$ ; SRC=9.5±5.5cm, CON=5.2±2.9cm) and a higher VOMS change score ( $p<0.001$ ; SRC=19.7±6.4, CON=0±0). A significant omnibus effect was noted in AP direction ( $p=0.015$ ) but not in the ML direction ( $p=0.996$ ) for the tandem gait CoP data. Follow-up comparisons noted that in the AP direction during ST, SRC had slower CoP excursion ( $p=0.003$ ; SRC=1.6±0.2cm, CON=1.9±0.4cm) and lower CoP velocity ( $p=0.004$ ; SRC=54.2±7.7cm/s, CON=66.1±14.2cm/s) but no differences during DT. **CONCLUSIONS:** These results suggest that during instrumented ST tandem gait, SRC have a more conservative and slower heel-to-toe stepping pattern.

2021 May 28 5:00 PM - 5:15 PM

### The Head Shake Sensory Organization Test And Screening Individuals With Self-reported History Of Concussion

Adrian Aron, Daniel Miner, Brent Harper, Ashley Dudding, Ashley Humphries, Sam Lawrence, Brooke McDermott, Radford University, Roanoke, VA. (Sponsor: A. Lynn Millar, FACSM)  
(No relevant relationships reported)

**PURPOSE:** The Sensory Organization Test (SOT) assesses impairments in postural control following acute concussion. Head Shake Sensory Organization Test (HS-SOT) is a superior test that challenges the vestibular system to help detect more subtle deficits missed by SOT. The purpose of this study was to assess the accuracy of the HS-SOT in identifying residual impairments of postural control in individuals with self-reported history of concussion.

**METHODS:** The Ohio State University-Traumatic Brain Injury Identification Method (OSU TBI-ID) determined self-reported history of concussion while NeuroCom was used to perform HS-SOT. Twenty-nine subjects were included (11 males and 18 females, mean age 25.2 ± 3.7; history of concussion:  $n=14$ , 5 males and 9 females, mean age 25.7±3.5; no concussion:  $n=15$ , 6 males and 9 females, mean age 24.8±4.0). Independent T-Tests were completed to determine performance differences based on history of concussion.

**RESULTS:** HS-SOT fixed surface equilibrium ratio was similar ( $p = 0.988$ ) between those without a history of concussion (0.998 ± 0.024) and those with a history of concussion (0.998 ± 0.026). Furthermore, HS-SOT sway reference surface equilibrium ratio was also similar ( $p = 0.431$ ) between those without a history of concussion (0.871 ± 0.128) and those with a history of concussion (0.9136 ± 0.160). Within subjects with a history of concussion, younger subjects (23.4 ± 0.8) had a lower sway index compared to older (30.3 ± 3.6) individuals (0.85 ± 0.11 vs 1.09 ± 0.16,  $p=0.021$ ). In addition, the younger group trended toward a more recent history of a concussive event (4.7 ± 4.8 vs. 8.0 ± 3.4,  $p=0.25$ ).

**CONCLUSIONS:** There was no difference in HS-SOT in subjects with or without a history of concussion demonstrating an inability to detect performance impairments. Of those with a concussion, the HS-SOT significantly identified subtle performance deficiencies in younger individuals, suggesting that time from concussion tends to normalize sub-clinical deficits. This indicates that postural control impairments initially persist but resolve over time, which may place individuals at risk for injury during this window of recovery.

2022 May 28 5:15 PM - 5:30 PM

### Comparing Functional Movement Under Single And Dual Task Conditions: Implications For Post-concussion Management

Landon B. Lempke, Rachel S. Johnson, Jeonghoon Oh, Julianne D. Schmidt, Robert C. Lynall. University of Georgia, Athens, GA.  
Email: lblempke@uga.edu  
(No relevant relationships reported)

Movement assessments are commonly performed while strictly completing the assessment (single task). Sport movement is highly dynamic and requires concurrent

cognitive processing and movement (dual task). Simultaneous cognitive processing and movement may alter human movement, but to date has not been examined. **PURPOSE:** To compare kinematic and kinetic outcomes between single and dual task functional movement among healthy individuals. **METHODS:** Physically active participants (n=41, 49% female; 22.5 ± 2.1yrs; 172.5 ± 11.9cm; 71.0 ± 13.7kg) completed a functional movement assessment (cut) under single and dual task (subtracting by 6's or 7's) conditions in random order. The cut involved jumping forward from a 30cm tall box set at 50% of the participant's height and performing a single, dominant-leg, 45 degree cutting motion after landing (four trials). The cut was completed in an eight camera (Qualisys; 120Hz) 3D motion capture space with two piezoelectric force plates (Bertec; 1200Hz). Multiple repeated measures ANOVAs ( $\alpha=0.05$ ) compared hip, knee, and ankle joint angles (deg) and normalized joint moments (Nm/kg) at initial contact in sagittal and frontal planes, and normalized peak vertical ground reaction force (vGRF; N/kg) between single and dual task conditions. **RESULTS:** Results are presented in the Table. Dual task resulted in significantly greater ( $p=0.03$ ) varus knee moments compared to single task. Dual task vGRF force was significantly less ( $p=0.01$ ) compared to single task. No other outcomes were significant ( $p\geq 0.06$ ). **CONCLUSION:** Slight kinematic and kinetic differences were observed between single and dual task during the cut. Reduced vGRF and greater varus knee joint moments during dual task may indicate altered movement during concurrent cognitive loading. Our findings provide initial metrics for future post-concussion biomechanical comparisons. Supported by the University of Georgia College of Education Early Career Faculty Research Grant.

**Table. Dominant Leg Kinematic and Kinetic Outcomes During a 45-Degree cut at Initial Ground Contact.**

Outcome	Value Direction	Single Task	Dual Task	P-Value
		Mean (95% CI)	Mean (95% CI)	
Hip Angle (deg)	Flexion	27.4(23.4 – 31.4)	25.9(22.0 – 29.9)	0.50
	Adduction	13.1(11.2 – 15.0)	12.6(10.7 – 14.5)	0.40
Knee Angle (deg)	Flexion	4.9(2.1 – 7.8)	4.9(2.0 – 7.7)	0.93
	Varus	1.9(0.8 – 3.1)	1.9(0.7 – 3.0)	0.65
Ankle Angle (deg)	Plantarflexion	43.2(38.9 – 47.6)	40.3(36.0 – 44.7)	0.06
	Inversion	12.3(10.4 – 14.3)	12.0(10.0 – 13.9)	0.45
Hip Moment (Nm/kg)	Extension	1.07(0.95 – 1.19)	0.99(0.87 – 1.11)	0.15
	Abduction	-0.18(-0.23 – -0.12)	-0.18(-0.24 – -0.13)	0.74
Knee Moment (Nm/kg)	Extension	-0.63(-0.68 – -0.58)	-0.63(-0.68 – -0.58)	0.96
	(+): Varus(-): Valgus	-0.0015(-0.05 – -0.02)	0.0025(-0.03 – 0.04)	0.03 <sup>a</sup>
Ankle Moment (Nm/kg)	Dorsiflexion	0.09(0.07 – 0.12)	0.09(0.07 – 0.11)	0.78
	Eversion	0.03(0.02 – 0.03)	0.02(0.02 – 0.03)	0.22
Peak Vertical Ground Reaction Force (N/kg)		2.90(2.79 – 3.01)	2.82(2.71 – 2.93)	0.01 <sup>a</sup>

<sup>a</sup> Significant at  $p \leq 0.05$ .

**2023** May 28 5:30 PM - 5:45 PM  
**Dual-task Balance Control in Adolescent Athletes Following Concussion**  
 Tracy Zaslow, Camille Burton, Nicole Mueske, Adriana Conrad-Forrest, Bianca Edison, Tishya Wren. *Children's Hospital Los Angeles, Los Angeles, CA.* (Sponsor: Tracy Zaslow, FACSM)  
*(No relevant relationships reported)*

**Purpose:** Previous research has identified deficient dual-task balance control at the time of return to play (RTP) and possible worsening after RTP in older adolescents/young adults with concussion. We investigated these issues in younger concussion patients, hypothesizing they would have slower walking speed and increased medial-lateral (ML) center of mass (COM) movement, which would normalize by RTP but worsen after resuming activity.

**Methods:** 13 concussed adolescents (7 male; age 10-17 years) were prospectively evaluated at their initial visit (mean 18, range 4-43 days post-concussion), at RTP clearance (46, range 12-173 days post-concussion), and one month later (26, range 20-41 days post-RTP). Standing balance was assessed using range and root mean squared (RMS) COM motion during 2-leg, eyes open standing while performing audio Stroop, side-to-side head turn (HT), and side-to-side thumb tracking tasks. Dynamic balance was assessed using walking speed and COM ML range and velocity during walking alone and with head turn and verbal fluency (reciting words starting with "F") dual tasks. Patients were compared to 11 controls (3 male) using t-tests, and changes over time were evaluated using linear mixed-effects regression. **Results:** During standing, patients had higher COM ML RMS than controls at baseline during HT and higher COM anterior-posterior (AP) range during thumb tracking. COM ML motion decreased from baseline to RTP (HT range -6.5mm,  $p=0.058$ ; HT RMS -16.8mm,  $p=0.002$ ; thumb range 9.2mm,  $p=0.012$ ) and increased from RTP to 1 month follow-up (HT RMS +10.0mm,  $p=0.040$ ; Stroop RMS +8.4mm,  $p=0.086$ ). Patients walked slower than controls at baseline during all tasks, and COM ML range was higher in patients during verbal fluency at baseline and RTP. Walking speed increased from baseline to RTP during verbal fluency (+7.8cm/s,  $p=0.044$ ), from RTP to post-RTP in single task walking (+6.1cm/s,  $p=0.041$ ), and at each successive visit during HT (+6.0cm/s and +6.5cm/s,  $p<0.07$ ). COM ML range decreased in patients from baseline to RTP with verbal fluency (-14.7mm,  $p=0.011$ ) and from RTP to post-RTP in single task walking (-4.0mm,  $p=0.061$ ). **Conclusion:** Balance control deficits improved by RTP and only worsened post-RTP during dual-task standing, suggesting that current conservative treatment protocols are appropriate.

**D-44** Clinical Case Slide - Oncology II  
 Thursday, May 28, 2020, 3:45 PM - 5:45 PM  
 Room: CC-2005

**2024** **Chair:** Rahul Kapur. *University of Minnesota, St Paul, MN.*  
*(No relevant relationships reported)*

**2025** **Discussant:** Suzanne S. Hecht, FACSM. *University of Minnesota, Minneapolis, MN.*  
*(No relevant relationships reported)*

**2026** May 28 3:45 PM - 4:05 PM  
**Concerning The Utility Of Ultrasound Imaging In Soft Tissue Lesions**  
 Chad Curtis<sup>1</sup>, Christopher Jordan<sup>2</sup>. <sup>1</sup>*St. Joseph Medical Center, Osceola, IN.* <sup>2</sup>*St. Joseph Medical Center, Mishawaka, IN.*  
*(No relevant relationships reported)*

**HISTORY:** A 13-year-old female initially presented to her primary care physician with a complaint of right forearm swelling. Her symptoms were present for approximately two weeks and she experienced constant pain in the area. Her pain and swelling were located over the dorsal aspect of the forearm. The patient's symptoms were initially presumed to be muscle strain and initial treatment included ibuprofen and ice. Of note the patient is right hand dominant. She had a follow up appointment two weeks later, and her symptoms were unchanged. Due to persistent symptoms x-rays were obtained, which were unremarkable. She was subsequently sent to the sports medicine office for possible ultrasound examination. Upon initial encounter with sports medicine clinic, the patient reported persistent pain and started to have intermittent numbness sensation in her 3<sup>rd</sup> - 5<sup>th</sup> digits. **PHYSICAL EXAMINATION:** Musculoskeletal exam of right upper extremity was completed. Inspection was without deformity or bruising. Palpation was with normal anatomy at elbow. No tenderness to palpation of the elbow was elicited. A firm mass over the right forearm extensor muscle bodies was identified in the region of the mid to proximal radius. There was also tenderness over this point. Her range of motion was within normal limits and was without pain. Her exam was significant for sensation deficit to soft touch at 3rd-5th digits. **DIFFERENTIAL DIAGNOSES:** 1. Hemangioma 2. Hematoma 3. Cystic structure 4. Malignancy **TEST AND RESULTS:** X-Rays Elbow - Normal x-rays of right elbow. Ultrasound - Hyperemic soft tissue muscle mass MRI - 2x1x4 cm gadolinium enhanced mass of anterolateral side of the mid-radius without obvious origin. Image-guided core needle biopsy Differential of PNET and monophasic synovial sarcoma. **FINAL DIAGNOSES:** Ewing Sarcoma **TREATMENT and OUTCOMES:** 1. Chemotherapy 2. Proximal radial diaphyseal resection and fusion of the distal radius with the proximal ulna. 3. NM PET was without FDG uptake to suggest recurrent or metastatic disease. 4. Follow up work up was significant for imaging with expected surgical changes and with apparent remission and without metastasis.

THURSDAY, MAY 28, 2020

2027 May 28 4:05 PM - 4:25 PM

**"Painless Fracture Hides Rare Bony Malignancy"**Alexander Chasin<sup>1</sup>, Amie Kim<sup>2</sup>. <sup>1</sup>Brookdale University Hospital and Medical Center, Brooklyn, NY. <sup>2</sup>Mount Sinai, New York, NY. Email: azc5154@gmail.com

(No relevant relationships reported)

**HISTORY:** 48 year old male with history of unprovoked DVT presents to the ED with left knee pain for 3 months. Symptoms began at rest, and described as sharp constant pain localized to the knee. Three weeks prior, he was evaluated by his primary care doctor and was clinically diagnosed with a knee sprain with conservative management. Two weeks ago, he felt an atraumatic "pop" in his lower extremity. Since that time he has since been unable to weight bear. No constitutional or B-type symptoms.

**PHYSICAL EXAM:** Thin, well appearing male, seated in a wheelchair. Seated exam was performed secondary to the patient's pain. He was unable to bear weight on his left lower extremity and it was held in passive internal rotation. His left hip had no tenderness over the greater tuberosity and he had limited range of motion. His left knee was without erythema, effusion or warmth and there was no tenderness over the medial or lateral joint lines. Range of motion of his knee was limited. No specialized tests were able to be performed given patients positioning and discomfort. His left ankle was nontender with no gross deformities. His dorsalis pedis pulse was 2+ and flexion/extension of the toes were intact.

**DIFFERENTIAL DIAGNOSIS:**

- 1) Hip dislocation/fracture, pelvic fracture / fragility fracture
- 2) Internal derangement of the knee
- 3) Femoral DVT
- 4) Pathological fracture

**TEST AND RESULTS:**

X-ray of Left Knee AP and Lateral

Displaced and angulated fracture of distal left femoral diaphysis.

MRI Left Lower Extremity (T1)

Abnormal soft tissue invades the mid to distal femoral shaft extending into anterior compartment of quadriceps and a portion of the short head of biceps femoris.

NM Bone Scan

Focal, mild to moderate increased tracer uptake noted in the left femur from the mid shaft to distal region.

Operative Biopsy Malignant fibrous histiocytoma / undifferentiated pleomorphic sarcoma

**WORKING DIAGNOSIS:** Occult femur fracture secondary to rare primary bone neoplasm**TREATMENT AND OUTCOMES:**

- 1) Patient transferred to outside facility for orthopaedic oncology service and operative plate fixation
- 2) Radiotherapy - post-operative of primary lesion site
- 3) Transfer to inpatient rehab facility with post-operative protocol
- 4) Remaining work-up and management follow-up pending - including oncologic imaging and therapy, surgical outcomes, rehabilitation course.

2028 May 28 4:25 PM - 4:45 PM

**Finger Pain In A Professional Dog Groomer**Kevin Matthew Mullins, Eugene Yousik Roh. *Stanford University, Redwood City, CA.*

(No relevant relationships reported)

**HISTORY:** A 36-year-old right-handed female professional dog groomer with past medical history of PCOS, presents with a chief complaint of left hand digit 3 and 4 fingertip pain. She reports progressive discomfort for the past 10 months, worsened with tactile touch especially during work, and mildly improves with rest. Describes the pain as sharp electrical sensations rated 10/10 on pain scale, sensitive to cold weather. Outside facility workup included normal hand x-rays, cervical x-rays and a hand MRI. Electrodiagnostic/nerve conduction studies demonstrated mild carpal tunnel syndrome on the left without radiculopathy, for which she has tried a neutral wrist splint without improvement. She has been seen by her PCP, rheumatology, neurology, endocrinology, and orthopedic surgery, all without a confirmatory diagnosis. Her pain is now debilitating and thus she presents to Stanford for a 6th opinion.

**EXAM:** On inspection no swelling or discoloration. Severe tenderness with light touch of digit 3 at the eponychial fold, ulnar side. Limited active and passive digit 3 DIP flexion due to pain. Sensation decreased in dorsal digital median nerve branch digits 3 and 4. Remaining strength and sensation in the hand intact. Phalen's test at the wrist positive while tinel's was negative. Spurling's negative.

**DIFFERENTIAL:** 1. Median or Palmar Digital Branch Mononeuropathy. 2. C7 Radiculopathy 3. Digital Collateral Ligament Injury 4. Tumor 5. Complex Regional Pain Syndrome 6. Mallet Finger 7. Raynaud's Phenomenon

**RESULTS:** Point-of-care ultrasound significant for digit 3 solitary hypochoic lesion with clear boundaries and regular shape, and internal abundant hyperemia. Finger MRI showed 4 x 3 x 3 mm circumscribed T1 hypointense T2 hyperintense, enhancing lesion at dorsal aspect of the third distal phalanx.

**DIAGNOSIS:** Glomus Tumor

**OUTCOME:** Initiation of gabapentin, lidocaine cream for symptomatic relief and referral to orthopedics for definitive treatment with plans for left middle finger glomus tumor excision. The patient is currently pending surgery at the time of this submission, additional follow-up to be presented.

2029 May 28 4:45 PM - 5:05 PM

**Posterior Shoulder Pain - Baseball Pitcher**Mary Lynch, Jacob Sellon, Marc Gruner. *Mayo Clinic, Rochester, MN.*

Email: breen.mary@mayo.edu

(No relevant relationships reported)

**HISTORY:** Patient is a 20 year old right handed college baseball pitcher with a past medical history of ulnar neuritis. He presented with a 4 month history of right-sided inferior periscapular pain after increasing his pitching speed and frequency. This pain initially occurred only with high velocity pitches but progressed to occur with all pitching and some overhead reaching activities. It was associated with a catching sensation but otherwise no mechanical shoulder symptoms or neurologic arm symptoms. He denied constitutional symptoms.

**PHYSICAL EXAM:****General:** Healthy appearing, athletic build.**Inspection:** No obvious asymmetry.

**Palpation:** Non-mobile, minimally prominent mass approximately golf ball size in diameter, just inferior and medial to the inferior angle of the scapula. This was mildly tender without fluctuance.

**Musculoskeletal:** Normal right shoulder ROM. No scapular dyskinesia.**Neurologic:** Normal right arm strength, sensation, and reflexes.**Special Tests:** Negative shoulder impingement signs.**DIFFERENTIAL DIAGNOSIS:**

Elastofibroma dorsi

Scapulothoracic bursitis

Snapping scapula

Lipoma

Sarcoma or other tumor

**TESTS AND RESULTS:****X-rays:** Unremarkable.

**Ultrasound:** Well-circumscribed solid soft tissue mass overlying the posterior 7th/8th ribs.

**MRI:** 5.4 x 1 x 3.5 cm mass in the infrascapular region underlying the serratus anterior and latissimus dorsi. No rib erosion or extension into the intercostal musculature.

**FINAL DIAGNOSIS:** Images favored a benign process. After waiting to complete the current season, the mass was excised. The mass was deep to the serratus anterior muscle and adhered to the 7<sup>th</sup> rib. Pathology demonstrated fibroblastic proliferation, likely reactive due to repetitive microtrauma.

**TREATMENT AND OUTCOME:** No follow up imaging or additionally treatments were necessary. Six weeks after excision, patient was able to throw a baseball with no pain and return to off-season baseball training.

2030 May 28 5:05 PM - 5:25 PM

**Acute Hip Pain In An Immunocompromised Soccer Player**Kathryn Stockbower. *The Children's Hospital of Colorado, Aurora, CO.* (Sponsor: Morteza Khodae, FACS)

Email: kathryn.stockbower@cuaanschutz.edu

(No relevant relationships reported)

**HISTORY:** A 15 year-old female with a history of Crohn's disease, celiac disease and primary sclerosing cholangitis on immune-modulating therapy (ustekinumab) presents with acute left hip pain. She had mild groin pain five days prior to presentation, with an acute worsening after soccer practice two days ago. There was no acute injury. She has been limping and reports fever to 38.3°C yesterday. Her PCP referred her to sports medicine clinic, and ordered Xrays and labs.

**PHYSICAL EXAM:** The patient is afebrile and appears well, but sits with her left hemi-pelvis elevated. There is no warmth or erythema of the skin overlying the left hip. There is tenderness to palpation over the anterior groin, anterior inferior iliac spine and anterior superior iliac spine. Range of motion of the left hip is limited and painful in all directions. Log roll, FADIR and FABER tests are all positive for anterior groin pain.

**DIFFERENTIAL DIAGNOSIS:** 1) Septic hip arthritis 2) Extra-articular myositis or abscess of hip flexors 3) Synovial chondromatosis 4) Tenosynovial giant cell tumor 5) Intra-articular chondroma 6) Sarcoma

**TEST AND RESULTS:**

**MRI enterography small bowel** (staging for inflammatory bowel disease, one year ago): incidentally noted synovitis of the left hip joint

**Xray hip/pelvis**, one year ago: subtle flattening of the left femoral head, possible erosion within the inferior femoral neck, slightly increased left hip joint space

*XRay hip/pelvis*, two days ago: left hip joint space widening and possible synovial calcification of the inferior hip joint capsule, progressive flattening and widening of the femoral head

*Labs*: CBC normal, ESR and CRP elevated from baseline

*MRI hip with and without contrast*: left hip joint effusion with multinodular/lobular intra-articular mass, mild erosions along the inferior femoral neck with reactive/inflammatory changes within the adjacent musculature

*Percutaneous biopsy*: Inflammatory synovial fluid without tumor cells or crystals.

Tissue pathology showed giant cell tumor

**FINAL DIAGNOSIS**: Tenosynovial Giant Cell Tumor (TGCT), formerly known as Pigmented Villonodular Synovitis (PVNS)

**TREATMENT AND OUTCOMES**: Arthroscopic debridement. The patient is doing well in physical therapy.

**2031** May 28 5:25 PM - 5:45 PM

### A Tibial Mass In A Zipline Instructor

Jennifer Oberstar. *University of Minnesota, Minneapolis, MN.*  
(Sponsor: Suzanne Hecht, FACSM)

(No relevant relationships reported)

**HISTORY**: A 26 yo college female active as a summer Zipline instructor presented with a right mid-shaft tibial mass present for four months. The patient had regular periods, no weight loss, no food avoidance, no hx of stress fractures, but reported fatigue. She denied past injury involving her tibia and the tibia was completely asymptomatic with running. After returning to college and less activity 3 weeks ago, the mid-tibia became swollen and painful. Over the past month her symptoms were worse at night and somewhat relieved by ibuprofen. She presented to her student health clinic and x-rays reported focal cortical thickening at the anterior aspect of the midshaft tibial diaphysis. An initial MRI Radiology read reported no bony edema suggesting an old stress fracture. The patient was treated with a CAM boot for a possible stress reaction. The patient presented to the Sports walk-in clinic for a second opinion after experiencing even more tibial pain when wearing a CAM boot.

**PHYSICAL EXAMINATION**: Examination revealed Ht 5'7", Wt 160 lbs, BMI 25 kg/m<sup>2</sup>, Pain 5/10. **CONSTITUTIONAL**: Healthy, no fever, alert & oriented. **SKIN**: 2 cm hard palpable mass on the subcutaneous border of the right mid-tibia. No erythema or edema. **MSK**: full ROM of her lower extremity, knee and ankle. Pain in tibia with squatting.

#### DIFFERENTIAL DIAGNOSIS:

1. Anterior tibial bone stress injury, chronic vs new
2. Reactive sclerosis surrounding an osteolytic lesion
3. Bone tumor, Osteoid osteoma

#### TEST AND RESULTS:

Radiographs of Tibia and Fibula:

1. Focal cortical thickening at the anterior cortex of the midshaft tibial diaphysis.

MRI Tibia and Fibula W & WO Contrast:

1. Cortical thickening within the middle third of the anterior tibial shaft.
2. No bony edema, periostitis, or other acute pathology to suggest acute stress reaction or acute osteoid osteoma.
3. Images reviewed with MSK Radiologist and Orthopedic Oncologist. Cross-sectional CT was recommended.

CT Tibia and Fibula Lower Leg WO Contrast:

1. Thickened area of the anterior cortex of the tibia which shows a circular nidus with a central calcified area.

#### FINAL WORKING DIAGNOSIS:

1. Osteoid Osteoma

#### TREATMENT AND OUTCOMES:

1. NSAIDs trialed with minimal relief
2. Discontinue CAM boot
3. Referral to Orthopedic Oncologist
4. Scheduled for radiofrequency ablation
5. Avoid weight lifting/impact activities for 2 months

**2032** May 28 3:45 PM - 5:45 PM

### Discussant

William W. Dexter, FACSM. *Maine Medical Center, Portland, ME.*

(No relevant relationships reported)

## D-45 Clinical Case Slide - Running III

Thursday, May 28, 2020, 3:45 PM - 5:25 PM

Room: CC-2016

**2033** **Chair**: Joseph Ihm, FACSM. *Rehabilitation Institute of Chicago, Chicago, IL.*

(No relevant relationships reported)

**2034** **Discussant**: Peter Sedgwick, FACSM. *Central Maine Sports Medicine, Yarmouth, ME.*

(No relevant relationships reported)

**2035** **Discussant**: Mark Riederer. *C.S. Mott Children's Hospital, Ann Arbor, MI.*

(No relevant relationships reported)

**2036** May 28 3:45 PM - 4:05 PM

### Chest Wall Pain In A Marathon Runner

Joseph G. Dadabo, Monica Rho. *Shirley Ryan AbilityLab/ Northwestern University, Chicago, IL.* (Sponsor: Joseph Ihm, FACSM)

Email: jdadabo@sralab.org

(No relevant relationships reported)

**History**: A 39-year old male marathon runner presented with 1 year of left-sided anterolateral chest wall pain at ribs 10 and 11. Pain started insidiously, without trauma or other inciting incident. Pain primarily occurred with running, and typically worsened as his pace increased. Lifting weights, deep breathing, and prolonged sitting did not exacerbate pain. He denied cough, dyspnea, or wheezing.

**Physical Examination**: Normal chest wall expansion. No visual deformity along the ribs or costal cartilage. Tenderness to palpation was noted along the left 10th and 11th ribs and intercostal muscle anterior to the mid-axillary line. No tenderness at adjacent segments or at the same segment on the contralateral chest wall. Mild left-sided chest wall pain with leftward thoracic rotation.

#### Differential Diagnosis:

1. Costochondritis
2. Tietze syndrome
3. Slipping rib syndrome
4. Thoracic radiculitis
5. Pleurisy

#### Tests and Results:

**MRI Chest Wall**: Focal thickening and edema along left lower ribs at region of pain, with surrounding soft tissue swelling. No pleural or pericardial effusion. No bone marrow edema within visualized osseous structures.

**Ultrasound Chest Wall**: Significant signal impedance and focal thickening noted along the intercostal muscle of the left 10th and 11th ribs at the area of maximal tenderness along the anterolateral chest wall. No comparable signal changes are observed at adjacent segment levels or the same segment on the contralateral chest wall.

#### Final/Working Diagnosis:

1. Tietze syndrome

#### Treatment and Outcomes:

1. Performed corticosteroid/lidocaine injection to left 10th-11th rib intercostal muscle under ultrasound guidance
2. Pain diary for 6 hours immediately following injection
3. Routine marathon training as tolerated
4. Ice as needed after running
5. Pain resolved following injection. Inflammation and intercostal muscle hypertrophy resolved on repeat ultrasound 2 months later.
6. Patient completed Berlin and Chicago Marathons in 2019

2037 May 28 4:05 PM - 4:25 PM

**An Unusual Cause Of Lower Leg Pain - Long Distance Running**

Wayne Elton Derman, FACSM<sup>1</sup>, Melissa Van Vuuren<sup>1</sup>, James Tunnickliffe<sup>2</sup>. <sup>1</sup>Stellenbosch University, Cape Town, South Africa. <sup>2</sup>Matley and Partners, Cape Town, South Africa.  
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(No relevant relationships reported)

**HISTORY:** A 42 yr runner presented to the sports medicine clinic two weeks after having successfully completed an ultra-marathon complaining of left calf pain. The onset of the pain occurred the day after the race but within a short period the pain was present after walking short distances. The pain was claudicant, with accompanying foot paraesthesia and leg weakness. Rest pain was absent. Besides hypercholesterolaemia and previous kidney stones, the patient was well, a non-smoker with some symptoms of atopy but no other relevant medical or family history.

**PHYSICAL EXAMINATION:** The patient appeared to be generally well, with normal vital signs. On inspection of his limbs, there was no obvious swelling, discoloration or evidence of tissue loss. On palpation the left limb was slightly cooler to touch with a prolonged capillary refill time. On examination of his pulses, his upper limb pulses were symmetrical and equal but on examination of his lower limbs his left femoral pulse was slightly diminished, with a soft bruit. The left popliteal and dorsalis pedis pulses were absent. He was unable to run, and was only able to walk approximately 100 m. No left foot pulses felt post exercise or heard on office Doppler examination.

**DIFFERENTIAL DIAGNOSIS:**

1. Musculoskeletal injury eg gastroc tear
2. Vascular occlusion: popliteal artery entrapment, atherosclerotic occlusion, other occlusive disease
3. Posterior chronic compartment syndrome
4. Referred pain

**TEST AND RESULTS:**

1. Duplex Doppler was performed but was obscured by bowel gas, yet aorta and proximal common iliac was patent. The distal common iliac and proximal external iliac could not be visualized. Distal external iliac and common femoral vessels were patent.
2. Angiogram performed of the external iliac artery, demonstrated a string-like appearance pathognomonic of fibromuscular dysplasia. A full visceral angiogram was normal.

**FINAL WORKING DIAGNOSIS:** Fibromuscular dysplasia of the external iliac artery

**TREATMENT AND OUTCOMES:**

1. A transverse arteriotomy was initially made in the CFA which revealed a 50% stenosis caused by a medial soft plaque. Fogarty thrombectomy was performed on the SFA resulting in good backflow
2. A long saphenous venous patch used.
3. Anticoagulation
4. Initial rest with gentle mobilization
5. Return to sport programme

2038 May 28 4:25 PM - 4:45 PM

**Hip And Thigh Pain In A Runner**

Matthew LaCourse, Brian Liem. *University of Washington, Seattle, WA.*

Email: mattlac@uw.edu

(No relevant relationships reported)

**HISTORY:** A 46-year-old male runner with a history of right-sided L3 radiculopathy presented with one month of recurrent right hip and thigh pain. He denied any trauma, inciting event, or recent alteration in his running regimen. Pain was described as stabbing, and localized to his right lateral hip with radiation down his anterior thigh to his knee. He also reported numbness and tingling down his anterior thigh to the knee. Recently, he experienced an incident of sudden bowel urgency with near bowel incontinence. No bladder incontinence or perineal numbness. He has a history of chronic gastroesophageal reflux disease and has taken omeprazole daily for 10 years.

**PHYSICAL EXAMINATION:** Full and symmetric lower extremity strength except for 4/5 with right hip abduction. Sensation intact to light touch at his hips, thighs, groin, buttocks, and scrotal region. No tenderness at the lumbar paraspinals, buttock musculature, greater trochanters, or anterior hip. Negative straight leg raise and reverse straight leg raise. Full, non-painful range of motion with lumbar flexion and extension. No pain with resisted hip flexion, or passive end range hip flexion. Negative FABER, FADIR, femoral nerve stretch.

**DIFFERENTIAL DIAGNOSIS:** 1. Recurrent Upper Lumbar Radiculopathy 2. Hip Flexor Tendinopathy 3. Iliotibial Band Syndrome 4. Hip Osteoarthritis 5. Femoral Stress Fracture

**TEST AND RESULTS:** 1. Right Hip X-Ray:- Mild osteoarthritis of bilateral hips.- Wedge sclerosis and mild periostitis of the medial aspect of the right femoral neck. 2. Lumbar Spine X-Ray:- Mild intervertebral disc height loss at T12-L1, L2-L3, and L5-S1.

3. Right Hip MRI:- Linear T1 focus with surrounding STIR hyperintensity along the medial aspect of the right femoral neck, compatible with a stress fracture.
  4. Lumbar Spine MRI:- Right foraminal/extraforaminal disc protrusion at L3-L4.
  5. DEXA Scan:- No signs of significant osteopenia or osteoporosis at the spine or hips.
  6. Calcium, 25-OH Vitamin D, Parathyroid Hormone levels: Normal
- FINAL WORKING DIAGNOSIS:** Right femoral neck stress fracture, potentially due to chronic proton pump inhibitor use
- TREATMENT AND OUTCOMES:**
1. Referral to orthopedic surgery 2. Toe-touch weight bearing for 6 weeks. 3. Discontinuation of omeprazole. 4. Consideration of future referral to endocrinology.

2039 May 28 4:45 PM - 5:05 PM

**Cardiovascular-Running**

Kevin Kuo<sup>1</sup>, Amie Kim<sup>2</sup>, Thomas Nguyen<sup>2</sup>. <sup>1</sup>Icahn School of Medicine at Mount Sinai, St. Luke's-West, New York, NY. <sup>2</sup>Icahn School of Medicine at Mount Sinai, Beth Israel, New York, NY.

(No relevant relationships reported)

**History:** A healthy, 26-year-old marathon runner was brought to the emergency department (ED) for altered mental status during an eighteen-mile run. At his fifteenth mile, he reported feeling increasingly warm with burning sensations. He sustained a witnessed collapse with loss of consciousness. He was alert in the ED, asymptomatic, but with anterograde amnesia. He denied prodrome including headache, dizziness, weakness, chest pain, dyspnea, or palpitations. During his ED course, he sustained a second witnessed episode of vomiting and syncope.

**Physical Examination:** Comfortable appearing male. Skin was warm to touch, mildly flushed. Lungs were clear to auscultation. Cardiac exam regular rate and rhythm with normal S1 and S2. He exhibited mild tenderness to palpation in lower distal extremities without peripheral edema. Compartments were soft. He was neurologically intact.

**Differential Diagnosis:**

Heat syncope  
Metabolic disorder  
Cardiogenic - Acute coronary syndrome, cardiomyopathy, exercise related dysrhythmia, channelopathy  
Seizure  
Rhabdomyolysis

**Test and Results:**

- CPK 7,639, peaked at 15,551
- Troponin 0.553, peaked at 2.19
- EKG with t-wave inversions and ST depressions in precordial leads
- pH 7.27, pCO<sub>2</sub> 41.3, Lactate 5.9
- Na 143, K 5.2, Cl 107, Bicarb 18.9 Glucose 97 Calcium 10.6
- Bun 24 Cr 2.2
- Urine tox negative

**Final Working Diagnosis:** Rhabdomyolysis

**Treatments and Outcomes:**

- Admitted to the cardiac ICU for NSTEMI secondary to rhabdomyolysis, recurrent syncope, acute kidney injury, and metabolic acidosis.
- Cardiac echo showed normal ejection fraction without wall motion abnormalities.
- EKG abnormalities normalized on 5 days continuous telemetry
- Maintained on intravenous fluids and bicarbonate drip. Secondary organ function improved, with discharge on hospital day 5
- NSTEMI and recurrent syncope are unusual presentations of rhabdomyolysis in young, healthy athletes
- Pending - outpatient electrophysiology, genetic screening, cardiac rehabilitation, precautions in return to distance running

2040 May 28 5:05 PM - 5:25 PM

**A Unique Overuse Stress Injury In A Professional Triathlete**

Nancy Phu<sup>1</sup>, Jonathan Minor<sup>2</sup>. <sup>1</sup>Burrell College of Osteopathic Medicine, Las Cruces, NM. <sup>2</sup>SPARRC - Sports Medicine, Rehabilitation and Concussion Care, Tucson, AZ.

(No relevant relationships reported)

**HISTORY:**

A 28-year-old male professional triathlete presented with acute on chronic low back pain for five days after completing an Olympic distance triathlon. He developed low back and hip pain the evening of the race. Pain was worsened by laying supine, sitting and walking. He reported back stiffness, which improved through the day. PT and dry needling offered little improvement. Nine months earlier he was seen for low back pain, diagnosed with sacroiliitis. This was managed by a licensed physical therapist with resolution. MRI performed years earlier identified disc bulge at L3-4.

**PHYSICAL EXAMINATION:**

Inspection was unremarkable, without swelling, deformity, or ecchymosis. Mild tenderness over the piriformis and gluteus medius. No point tenderness over the PSIS, SI joints, or spinous processes. Range of motion of the trunk was full but painful with

extension, rotation to the right, and Kemp test to the right. No pain with trunk flexion, rotation to the left, side bending, or Kemp test to the left. Familiar right posterior hip pain with axial load of the flexed hip. Pain with resisted hip flexion on the right. Mild familiar right posterior hip pain with resisted hip flexion on the left. FABER, piriformis stretch, SI torque tests, and straight leg raises negative bilaterally.

**DIFFERENTIAL DIAGNOSIS:**

1. Strain of pelvic muscle
2. Sacroiliitis
3. Pelvic stress injury
4. Lumbo-sacral radiculopathy

**TEST AND RESULTS:**

MRI pelvis without contrast revealed bone marrow edema of the right inferior iliac bone adjacent to the SI joint with subtle incomplete fracture line, suggesting grade 4 stress fracture. Calcium, alkaline phosphatase, phosphorus, and magnesium levels within normal range. 25-OH-Vitamin D within normal range, perhaps lower end for high-level athlete (46.6 ng/mL). CBC and celiac screening within normal limits.

**FINAL WORKING DIAGNOSIS:**

Stress fracture right iliac bone

**TREATMENT AND OUTCOMES:**

1. 8-weeks rest from impact activities (running and cycling).
  2. Swimming with pull buoy for 4 weeks with gradual kicking introduction.
  3. Elliptical and aerobic cycling at 6 weeks, with guided power advancement.
  4. Calcium/vitamin D supplementation.
  5. Targeted PT strengthening.
- Outcome - pain free with progression and returned to uninhibited training at 12 weeks.

**D-46 Clinical Case Slide - Shoulder II**

Thursday, May 28, 2020, 3:45 PM - 5:25 PM  
**Room:** CC-2022

**2041 Chair:** Andrew Gregory, FACSM. *Vanderbilt University School of Medicine, Nashville, TN.*  
*(No relevant relationships reported)*

**2042 Discussant:** William F. Micheo, FACSM. *University of Puerto Rico, San Juan, PR.*  
*(No relevant relationships reported)*

**2043 Discussant:** Yao-wen Eliot Hu. *Naval Hospital Camp Pendleton, Camp Pendleton, CA.*  
*(No relevant relationships reported)*

**2044 May 28 3:45 PM - 4:05 PM**  
**Atypical Nontraumatic Shoulder Pain In A Baseball Player**

Stacie Hirota<sup>1</sup>, Emily Dixon<sup>2</sup>, Richard Okragly<sup>1</sup>. <sup>1</sup>*Trihealth Primary Care Sports Medicine, Cincinnati, OH.* <sup>2</sup>*Trihealth Orthopedic and Sports Institute, Cincinnati, OH.* (Sponsor: Henry Stiene, FACSM)  
*(No relevant relationships reported)*

**HISTORY:** 15 year old male high school baseball player with past medical history of asthma, who presented with right shoulder pain. Pain started after swinging in a baseball tournament, with no specific trauma. Pain was located posterior. He was able to continue playing baseball, however pain persisted. Initially he tried heat, ice and ibuprofen with no improvement. Pain progressively worsened over the week with walking, deep breathing and coughing. Additional symptoms included radiation into his neck and shallow breathing. He pursued evaluation at the Emergency Department. His vitals were stable with mild tachypnea, saturating 100% on room air and pulse of 72. Right first rib fracture was noted on CXR. He was discharged with ibuprofen and referral to Sports Medicine. **PHYSICAL EXAMINATION:** Vital signs stable. Respiratory exam clear to auscultation with good air movement throughout and no distress. Cervical exam with full range of motion and strength in flexion, extension, side bending and rotation with mild pain with resistant right-side bending. Right shoulder exam showed no obvious deformities, swelling or bruising. Tenderness over right supra and infraclavicular areas. Hypertonic scalene and trapezius muscles on the right. Range of motion demonstrated glenohumeral internal rotation deficiency with internal rotation of 20 degrees and external rotation of 110. **DIFFERENTIAL DIAGNOSIS:** Clavicle fracture. Pneumothorax. Scalene muscle strain. Scapula

fracture. SC or AC separation. **TEST AND RESULTS:** CXR 2 views demonstrated a transverse fracture of the first rib on the right with minimal displacement **DIAGNOSIS:** Right first rib fracture **TREATMENT AND OUTCOMES:** 1. Repeat imaging at 3 weeks post injury showed minimal callous formation. 2. Advised strict rest with non-weight bearing of the right upper extremity until repeat imaging. 3. Physical therapy for glenohumeral internal rotation deficiency found on evaluation. Including aggressive stretching and strengthening exercises for 4-6 weeks. 4. Re-evaluation at 7 weeks post injury showed no tenderness with palpation. 5. Repeat imaging at 7 weeks post injury finally showed callous formation. 6. Return to play with no restrictions at 7 weeks post injury after repeat x-rays showed callus formation, no tenderness with palpation, and full strength and range of motion.

**2045 May 28 4:05 PM - 4:25 PM**  
**Chest Wall Injury-CrossFit**

Christian Douthit, MD, Hunter Miers, Mimi Zumwalt, MD.  
*Texas Tech University Health Science Center, Lubbock, TX.*  
 (Sponsor: Jacalyn McComb, FACSM)  
*(No relevant relationships reported)*

**HISTORY:** 21 y/o M RHD CrossFit Coach sustained an injury to his R upper extremity while performing the “muscle up” exercise on a high bar about six weeks prior to presentation. He felt a painful pop in his shoulder/arm area after which he experienced bruising near his axilla/chest wall then unable to complete his workout. He continued to have pain/weakness along with difficulty working out with his usual gym routine, especially exercises involving pushing maneuvers. He was initially seen by another Orthopaedist, an MRI obtained, then referred to our Sports clinic. Other than a history of rapid weight loss of over 100 pounds a couple of years prior to the traumatic episode, he denies any supplement usage.

**PHYSICAL EXAMINATION:** Ventral Trunk/R upper extremity: loss of R chest wall contour in the “hands on hips” position/asymmetric axillary fold; TTP at bicipital groove; shoulder-painful ROM arc upon extreme abduction/elevation; weakness/pain with resisted IR/horizontal adduction.

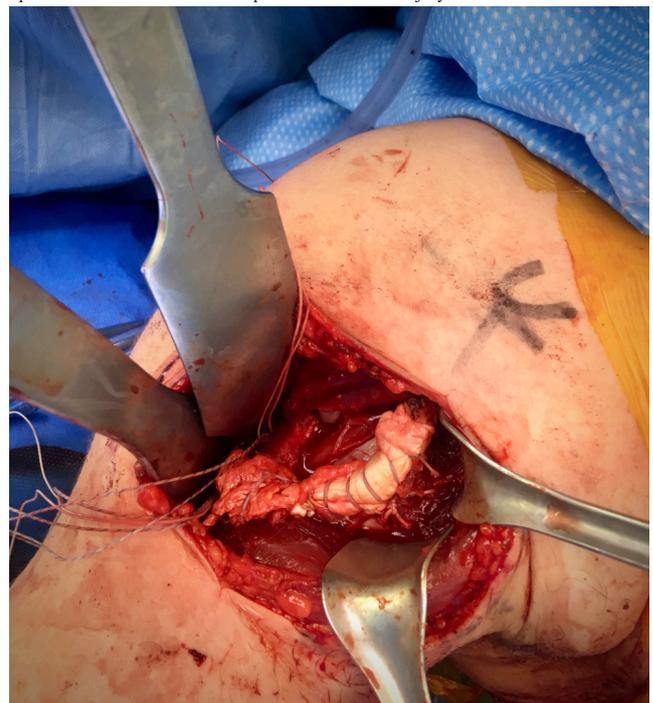
- DIFFERENTIAL DIAGNOSIS:**
1. R LH biceps tendon rupture
  2. R pectoralis muscle tear
  3. R pectoralis tendon rupture

**TEST AND RESULTS:** R shoulder XR plain films without abnormality MRI show signal changes in pectoralis major tendon consistent with rupture of humeral detachment/retraction into chest wall; posterior glenoid labral tear

**FINAL WORKING DIAGNOSIS:** R pectoralis major tendon rupture

**TREATMENT AND OUTCOMES:** 1. Patient underwent subacute repair with Achilles allograft augmentation 2 months post-injury.

2. He was placed in a shoulder immobilizer for 6 weeks and formal PT started at 2 weeks.
3. At his last visit 5 months post-op he was doing very well, progressing with self PT rehab exercises in the gym, no pain with daily activities and pleased with cosmesis/symmetrical chest muscle contour. He started working out again and back to approximately 80% muscle strength/endurance with push-ups/pull-ups but avoiding explosive movements that would put him at risk of reinjury.



THURSDAY, MAY 28, 2020

2046 May 28 4:25 PM - 4:45 PM

**Shoulder Injury - Soccer, Water Polo**

Dana L. Sheng, Kevin Burnham, Robert D. Boutin, Jeremiah W. Ray, Brian A. Davis, FACSM. *UC Davis, Sacramento, CA.*  
(Sponsor: Dr. Brian A. Davis, MD, FACSM)  
Email: DLSHENG@UCDAVIS.EDU  
(No relevant relationships reported)

HX: 3 Division I athletes at 1 university.

Case 1- 21F soccer center midfielder presented with 1 month of insidious L shoulder pain that started posteriorly at the rhomboids and slowly migrated anteriorly. She denied any trauma. All activity worsened the pain, particularly shoulder ROM. She completed 6 weeks of rest and PT without improvement.

Case 2- 19M water polo player presented with 2 months of R posterior shoulder pain without preceding trauma. He improved with 2 weeks of light activity and PT, but the pain worsened as he increased activity and acutely worsened after contact play.

Case 3- 19M water polo player presented with 2 weeks of insidious onset L posterior shoulder pain. While executing power cleans, the pain became severe and he went to the ED.

EXAM:

Case 1-Diffuse pain limited L shoulder ROM. +mild GH internal rotation deficit. +tenderness and spasm of L trapezius, neck, levator, posterior deltoid, rhomboids. Spurling's (-). RTC testing nl except for pain with supraspinatus testing. O'Brien's (-). Case 2-NI visual inspection. The R shoulder had full ROM with mild discomfort posteriorly with full abduction. R rhomboid major tender to palpation. RTC testing nl; O'Brien's (-).

Case 3-NI inspection, ROM. L rhomboid major tender to palpation. RTC testing nl, biceps testing (-).

DDX:1. Rhomboid strain 2. Myofascial pain 3. Suprascapular nerve impingement 4.

Thoracic outlet syndrome

TESTS/RESULTS: Case 1-

L shoulder XR- nondisplaced stress fracture L 1st rib

Bedside U/S- cortical irregularity of 1st rib

CT chest w/o contrast- stress fracture L 1st rib

Case 2-

R shoulder XR,R ribs XR,MR RUE w/o contrast- nl

Bedside U/S- cortical irregularity of R 1st rib

Retrospective review of original XRs revealed subtle cortical irregularity of R 1st rib

CT chest w/o contrast- nondisplaced stress fracture R 1st rib

Case 3-

CXR,L shoulder XR,CT chest w/o contrast- nondisplaced fracture L 1st rib

Bedside U/S- L 1st rib fracture with large callus formation

FINAL DX:1st rib stress fracture

TX/OUTCOME:All cases with 1st rib stress fracture healed with standard relative rest, calcium and Vitamin D supplementation.

2047 May 28 4:45 PM - 5:05 PM

**Back And Shoulder Pain - Heavy Lifting**

Rijo Maracheril<sup>1</sup>, Amie Kim<sup>2</sup>, Kaushal Shah<sup>3</sup>. <sup>1</sup>Mount Sinai Hospital, New York, NY. <sup>2</sup>Mount Sinai Hospital Beth Israel, New York, NY. <sup>3</sup>Weill Cornell Medicine, New York, NY.  
Email: rijo.maracheril@gmail.com  
(No relevant relationships reported)

**History**

52 year-old male presents with right (R) upper back pain and R anterior chest pain. Presented to Emergency Department (ED) for R scapular pain after pulling a piano 1 week ago. Clinically appreciated painful R scapular stabilizers without swelling or bony tenderness. Discharged with analgesia and muscle relaxant. Subsequently developed erythema at site and went to second ED. Clinically evaluated and discharged with opiate. Erythema progressed, and patient returned to ED.

**Physical Examination**

Inspection with erythema extending into R lateral neck. Blanching and warm bilateral anterior chest wall. Tenderness on palpation greater on R than L including pectoralis origin, SC joint. No crepitus. Heart and lung sounds normal, painless chest excursion. R shoulder painful adduction with FROM. R scapula painful protraction and retraction. R AC joint painless scarf sign. Cervical spine, left shoulder, bilateral elbow without additional findings.

**Differential diagnosis**

1. Cellulitis/Necrotizing fasciitis
2. Thoracic outlet syndrome
3. Pectoralis myositis
4. Thrombophlebitis/DVT
5. Osteomyelitis/Septic joint

**Tests and Results** Remarkable Labs

- WBC 15.8
- CPK 68
- CRP 460

- ESR 108

- Alk Phos 253

Chest X-Ray

- Paratracheal lymphadenopathy

CT Chest with Contrast

- Fluid collection with inflammatory changes midline between pectoralis major

muscles without gas at the level of sternal notch and manubrium

- Asymmetric soft tissue thickening in the R clavicular head, SC joint, and retrosternal region with fluid collections

MRI Chest with/without Contrast

- Sternomanubrial effusion 2.3 cm posteriorly

- R 1st rib Osteomyelitis

- R supraclavicular clavicle fluid collection 4.6 x 1.5 x 2.6 cm

**Final/Working Diagnosis**

Septic Arthritis

**Treatment and Outcomes**

1. Source unable to be found: echocardiogram WNL, drug screen negative, HIV/Hepatitis B & C/EBV/Thyroid studies negative, esophagram WNL
2. Blood cultures positive for MSSA. IR aspiration of body fluid performed without speciation. PICC line placed with 8 weeks of IV cefazolin.
3. Hospital course complicated by non-occlusive thrombus in R subclavian/proximal SVC - started on apixiban for 6 months.
4. Serial CT with resolution of infection. One month inpatient, discharged to outpatient rehabilitation.
5. Pending outpatient ID and CT surgery, serial vascular imaging.

2048 May 28 5:05 PM - 5:25 PM

**Posterior Shoulder Instability In A 17 Year Old Wrestler: A Case Report.**

Kathryn Alfonso<sup>1</sup>, Jason Lee<sup>2</sup>. <sup>1</sup>Mayo Clinic, Rochester, MN.  
<sup>2</sup>Mayo Clinic Health System, Faribault, MN.  
Email: alfonso.kathryn@mayo.edu  
(No relevant relationships reported)

**HISTORY**

A 17 year old male wrestler presented to the sports medicine clinic with superoposteriorly located right shoulder pain and apprehension with overhead movements 2 days after sustaining a posterior shoulder dislocation. He received an on-site closed reduction, and was seen following the match at a local emergency room with arm numbness. He was placed in a sling after unremarkable radiographs and symptom resolution.

**PHYSICAL EXAMINATION**

No erythema, ecchymosis, or edema about the right shoulder joint. Tender to palpation at AC joint, acromion, and anterior capsule. Active abduction 70°, flexion 80°. External rotation 20° (pain limited). Full strength with elbow, wrist, and finger flexion and extension. Empty can, Speed's and anterior apprehension were positive; Neer's, Hawkins's, O'Brien's, and Speed's and posterior apprehension were negative.

**DIFFERENTIAL DIAGNOSIS**

1. Bankart lesion
2. Hill-Sachs lesion
3. Labral tear
4. Rotator cuff tear
5. Humeral fracture

**TEST AND RESULTS**

Right shoulder and clavicle radiographs: unremarkable.

Right shoulder MR arthrogram:

- Tear at the humeral attachment of the posterior band inferior glenohumeral ligament.
- Partial thickness teres minor tear at inferior margin insertion.
- No reverse Hill-Sachs lesion.

**FINAL WORKING DIAGNOSIS**

Complete reverse humeral avulsion of the glenohumeral ligament lesion (rHAGL) and isolated teres minor avulsion.

**TREATMENT AND OUTCOMES**

1. A right shoulder arthroscopic rHAGL and teres minor repair was performed 3 weeks after the injury.
  2. The slow posterior Bankart protocol was initiated post-operatively for 6 weeks duration with progression to active range of motion and standard shoulder stabilization protocol therapy.
  3. Pain free with full strength and range of motion at 3 months post-op.
  4. Cleared to return to sport at 5 months post-op.
- rHAGL lesions with concurrent teres minor avulsions are a rare cause of posterior shoulder instability, and should be considered when a patient presents with posterior shoulder pain and instability following a posterior shoulder dislocation. In the absence of therapy or surgical repair, there is a risk of recurrent dislocations and the development of chronic degeneration. There are limited reported cases in the literature, with return to play reported 5-8 months post-operatively.

**D-47 Rapid Fire Platform - New Findings in Physical Activity and Health**

Thursday, May 28, 2020, 3:45 PM - 5:05 PM  
 Room: CC-Exhibit Hall

**2049 Chair:** Bryna C. Chrismas. *Qatar University, Doha, Qatar.*  
 (No relevant relationships reported)

**2050 May 28 3:45 PM - 3:55 PM  
 Non-Exercise Estimated Cardiorespiratory Fitness And Mortality From All-Causes, Cardiovascular Disease And Cancer In The NIH-AARP Diet And Health Study**

Baruch Vainshelboim<sup>1</sup>, Jonathan Myers, FACSM<sup>1</sup>, Charles Matthews, FACSM<sup>2</sup>. <sup>1</sup>*Veterans Affairs Palo Alto Health Care System/ Stanford University, Palo Alto, CA.* <sup>2</sup>*National Cancer Institute, Bethesda, MD.* (Sponsor: Charles Matthews, FACSM)  
 Email: baruch.v1981@gmail.com  
 (No relevant relationships reported)

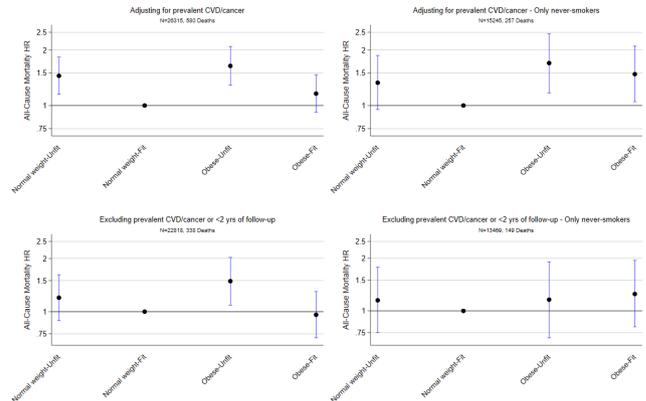
Measured cardiorespiratory fitness (CRF) with exercise testing is a powerful predictor of mortality but unfeasible in many health-care and research settings. Although non-exercise estimated CRF (NEE-CRF) has been shown to be associated with mortality outcomes, relatively small cohorts and impractical predicting variables used to estimate CRF are challenging its broad application. **PURPOSE:** To assess the association between NEE-CRF using pragmatic variables and mortality outcomes in a large prospective cohort of men and women. **METHODS:** The NIH-AARP Diet and Health Study of 330,769 participants [men (n=186,469) and women (n=144,300)] aged 50-71 years at the recruitment (1995-1996) were prospectively followed for 14.9±2.1 years until December 31, 2015. NEE-CRF was estimated using previously validated equation [34.142+1.463 (physical activity status) +0.133 (age)-0.005 (age<sup>2</sup>) +11.403 (sex)-0.254 (weight) +9.170 (height)] and analyzed for its association with mortality outcomes, utilizing multivariable Cox hazard models. **RESULTS:** During the follow up, 34,317 men and 20,295 women died from all-causes. Higher NEE-CRF was associated with lower risk of mortality due to all-causes, cardiovascular disease and cancer. For every 1-MET higher NEE-CRF there was 15%, 15%, 11% and 16%, 16%, 11% reduction in mortality risks from all-cause, cardiovascular disease and cancer, in men and women respectively. The corresponding hazards ratios and 95% confidence intervals were: 0.85 (0.84-0.86), 0.85 (0.82-0.88), 0.89 (0.87-0.91), and 0.84 (0.83-0.85), 0.84 (0.81-0.88), 0.89 (0.87-0.91) for men and women respectively (all p<0.001). **CONCLUSIONS:** Higher NEE-CRF is associated with lower risk of death due to all-causes, cardiovascular disease and cancer in a large prospective cohort. The results provide a practical implication of NEE-CRF for clinical risk stratification, referral to prevention and rehabilitation programs and utilization in large-scale epidemiological studies.

**2051 May 28 3:55 PM - 4:05 PM  
 All-cause Mortality And The Fat-but-fit Hypothesis: A Reexamination Using Uk Biobank**

Jakob Tarp<sup>1</sup>, Miguel Adriano Sanchez-Lastra<sup>2</sup>, Ding Ding<sup>3</sup>, Anders Grøntved<sup>4</sup>, Ulf Ekkelund, FACSM<sup>1</sup>. <sup>1</sup>*Norwegian School of Sports Sciences, Oslo, Norway.* <sup>2</sup>*University of Vigo, Pontevedra, Spain.* <sup>3</sup>*University of Sydney, Camperdown, Australia.* <sup>4</sup>*University of Southern Denmark, Odense, Denmark.*  
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Obesity is associated with an increased risk of premature mortality, but observational studies implies that obese adult with high cardiorespiratory fitness (CRF; ‘fat-but-fit’) may not be at an increased risk. However, the evidence for the ‘fat-but-fit’ hypothesis is limited by insufficient control of confounding from smoking and risk of reverse-causality bias from pre-existing conditions. **PURPOSE:** To examine evidence for the ‘fat-but-fit’ hypothesis using different approaches for reducing confounding and reverse-causality bias. **METHODS:** CRF was estimated from linear extrapolation of the heart rate response during a submaximal bicycle ergometer test in women and men from the UK Biobank cohort. Watts per kg fat-free mass was split into unfit (<20%) or fit (>60%) based on the age-sex stratified sample distribution and combined with measured body-mass index (BMI) as normal weight (NW; BMI 18.5 – 25) or obese (BMI ≥ 30) yielding four CRF-BMI combinations. All-cause mortality was ascertained from death registers. Multivariable-adjusted cox-regression models were used to estimate hazard ratios (HR) and 95% confidence intervals (CI). **RESULTS:** Over a median follow-up of 7.7 years, 580 deaths in 26,315 participants were recorded. In analysis adjusting for prevalent CVD/cancer and using NW-fit as

the reference, being NW-unfit or obese-unfit were associated with increased mortality with HRs of 1.45 (CI: 1.15, 1.83) and 1.64 (1.29, 2.09), see figure. Mortality was not increased in the obese-fit against the reference (1.16 (CI: 0.92, 1.47)). Associations were attenuated when excluding individuals with prevalent CVD/cancer and early deaths. Re-analyzing with restriction to never-smokers resulted in similar HRs across the fat-fit combinations against the NW-fit reference. **CONCLUSION:** Obese-unfit, but not obese-fit, individuals have an increased risk of premature mortality as compared with NW-fit individuals. The association appears susceptible to bias.



**2052 May 28 4:05 PM - 4:15 PM  
 Association Of Physical Activity Best Practices For Early Care And Education With Time-use And Children’S Physical Activity**

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**PURPOSE:** Our goal was to estimate the time-use exchanges associated with physical activity (PA) best practices for early care and education (ECE) centers on the PA behaviors of children. **METHODS:** The Environment and Policy Assessment and Observation (EPAO) was collected on 150 classrooms from 80 child care centers along with corresponding accelerometer (ActiGraph GT3X+) data on 472 children. Data were aligned to evaluate how center activities matched with children’s sedentary and PA behaviors. EPAO data were used to assess compliance with select best practices from the Nutrition and PA Self-Assessment for Child Care: ≥60 min/d of outdoor play, ≥120 min/d of indoor/outdoor play, and <60 min/d of sedentary time. Linear mixed models were used to examine children’s PA outcomes based on compliance with best practices. Center-level models were adjusted for day of week, month, and wear time. Child-level models were additionally adjusted for child’s age, sex, and race/ethnicity. **RESULTS:** Meeting the outdoor play best practice was associated with a significant shift in centers’ time use: +56.7 min/d of outdoor play and -38.5 min/d of indoor play. Meeting this best practice was associated with ~9 min/d increase in children’s total PA. Meeting the indoor/outdoor play best practice was also associated with a shift in centers’ time use: +66.9 min/d of indoor/outdoor play, -29.7 min/d of screen/sitting, -11.4 min/d for circle time, -2.9 min/d for snack, -3.8 min/d for morning meal, and -19.2 min/d of non-classified activities. Meeting this best practice was also associated with a ~14 min/d increase in children’s total PA. Meeting the best practice for limiting sedentary time was associated with -55.0 min/d of screen/sitting, +24.4 min/d of indoor play, +15.1 min/d of outdoor play, +8.4 min/d for circle time, and +2.2 min/d for lunch. Meeting this best practice was associated with a ~7.0 min/d increase in children’s light activity, but there were no significant associations with their sedentary or moderate-vigorous PA. **CONCLUSIONS:** These results suggest that increasing time for play does not directly translate to increases in total PA. These findings suggest the need for more quality play opportunities (e.g. provider-led PA) rather than allocating time alone to improve daily PA.

THURSDAY, MAY 28, 2020

2053 May 28 4:15 PM - 4:25 PM

**The Prevalence Of Meeting 2008 Versus 2018 Physical Activity Guidelines In Adults With Overweight/obesity**

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Both the 2008 and 2018 Physical Activity Guidelines for Americans (PAG) recommend  $\geq 150$  min/wk of moderate physical activity (PA) for substantial health benefits and suggest many adults may need  $\geq 300$  min/wk of moderate PA for additional health benefits (including weight control). The 2008 PAG specified that PA be accumulated in bouts  $\geq 10$  minutes, however, this criteria was removed in the 2018 PAG.

**PURPOSE:** To determine the extent to which removing the bout criteria impacts the prevalence of meeting PAG for weight control in adults with overweight/obesity.

**METHODS:** Participants were 155 adults with overweight/obesity enrolled in an 18 month weight loss intervention. Baseline levels of bout and total moderate-to-vigorous PA (MVPA, SenseWear device) were used to determine proportion meeting 2008 vs 2018 PAG, and to classify subjects into 3 mutually exclusive groups: meeting 1)  $\geq 300$  min/wk of both bout and total MVPA (BOTH; n=28), 2)  $\geq 300$  min/wk of total (but not bout) MVPA (TOTAL; n=65) or 3)  $< 300$  min/wk of bout or total MVPA (NEITHER; n=62). We also compared age, sex, BMI, body fat mass (FM, DXA), and fitness ( $VO_{2max}$ ) across groups.

**RESULTS:** The proportion of subjects meeting 2008 (18%) vs. 2018 (60%) PAG was significantly lower ( $P < 0.01$ ). BOTH had a higher mean age vs TOTAL (mean $\pm$ SD; 43 $\pm$ 10 vs 37 $\pm$ 9 y,  $P < 0.01$ ). BOTH had the lowest proportion of females, followed by TOTAL, and then NEITHER (64% vs 83% vs 94%,  $P < 0.01$ ). BOTH had a lower BMI and FM compared to TOTAL and to NEITHER (BMI: 32 $\pm$ 3 vs 35 $\pm$ 4 vs 36 $\pm$ 4 kg/m<sup>2</sup>,  $P < 0.01$ ; FM: 36 $\pm$ 7% vs 41 $\pm$ 5% vs 43 $\pm$ 4%,  $P < 0.01$ ), with no differences between TOTAL vs NEITHER. BOTH had the highest  $VO_{2max}$  (adjusted for age and sex), followed by TOTAL, and then NEITHER (28.1 $\pm$ 4.6 vs 25.0 $\pm$ 4.4 vs 22.6 $\pm$ 3.9 mL/kg/min,  $P < 0.01$ ).

**CONCLUSIONS:** In this cross-sectional analysis of adults with overweight/obesity, removing the bout criteria resulted in a 3 fold greater prevalence of meeting PAG for additional health benefits (including weight control). Meeting 2018 PAG (but not 2008 PAG) did not significantly differentiate between levels of BMI or FM compared to not meeting 2018 PAG. Researchers planning on using PAG for screening eligibility should be aware of the clinical health differences in adults who meet 2008 vs 2018 PAG. Prospective studies are needed to determine how removing the bout criteria impacts weight control.

2054 May 28 4:25 PM - 4:35 PM

**Physical Activity Time Of Day And Risk Of Weight Change In Men And Women**

Erika Rees-Punia, Mark A. Guinter, Susan M. Gapstur, Ying Wang, Alpa V. Patel, FACSM. *American Cancer Society, Atlanta, GA.* (Sponsor: Alpa V Patel, FACSM)  
(No relevant relationships reported)

**PURPOSE:** Laboratory studies suggest there are potential benefits of morning vs. evening exercise on various physiologic responses in humans but results from epidemiologic and intervention studies are less consistent. The purpose of this study was to examine the association between free-living physical activity timing and change in weight over a three-year period.

**METHOD:** Participants (n=549, 58% women, 66% non-Latinx white) completed an accelerometer protocol for at least six days during two non-consecutive quarters in 2015 and self-reported weight in 2015 and 2018. Multinomial logistic regression was used to explore associations between the proportion of total moderate-vigorous physical activity (MVPA) achieved before noon and percent weight change (loss, gain, stable). All analyses were stratified on sex and adjusted for age, race/ethnicity, number of comorbidities, energy intake (self-reported in 2015), accelerometer wear time, sleep time, and total MVPA (to isolate time-of-day effect).

**RESULTS:** Participants accumulated 12-64% of their MVPA in the morning hours. Participants who accumulated more MVPA in the morning were more physically active overall (81 vs. 69 min./day MVPA Q4 vs. Q1) but were also more likely to have insufficient sleep (7.1 vs. 8.2 hr./day Q4 vs. Q1). Women accumulating most of their MVPA in the morning hours (Q4, >42%) were 1.99 times more likely to maintain their weight over three years (95% confidence interval [CI]: 0.95, 4.69). MVPA timing did not appear to be associated with weight change among men. Race/ethnicity-stratified results suggested that the associations were not different among black, Latinx, or white participants.

**CONCLUSION:** In addition to the impact of physical activity duration, frequency, and intensity on weight control, physical activity timing may also play a role, particularly

in women. The timing of MVPA is a fairly flexible aspect of the behavior and may confer additional benefits regarding weight control; however, more research is needed to fully understand the associations.

2055 May 28 4:35 PM - 4:45 PM

**Cardiorespiratory Fitness And Muscle Strength With The Prevalence Of Diabetes: WASEDA'S Health Study**

Dong Wang, Susumu S. Sawada, FACSM, Hiroki Tabata, Kumpei Tanisawa, Ryoko Kawakami, Kaori Ishii, Katsuhiko Suzuki, Mitsuru Higuchi, FACSM, Koichiro Oka, Shizuo Sakamoto. *Waseda university, Saitama, Japan.*  
(No relevant relationships reported)

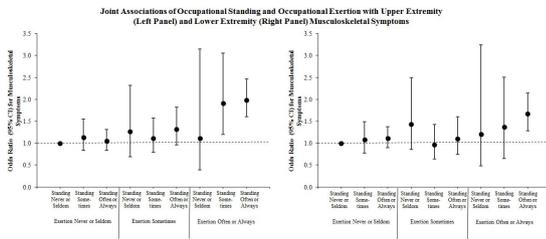
Limited data are available on the relationship of cardiorespiratory fitness (CRF) and muscle strength (MS) with the prevalence of diabetes. **PURPOSE:** This cross-sectional study was to investigate the independent and joint relationship of CRF and MS with the prevalence of diabetes among Japanese men in the WASEDA'S Health Study. **METHODS:** WASEDA'S Health Study is a cohort study which was launched in 2014. We used part of the baseline data collected for this study. Participants were 627 Japanese men [median (inter quartile range) age 56 (48-65) years] who completed a medical examination, leg extension power test, and graded exercise test using cycle ergometers at baseline. The participants were divided into two groups based on CRF and MS, respectively. The prevalence of diabetes was based on self-reports from questionnaires and/or blood tests at the medical examination. Odds ratios and 95% confidence intervals (95% CIs) for the prevalence of diabetes were obtained using logistic regression models while adjusting for age, body mass index, physical activity, family history of diabetes, cigarette smoking, and alcohol intake. **RESULTS:** 49 participants had diabetes. Using the lower CRF and MS as a reference, odds ratios and 95% CIs for the higher CRF and MS were 0.56 (0.26-1.21) and 0.51 (0.25-1.05), respectively. Also, using the lower CRF and lower MS group as a reference, odds ratios and 95% CIs were 0.52 (0.20-1.33) for the lower CRF&higher MS group, 0.55 (0.21-1.41) for the higher CRF&lower MS group, and 0.31 (0.12-0.79) for the higher CRF&higher MS group, respectively. **CONCLUSIONS:** These results suggest that there is a relationship between CRF and MS with the prevalence of diabetes. In addition, there is a joint relationship of CRF and MS with the prevalence of diabetes among Japanese men.

2056 May 28 4:45 PM - 4:55 PM

**Joint Associations Of Occupational Standing And Occupational Exertion With Musculoskeletal Symptoms In A Us National Sample**

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**PURPOSE:** As evidence has implicated sedentary behavior as a health risk factor; initiatives to reduce workplace sitting time by replacing it with standing have received considerable interest. However, concerns have been raised that standing exposes workers to other health hazards; notably observational studies have linked occupational standing to musculoskeletal pain. These prior studies, however, are potentially flawed. For many occupations, standing at work co-occurs with high physical exertion, thus the observed associations between standing and musculoskeletal pain could be confounded by the physical exertion that accompanies many standing-based occupations. The purpose of this study was to examine the joint associations of occupational standing and occupational exertion with musculoskeletal symptoms. **METHODS:** Data for this analysis come from the 2015 National Health Interview Survey, a US nationally representative survey. Occupational standing and exertion were assessed by self-report on a 5-point Likert scale. Presence of musculoskeletal symptoms (pain, aching, or stiffness) for upper extremity (neck, shoulders, elbows, wrists, fingers) and lower extremity (hips, knees, ankles, toes) joints was also assessed. **RESULTS:** There was a significant interaction between occupational standing and occupational exertion ( $p < 0.05$ ). Occupational standing was associated with upper extremity and lower extremity symptoms only among the group with high levels of occupational exertion (Figure). Among those reporting lower levels of occupational exertion; occupational standing was not associated with upper or lower extremity symptoms. **CONCLUSIONS:** Results from this US representative survey suggest the association between occupational standing and musculoskeletal symptoms is largely driven by the co-occurrence of occupational exertion and bring into question the contention that standing in itself incurs adverse musculoskeletal symptoms.



**2057** May 28 4:55 PM - 5:05 PM  
**Late Adulthood Physical Activity Trajectories In Relation To All-cause Mortality**  
 Alpa V. Patel, FACSM<sup>1</sup>, Sara E. Strollo<sup>1</sup>, Erika Rees-Punia<sup>1</sup>, Lauren R. Teras<sup>1</sup>, Ying Wang<sup>1</sup>, Corinne R. Leach<sup>1</sup>, Janet E. Fulton, FACSM<sup>2</sup>, Susan M. Gapstur<sup>1</sup>. <sup>1</sup>American Cancer Society, Atlanta, GA. <sup>2</sup>Centers for Disease Control and Prevention, Atlanta, GA.  
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 (No relevant relationships reported)

**PURPOSE:** Despite the known benefits of being physically active, about half of U.S. adults (and nearly two-thirds of adults age 65+ years) do not meet current U.S. Physical Activity Guidelines for Americans of 150-300 minutes of moderate (75-150 minutes of vigorous) physical activity (MVPA) per week. Given the aging U.S. population and rising healthcare costs, identifying factors associated with healthy aging is critical. There is limited epidemiologic evidence examining whether increasing or initiating MVPA in later adulthood can increase longevity. This study examined the association between late adulthood MVPA trajectories and all-cause mortality in a large U.S. prospective cohort.  
**METHODS:** This analysis included 71,862 Cancer Prevention Study-II Nutrition Cohort participants (mean age 74.1 years; range 52-89 years) who were free of major chronic diseases. Participants self-reported MVPA at two time points approximately 5-years apart and were categorized based on their level of adherence to MVPA guidelines at each time point (inactive, “insufficiently active”, “sufficient”, and “>double minimum recommended”). 12 trajectories were defined (4 each for consistent, increasing, or decreasing MVPA); participants who were consistently “insufficiently active” served as the reference category. Multivariable Cox proportional hazards regression modeling was used to estimate hazard ratios (HR) and 95% confidence intervals (CI).  
**RESULTS:** After an average of 9.9 years of follow-up, 22,736 deaths occurred. The most active participants (>double recommended) at both time points had a 24% lower mortality risk compared to insufficiently active participants (95% CI 0.73-0.79). Those who increased MVPA over time (insufficient to sufficient) also had a lower mortality risk (HR=0.85, 95% CI 0.80-0.91). Conversely, those who decreased activity (sufficient to inactive) had a higher mortality risk (HR=1.18, 95% CI 1.10-1.26). Associations were similar for men and women, and for cardiovascular disease and cancer-specific mortality.  
**CONCLUSIONS:** Maintaining a physically active lifestyle at older ages is optimal for longevity. Public health messaging should encourage active individuals to maintain their physical activity level as they age and reinforce that it is never too late to start being active.

**D-58** Free Communication/Poster - Older Adults  
 Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
 Room: CC-Exhibit Hall

**2082** Board #1 May 28 2:00 PM - 3:30 PM  
**Arterial Elasticity Response To Short-term Endurance Resistance And Blood Flow Restriction Training In Older Men**  
 Murat Karabulut, FACSM<sup>1</sup>, Ricardo Parra<sup>1</sup>, Michael G. Bembien, FACSM<sup>2</sup>, Ulku Karabulut<sup>1</sup>. <sup>1</sup>University of Texas Rio Grande Valley, Brownsville, TX. <sup>2</sup>University of Oklahoma, Norman, OK.  
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 (No relevant relationships reported)

**PURPOSE:** To test hemodynamic and arterial elasticity response to 8-week endurance (END) and blood flow restriction resistance training (BFR) in older men.

**METHODS:** Fifteen older male subjects (age= 57±4.6 yr.) were randomly assigned to one of two training groups (END, n=8 & BFR, n=9) that performed the leg press, leg extension, leg curl, chest press, lat pulldown, and biceps curl exercises 3x/wk for 8 weeks. All training sessions began with subjects warming up in a gym by walking/ jogging at their self-selected speed for 5 min. The END group performed exercise for 4 sets of 15 reps at 40-65% of one repetition maximum (1RM) with 30 sec rest between each set. The BFR group performed exercises for 4 sets of 20 reps at 20-30% of 1RM with 30 sec rest between each set. The BFR cuffs were placed on both arms (pressure ranged from 140 to 160 mmHg) or legs (pressure ranged from 160 to 200 mmHg) for the related exercises with 3-5 min rest in between upper and lower body exercises for cuff placement. Fasted subjects (for at least 8 hr.) reported to the lab and hydration level was assessed by clinical urine refractometer before testing sessions. Pre and post-training pulse wave analysis (PWA) and velocity (PWV) were measured non-invasively using SphygmoCor-Xcel.  
**RESULTS:** One-way ANOVA did not detect any significant differences between group means for any of the hemodynamic variables at baseline. There were no significant condition main effects for any of the variables measured. However, there were significant main effects for time with the pre-test demonstrating higher values than the post-test values for aortic diastolic pressure (p< 0.04), aortic and systemic mean arterial pressure (p< 0.03), end systolic pressure (p= 0.04), and mean arterial pressure during diastole (p< 0.04). In addition, trends for significant time main effects were detected for PWV (p= 0.09), aortic systolic pressure (p= 0.06), systemic systolic and diastolic pressure (p= 0.08), systemic mean arterial pressure (p= 0.06), and pressure time index for diastolic pressure (p= 0.08).  
**CONCLUSIONS:** The findings of the study indicate that both BFR and END resistance training programs are similarly effective in decreasing the central and systemic blood pressure that could be due to training-related adaptations in vascular function and structure.

**2083** Board #2 May 28 2:00 PM - 3:30 PM  
**No, Near And Far Transfer Upon Balance Training Interventions Through Lifespan: Findings From Rcts And Practical Implications**  
 Lars Donath, German Sport University, Cologne, Germany.  
 (Sponsor: Prof. Dr. Scott Drum, FACSM)  
 Email: l.donath@dshs-koeln.de  
 (No relevant relationships reported)

**Task-specificity vs. task-transfer upon neuromuscular exercise training through lifespan: Practical implications derived from RCTs and meta-analytical reviews**

**Prof. Dr. Lars Donath & PD Dr. Oliver Faude**  
 Department of Intervention Research in Exercise Training, German Sport University, Cologne  
 Department of Sport, Exercise and Health, University of Basel, Germany

Neuromuscular training can reduce injuries and falls in athletes and the aging population. However, the training responses and adaptability to different types of neuromuscular exercises are not fully elucidated.  
**PURPOSE:** To provide an overview based on several randomized controlled trials and meta-analyses of our group with respect to training adaptation with a) lacking, b) near) and c) far transfer effects. **METHODS:** Data of more than 5000 healthy participants between the age of 8 and 80 years of age were considered. Neuromuscular performance was assessed employing static, unstable and dynamic balance testing, gait assessment and strength examination. All tests were conducted before and after the intervention period. The intervention included different types of balance training ranging from static tasks to agility tasks and lasted from 8 to 50 weeks of training. Repeated measures analyses of variance with baseline measures as covariate were computed in the RCTs and inverse variance models with random effect size estimation (Hedges g adjusted for small samples) have been conducted in the meta-analytical reviews.  
**RESULTS:** All randomized controlled trials revealed significant (p<0.05) moderate to large effects (SMD>0.5) in the tests that are closely related to the trained exercise task. Transfer effects to other neuromuscular tasks (e.g., strength, balance) are negligible to small (SMD<0.3). These findings have been underpinned by two meta-analytical reviews. Transfer effects have been observed for some strength variables (e.g., rate of force development), performance indicators (e.g., sprint) and selected dynamic balance indices **CONCLUSION:** In order to ensure adequate and specific training adaptations, multimodal exercise programming should be carefully conducted based on complexity, challenge, background and progression, aligned with the intended training goals.

THURSDAY, MAY 28, 2020

2084 Board #3 May 28 2:00 PM - 3:30 PM

**Bouncing For Balance: Mini-Trampoline Training Reduces Fall Risk In Older Adults**Quinn Anderson, Sara Bergen, Rachel Breuer, Erik Hayes, Bradley J. Kendall. *Taylor University, Upland, IN.**(No relevant relationships reported)*

While CVD is the leading cause of death, falls are one of the most prominent causes of accidental mortality in older adults. Unfortunately, interventions in older adults often target either cardiovascular fitness or balance, with few utilizing exercise modalities that address both at once. One modality that has shown promising results on cardiovascular fitness and balance is mini-trampoline training. However, investigations on this modality have been limited in older adults. **PURPOSE:** To compare the effects of 6-weeks of mini-trampoline training to 6-weeks of walking on fall risk and functional fitness in older adults. **METHODS:** Twenty participants (mean age 72±6.9) completed six weeks (3 sessions/week) of trampoline training consisting of aerobic (e.g., jumping jacks) and balance (e.g., tandem skips) exercises, all of which took place on a mini-trampoline. Each session was led by a trained research staff member. For comparison, a control group (n=18, mean age 66±7.4) participated in an unmonitored walking program for six weeks (3 sessions/week) with a goal of increasing average step count by 100 steps every week. At the start and conclusion of the intervention, all participants were assessed on measures of balance (i.e., fall risk and single-leg stands), mobility (i.e., 4-square step test and 8-foot up-and-go), and aerobic endurance (i.e., 6-minute walk test). **RESULTS:** Due to significant differences between the groups at baseline, change scores were calculated for all measures and were compared using independent samples t-tests. Following training, the trampoline group significantly reduced fall risk  $t(36) = 2.129, p < .05, d = .87$ , increased single-leg stand time,  $t(36) = 7.04, p < .01, d = .87$ , and decreased 4-square step test time  $t(36) = 2.651, p < .05, d = 1.5$  compared to the walking group. Both groups decreased their 8-foot up-and-go times and increased 6-minute walk distance after the six weeks. However, change scores were not statistically different between the groups ( $p > .05$ ). **CONCLUSION:** As a result of this study, it appears that mini-trampoline training is a viable exercise modality for older adults to reduce fall risk and improve balance while providing similar cardiovascular benefits (i.e., improvements in walking distance) to those as a result of walking.

2085 Board #4 May 28 2:00 PM - 3:30 PM

**Comparison Of The Effects Of Two Different Resistance Training Programs On Strength In Older Males**Ricardo Parra, Murat Karabulut, FACSM. *University of Texas - Rio Grande Valley, Brownsville, TX.**(No relevant relationships reported)*

**PURPOSE:** The purpose of this study was to compare the effects of 8 weeks of blood flow restriction (BFR) training and traditional endurance resistance training on isotonic, isokinetic, isometric strength in older males. **METHODS:** A total of 17 males (57.0 yr ± 4.6 yr) completed the study. Subjects were randomly assigned to two training groups: blood flow restriction (BFR; n = 9) or endurance resistance training (END; n = 8). Prior to exercise training, baselines measurements were recorded, including height, weight, one repetition maximum (1RM), and unilateral knee extension testing to determine maximal voluntary contraction (MVC) and isokinetic torque at 60°/sec and 180°/sec. Training was held three times a week in a training room under laboratory settings and under the supervision of an experienced and certified strength and conditioning specialist, who ensured that subjects used proper exercise form and provided verbal encouragement. The following machine-based exercises were performed: Leg press, leg extension, leg curl, chest press, and shoulder press. Following a warm-up consisting of a 5-minute walk or jog, the BFR group performed 4 sets of 20 repetitions of the 5 exercises at 20-30% 1RM, while the END group performed 4 sets of 15 repetitions of the 5 exercises at 40-65% 1RM, with 30-60 seconds of rest between exercises. Cuffs were placed at the upper most portion of the limbs. Initial cuff tightness was kept between 30 and 40 mmHg for upper and lower limbs, and final pressure of the cuffs was between 140 to 160 mmHg for upper body 160 to 200 mmHg for lower body. BFR group rested 3-5 minutes between upper and lower body exercises. Following completion of the 8-week training, the measurements at baseline were re-recorded. **RESULTS:** One-way ANOVA resulted in no difference between groups at baseline. Time main effects were seen in 1RM ( $p \leq .05$ ), isokinetic torque at 60°/sec ( $p \leq .05$ ) and 80°/sec ( $p \leq .05$ ), and MVC ( $p \leq .05$ ) tests. **CONCLUSION:** The BFR and END training protocols resulted in similar results on improving strength after 8 weeks of resistance training. It could be speculated that even though half the weight was lifted during the BFR sessions compared to the END sessions, the BFR-related local and systemic changes elicited similar improvements in isotonic, isokinetic, and isometric strength in older males.

2086 Board #5 May 28 2:00 PM - 3:30 PM

**The Impact Of Verification Phase Intensity For Determination Of VO<sub>2</sub>max In Older Adults**Jared M. Dickinson, FACSM<sup>1</sup>, Ian R. Villanueva<sup>2</sup>, John N. Campbell<sup>2</sup>, Serena M. Medina<sup>2</sup>, Theresa M. Jorgensen<sup>2</sup>, Shannon L. Wilson<sup>2</sup>, Nathan Serrano<sup>2</sup>, Siddhartha S. Angadi, FACSM<sup>2</sup>, Glenn A. Gaesser, FACSM<sup>2</sup>. <sup>1</sup>Arizona State University and <sup>2</sup>Central Washington University, Ellensburg, WA. <sup>2</sup>Arizona State University, Phoenix, AZ.*(No relevant relationships reported)*

Maximal oxygen uptake (VO<sub>2</sub>max) declines with age and is a strong predictor of morbidity and mortality risk. Thus, accurate assessment of VO<sub>2</sub>max is important for the older population. **PURPOSE:** To evaluate the use of a verification phase performed at different intensities for determination of VO<sub>2</sub>max on a stationary cycle ergometer in older adults. **METHODS:** Twenty-two older adults (67±6 yr; 26.3±5.1 BMI) were recruited to participate in the study. Each subject completed two experimental trials in a randomized, counterbalanced cross-over design. Both trials consisted of an identical traditional ramp test, followed by 10 min of active recovery, and a verification phase performed at either 85% (VP85) or 110% (VP110) of the peak work rate achieved during the ramp. Expired gases and heart rate (HR) were continuously monitored throughout each test. VO<sub>2</sub>peak was determined using the highest 30-sec average. **RESULTS:** No significant differences were observed for absolute (L/min) VO<sub>2</sub>peak between VP85 (1.86±0.72; P=0.679) or VP110 (1.79±0.73; P=0.200) and the associated ramps (1.85±0.73 and 1.82±0.72, respectively). There was also no significant difference in maximal HR (bpm) between VP85 (153±17; P=0.243) or VP110 (146±16; P=0.085) and the associated ramps (150±17 and 149±16, respectively). However, individual data indicated that 36% of subjects achieved a ≥2% greater VO<sub>2</sub> (L/min) during the VP85 compared to the ramp, while only 15% of subjects achieved a ≥2% greater VO<sub>2</sub> (L/min) during the VP110 compared to the ramp. Moreover, the trend of a decreased percentage of subjects achieving a higher value compared to the ramp during VP110 as compared to the VP85 was fairly consistent across all physiological data (using the collected coefficient of variation [CV] data). While no significant differences (P>0.05) were found for most variables between the two ramp tests, 40% of subjects achieved a VO<sub>2</sub> (L/min) during the second ramp test that was higher than the CV between ramp tests. **CONCLUSION:** These data suggest that if a verification phase is employed for VO<sub>2</sub>max assessment in otherwise healthy older adults, a power slightly below peak work rate may provide a more accurate assessment compared to a power slightly above peak work rate. Supported by intramural funds from ASU

2087 Board #6 May 28 2:00 PM - 3:30 PM

**Assessment Of Cardiorespiratory Fitness In Older Adults With Cognitive Impairment**Shirit Rosenberg, Hallie Nuzum, Heather Taylor, Peter Louras, J. Kaci Fairchild. *Palo Alto Veterans Health Care System, Los Altos, CA.* (Sponsor: Dr. Jonathan Myers, FACSM)  
Email: shiritkamil@gmail.com*(No relevant relationships reported)*

Interest in the potential benefits of physical activity (PA) and exercise on cognition in late life has grown exponentially in the past decade. Peak oxygen uptake (VO<sub>2</sub>) is one of the most widely used metrics of physical fitness. The most accurate measure of VO<sub>2</sub> is cardiopulmonary testing (CPX); however, this method may not be easily accessible in many settings nor appropriate for all populations, including older adults. Self-report measures of PA are easily administered and readily available, yet these measures rely on an accurate recall of past activity. This may be difficult for older adults with even mild forms of cognitive impairment. Identifying alternative methods that accurately estimate a patient's physical fitness are essential.

**PURPOSE:** To evaluate the use of multiple measures of physical fitness in a sample of older adults with amnesic Mild Cognitive Impairment (aMCI).

**METHODS:** The sample included 105 older adults who were diagnosed with aMCI (93.3% male, aged = 71.2 ± 9.2 years). Measures of physical fitness included CPX, 6-minute walk test (6MWT), and the Yale Physical Activity Survey (YPAS). Analysis included comparison of the sub-maximal measures of physical fitness (6MWT) and self-report measures (YPAS) with directly-measured cardiorespiratory fitness on key measures on physiologic measures of fitness (e.g., peak VO<sub>2</sub>, resting blood pressure (BP), BMI).

**RESULTS:** The 6MWT demonstrated a stronger correlation with directly-measured peak VO<sub>2</sub> ( $r = 0.62, p = 0.00$ ) compared to YPAS. The YPAS activity dimensions summary index (composed of questions on vigorous activity, leisurely walking, moving, sitting, and standing) correlated marginally with VO<sub>2</sub>max ( $r = 0.28; P = 0.01$ ). The YPAS index of vigorous activity was slightly correlated with VO<sub>2</sub>max ( $r = 0.21; P = 0.03$ ). CPX was inversely correlated with BMI ( $r = -0.21; P = 0.03$ ) and non-significantly with resting BP. Resting BP and BMI was not significantly associated with 6MWT nor the YPAS indices.

**CONCLUSION:** The present analysis suggests that even mild forms of cognitive impairment impact the validity of self-report measures of physical fitness. Sub-maximal tests of aerobic capacity, such as the 6MWT, provide more accurate estimates of cardiorespiratory fitness and are easily administered in a variety of settings in which older adults receive health care.

**2088 Board #7 May 28 2:00 PM - 3:30 PM**  
**Physical Fitness In Older Adults: Is There A Relationship With The Modified Functional Movement Screen?**

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 (No relevant relationships reported)

There is an increasing emphasis on maintaining and improving physical function and capacity in older adults. Measures obtained through physical fitness testing can help provide health/fitness practitioners with important information used to structure the exercise and rehabilitation programs prescribed for older adults. The modified Functional Movement Screen™ (mFMS) has been utilized as a tool to screen for movement proficiency, stability, motor control and balance in older adults. Yet, its relationship to other measures of physical fitness is not yet fully understood. **PURPOSE:** Determine the relationship between mFMS scores and measures of physical fitness in older adults. **METHODS:** In total, 78 older adults (36 males and 42 females; mean age  $\pm$  SD: age 69.00  $\pm$  7.61 years) completed this cross-sectional study. Physical tests included: handgrip strength (HG), back-leg strength dynamometer (BLS), 8 ft. Up-and-Go (8UG), vertical jump (VJ), medicine ball throw (MBT), chair stand (CST), arm curl (AC), and 6-minute walk (6MW). Participants also completed the mFMS which consists of 4 screens: Shoulder Mobility Screen (SMS), Deep Squat (DS), Active Straight Leg Raise (ASLR), and Lower Body Motor Control Screen (LB-MCS). Scoring criteria ranges from (0-3) for the SMS, DS, and ASLR screens, with higher scores indicating better performance. The LB-MCS is scored as pass/fail. Spearman's *R* correlations were conducted to determine associations between physical fitness tests and the mFMS. **RESULTS:** The DS was significantly correlated with all fitness tests ( $p < 0.05$ ). Specifically, higher DS scores were associated with improved HG ( $r = 0.29$ ), BLS ( $r = 0.50$ ), VJ height ( $r = 0.51$ ), MBT ( $r = 0.41$ ), CST ( $r = 0.56$ ), AC ( $r = 0.29$ ), 6MW ( $r = 0.53$ ), and 8UG ( $r = -0.64$ ) performance. Lastly, better 8UG ( $r = -0.35$ ), BLS ( $r = 0.32$ ), and 6MW ( $r = 0.29$ ) performance were associated with individuals who passed the LB-MCS ( $p < 0.05$ ). No other screens were significantly associated with physical fitness tests. **CONCLUSION:** Increased DS scores and passing the LB-MCS may contribute to overall improvement of physical fitness in older adults. Health practitioners desiring to increase measures of physical fitness in older adults and who use the mFMS as a screening tool may want to focus on increasing DS and LB-MCS movement proficiency.

**2089 Board #8 May 28 2:00 PM - 3:30 PM**  
**The Relationship Between Hip Displacement In The Anteroposterior Direction And Life-space Mobility Among Older Women**

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**PURPOSE:** The ability to recover one's balance using a hip-based strategy is important to avoid falls, but many older adults have limited hip flexibility. This study aimed to clarify the relationship between hip displacement during voluntary motion (Hip-D) in the anteroposterior direction and life-space mobility, and to examine whether Hip-D could be used to independently distinguish the quality of one's life-space mobility by comparing the results on the Life-Space Assessment (LSA) scale. **METHODS:** Hip-D and physical functions related to fall prevention were measured in 319 community-dwelling older women. Hip-D was defined as the maximum moving distance of the great trochanter in the anteroposterior direction. The participants were also classified into good and poor life-space mobility groups based on their LSA scores. The ability of the Hip-D and physical functioning tests to distinguish the above groups was determined using DeLong's test of the area under the receiver operating characteristic curve (AUC) for each test. **RESULTS:** Hip-D was significantly greater in the good life-space group (25.2  $\pm$  6.9 cm) than in the poor life-space group (17.3  $\pm$  5.1 cm). The LSA score was moderately correlated with Hip-D ( $r = 0.51$ ,  $p < 0.05$ ) but only weakly with the fall-related physical functioning parameters ( $|r| = 0.15-0.39$ ). Hip-D had the highest AUC (0.824, 95%CI: 0.776-0.872) among all parameters, and the Hip-D cutoff value was 20.9 cm. The AUC for Hip-D was significantly greater than those for all fall-related physical functioning parameters (AUC = 0.591-0.754) in an examination based on DeLong's test. **CONCLUSIONS:** Hip-D measurements of older adults were easy to obtain and were moderately correlated with life-space mobility.

As such, this approach represents a useful way to predict life-space mobility. Hip-D measurements proved to be more reliable for this purpose than the other fall-related physical functioning parameters studied. It will be necessary the care prevention exercise to improve Hip-D (at least over 21 cm) for older adults.

**2090 Board #9 May 28 2:00 PM - 3:30 PM**  
**Validity And Reliability Of Walk Tests For Cardiopulmonary Fitness In The Elderly According To Distances And Time To Walk**

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**Abstract**

**Background and Purpose:** Cardiopulmonary Fitness is one of health fitness factors, and it correlates chronic disease incidence and mortality in terms of cardiovascular diseases, hypertension, and diabetes. Walk test is commonly used to maintain physical function for CF of the elderly in their daily lives. The most commonly used walk tests are 6MWT (6 minute walk test) at a 30m straight line suggested by ATS (American Thoracic Society) and 20m walk test suggested by the SFT (Senior Fitness Test). However, both tests need long hallway and big space. The purpose of this study was to assess the validity and reliability of walk tests to estimate CF for elderly according to distances and time to walk.

**Methods:** 57 subjects without any disease were recruited from community site. Over 2 or 3 days, 57 subjects performed three CF tests. First test was sub-maximal exercise test on treadmill using modified Bruce protocol. Second test was 10min walk test at 20m straight line. Third test was 10min walk test at 30m straight line. In walk tests, distance was measured for 2, 4, 6, 8, and 10min. Mean and SD were calculated to describe the data. For validity of the test, the Pearson correlation coefficient was used to compare  $VO_{2max}$  (kg/min/kcal) to distances. Multiple regression analysis was conducted to develop several Equations for predicting  $VO_{2max}$  were developed by multiple regression analysis through gender, age, BMI and distance to walk. Win SPSS 25.0 was used for statistical analysis and significance level was  $p < 0.05$ .

**Results and discussion:** The results of walk tests were moderately correlated with  $VO_{2max}$  (0.64  $< r < 0.66$ ,  $p < 0.05$ ). The model from 20m course at 6mins explained 48% of  $VO_{2max}$ . In addition, the model from 30m course at 2mins explained 47% of  $VO_{2max}$ . According to these results, both walk tests were moderately correlated with  $VO_{2max}$ . **Conclusions:** The feasibility of walk test for estimating CF of the elderly was confirmed to be highly positive correlated with  $VO_{2max}$ . In the 20 meter, straight distance model explained 47% of the variability in  $VO_{2max}$ . And in the 30 meter, straight distance model explained 48% of the variability in  $VO_{2max}$ . As the result, CF of the elderly can be estimated by walk test regardless of its distance and time.

**Keywords:** Walk Test, Cardiopulmonary Fitness Test, Validity, Reliability

**2091 Board #10 May 28 2:00 PM - 3:30 PM**  
**Accelerometer-determined Physical Activity And Functional Fitness In Community-dwelling Older Japanese Women**

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 (No relevant relationships reported)

**PURPOSE:** The proportion of elderly people in Japan's population now exceeds 28%, identifying the country as a "super-aging society." It is important for people to maintain health and independence as they age. Therefore, it is important for them to maintain functional fitness. The purpose of this study was to analyze the associations between accelerometer-determined physical activity and clinical measures of functional fitness. **METHODS:** One hundred ninety-nine community-dwelling Japanese women (age: 68.9  $\pm$  4.8 years, BMI: 22.4  $\pm$  2.8) wore an Active Style Pro HJA-350IT accelerometer for five weeks (Omron Healthcare Co., Ltd, Japan) on their waistline for the entire day, except when bathing, showering, swimming, or sleeping. The instrument measured the daily number of steps and accumulated time (minutes) spent in sedentary behavior (SB:  $< 1.5$  metabolic equivalents or METs; 1 MET = 3.5 ml/kg/min), light-intensity physical activity (LPA: 1.5 to 2.9 METs), and moderate- and vigorous-intensity physical activity (MVPA:  $\geq 3.0$  METs). Common functional fitness measures included hand grip, sit-up, sit and reach, functional reach, chair stands, 10-m walk, 10-m obstacle walk, and timed up and go. Functional fitness of participants was compared according to quartiles of steps/day and time spent in SB, LPA, and MVPA.

These quartiles are denoted as Q1 (lowest activity quartile), Q2, Q3, and Q4 (highest activity quartile). RESULTS: Participants accumulated (median, [IQR]) 6,939 [5,000-8,896] steps/day, 286.1 [228.0-349.7] SB min/day, 451.1 [398.1-509.3] LPA min/day, and 68.9 [45.7-93.0] MVPA min/day. The 10-m walk, 10-m obstacle walk, and timed up and go measures differed significantly across the steps/day quartiles (Q1<Q2, p<0.05) and MVPA quartiles (Q1<Q2, Q3, Q4, p<0.05). The 10-m walk (Q1<Q2, p<0.05), timed up and go (Q1<Q2, p<0.05), and functional reach (Q2, Q3> Q4, p<0.05) measures differed significantly across SB quartiles. There were no differences observed across LPA quartiles. CONCLUSIONS: Accelerometer-determined physical activity, especially time in MVPA, was associated with a number of different functional fitness measures.

**2092** Board #11 May 28 2:00 PM - 3:30 PM  
**Functional Assessment Of Older Adults: Inter-rater Reliability Of Rapid Stepping And Weight-shifting Tests**

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The control of both rapid stepping movements and medial-lateral (ML) motion during standing balance and locomotion becomes increasingly difficult with aging. This aspect of function can be an early indicator of fall risk in older adults, but the ability to measure this in the clinic is limited. This analysis is part of a project to develop a clinically-feasible test of rapid stepping performance that challenges medial-lateral motion in older adults. PURPOSE: To determine the inter-rater reliability for three tests challenging rapid stepping performance and ML control of weight-shifting motion. METHODS: Older adults aged 70-96 yrs performed three rapid stepping tests: 1) the Step in Place test (SIP, n = 43) where participants stepped in place as fast as safely possible until reaching 20 footfalls of the first stepping foot, 2) the Repeated Alternating Stair Touch Test (RASTT, n = 37) where participants tapped, alternating right and left, with the ball of each foot a centered piece of tape on the top front edge of a small step as fast as safely possible for 20 s, and 3) the modified-RASTT (n = 37) which differed from the RASTT with the foot taps aimed straight forward on the step. Observations (# of steps for the RASTT tests, and time (s) for SIP) were compared between two experimenters rating one trial from each participant using independent, two-tailed t-tests, Pearson (r) correlations, and intra-class correlations (ICC) for the two RASTT tests. Given its non-normal distribution, a Spearman Rank (rho) test and a two-tailed Mann-Whitney U test were used to compare the SIP test results between raters. RESULTS: There was no difference between raters for the RASTT (mean [SD]: 22.9 [6.8] vs. 22.8 [6.9] steps, p = 0.194), the modified-RASTT (mean [SD]: 23.3 [7.3] vs. 23.2 [7.2] steps, p = 0.168), or the SIP (median [IQR]: 10.7 [8.6] vs. 10.8 [8.6] s, U = 912, p = 0.920). The two experimenters' ratings were highly correlated for both the RASTT (r = 0.998, ICC = 0.998), the modified-RASTT (r = 0.994, ICC = 0.993), and the SIP (Spearman's rho = 0.997). CONCLUSIONS: Our results indicate that these tests exhibit high inter-rater reliability.

**2093** Board #12 May 28 2:00 PM - 3:30 PM  
**Efficacy Of 6-week Suspension Training Exercises On Fitness Components In Older Adults**

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 (No relevant relationships reported)

PURPOSE: : To determine the efficacy of a 6-week suspension training exercises on fitness components in older adults. METHODS: Three male and eight female volunteers (Age = 80.0 ± 4.9 yrs; Height = 166.3 ± 9.5 cm; Body Mass = 71.2 ± 4.9 kg; Body Fat = 34.2 ± 2.6 %) participated in the 6-week suspension training program. Pre- and post-fitness assessments comprised of handgrip dynamometer, functional reach, and overall balance. The 6-week suspension training intervention required individuals to perform a variety of exercises on the suspension training system for forty-five minutes, twice per week. A paired sample t-test was used to determine differences from pre to post (p ≤ 0.05). RESULTS: Data revealed no significant difference between pre- and post-body fat (34.2 ± 2.6 % vs 34.3 ± 2.8 %) or handgrip dynamometer (22.4 ± 1.9 kg vs 22.8 ± 1.8 kg). There was, however, a statistical improvement from pre- to post in functional reach (57.2 ± 6.4 cm vs 68.6 ± 4.3 cm; p = 0.02) and overall balance score (67.5 ± 2.4 vs 72.2 ± 2.2; p = 0.02). CONCLUSIONS: A 6-week suspension training exercise program was adequate to enhance core stability and overall balance amongst older adults.

**2094** Board #13 May 28 2:00 PM - 3:30 PM  
**Relationship Between Ecg Abnormalities And Senior Fitness Test Performance In Older Adults**

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 (No relevant relationships reported)

Background: ECG abnormalities in older adults are associated with high risk of coronary heart disease and subsequent cardiac events. Cardiorespiratory fitness (CRF) is an important predictor of mortality in older adults. CRF is impacted by loss of mobility, strength, and function leading to increased risk of mortality in the elderly. The Senior Fitness Test (SFT) is a functional measure of strength, aerobic endurance, flexibility, and agility/balance in older adults. ECG testing may be related to SFT performance, and may indicate deficits in CRF or functional capacity. Understanding the relationship between ECG abnormalities and SFT performance may aid in prescribing safe, effective exercise programs for this population. Purpose: The purpose of this pilot study was to measure the relationships between 12-Lead resting ECG data and SFT performance in male and female older adults. Methods: Anthropometrics, BP, resting HR, 12-lead resting ECG, and SFT measurements were taken in 30 older adults (Age: 71.9±7.69yrs; Height: 65.81±3.39 in; Weight: 174.55±64.61lbs; BMI: 28.4±5.59kg/m<sup>2</sup>). SFT performance and ECG abnormalities were recorded, and relative VO<sub>2</sub> was calculated. Relationships were analyzed using chi square statistics and Pearson's correlations. Results: ECG abnormalities were present in 57% of this population, but no significant relationship between abnormal ECG and age, gender, VO<sub>2</sub>, or SFT performance was found. There was a significant positive association between 30-sec chair stand (lower body strength) and 30-sec arm curl (upper body strength) performance (r=.73, p=.000), and between the 8-ft up and go (agility) and 6-min walk (CRF) distance (r=.77, p=.000). There was a significant inverse relationship between 30-sec chair stand (lower body strength) and 8-ft up and go (agility) time (r=-.69, p=.000). Conclusion: The presence of ECG abnormalities in over half of this population did not correlate with poor CRF or SFT performance. Lower body strength was associated with higher CRF and agility/balance, regardless of gender, age group, or ECG. Presence of ECG abnormalities may not have a negative effect on SFT performance, and older adults should be encouraged to participate in a supervised exercise program to prevent frailty and loss of independence.

**2095** Board #14 May 28 2:00 PM - 3:30 PM  
**Senior Fitness Test Performance Vs. Norms In Older Adults: A Pilot Study**

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 (No relevant relationships reported)

Background: Functional capacity and independence in older adults is affected by mobility limitations, strength deficits, and loss of function, all of which can lead to frailty and mortality in older adults. This physical decline can be attenuated by early detection of functional limitations. The Senior Fitness Test (SFT) measures functional strength, aerobic endurance, flexibility, and agility/balance in older adults. Purpose: The purpose of this pilot study was to examine SFT functional performance scores in comparison to criterion-referenced population norms in male and female older adults. Methods: Anthropometrics, BP, resting HR, and SFT measurements were taken in 30 older adults (Age: 71.9±7.69yrs; Height: 65.81±3.39 in; Weight: 174.55±64.61lbs; BMI: 28.4±5.59kg/m<sup>2</sup>). SFT scores were recorded, and relative VO<sub>2</sub> was calculated. Performance scores were compared to norms and percentile ranks based on age group and gender. Relationships were analyzed using 2-way ANOVA. Results: In this sample, a higher BMI was significantly related to upper body strength(p=.007), but not lower body strength. There were no significant differences in SFT scores or relative VO<sub>2</sub> based on age group or gender. Almost all age groups and genders were classified as "average" or "above average" in comparison to SFT norms for all tests. Only males <64yrs scored below average (10<sup>th</sup> percentile) on the 6-min walk test. There were no significant differences between this population and SFT normative data. Conclusion: Overall, results indicated that age and gender were not significantly related to lower SFT performance, CRF, or function in tasks of daily living. However, a higher BMI was significantly related to higher upper body strength. SFT scores can be used to track functional physical ability in older adults and may be beneficial prior to beginning a supervised exercise program.

2096 Board #15 May 28 2:00 PM - 3:30 PM  
**Using Virtual Reality To Improve Postural Stability In Elderly Women**

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**PURPOSE:** To observe through objective testing using an assessment module incorporated in a new virtual reality (VR) system whether elderly people's static and functional balance is improved by VR balance training program that is based on movements performed in everyday life.

**METHODS:** Thirteen healthy elderly women participated in 12 sessions of balance-based VR training (three times a week, 30 minutes per session). The system used combined a posturographic platform with a 3D measurement system based on time-of-flight cameras (Kinect). All objective outcomes: the quiet standing test, Functional Balance Test (FBT) and limit of stability (LOS) test were measured on 3 occasions: before the intervention, after 6 training sessions and after the completion of the 4-week program.

**RESULTS:** Results showed significant improvement in LOS performance after the intervention. In FBT participants exhibited significant decrease ( $p < .01$ ; Kendall's  $W = 0.5$ ) in the average time to target hit after 6 trainings. The average center of pressure velocity increased after 6 and 12 sessions, however, did not reach significance ( $p = .053$ ), nevertheless, the effect size was large ( $\eta^2 = 0.22$ ). Movement optimization in FBT and parameters of quiet standing test were not significantly affected by training.

**CONCLUSIONS:** These results demonstrate that even a relatively short 4-week training period can bring positive outcomes. 12 training sessions of balance VR training using the force platform and Kinect sensor resulted in significant improvement of postural stability in healthy elderly women. This trial supports the potential therapeutic use of VR training program which is based on movements performed in everyday life.

2097 Board #16 May 28 2:00 PM - 3:30 PM  
**Effects Of Jump Training On Postural Balance And Leg Muscle Function In Healthy Older Adults**

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Age-associated loss of skeletal muscle strength and postural balance are critical determinants of independent daily living activities in later life. **PURPOSE:** This study aimed to investigate the effects of different jumping exercise tempos on static balance and leg muscle function in healthy older adults. **METHODS:** Twenty-six community-living older adults were randomly assigned to a quick 108 per minute tempo (QJ;  $n = 14$ ; 6 men) or slow 60 per minute tempo [AS1] (SJ;  $n = 12$ ; 5 men) jumping exercise group. Both groups performed one set of jumps until they reached a level of exertion they perceived as difficult (Borg-RPE Scale of 15). Both groups trained three times a week for 12 weeks and participated in 60-min supervised group exercise sessions at a local health center. Outcome measures included center of foot pressure (CoP) sway parameters during quiet standing with eyes open (EO) and eyes closed (EC), four-square step (FSS), two-step stride length (TSL), and rate of force development (RFD) for vertical ground reaction force in sit-to-stand movement. **RESULTS:** Repeated-measures analysis of variance showed a significant main effect for FSS ( $P = 0.009$ ) and TSL ( $P = 0.002$ ). After the training period, QJ demonstrated a significantly decreased FSS time ( $5.17 \pm 1.00$  vs.  $4.87 \pm 1.00$  s,  $P < 0.05$ ) and SJ demonstrated a significantly increased TSL ( $210.8 \pm 21.1$  vs.  $227.3 \pm 27.2$  cm,  $P < 0.05$ ). Both groups showed no changes in CoP sway parameters with EO or EC in quiet standing. **CONCLUSIONS:** Jumps at a quick tempo improved dynamic standing balance evaluated by the FSS, while jumps at a slow tempo improved leg muscle strength. Thus, 12 weeks of jump training at different tempos appeared to have no effects on quiet standing balance, but different effects on dynamic standing balance and leg muscle strength in healthy older adults. [AS1]The phrase 'per minute' was included for one group only, but the meaning was not clear. Please check my suggested alterations.

2098 Board #17 May 28 2:00 PM - 3:30 PM  
**Effects Of Water-based Detraining/re-training On Muscular Fitness And Functional Capacity In Elderly People**

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The positive long-term effects of exercise training on health-related outcomes in elderly people as well as the negative effects of training interruption are well documented. Despite largely used, little is knowing about the effects of detraining/re-training in water-based exercise training.

**PURPOSE:** To evaluate the effects of water-based detraining/re-training on low limb peak torque and functional capacity in an elderly population.

**METHODS:** One hundred and eighty-nine older individuals (68±6yrs) from both genders (176 female and 13 male) engaged in water-based training (training period = 6±3yrs), had their lower limb peak torque (dynamometer), functional capacity (Time Up and Go test [TUG]; and 6-min walk test [6WT]) assessed before exercise training interruption (TI), after 12-weeks of interruption (DT) and after 12-weeks of re-training (RT) on water-based strength training (45minute per session twice a week).

**RESULTS:** Lower limb peak torque decreased from TI ( $12.83 \pm 3.86$  kg/f) to DT ( $10.78 \pm 3.66$ ) ( $p < 0.01$ ), and was increased after RT ( $17.37 \pm 4.35$  kg/f) ( $p < 0.01$ ), achieving higher values compared to TI ( $p < 0.01$ ). No effects of detraining were observed for both 6WT or TUG ( $P > 0.05$ ), however re-training increases the performance on 6WT ( $425.94 \pm 65.30$  m) and TUG ( $6.84 \pm 1.50$  sec) compared to the TI (6WT =  $390.00 \pm 55.47$  m; TUG =  $9.71 \pm 1.91$  sec;  $p < 0.01$ , for all).

**CONCLUSIONS:** Detraining decreases muscle strength, but does not affect functional capacity. Water-based re-training induces additional improvements on muscle low limb peak torque and functional capacity in elderly people previously engaged in water-based training.

2099 Board #18 May 28 2:00 PM - 3:30 PM  
**How Age Range Affect Energy Expenditure And Exercise Efficiency Among Older People During Cycling**

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The reduced cardiorespiratory function and muscle performance in the elderly significantly minify an individual's functional aerobic capacity. Any further decline may make them unable to complete daily activities and then have a negative influence on living independently.

**PURPOSE:** the purpose of this study was to examine the influence of age on changes in energy cost in two significantly different age elderly groups and one young counterpart group.

**METHODS:** The investigation was conducted on 30 healthy women in stationary cycling. Participants were stratified by age into young adults (Y; 20-25 years), older adults (OD; 60-65 years) and the more older adults (OU; 66-70years) with the same sample size.

The position on the cycle ergometer was adjusted for each participant. The protocol started with a rest metabolism test using a calibrated K4b<sup>2</sup> in which subjects were sitting on the cycle ergometer quietly. Then followed by a familiarization process. During the cycling test, each participant performed eight different 300-second trials. Eight trails were under the combination of 2 power output (60 and 100 Watts, W) and 4 cadences (self-selected, 40, 60 and 90 rotations-per-minute, rpm). Oxygen consumption (ml/min) and energy expenditure (EE, kcal/min) were calculated during the last 3 min of each testing condition.

**RESULTS:**

1.  $\dot{V}O_2$  Outcomes  
 Gross  $\dot{V}O_2$  and net  $\dot{V}O_2$  had a similar pattern.  $\dot{V}O_2$  at 100 W output power was larger than those at 60 W of each age group ( $p < 0.05$ ). However, for the same level of output power, only  $\dot{V}O_2$  parameters in the Y group ( $M_G = 1916.40$  and  $M_N = 1606.96$ ) were significantly higher than those in the OU group ( $M_G = 1577.88$  and  $M_N = 1279.05$ ) at 100 W output power ( $p < 0.05$ ).

2. EE outcomes

The age\*power interaction effect on gross EE and net EE was significant, which were  $F(2, 27) = 4.07$ ,  $p = .029$  and  $F(2, 27) = 3.73$ ,  $p = .037$ , respectively. Similarly, The interaction effect of age\*cadence was significant with respect to gross EE and net EE, which were  $F(6, 81) = 2.36$ ,  $p = .038$  and  $F(6, 81) = 2.66$ ,  $p = .021$ , respectively.

**CONCLUSION:**

Based on the above findings, the small change of age range would significantly affect the body energy cost during cycling. In view of oxygen consumption and energy cost, the choice of power output and cadence should be mainly considered in older adults, especially for the age  $\geq 66$  yrs individuals.

**2100** Board #19 May 28 2:00 PM - 3:30 PM

**Resistance Training Increases Insulin-Like Growth Factor-1, Strength, Physical Function, And Mental Flexibility In Female Older Adults**

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(No relevant relationships reported)

The hormone insulin-like growth factor-1 (IGF-1) has anabolic effects in adults. The aging process negatively affects IGF-1 levels, muscle strength, physical performance, and cognitions. There is limited evidence regarding the effects of resistance training (RT) exercise on IGF-1 levels, muscle strength, physical function, and cognitions in Latin American female older adults. **PURPOSE:** To determine the effect of a RT program on IGF-1, muscle strength, physical function and cognitions in Costa Rican female older adults. **METHODS:** Twenty-six older adults were randomly assigned to a control (CTRL, n = 14, age = 68.8  $\pm$  3.7 yr.) or experimental (EXP, n = 12, age = 69.3  $\pm$  2.5 yr.) group. Both groups attended the exercise sessions two times/week, 40-min/session, for 8 weeks. The CTRL group performed slow-motion stretching exercises, and the EXP group performed RT exercises at 70% of 8-RM. Pre- to post-measurements were obtained on IGF-1, muscle strength, the 30-s chair-rise test, and short-term memory, working memory, psychomotor speed, attention and mental flexibility. Mean differences were studied by mixed 2 (groups)  $\times$  2 (measurements) ANOVA. Tukey's post-hoc tests followed significant ANOVA interactions. **RESULTS:** IGF-1 increased in EXP (Pre= 161.0  $\pm$  55.6 vs. Post= 205.3  $\pm$  49.3 ng/mL) and CTRL (Pre= 128.6  $\pm$  51.5 vs. Post = 174.9  $\pm$  70.7 ng/mL) groups (p < 0.05). Significant improvements (p < 0.05 for all) were found in leg extension (EXP= 52.3  $\pm$  9.4 vs. CTRL= 47.9  $\pm$  8.6 kg), chest press (EXP= 52.3  $\pm$  16.1 vs. CTRL= 42.6  $\pm$  9.1 kg), hip adduction (EXP= 47.1  $\pm$  12.8 vs. CTRL= 37.8  $\pm$  6.7 kg), back strength (EXP= 45.5  $\pm$  10.4 vs. CTRL= 39.4  $\pm$  4.6 kg), 30-s chair test performance (EXP= 14.8  $\pm$  1.3 vs. CTRL= 10.3  $\pm$  1.8 rep/30-s), and mental flexibility (EXP= 143.0  $\pm$  16.6 vs. CTRL= 142.1  $\pm$  16.4 s). **CONCLUSION:** A RT program improved muscle strength, physical function, and mental flexibility in female older adults compared to an active control group. The positive change in mental flexibility is a relevant finding due to the small number of studies in older adults. The increase in IGF-1 in both groups following eight weeks of physical activity and training are beneficial for older adults due to the proven importance of growth factors for brain health.

**2101** Board #20 May 28 2:00 PM - 3:30 PM

**Functional Characteristics Of Musculoskeletal Ambulation Disability Symptom Complex (mads) In Community-dwelling Older Women**

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**PURPOSE:** For promoting the independence and prevention of falls of older adults, new category of motor disorders was established: musculoskeletal ambulation disability symptom complex (MADS). MADS is defined as an increased risk of falls and isolation due to an age-related decline in balance and walking ability. The purpose of this study was to understand functional characteristics of MADS by examining the association among physical performance, cognitive functions and sedentary behavior in older community-dwellers in Japan.

**METHODS: Participants:** 59 women aged 65 years and older (mean age 71  $\pm$  4 yrs.) participated in this study. After the participants completed a demographic questionnaire, motor function assessments measurements, one-leg standing time with eyes open (OLS) and timed up-and-go test (TUG), were conducted as diagnostic criteria for MADS. Then, the participants were divided into two groups according to OLS time; **G1:** longer than 15 sec. and **G2:** less than 15 sec. **Measurements:** Following variables were measured; 1) physical function -- hand-grip strength, chair-stand, functional reach, gait speed (10 m), 2) cognitive function -- Mini-Mental State

Examination (MMSE) and Trail Making Test-A (TMT-A), and 3) sedentary behavior -- self-reported questionnaire. Data are presented as means  $\pm$  SD, and analyzed using unpaired t-test and ANCOVA.

**RESULTS:** The average time of OLS was significantly different between G1 and G2 groups (61.3  $\pm$  36.9 and 8.2  $\pm$  3.6 sec., p<0.01). Age was significantly different between the G1 and G2 (70.3  $\pm$  2.5 vs. 72.7  $\pm$  3.2 yrs., p<0.05). The results show that maximal gait speed and TUG were significantly lower in G1 than G2 (1.82  $\pm$  0.24 vs. 1.66  $\pm$  0.25 m/sec., p<0.01) and (7.0  $\pm$  1.1 vs. 8.0  $\pm$  1.5 sec., p<0.05), respectively. In ANCOVA adjusting for the age, TMT-A and sedentary time were significantly different between G1 and G2; TMT-A : 93.9  $\pm$  29.8 sec. vs. 103.3  $\pm$  30.6 sec., p<0.01 and sedentary time: 8.8  $\pm$  0.9 vs. 10.2  $\pm$  1.5 hrs./day, p<0.05. MADS may affect the TMT-A and sedentary time in the older women.

**CONCLUSIONS:** These results suggest that decline in physical and cognitive functions, and sedentary behavior may be significantly associated with the risk of MADS in older women. Follow up studies are necessary to examine physical and cognitive functions of older adults with and without MADS.

**2102** Board #21 May 28 2:00 PM - 3:30 PM

**Distinct Types Of Physical Exercise On Functional Autonomy, Quality Of Life And Elderly Fitness**

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(No relevant relationships reported)

The aging process is associated with physiological changes that cause progressive declines in biological function, imposing a potential threat to the functional capacity. This condition impairs elderly independence, primarily when it is associated with chronic diseases or locomotive disorders. On the other hand, the physical exercise can mitigate some of those effects. **PURPOSE:** the study aimed to analyze the effects of three different training programs (strength, muscular endurance, and aerobic) on functional autonomy, quality of life, and elderly physical fitness index. **METHODS:** After the inclusion and exclusion criteria, the sample consisted of 133 individuals, randomly divided into four groups: muscle strength group (MSG=31) muscular endurance group (MEG=32) aerobic group (AG=35) and a control group (CG=35). Initially, the sample groups were submitted to the following procedures: functional autonomy (GDELAN protocol), quality of life (WHOQOL-OLD), and elderly physical fitness index (1600m walking test, left leg calf circumference and lean mass for body composition assessment, elbow flexion, and extension test, sit and stand-up test, range of motion evaluation through the Normalflex). **RESULTS:** After four months of training, there was a significant difference (p<0.0001) between the CG and all other experimental groups for functional autonomy. For quality of life, there was a significant difference in the post-test phase between the CG and the experimental groups in the domain 1 (AG: p=0.001; MSG: p<0.0001; MEG: p=0.001) and domain 6 (MSG: p=0.011), the results being favorable to those three groups. In the pretest phase, there was no significant difference between the groups. For the elderly physical fitness index there was a significant difference in the post-test phase between the CG and the experimental groups, in the VO2max (AG: p<0.0001 and MEG: p<0.0001), range of motion (AG: p<0.0001; MSG: p<0.0001; MEG: p<0.0001) and muscle endurance (AG: p=0.025), the results being favorable for those three groups. In the pretest, there was no significant difference between the groups. **CONCLUSIONS:** The strength group presented a higher rate of functional autonomy improvement ( $\Delta\%$  -22.5876, p<0.0001), quality of life ( $\Delta\%$  11.96531, p<0.0001) and elderly physical fitness index ( $\Delta\%$  11.0992, p<0.0001).

**2103** Board #22 May 28 2:00 PM - 3:30 PM

**EKG CHARACTERISTICS IN SENIORS PARTICIPATING IN A STRUCTURED FITNESS PROGRAM: A PILOT STUDY**

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**PURPOSE:** Undergraduate exercise science students can benefit from curriculum which includes authentic, hands-on opportunities for learning. A 12-lead

electrocardiograph (ECG) can serve as both as a teaching and screening tool to assess cardiac abnormalities in seniors (over age 65) prior to beginning an exercise program. The purpose of this pilot study was to evaluate the ECG characteristics of older adults prior to participation in a twice-weekly supervised strength training program. **METHODS:** Thirty seniors (Males = 10; Females = 20; Age = 72 ± 7.6yrs) completed cardiovascular screening with resting 12-lead ECG analysis prior to program participation. An exercise physiologist reviewed all ECG results and any identified abnormalities were referred to a cardiologist. Gender, ECG abnormalities, and anthropometrics were compared using a mixed model ANOVA. Chi-square analysis was used to test for differences in the frequency of ECG findings across gender. **RESULTS:** Thirty seniors (Males = 10; Females = 20; Age = 72 ± 7.6yrs) completed cardiovascular screening with resting 12-lead ECG analysis prior to program participation. An exercise physiologist reviewed all ECG results and any identified abnormalities were referred to a cardiologist. Gender, ECG abnormalities, and anthropometrics were compared using a mixed model ANOVA. Chi-square analysis was used to test for differences in the frequency of ECG findings across gender. **CONCLUSIONS:** A pre-exercise ECG can be a useful teaching and screening tool for students who are preparing to supervise older adults in a structured strength training program. ECG results can be used to adjust training variables (type, duration, and intensity) accordingly for each individual senior participant.

**D-59 Free Communication/Poster - Special Populations**

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
 Room: CC-Exhibit Hall

**2104 Board #23 May 28 2:00 PM - 3:30 PM  
 Chatting While Cycling Can Enhance "Positive Affect" In Patients With Cardiovascular Disease**

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**PURPOSE:** Previous studies demonstrated that aerobic exercise activates the frontal area of the left hemisphere, which stimulates optimistic feelings. We hypothesized that having fun chatting with friends while cycling (Chatting While Cycling: CWC) would enhance the benefits of exercise, and this would particularly benefit patients with cardiovascular diseases who find exercising a strenuous activity. Therefore, the aim of present study was to analyze the differences in the positive affect of patients during two aerobics routines: CWC and cycling alone.

**METHODS:** The sample comprised eight patients with cardiovascular disease and nine healthy gender-matched volunteers that performed two aerobics routines. To determine the positive affect, we performed electroencephalography (EEG; NegPos, Neuro Sky) and applied the following formula (Right Alpha 10 sec Avg - Left Alpha 10 sec Avg) / (Right Alpha 10 sec Avg + Left Alpha 10 sec Avg). In addition, the subjective optimistic feelings during exercise was measured using a questionnaire. Each routine involved the same exercises and duration (15 minutes). The intensity was controlled through a 60% peak VO<sub>2</sub> in the cardiopulmonary exercise test. The mean values of EEG data were calculated and used for analysis in the paired t test (level of significance, p < .05). The relationship between positive affect and subjective optimistic feelings was analyzed using Pearson's coefficient of correlation.

**RESULTS:** In patients with cardiovascular disease, the positive affect during exercise was significantly higher for CWC than cycling alone (CWC 46.9 vs. cycling alone -5.9, p = 0.014). On the other hand, healthy volunteers exhibited no such routine-dependent differences. Furthermore, positive affect was associated with increased subjective optimistic feelings during CWC (r = 0.839, p = 0.005).

**CONCLUSIONS:** Aerobic exercise while chatting with friends is recommended for positive affect in cardiac rehabilitation settings. The authors have no conflicts of interest.

**2105 Board #24 May 28 2:00 PM - 3:30 PM  
 Technological Advancements Fail To Elicit Improvements In CVD Detection**

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 (No relevant relationships reported)

Modern and more sophisticated body composition instruments may offer superior determination of cardiovascular risk compared to older, more simple assessments such as body mass index (BMI). **PURPOSE:** To determine whether the Fit3D-calculated measurement of "Body Shape Rating" (BSR) is more accurate than BMI

as a predictor of cardiovascular risk factors. **METHODS:** 17 subjects (7 female, 10 male; aged 18-26) underwent laboratory testing beginning with a body composition assessment by the Fit3D (FIT3D Inc., San Mateo, CA). Subjects then had their heart rate and blood pressure recorded in a resting state before, during, and after a treadmill exercise bout. Descriptive statistics characterized the study sample and simple linear regressions tested the relationships between BSR and blood pressure. **RESULTS:** In the pre-exercise measurements, BSR correlative measures with systolic blood pressure, diastolic blood pressure, and mean arterial pressure were: r = -0.082 (P=0.755), r = -0.052 (P= 0.843), and r = -0.102 (P= 0.698) respectively. In the post measures, BSR correlative values with systolic blood pressure, diastolic blood pressure, and mean arterial pressure were: r = -0.128 (P= 0.625), r = -0.073 (P= 0.782), r = -0.102 (P= 0.698) respectively. **CONCLUSION:** In our sample, BSR failed to elicit significant correlations with blood pressure. While the Fit3D offers a clear technological improvement to simple anthropometric measurements, the pre- and post-exercise measurements did not indicate utility in determining cardiovascular risk.

**2106 Board #25 May 28 2:00 PM - 3:30 PM  
 Walking Characteristics In Individuals With Stroke Differ Based On Walking Speed, Endurance And Daily Steps**

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**PURPOSE:** Walking is an ideal means of obtaining physical activity, yet people with stroke take few daily steps. The purpose of this study was to examine how the walking characteristics of bouts per day, maximum steps per bout and time spent walking differ between individuals with various walking speeds, walking endurance and daily steps. Additionally, we aimed to identify cutoff values for differentiating active and inactive ambulators (i.e. those who do and do not achieve physical activity guidelines through walking).

**METHODS:** Stepping data from 252 individuals with chronic stroke (>6 months) with mean age of 63 (13) years and step count of 4,277 (3,064) steps per day were analyzed. Individuals were placed into previously established levels of ambulation (i.e. household ambulators, limited community and unlimited community ambulators), based on walking speed, walking endurance and daily steps (via two days of StepWatch activity monitoring). Differences in walking characteristics were assessed between ambulation levels (e.g. household vs. community ambulators). Linear regression determined which characteristics best predicted daily step counts. Receiver Operating Characteristic (ROC) curves and area under the curve (AUC) determined which variable was most accurate in classifying active (>5,500 steps) and inactive (<5,500 steps) individuals.

**RESULTS:** Regardless of categorization by walking speed, walking endurance or daily steps, household ambulators had significantly fewer bouts per day, maximum steps per bout and time spent walking compared to both limited and unlimited community ambulators (p = <0.001). Only 81 (32%) participants obtained >5,500 steps per day. The two highest AUC values were 0.91 (95% CI 0.88, 0.95) for maximum steps per bout and 0.83 (95% CI 0.78, 0.88) for bouts per day. Cutoff values of 648 maximum steps per bout or 53 bouts were used to differentiate active and inactive ambulators.

**CONCLUSIONS:** Walking characteristics differed based on an individual's walking speed, walking endurance and daily steps. Differences in daily steps between household and community ambulators are largely due to shorter and fewer walking bouts. Interventions aimed at improving walking after stroke should promote increased walking bouts of any length to increase physical activity after stroke.

**2107 Board #26 May 28 2:00 PM - 3:30 PM  
 Gross Motor Functions Assessed Through The Tgmd-3 In Down Syndrome Individuals And Related Gender Differences**

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**PURPOSE:** Down Syndrome (DS) individuals show a markedly reduced general coordination, resulting in an overall reduced motor proficiency which limits their participation and, consequently, inclusion in sport activities. In this work we aim to characterize gross motor functions in DS, assessed by means of the Test of Gross Motor Development (TGMD 3), and assess possible gender-related differences.

**METHODS:** Thirty-six age- and gender-matched DS individuals (Age: 29.1±7.5 years; Stature: 1.53±0.09 m; Mass: 67±14 kg; BMI: 28.6±14.1 kg/m<sup>2</sup>; n = 18 females (FE), 18 males (MA)), recruited in 5 European countries, performed the TGMD

version 3 (TGMD-3). Participants were matched also for their daily physical activity ( $p = 0.6$ ) as assessed by the international physical activity questionnaire (IPAQ). TGMD-3 includes 13 skills classified as Locomotor Skills (Running, Galloping, Hopping, Skipping, Horizontal jumping, and Sliding) or Ballistic Skills (Two-hand and One-hand striking, Dribbling, Overhand throwing, Underhand throwing, Catching, and Kicking). For each skill, two attempts were performed. A video analysis was performed to assess if the performance criteria were respected. For each criterion, the participant scored 1 if the performance criterion was respected and 0 if not. Individual scores of the two attempts for each skill classified as Locomotor or Ballistic were separately summed. The total gross motor functions score was the sum of Locomotor and Ballistic skills. All scores were computed as a percentage of the maximum achievable score. MA and FE scores were compared using RM-ANOVAs ( $\alpha=0.05$ ). **RESULTS.** The participants had a total gross motor function score of 51% on average, similar for MA and FE ( $F_{1,34} = 1.39$ ;  $p = 0.24$ ;  $M = 54\%$ ;  $F = 48\%$ ). No significant differences between MA and FE were observed for the total scores of Locomotor or Ballistic skills ( $F_{1,34} = 1.45$ ;  $p = 0.23$ ). At single skill level, MA outperformed FE in the kicking skill ( $F_{1,34} = 8.14$ ;  $p = 0.007$ ;  $M = 47\%$ ;  $F = 22\%$ ). **CONCLUSION.** These results highlight gross motor functions limitations in this population, showing a similar impairment of MA and FE, especially for locomotor functions. The different score obtained between MA and FE in the kicking skill may reflect an European cultural bias. Co-funded by the Erasmus + Programme of the European Union, GA 2018-2512.

**2108** Board #27 May 28 2:00 PM - 3:30 PM  
**Using Causal Agency Theory To Promote Functional And Independent Performance In Adults With Intellectual Disabilities**

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 (No relevant relationships reported)

Research suggests adults with intellectual disabilities (ID) have significantly lower levels of physical activity (PA) and fitness compared to the general population. This can affect their physical functioning and increase risk for obesity. Carefully structured exercise has improved functional performance in adults with ID. Limited exercise interventions for adults with ID emphasize self-determined behaviors, which can facilitate PA and ultimately quality of life among adults with ID. Causal Agency Theory (CAT) explains how people become self-determined; that is how they develop the actions and beliefs necessary to engage in self-caused, autonomous action in response to basic psychological needs and autonomous motivation as well as contextual and environmental challenges. **PURPOSE:** To examine the effects of a 10-week guided progressive resistance training (PRT) program on functional and independent performance in adults with ID. **METHODS:** Using a block randomization, 11 participants (25±6yrs) were allocated to a guided group (GG) and 11 (23±8yrs) to a non-guided group (NGG). GG received a PRT intervention in a community-based fitness center that included 3-week familiarization to promote correct and independent performance of exercises and technology-enhanced strategies to promote CAT skills (e.g., goal setting, choice-making). NGG only received the PRT intervention with instruction typically provided by a certified personal trainer. **RESULTS:** Paired *t* tests showed that after the 10-week PRT program, only the GG significantly improved ( $p < .05$ ) correct and independent performance of 4 PRT exercises and scores on Six-Minute Walk Test (SMWT) and Plank Test compared to the NGG. Both groups significantly improved ( $p < .05$ ) Chest Press 1RM and Leg Press 1RM. After controlling for preintervention differences, ANCOVA found practically and/or statistically significant differences between GG and NGG for postintervention Chest Press 1RM,  $F(1, 20) = 3.00$ ,  $p = .100$ ,  $\eta_p^2 = .14$ ; Leg Press 1RM,  $F(1, 20) = 7.25$ ,  $p = .015$ ,  $\eta_p^2 = .29$ ; SMWT,  $F(1, 20) = 10.85$ ,  $p = .000$ ,  $\eta_p^2 = .38$ ; and Plank Test,  $F(1, 20) = 3.49$ ,  $p = .078$ ,  $\eta_p^2 = .16$ . **CONCLUSION:** The guided PRT intervention with its familiarization training and technology-enhanced CAT strategies has the potential to promote functional and independent performance in adults with ID.

**2109** Board #28 May 28 2:00 PM - 3:30 PM  
**Which Exercises Close Diastasis Recti Abdominis In Parous Women? An Experimental Cross-sectional Study**

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Diastasis recti abdominis (DRA) is defined as an impairment with midline separation of the two rectus abdominis muscles along the linea alba. The condition affects a significant number of women during the antenatal- and postnatal period and is hypothesized to cause abdominal-, pelvic-, and low back pain, decreased abdominal muscle strength, as well as cosmetic concerns. A study among US physical therapists

found that the most commonly used exercises in treatment of DRA were indrawing and pelvic floor muscles (PFM) exercises. However, experimental studies have found that both indrawing and PFM contraction increase the inter-recti distance (IRD). Randomized controlled trials (RCT) are few, and both interventions and results differ between studies. **PURPOSE:** To investigate the immediate effect of different abdominal- and PFM exercises on IRD in women with DRA. **METHODS:** Following power calculation of sample size, 38 parous women were included in this cross-sectional study. 2D ultrasound was used to measure IRD at rest and in random order of eight different exercises. A paired *t*-test was used to compare IRD at rest with IRD recorded during each of the exercises and differences between exercises. Means with 95% confidence intervals (CI) are reported. *P*-value was set to  $<0.05$ . **RESULTS:** Head lift and twisted crunch significantly decreased the IRD, both above and below the umbilicus. Above the umbilicus, the mean difference between rest and head lift was 10 mm (95% CI: 7, 13.2,  $p < .001$ ) and twisted crunch 9.4 mm (95% CI: 6.3, 12.5,  $p < .001$ ). Below the umbilicus, the mean difference between rest and head lift was 6.1 mm (95% CI: 3.2, 8.9,  $p < .001$ ) and twisted crunch 3.5 mm (95% CI: 0.5, 6.4,  $p = .02$ ). PFM contraction, maximal in-drawing and PFM contraction+maximal in-drawing increased the IRD below the umbilicus, mean difference; -2.8 mm (95% CI: -5.2, 0.5,  $p = .02$ ), -4.7 mm (95% CI: -7.2, -2.1,  $p < .001$ ) and -5.0 mm (95% CI: -7.9, -2.1,  $p < .001$ ), respectively. **CONCLUSION:** Head lift and twisted crunch decrease, while maximal in-drawing and PFM contraction increase the IRD. RCTs are needed to investigate whether head lift and twisted crunch are effective in permanently narrowing the IRD. The Norwegian Women's Public Health Association fully funded the study.

**2110** Board #29 May 28 2:00 PM - 3:30 PM  
**Critical Ages For Changes In Isometric Force Production In Women Aged 20 To 89 Years**

Ryan M. Miller, Aaron D. Heishman, Eduardo D.S. Freitas, Samuel R. Buchanan, Japneet Kaur, Brady S. Brown, Keldon M. Peak, Jennifer N. Norman, Kelly E. Joniak, J. Mikhail Kellawan, Hugo M. Pereira, Debra A. Bembem, FACSM, Michael G. Bembem, FACSM. *University of Oklahoma - Department of Health & Exercise Science, Norman, OK.* (Sponsor: Michael G. Bembem, FACSM)  
 (No relevant relationships reported)

Although one of the greatest changes observed with aging is the loss of muscular strength, few studies have identified the onset of these reductions in women with increasing age. **Purpose:** To examine the influence of chronological age on maximal voluntary isometric contraction (MVIC) force for the finger flexors and knee extensors (KE) in recreationally active women. **Methods:** One-hundred and forty-two women (age:  $47.1 \pm 17.7$  years, height:  $164.2 \pm 7.0$  cm,  $67.1 \pm 10.7$  kg), matched for physical activity were included in the present analysis. Participants were selectively recruited to include  $\geq 10$  participants for each five-year age interval (e.g. 20-24, 25-29 years, etc.). Testing included three separate visits where participants completed three trials of maximal handgrip strength tests (HGS) followed by three trials of KEMVICs performed on the right side of the body. Participants completed each trial within the same hour of day as the initial testing session and all testing visits were completed 7-10 days apart. Segmental analyses were performed in combination with the Davies test to verify critical age periods for mean MVIC values. An age was deemed 'critical' when statistical significance was achieved performing the Davies test *a priori* at  $p \leq 0.05$ . **Results:** Mean  $\pm$  SD for KEMVIC and HGS were  $209.2 \pm 43.6$  Nm and  $31.6 \pm 4.3$  kg, respectively, and model fit for the KEMVIC and HGS across the participants was  $r^2: 0.64$  and  $r^2: 0.67$  ( $p < 0.001$ ), respectively. The Davies test revealed critical age periods for KEMVIC and HGS of  $46.1 \pm 3.6$  and  $66.28 \pm 1.29$  years, respectively. Both muscle groups displayed marginal losses prior to the respective critical age periods (KEMVIC:  $-0.45$  Nm/year and HGS:  $-0.03$  kg/year), whereas following the critical age period, the reductions increased significantly for both muscle groups (KEMVIC:  $2.32$  Nm/year,  $p < 0.001$ ; HGS:  $-0.67$  kg/year,  $p = 0.03$ ). Importantly, the segmented model provided a significantly improved fit when compared to linear and quadratic models for KEMVIC ( $p < 0.001$  and  $p < 0.001$ , respectively) and HGS ( $p < 0.001$  and  $p = 0.027$ , respectively). **Conclusion:** These data indicate that muscle groups of the upper and lower body do not display uniform changes with increased age. Although both muscle groups are routinely needed in daily life, the upper body appears to maintain strength until later in life.

**2111** Board #30 May 28 2:00 PM - 3:30 PM  
**Increasing Exercise Is Not Associated With An Increase In Sedentary Time In Obese Adults**

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 (No relevant relationships reported)

**BACKGROUND:** It is now established that sedentary time is an independent predictor of morbidity and mortality. Whether increasing exercise is associated with an increase in objectively measured sedentary time is unclear.

**PURPOSE:** To determine if increasing exercise consistent with consensus recommendations is associated with corresponding increases in sedentary time in abdominally obese adults. **METHODS:** Participants were 98 sedentary adults (BMI  $31.8 \pm 3.7$  kg/m<sup>2</sup>, age  $55 \pm 7.1$  years) randomly assigned to one of the following 4 groups: i) no-exercise control (n=19), ii) low-amount, low-intensity exercise (LALI) (180 and 300 kcal/session for women and men, respectively, at 50% of VO<sub>2</sub>peak, n=24), iii) high-amount, low-intensity exercise (HALI) (360 and 600 kcal/session, respectively, at 50% of VO<sub>2</sub>peak, n=36), iv) high-amount, high-intensity exercise (HAHI) (360 and 600 kcal/session, respectively, at 75% of VO<sub>2</sub>peak, n=24). All exercise sessions were supervised. Sedentary time was determined objectively by accelerometry measured at baseline, 8, 16 and 24 weeks using established cut-points. **RESULTS:** The mean exercise time for LALI, HALI and HAHI were  $31.2 \pm 6.7$ ,  $58.3 \pm 7.8$  and  $42.7 \pm 4.5$  min/day respectively. Corresponding values for sedentary time were 10.6, 10.3, and 10.4 hrs/day respectively. No statistically significant differences in sedentary time at baseline was observed between exercise groups ( $p=0.81$ ). Similarly, no significant difference in the change in sedentary time at 24 weeks was observed between exercise groups ( $p=.59$ ). The mean value for change in sedentary time for the 3 exercise groups combined was -15 mins/day. **CONCLUSIONS:** Increasing exercise consistent with consensus recommendations is not associated with a corresponding change in sedentary time independent of exercise amount or intensity. These observations counter the suggestion that fatigue associated with the adoption of exercise in obese adults may lead to corresponding increase in sedentary time.

**2112 Board #31 May 28 2:00 PM - 3:30 PM**  
**VO<sub>2</sub>-PO Discordance In Paraplegia; Considerations For Using Power Output To Prescribe Exercise At Various Intensities**

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Endurance exercise is often prescribed relative to peak power output (% PO<sub>peak</sub>) obtained during a graded exercise test (GXT). Persons with spinal cord injury (SCI) conducting arm cycle ergometry (ACE) display a unique VO<sub>2</sub>-PO relationship not yet quantified in the context of exercise prescription. Indirect evidence suggests that a relatively low % PO<sub>peak</sub> will be required to elicit a given % VO<sub>2peak</sub> during moderate intensity continuous exercise (MICE). Applying this concept of VO<sub>2</sub>-PO discordance to high intensity interval exercise (HIIE) prescription, one must consider the possibility for a seemingly moderate intensity % PO<sub>peak</sub> to elicit a physiological response indicative of HIIE.

**PURPOSE:** To determine the % PO<sub>peak</sub> required to elicit a target VO<sub>2</sub> during MICE, and to explore the use of % PO<sub>peak</sub> to prescribe HIIE in persons with SCI.

**METHODS:** Ten adult men (39±10 yr) with chronic (13.2±8.8 yr) paraplegia (T2-T10) completed a GXT with 3 min stages where PO increased 20 W-stage<sup>-1</sup> from a starting PO (10-40 W) estimated to elicit volitional exhaustion in 8-12 min. Then, in a randomized order, % PO<sub>peak</sub> was used to prescribe MICE and HIIE. The duration of each session was chosen so that the sessions were isocaloric. During MICE, ΔVO<sub>2</sub>/ΔPO was used to estimate the power output that would elicit a steady state 50% VO<sub>2peak</sub>. HIIE was completed with 2 min duty cycles at 70:10% PO<sub>peak</sub>. For HIIE, the last minute of the work or recovery phase was used to calculate the mean VO<sub>2</sub> of working and recovery phases.

**RESULTS:** Mean cardiorespiratory fitness (19.2±5.2 ml·kg<sup>-1</sup>·min<sup>-1</sup>) classified participants as 'good' based on normative data. PO<sub>peak</sub> was a strong predictor of VO<sub>2peak</sub> ( $r=.960$ ,  $p<.001$ ) and VO<sub>2</sub> gain (ΔVO<sub>2</sub>/ΔPO) was  $10.3 \pm 1.8$  ml·min<sup>-1</sup>·W<sup>-1</sup>. During MICE, 24.6±6.7% PO<sub>peak</sub> elicited a VO<sub>2</sub> of  $53.1 \pm 6.5\%$  VO<sub>2peak</sub> ( $10.1 \pm 2.2$  ml·kg<sup>-1</sup>·min<sup>-1</sup>). During HIIE, the work and recovery phases averaged  $88.3 \pm 6.7$  and  $49.2 \pm 6.8\%$  VO<sub>2peak</sub> ( $16.9 \pm 4.2$  and  $9.3 \pm 2.2$  ml·kg<sup>-1</sup>·min<sup>-1</sup>, respectively), and 29.4±7.7% of the session was spent above 80% VO<sub>2peak</sub>. MICE and HIIE were isocaloric ( $115.9 \pm 21.8$  and  $116.6 \pm 35.0$  kcal, respectively;  $p=.903$ ).

**CONCLUSION:** Both MICE and HIIE conditions demonstrated evidence of VO<sub>2</sub>-PO discordance. These findings emphasize the unique considerations pertaining to the use of % PO<sub>peak</sub> to prescribe ACE in SCI.

**2113 Board #32 May 28 2:00 PM - 3:30 PM**  
**Avoiding Diabetes After Pregnancy Trial In Moms (ADAPT- M): Evaluating Fitness In Postpartum Women Who Have Had Recent Gestational Diabetes Mellitus (GDM)**

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 (No relevant relationships reported)

Gestational diabetes mellitus (GDM) affects approximately 6% of women, and 20% develop type 2 diabetes (T2DM) by 10 years post delivery with higher rates in non-Caucasian ethnic groups. Early postpartum lifestyle interventions such as physical activity (PA) are recommended to improve health outcomes and reduce future T2DM. Despite benefits of PA, postpartum women report difficulty to engage and adhere to PA due to barriers such as childcare and poor support. Little is known about whether this high-risk group are achieving age-predicted fitness (APF) and meeting PA guidelines.

**PURPOSE:** To describe cardiorespiratory fitness and PA levels in Caucasian and non-Caucasian women with recent GDM, and the association between fitness and PA measures. **METHODS:** This cross-sectional study recorded baseline data from a multi-ethnic cohort of women with recent GDM at 12 to 20 weeks postpartum, who were part of a health-coaching intervention called Avoiding Diabetes after Pregnancy Trial in Moms (ADAPT-M) between 2014 and 2017. Women underwent a graded exercise treadmill test, anthropometric measures, diastasis rectus screening and completed the International Physical Activity Questionnaire (IPAQ). Baseline characteristics were compared between Caucasian and non-Caucasian ethnicity using T-test, Chi square and Mann-Whitney U tests. The relationship between APF and PA guidelines was assessed with a Chi-Square test. **RESULTS:** We evaluated 149 participants at mean  $16.5 \pm 4.3$  weeks postpartum (mean age  $36.7 \pm 4.6$  years, 70.5% non-Caucasian), had a mean fitness of  $9.7 \pm 1.9$  metabolic equivalents ( $98 \pm 19.2\%$  APF), body fat  $36.2 \pm 5.6\%$ , BMI  $29.7 \pm 6.8$  kg/m<sup>2</sup>, and diastasis rectus was present in 20%. Of those, 52% were below APF while 84.5% were meeting PA guidelines (IPAQ). Non-Caucasian women were significantly less likely to meet PA guidelines ( $p=0.0002$ ) and had lower PA levels ( $p<0.001$ ). Overall, level of PA on the IPAQ did not correlate with APF ( $p<0.10$ ). **CONCLUSION:** Postpartum women with recent GDM had average APF and 84.5% were meeting PA guidelines, although significantly lower levels were seen in non-Caucasian women. Level of PA on the IPAQ did not correlate with APF in this population. Postpartum diabetes prevention programs for women with recent GDM should optimize PA, particularly for higher-risk non-Caucasian ethnic groups.

**2114 Board #33 May 28 2:00 PM - 3:30 PM**  
**Pregnancy In Elite Athletes And Their Return To Sport**

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**PURPOSE:** The study aimed to enhance knowledge on pregnancy and return to sport in the postpartum period in elite female athletes.

**METHODS:** 34 Norwegian elite athletes (33.1 year) and 34 active controls (31.5 year) were asked about training and competitive history, pregnancy-related issues, injuries, eating disorders (ED) and practical experiences, through a questionnaire and interview. Independent Samples T-tests or Chi-square Tests for between-group differences and paired-Samples T-tests and repeated measures ANOVA for within group differences were used.

**RESULTS:** No group differences in fertility problems, miscarriage, pre-term birth or low birth weight were found. Both groups decreased training volume all trimesters and the first two postpartum periods compared to pre-pregnancy. More athletes (71 %) than controls (32 %) ( $p=.002$ ) returned to sport/exercise at week 0-6 postpartum. We found no group differences in complications during pregnancy and delivery, but athletes reported fewer common complaints such as nausea ( $p<.01$ ), musculoskeletal complaints ( $p<.05$ ) and obstipation ( $p<.05$ ). Twelve percentage of the athletes experienced stress fracture postpartum. Number of athletes with clinical ED (12 %) was reduced postpartum (6 %), while constant in controls (3 %). Athletes were not satisfied with advice related to strength training (18 %) and nutrition (41 %) during pregnancy.

**CONCLUSION:** Elite athletes and active controls get pregnant easily, deliver healthy babies and decrease training during pregnancy and the first postpartum periods compared to pre-pregnancy. Most athletes and every third control returned to sport or exercise at week 0-6 postpartum. Athletes report limited nutrition guidance, stress fractures and decreased ED postpartum.

**2115** Board #34 May 28 2:00 PM - 3:30 PM  
**Preferred Leg Drives Seated And Bilateral Exercise In Chronic Stroke And Healthy Control**  
 Jordan Brown<sup>1</sup>, Nicholas Siekirk<sup>1</sup>, Bradley Kendall<sup>2</sup>, Victoria Pardo<sup>3</sup>, Qin Lai<sup>3</sup>, Sujay Galen<sup>4</sup>, Trevor McCready<sup>5</sup>, Samantha Atty<sup>6</sup>, Sam Wilson<sup>1</sup>, Jessica Mutchler<sup>1</sup>, Tamara Hew-Butler, FACSM<sup>3</sup>. <sup>1</sup>Georgia Southern University, Statesboro, GA. <sup>2</sup>Taylor University, Upland, IN. <sup>3</sup>Wayne State University, Detroit, MI. <sup>4</sup>Georgia State University, Atlanta, GA. <sup>5</sup>Central Michigan University, Mount Pleasant, MA. <sup>6</sup>University of Southern California, Los Angeles, CA. (Sponsor: Tamara Hew-Butler DPM, PhD, FACSM, FACSM)  
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 (No relevant relationships reported)

**PURPOSE:** The NuStep Cross Trainer (NS) approximates the bipedal and upright stepping pattern. However, it is unknown how the history of stroke may influence recurrent exercise. The purpose of this study was to examine performance outcomes on the NS in a chronic stroke condition (SC) and an age plus sex-matched control (HC). **METHODS:** In order to determine cadence, each participant performed a 10 minute (min) pretest on the NS at an RPE between 12 and 16. After returning to resting HR and BP, participants then performed a 5-min exercise bout on the NS. **Summary of RESULTS:** SC and HC did not differ in age (*Mdn*: 66 years vs. 57 years, respectively) or BMI (Stroke:  $M = 27.02 \pm 4.57$  vs. Healthy:  $M = 26.46 \pm 4.63$ ),  $p > .05$ . There were no differences in RPE, METS, elevation gain (ft), estimated energy cost (kcal), average (avg.) speed (mph), avg. steps per min, or avg. bilateral power (W) between the HC ( $n = 19$ ) and SC ( $n = 15$ );  $p > .05$ . However, HC produced higher total steps ( $M = 723.18$  steps  $\pm$  137.64) compared to the SC ( $M = 597.67$  steps  $\pm$  116.90);  $t(30) = 2.683$ ,  $p = .012$ . Total step distance (miles) for the HC (mean rank = 19.74) was also greater than the SC (mean rank = 11.77),  $U = 62.0$ ,  $z = -2.363$ ,  $p = .018$ . However,  $\Delta$ avg. pedal power (W) between the HC's limbs (left-right) ( $M = -2.00 \pm 3.528$ ) was not different than SC (affected-non-affected) ( $M = -3.50 \pm 4.852$ );  $t(29) = .997$ ,  $p = .32$ . HC  $\Delta$ ROM (in) (mean rank = 17.50) did not differ from SC (mean rank = 13.62),  $U = 85.5$ ,  $z = -1.214$ ,  $p = .252$ . The SC did not demonstrate strength deficits on their affected side;  $p > .05$ . Bilateral comparison revealed the SC's affected side contributed less pedal power ( $18.08W \pm 9.61$ ) than the non-affected side ( $21.58 \pm 10.34$ );  $p = .030$ . HC produced higher levels of force on their preferred right leg ( $M = 48.68$  lbs  $\pm$  10.05 lbs vs.  $M = 44.42 \pm 9.78$ );  $p < .001$ . No ROM difference was observed between limbs in HC or SC;  $p > .05$ . **CONCLUSION:** Healthy participants covered more distance by producing more steps (not  $\Delta$ ROM) in the 5-minute exercise bout on the NS. The mechanical coupling of the NS seems to encourage equal ROM contribution, but the preferred leg will contribute higher avg. power in both SC (i.e., via non-affected) and the HC (i.e., via right leg). This study was supported by a grant from the National Institutes of Health, P30 AG015281. And the Michigan Center for Urban African American Aging Research.

**2116** Board #35 May 28 2:00 PM - 3:30 PM  
**Patient-provider Discussions And Postpartum Health Outcomes**  
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 (No relevant relationships reported)

Evidence suggests women value health-related conversations with health care providers, particularly during and after pregnancy. Patient-provider discussions about postpartum mental/physical changes during postpartum care may prepare women to cope with and view postpartum changes more favorably and engage in healthier behaviors after delivery. **PURPOSE:** To examine relationships between patient-provider discussion occurrence and satisfaction and 1) moderate-to-vigorous physical activity (MVPA), 2) body satisfaction, and 3) depressive symptoms postpartum. **METHODS:** Survey data were collected from 230 postpartum women (3-12 months) who received pre/postnatal care in the United States for a singleton pregnancy. Women reported occurrence of (yes/no) and satisfaction with (5-point Likert scale; 1=very dissatisfied, 5=very satisfied) patient-provider discussions about expected postpartum mental and physical health changes, current MVPA, body satisfaction (Body Areas Satisfaction Scale) and depressive symptoms (10-item Center for Epidemiologic Studies Depression Scale). Linear and logistic regression models examined relationships between postpartum patient-provider discussions (occurrence and satisfaction) and current MVPA (any vs. none; meeting recs vs. not meeting recs), body satisfaction, and depressive symptoms. **RESULTS:** Women were 7.2 $\pm$ 2.8 months postpartum at the time of survey completion. Postpartum patient-provider discussions were reported in 73.4% of women. Satisfaction with information provided during postpartum discussions averaged 4.0 $\pm$ 0.8. Overall, 74.3% engaged in any MVPA and 47.4% met recommendations. Women who reported a postpartum discussion were more likely to engage in any MVPA (OR=2.00, 95% CI: 1.06, 3.81). Higher body satisfaction was observed in women reporting postpartum discussions ( $p=0.04$ )

and greater discussion satisfaction ( $p=0.002$ ). Depressive symptoms were inversely related to discussion satisfaction during postpartum care ( $p=0.02$ ). **CONCLUSION:** Postpartum discussions with healthcare providers may not only benefit physical health, but also mental health and health behavior. Understanding the content of such discussions may help provide insight into what types of discussions can most effectively promote all aspects of postpartum health.

**2117** Board #36 May 28 2:00 PM - 3:30 PM  
**Postpartum Body Composition: A Case Study Of Two Pregnancies**  
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 (No relevant relationships reported)

Numerous changes to body composition occur during and post-pregnancy in apparently healthy women. Significant changes, specifically to fat mass and bone mineral density, have acute and chronic impacts on overall wellness. **PURPOSE:** The purpose of this case study is to examine the body composition changes of a woman in her 30s over two pregnancies. **METHODS:** Dual-energy x-ray absorptiometry (DEXA) scans were performed before each pregnancy and two weeks, five months, and twelve months after delivery. At each scan the participant was asked about physical activity, lactation status, and supplementation. **RESULTS:** DEXA scan results prior to pregnancy 1 (P1) and pregnancy 2 (P2) were similar for all variables, except total bone mineral density. However, the individual gained considerably more fat during P2 (P1: 15.7 lbs; P2: 28.7 lbs fat gained). Five months post-pregnancy, fat mass was still elevated (P1: 3.8 lbs; P2: 12.7 lbs over baseline) and continued to decrease until 12 months after delivery. Lean mass was increased from baseline at two weeks post-pregnancy (P1: 96.52 lbs.; P2: 97.1 lbs). However, gained lean mass was lost by five months postpartum (P1: 89.89 lbs.; P2: 91.2 lbs). During P1, lean mass remained about the same from five to 12 months but increased at 12 months after P2 (96.2 lbs). After P1, the individual had a substantial decrease in bone mineral density, losing 0.49% at two weeks postpartum, 4.68% at five months, and 9.20% twelve months. Bone mineral density remained below baseline prior to P2, but did not decrease as dramatically following P2. Using the initial baseline, bone mineral density was 3.53% lower at two weeks, 6.57% at five months, and 7.64% at 12 months. During both postpartums, the trunk (P1: 12.1%; P2: 11.54%), spine (P1: 13.5%; P2: 11.36%), and pelvis (P1: 12.4%; P2: 14.34%) decreased more than total bone mineral density. At each appointment, the participant reported breastfeeding, being physically active, but did not exercise consistently. **CONCLUSIONS:** Exclusive breastfeeding combined with an active lifestyle but no formal exercise was adequate to restore fat mass and lean mass by 12 months postpartum. Total bone mineral density decreased following both pregnancies. The baseline bone mineral density for the second pregnancy was lower than the initial baseline, but less decline post-partum.

**D-60** Free Communication/Poster - Cardiac  
 Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
 Room: CC-Exhibit Hall

**2118** Board #37 May 28 3:00 PM - 4:30 PM  
**Sex Differences On Measures Of Pulse Wave Reflection Response To Heavy Battle Rope Exercise**  
 Alena J. Varner, Erica M. Marshall, Jason C. Parks, Stacie M. Humm, Sarah G. Kearney, Meredith C. Paskert, J. Derek Kingsley, FACSM. Kent State University, Kent, OH.  
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 (No relevant relationships reported)

**PURPOSE:** To determine if there are sex-specific responses to heavy battle rope exercise (HRE) on measures of pulse wave reflection. **METHODS:** Twenty-seven resistance-trained individuals (Men:  $n=14$ , Mean $\pm$ SD: Age: 23  $\pm$  3 yrs; Women:  $n=13$ , Age: 22  $\pm$  2yrs) participated. All measurements were collected at Rest, and 15 (Rec1), 30 (Rec2), and 60 (Rec3) minutes following HRE. Augmentation index (AIx), augmentation index at 75bpm (AIx@75), wasted left ventricle energy (EW), and subendocardial viability ratio (SEVR) were recorded via applanation tonometry. HRE utilized six 15-second exercise bouts using a double wave pattern (180bpm), with 30-second seated recovery. Two-way repeated measures ANOVAs were used to determine sex differences across time. **RESULTS:** There were significant sex by time interactions for AIx ( $p = 0.003$ ), AIx@75 ( $p = 0.029$ ), and EW ( $p \leq 0.001$ ). AIx for men was augmented compared to women during Rec1, Rec2, and Rec3 (Men= Rest: 9.4  $\pm$  9.6 %, Rec1: 31.4  $\pm$  13.1 %, Rec2: 18.3  $\pm$  12.4 %, Rec3: 18.6  $\pm$  8.3 %; Women= Rest: 10.5  $\pm$  10.8 %, Rec1: 21.1  $\pm$  10.6 %, Rec2: 12.6  $\pm$  7.3 %, Rec3: 7.1  $\pm$  5.7 %).

Alx@75 for men was augmented during Rec1, Rec2 and Rec3 compared to women (Men= Rest: 0.4 ± 7.6 %, Rec1: 33.6 ± 12.4 %, Rec2: 20.1 ± 13.3 %, Rec3:15.8 ± 9.9 %; Women= Rest: 16.8 ± 39.5 %, Rec1: 33.6 ± 12.4 %, Rec2: 20.1 ± 13.3 %, Rec3: 15.8 ± 9.9 %). EW for men was augmented compared to women during Rec1, Rec2, and Rec3 (Men= Rest: 305.4 ± 219.6 dynes/sec/cm-2, Rec1: 2153.5 ± 866.7 dynes/sec/cm-2, Rec2: 1235.3 ± 779.5 dynes/sec/cm-2, Rec3: 1212.0 ± 593.7 dynes/sec/cm-2; Women= Rest: 258.4 ± 248.2 dynes/sec/cm-2, Rec1: 1257.3 ± 656.7 dynes/sec/cm-2, Rec2: 706.1 ± 688.9 dynes/sec/cm-2, Rec3: 331.9 ± 287.2 dynes/sec/cm-2). Compared to Rest, Alx, Alx@75, and EW for men was significantly greater during Rec3, while Rec3 for women returned to Rest. SEVR had a significant main effect of time ( $p \leq 0.001$ ), in that Rest was augmented compared to Rec1, Rec2, and Rec3 for both sexes (Men= Rest: 159.4 ± 26.0 %, Rec1: 92.3 ± 14.2 %, Rec2: 103.9 ± 27.6 %, Rec3: 127.6 ± 22.4 %; Women= Rest: 142.4 ± 25.3 %, Rec1: 83.2 ± 15.5 %, Rec2: 109.0 ± 21.3 %, Rec3: 129.3 ± 22.0 %). **CONCLUSION:** These data suggest sex differences in pulse wave velocity after HRE. There was a greater decrement of left ventricular function in men up to 60 minutes, and women recovered faster following HRE.

**2119 Board #38 May 28 3:00 PM - 4:30 PM**  
**Exercise Training Improves High Blood Pressure Variability-induced Cardiac Damage In Normotensive Rats**

Ivana C. Moraes-Silva<sup>1</sup>, Katia De Angelis<sup>2</sup>, Nilsa R. Damaceno-Rodrigues<sup>3</sup>, Elia G. Caldini<sup>3</sup>, Maria Claudia Irigoyen<sup>1</sup>. <sup>1</sup>Heart Institute (InCor), University of São Paulo Medical School (FMUSP), São Paulo, Brazil. <sup>2</sup>Federal University of São Paulo (UNIFESP), São Paulo, Brazil. <sup>3</sup>University of São Paulo Medical School (FMUSP), São Paulo, Brazil.  
 (No relevant relationships reported)

High blood pressure variability (BPV) at rest is harmful to organ perfusion even if blood pressure (BP) is within normal values. Exercise training (ET) is known for its effectiveness in reducing BP and BPV; however, the effects of high BPV without sustained hypertension are unclear. **PURPOSE:** To study the effects of ET in cardiac morphofunctional parameters in an experimental model of high BPV. **METHODS:** Normotensive rats (256±4 g, mean BP 110±4 mmHg) underwent sinoaortic denervation (SAD) or sham surgery. SAD consists of baroreceptors afferent arm resection, thus increasing BPV. After 1 week of SAD, rats were divided into sedentary or trained. ET was performed on a treadmill (10 weeks, 5x/week, 60-70% of VO<sub>2</sub> max). After this period, BP and heart rate (HR) were directly measured (Windaq, 2kHz). Cardiovascular autonomic modulation and spontaneous baroreflex sensitivity were analyzed in frequency domain (Matlab). Echocardiography and cardiac histomorphometry were also performed. Two-way ANOVA was used to compare groups; numeric results are described when  $p < 0.05$ ; 8 rats/group were used. **RESULTS:** When compared to control, SAD increased BPV in 5x, as well as the % of cardiac collagen in 2.5x, and the diastolic parameter isovolumetric relaxation time (IVRT) (21±1 vs. 35±1 ms); whereas it reduced VO<sub>2</sub> max (-20%) and the cardiac capillary density (-54%). In sham rats, ET reduced resting HR (-50 bpm/14%), while cardiac vagal modulation (+8.5%), baroreflex sensitivity (+55%), cardiac capillary density (+45%), and VO<sub>2</sub> max (+10%) were augmented. In contrast, ET in SAD increased both HR (~+30 bpm/8%) and cardiac sympathetic modulation (~+50%), with no alterations in baroreflex and vagal modulation. Interestingly, ET in SAD rats improved BPV (-30%), VO<sub>2</sub> max (+9%), IVRT (-6 ms/17%), collagen content (-29%) and capillary density (+50%) in the heart. BPV was highly associated with VO<sub>2</sub> max ( $r = -0.74$ ), collagen  $(r = 0.87)$  and capillary density ( $r = -0.72$ ). **CONCLUSION:** High BPV by SAD impaired cardiac function, morphology, and autonomic nervous system. ET ability to decrease BPV was associated with better aerobic capacity and cardiac morphology, even without improvements in BP, HR and autonomic modulation. Therefore, ET-induced cardiac adaptations do not depend, at least in part, on baroreceptors signaling to central commands.

**2120 Board #39 May 28 3:00 PM - 4:30 PM**  
**The Affection Of Different Weeks Hiit And Moderate Intensity Aerobic Exercise For Cardiac Muscle'S Ampk And Pgc1 α Of Rats**

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**PURPOSE:** Through the research about the affection of different weeks HIIT and moderate-intensity aerobic training on cardiac muscle oxidative ability and cardiorespiratory fitness to determine the effective load of HIIT and MICT to improve the cardiorespiratory fitness. **METHODS:** 120 6-week-old male Wistar rats were randomly divided into 4 groups (N=30): 2 week Group (C), 4 week Group (D), 6 week Group (E), 10 week Group (F). Each group contains a control, moderate-intensity training with HIIT three teams, 10 rats in each group. Rats in the control group didn't exercise, the training program

of exercise group rats were depended on the Results of the maximal oxygen uptake test. 50 minutes exercise per day and 5 times per week. Rats in each group after the prescribed number of weeks were collected cardiac muscle. Protein levels of AMPK and PGC-1α were detected by Western blotting. SPSS17.0 for data analysis. **RESULTS:** 1. 2 weeks and 10 weeks of HIIT group on improving of rat cardiac muscle oxidative capacity and cardiovascular fitness has a significant impact ( $P < 0.05$ ); 2. HIIT on aerobic capacity in rats at 10 weeks improved most significantly ( $P < 0.05$ ), MICT on aerobic capacity of rats had no significant effect in 10 weeks; 3. The change of AMPK and PGC-1α and Vo<sub>2</sub>max in the HIIT group are more consistent than its in the MICT group. **CONCLUSION:** 1. HIIT is more effective than Moderate-intensity continuous training in the way to improve aerobic capacity; 2. Effect of Long-term HIIT can be more pronounced in respect of enhancing aerobic capacity; 3. HIIT can promote cardiac muscle aerobic capacity through AMPK/PGC-1α Signaling Pathway.

Group	2weeks	4weeks	6weeks	10weeks
CON	1.00±0.00	1.00±0.00	1.00±0.00	1.00±0.00
MICT	1.12±0.38	1.06±0.03	0.76±0.12	1.15±0.04
HIIT	0.95±0.24	0.91±0.03	1.09±0.43	1.32±0.26

Group	2weeks	4weeks	6weeks	10weeks
CON	1.00±0.00	1.00±0.00	1.00±0.00	1.00±0.00
MICT	1.04±0.26	1.16±0.30	0.97±0.26	1.16±0.14
HIIT	0.93±0.22	0.83±0.19	1.17±0.36	1.28±0.17

**2121 Board #40 May 28 3:00 PM - 4:30 PM**  
**COMPARISON OF THE 'SEATTLE' AND 'INTERNATIONAL' CRITERIA ELECTROCARDIOGRAM INTERPRETATION IN DIVISION II COLLEGE ATHLETES**

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**PURPOSE:** A 12-lead exercise stress test is a screening tool used to detect abnormalities that may predispose collegiate athletes to sudden cardiac death. Experts in the field have developed new standardized criteria to better interpret electrocardiogram (ECG) in athletes. The purpose of this study was to compare the Seattle criteria to the most recently created International criteria in regards to ECG abnormalities in Division II collegiate athletes. **METHODS:** Fifty-two athletes (Males = 26; Females = 26) completed cardiovascular screening with a resting 12-lead ECG analysis which was read and interpreted according to each criteria by an expert in the field of exercise science. ECGs were classified as 'normal' and 'abnormal' according to the parameters of each criteria and the abnormal condition was noted. Chi-square analysis was used to assess differences between criteria. **RESULTS:** The total number of ECGs identified as abnormal decreased from 6 (11.5%) using the Seattle Criteria to 1 (1.9%) using the International Criteria ( $p < 0.05$ ). The most common ECG abnormality identified using the International Criteria was T wave inversion 6 (11.5%). The newer definition of pathological Q waves reduced the number of ECGs identified as abnormal from pathologic Q waves from 3 (Seattle) to 1 (International) (66% reduction;  $p < 0.05$ ). **CONCLUSIONS:** Following the International Criteria for ECG interpretation significantly reduces the total abnormal and false-positive ECG rates in DII collegiate athletes compared to the Seattle Criteria without compromising sensitivity

**2122 Board #41 May 28 3:00 PM - 4:30 PM**  
**Effect Of Astragalus Injection Combined With Aerobic Exercise On Myocardial Renin-angiotensin System In Diabetic Mice**

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**Abstract:** **PURPOSE:** This investigation aimed at investigating the synergistic effect of Astragalus injection combined with aerobic exercise on myocardial renin-angiotensin system in diabetic mice, and clarify whether the myocardial disease of diabetic mice is improved. **METHODS:** 32 6-week-old male db/db mice were randomly

divided into 4 groups,Diabetes mellitus group, Astragalus injection group,Swimming group and Astragalus injection + swimming group.Monitor the amount of drinking water,body weight and blood glucose changes.The myocardial tissue was executed after 6 weeks and the ventricular mass index was calculated;detect the angiotensin II (Ang-II),angiotensin-converting enzyme (ACE) and angiotensin converting enzyme 2(ACE2) in each group of myocardium tissues.**RESULTS:**In addition to diabetic group, the ventricular mass index of each group was elevated ( $P<0.05$ ).In addition to the diabetic group, the Ang-IIlevels of myocardial tissues were decreased ( $P<0.05$ ). In addition to the diabetic group, the ACE and ACE2 levels averaged increased ( $P<0.05$ ).**CONCLUSIONS:**Myocardial ACE,ACE2 enzyme activity is generally low, Ang-II content is also higher than other groups, and the decrease of enzyme activity will promote the increase of Ang-II content, indicating that renin-angiotensin system is overactivated, resulting in strong vasoconstriction and myocardial ischemia and hypoxia, and eventually lead to all kinds of cardiomyopathy. After the intervention of astragalus membranaceus or aerobic exercise, the activity of ACE,ACE2 enzyme was increased and the level of Ang-II content was also significantly suppressed. Astragalus membranaceus or aerobic exercise had a positive effect on renin-angiotensin system in myocardial tissue of diabetic mice, and played a protective role in the myocardium of diabetic mice. It was speculated that there was a great deal of inhibition on renin-angiotensin system in myocardium of diabetic mice. It may be achieved by increasing the enzyme activity of ACE2 to inhibit the formation of Ang-II in diabetic myocardial tissue.

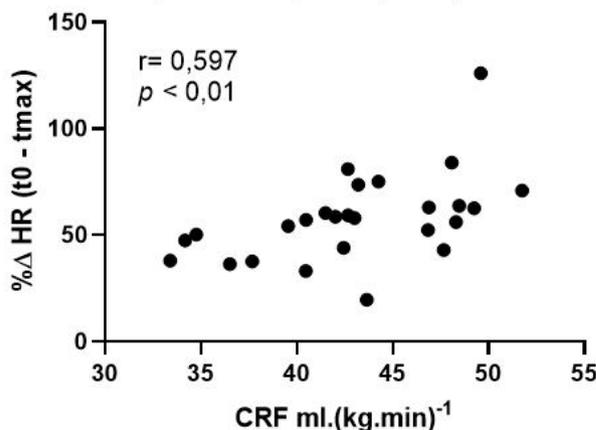
**FUNDING:**This study was supported by Practical Innovation training Program for College students in Jiangsu Province(201510330021Y).

**2123 Board #42 May 28 3:00 PM - 4:30 PM**  
**Cardiorespiratory Fitness And Cardiac Autonomic Function In Brazilian Firefighters**

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**INTRODUCTION:** There are many ways to indirectly determine the autonomic balance, such as by means of heart rate variability, Valsalva maneuver and active orthostatic stress (AOS). In an AOS test, heart rate (HR) shows a bimodal behavior with a fast HR increase that is explained mainly by vagal withdrawal and a subsequent HR decrease, associate to a vagal reactivation and baroreflex control. Studies have shown a controversial relationship between cardiorespiratory fitness (CRF) and the cardiac autonomic function. **PURPOSE:** To correlate CRF and the vagal withdrawal response to AOS in Brazilian firefighters. **METHODS:** We evaluated 26 male military firefighters. AOS test was performed in the morning immediately before the on-duty period. A Heart Rate monitor was used to continuously record HR during AOS. Jackson's questionnaire was used to estimate CRF. The relative difference between the basal (supine) and peak HR (orthostatic) during AOS (% $\Delta$  HR [t0 - tmax]) was calculated to express the vagal withdrawal in relation to basal HR. Due to a nonparametric distribution Spearman correlation test was used ( $p \leq 0,05$ ). **RESULTS:** We observed a positive correlation ( $r = 0,597, p < 0,01$ ) between % $\Delta$  HR (t0 - tmax) and CRF (Figure 1). **CONCLUSION:** It was shown that the higher the cardiorespiratory fitness (CRF), the greater the vagal withdrawal as evaluated by % $\Delta$  HR (t0 - tmax). Besides being necessary for job-task performance, higher CRF seems to be associated with an improved cardiac autonomic function in firefighters. CRF may be a protective factor for autonomic disorders in firefighters.

Figure 1: Spearman correlation between CRF and HR response during AOS (n = 26)



**2124 Board #43 May 28 3:00 PM - 4:30 PM**  
**40 YEARS OF SECULAR TREND OF RESTING HEART RATE IN 12-14 YEARS-OLD STUDENTS**

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 (No relevant relationships reported)

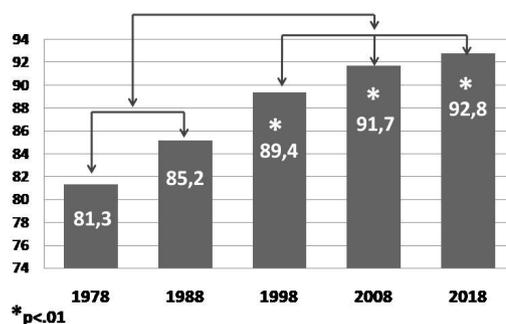
**PURPOSE:** To compare the behavior of rest heart rate (RHR) during four decades in schoolchildren

**METHODS:** Data were obtained from the Ilhabela Mixed Longitudinal Project of Growth and Development from Ilhabela, organized since 1978 with 2 appraisals a year, carried out during the months of May and October. Sample consisted of 262 boys from 12-14 years old, divided into 5 periods: 1978 (n = 41), 1988 (n = 43), 1998 (n = 61), 2008 (n = 52) and 2018 (n = 65). Measures included body weight, height, BMI, and Rest Heart Rate, that was measured by stethoscope before starting a cycle ergometer test. It was taken an ANOVA one-way to compare the RHR from each decade, followed by Scheffé post-hoc test; with a significant level of  $p < .01$ .

**RESULTS:** Figure 1 shows that RHR was significant higher in 1998, 2008, and 2018 when compared to 1978 and 1988. The percent delta of each decade RHR from 1998, 2008 and 2018 was 9.1%, 11.3%, and 12.4% higher than the 1978 values, respectively. RHR from 1998, 2008, and 2018 were 4.7%, 7.1%, and 8.2% higher than in 1988, respectively.

**CONCLUSIONS:** In 40 years there was a positive secular trend of resting heart rate among adolescents from Ilhabela. It was hypothesized that this increase may be related to changes in the studentslifestyle and in the environment they live, which may have contributed to a hypokinetic behavior, reducing the level of physical fitness, and resulting in a cardiac overload.

Figure 1 – Secular Trend of Resting Heart Rate



THURSDAY, MAY 28, 2020

**2125 Board #44 May 28 3:00 PM - 4:30 PM**  
**Echocardiographic Characteristics Of Endurance And Non-Endurance Competitive Athletes**

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 (No relevant relationships reported)

**PURPOSE:** To compare echocardiographic measures between endurance and non-endurance athletes.  
**METHODS:** Echocardiographic studies were performed in 250 well-trained male and female subjects aged between 13 and 38 years (Age = 20.9 ± 5.5 years, BMI = 22.7 ± 3.3 kg/m<sup>2</sup>; mean ± SD). Twenty-five variables were analyzed. Statistical summaries stratified by gender and age group were initially produced. Afterwards, the subjects aged 15 years or over (n = 224) were classified into two categories according to the characteristics of their sport discipline: "Endurance" (cardiorespiratory endurance) and "Other" (Non-Endurance). Univariate comparisons between the two groups were conducted within each gender stratum in a subset of fifteen variables: Heart rate (HR), Left ventricular diastolic diameter (LVDD), Left ventricular diastolic diameter index (LVDDI), Interventricular septum thickness (IST), Left ventricular shortening fraction (LVSF), Left ventricular posterior wall thickness (LVPWT), Relative wall thickness (RWT), Left ventricular mass index (LVMI), Left auricular diameter (LAD), Aortic root diameter (ARD), Inferior vena cava diameter (IVCD), E/A ratio (EAR), E/e' ratio (Ee'R), Right ventricular systolic velocity (RVs) and Left ventricular global longitudinal strain (GLS). The Student's *t*-test for independent samples was applied. Statistical significance was declared at the 0.05 level.  
**RESULTS:** In men, statistically significant higher values were identified in the endurance group for IST (10.5 ± 0.2 vs. 9.7 ± 0.1 mm), LVPWT (9.4 ± 0.1 vs. 8.8 ± 0.1 mm), RWT (0.33 ± 0.005 vs. 0.32 ± 0.004), LVMI (117.2 ± 3.0 vs. 104.5 ± 2.3 mm) and LAD (39.2 ± 0.5 vs. 37.5 ± 0.4 mm); and in women, the endurance group had significantly lower HR values (60.1 ± 1.8 vs. 64.5 ± 1.2 beats/min), and significantly higher LVDDI (31.6 ± 0.5 vs. 29.2 ± 0.3 mm/m<sup>2</sup>) and LVMI (95.9 ± 2.6 vs. 82.4 ± 1.7 mm) values; (mean ± SE).  
**CONCLUSIONS:** Most of the echocardiographic variables showed higher sample means in the endurance athletes, although not all the differences were statistically significant. The endurance group showed significantly higher values of left ventricular wall thickness and left auricular diameter in men, and significantly higher values in variables related to the left ventricular eccentric hypertrophy in women.

**2126 Board #45 May 28 3:00 PM - 4:30 PM**  
**Associations Between Sedentary Behavior And Steps With Heart Rate Variability In Desk Workers**

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**PURPOSE:** More sedentary behavior (SB) has been associated with reduced heart rate variability (HRV) in blue-collar workers; however, this association has not yet been examined in desk workers who engage in high levels of SB. This study explored associations between SB and steps/day with HRV in desk workers. **METHODS:** This analysis of baseline data of a subsample of participants from an ongoing clinical trial included thirty-three insufficiently active adults (age: 43.7 ± 11.6 yr; BMI: 30.0 ± 6.3 kg/m<sup>2</sup>) with desk jobs and elevated blood pressure. An activPAL3 micro device was placed on the anterior midpoint of the thigh for one week to measure SB and steps. Total and prolonged (≥30 continuous minutes) SB and total steps/day were averaged across valid days for participants with ≥10 hr/day on ≥4 days. For HRV, beat-to-beat intervals were collected during a 10-min supine rest using a Polar V800 monitor, with the last 5 min analyzed using Kubios software to measure parasympathetic-related HRV parameters including: mean R-R intervals, root mean square of successive differences (RMSSD), standard deviation of normal R-R intervals (SDNN) and high frequency (HF). Natural-log (ln) transformation was applied for skewed HRV variables. Simple and partial Pearson's correlations between SB, steps/day and HRV parameters were calculated before and after controlling for age. **RESULTS:** Correlations were not statistically significant between total or prolonged SB with any of the HRV parameters (Table 1.). Steps/day were correlated with mean R-R intervals (r = .371; p = .034), with the correlation attenuated when controlling for age (r = .320; p = .075). No other significant correlations were detected between steps/day and other HRV parameters. **CONCLUSION:** While SB was not correlated to HRV, more steps/day were related to greater parasympathetic-related HRV in adults with desk jobs. These results may suggest that movement rather than SB should be the focus of approaches to enhance HRV.

Table 1. Correlation between sedentary behavior, steps per day and HRV parameters.

	Total sedentary time	Prolonged sedentary time (≥30 min bouts)	Steps/day
Mean R-R	r = -.200; p = .265	r = -.163; p = .364	r = .371; p = .034*
lnRMSSD	r = -.006; p = .974	r = -.094; p = .604	r = .131; p = .468
lnSDNN	r = -.052; p = .776	r = -.117; p = .515	r = .145; p = .420
lnHF	r = -.030; p = .869	r = -.076; p = .675	r = -.080; p = .658

\* indicates significant correlation at p < .05; r = Pearson's correlation; lnRMSSD, natural logarithmic root mean square of successive differences; lnSDNN, natural logarithmic standard deviation of R-R; lnHF, natural logarithmic high frequency.

**2127 Board #46 May 28 3:00 PM - 4:30 PM**  
**Effect Of Aerobic Exercise On Cardiac Diastolic Dysfunction: Role Of Heat Shock Protein 27**

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**Purpose:** To evaluate the role of heat shock protein 27 (HSP27) in the effect of aerobic exercise on cardiac diastolic dysfunction in type 2 diabetic rats.  
**Methods:** Forty male Sprague-Dawley rats were randomly divided into four groups: control (C), aerobic exercise (A), diabetes (D), and diabetes plus aerobic exercise (DA). Type 2 diabetes was induced by feeding with a high-fat high-sugar diet for 7 weeks followed by a single intraperitoneal injection of streptozotocin (30mg/kg) in the rats. Aerobic exercise was performed on a rodent treadmill at 21m/min for 60 min, 5 days per week for 8 weeks. Metabolic factors, such as fasting blood glucose (FBG), triglycerides (TG), cholesterol (CHOL) and lipoproteins, were determined by a standard procedure. Cardiac structure and function, such as left ventricular diastolic upper diameter (LVIDd), left ventricular diastolic terminal volume (EDV) and ejection fraction (EF), were measured using echocardiography. Myocardial HSP27 protein expression and phosphorylation were determined using western blot, and myocardial HSP27-titin colocalization were determined using double immunofluorescence. Two-way ANOVAs with post-hoc tests were used to assess differences between groups.  
**Results:** No pathological changes were observed in the myocardial structure in all four groups. Compared to the C group, the D group had significantly higher levels of FBG, TG, and CHOL (all p<0.01), and significantly lower LVIDd and EDV (both p<0.01). Compared to the D group, the DA group had significantly lower levels of FBG, TG, and CHOL (all p<0.01) and significantly higher LVIDd and EDV (both p<0.05). Interestingly, compared to the C group, the D group showed significantly lower myocardial HSP27 phosphorylation and HSP27-titin colocalization (both p<0.05), while the DA group showed significantly higher myocardial HSP27 protein expression and phosphorylation, and HSP27-titin colocalization than the D group (all p<0.01). **Conclusion:** Decreases in myocardial HSP27 phosphorylation and HSP27-titin colocalization are likely involved in early diastolic dysfunction in diabetic rats. Increased HSP27 phosphorylation and titin colocalization may be an important mechanism by which aerobic exercise restores diastolic function in diabetic rats.

**2128 Board #47 May 28 3:00 PM - 4:30 PM**  
**Cardiac Autonomic Function Is Associated With Blood Pressure And Cardiovascular Disease Risk In Adults**

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Risk of cardiovascular disease (CVD) can begin as early as young adulthood. With the prevalence of CVD in the United States expected to increase as the population ages, strategies for the early identification of CVD risk are needed to improve interventions and reduce the future burden of CVD. Cardiac autonomic dysfunction, measured non-invasively through heart rate variability (HRV), has been suggested as an early marker of CVD. Reduced HRV is associated with increased CVD risk among older adults or those with existing metabolic disease, but data are limited in young adults. **PURPOSE:** This study examined the association between HRV and a commonly used CVD risk prediction variable, systolic blood pressure (SBP), and 30-year Framingham risk score as a measure of long-term CVD risk, in a cohort of young adults. **METHODS:** A total of 23 females (24.8 ± 1.9 yr) and 17 males (26.0 ± 2.3 yr) performed study measurements in one visit. Assessments included 10-minute seated HRV collection using a wearable sensor, blood pressure, waist circumference and body mass index. HRV data were filtered and visually inspected for artifacts. The root mean square of successive differences in the time domain (RMSSD) was used as the variable

of interest. The 30-year Framingham risk score was calculated from sex, age, SBP, body mass index and antihypertensive treatment, smoking, or diabetes mellitus status. Multiple linear regression was used to investigate the association between RMSSD and SBP or 30-year risk score, adjusted for sex. **RESULTS:** Hypertension was observed in 43% of females and 76% of males. RMSSD was inversely associated with SBP ( $p = 0.01$ ,  $\beta = -0.11$ ) and 30-year risk score ( $p=0.217$ ,  $\beta = -1.9$ ). Sex significantly influenced the association between RMSSD and SBP ( $p<0.05$ ). **CONCLUSIONS:** In this limited sample, our data suggest that lower HRV is associated with higher SBP and higher CVD risk. Because 30-year risk score is designed to better discriminate long-term CVD risk from multiple factors, this supports the predictive capacity of reduced HRV as an early marker of CVD. Further research is needed to determine whether additional factors, such as race disparities, physical activity level or metabolic variables, can influence this association. Supported by NIGMS/NIH UL1GM118979, TL4GM118980 and RL5GM118978.

**2129 Board #48 May 28 3:00 PM - 4:30 PM**  
**Utility Of Serial Short-time Indices Of HRV And Cardiac Dynamics Throughout The Day**

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 (No relevant relationships reported)

Short-time indices of heart rate variability (HRV) and cardiac regulatory dynamics (CRD) throughout a 24-hr recording may provide an alternative to the collection of a full 24-hr recording, however, methodological approaches need to be further evaluated. **PURPOSE:** The purpose of this study was to examine the robustness of various methodological approaches of short-time indices of HRV and CRD throughout a 24-hr period.

**METHODS:** Eight healthy males completed two 24-hr visits. R-R intervals were recorded continuously using a heart rate monitor. Measures of HRV include the root mean square of successive R-R intervals (RMSSD) and the standard deviation of R-R intervals (SDNN), while CRD was assessed using sample entropy (SampEn). Each 24-hr recording was separated into 145 epochs to create a new time-series (HRV<sub>ep</sub>). Length and position of these epochs were varied around every 10<sup>th</sup>-min: the 3-min before every 10<sup>th</sup>-min (B3), the 3-min following every 10<sup>th</sup>-min (A3), the 3-min splitting every 10<sup>th</sup>-min (S3), and the 5-min splitting every 10<sup>th</sup>-min (S5). The dimensionality and complexity of each of these epoched profiles were subsequently analyzed. Tests of equivalence (TOST) were used to compare the raw values of rMSSD, SDNN, and SampEn between epoching methods at the individual level while paired TOST tests were used to examine the dynamics of these epoched profiles between epoching methods.

**RESULTS:** TOST test between epoching methods of the raw values for rMSSD<sub>ep</sub> and SDNN<sub>ep</sub> at the individual level were equivocal ( $p \geq 0.05$ ), whereas SampEn<sub>ep</sub> showed equality ( $p < 0.05$ ). Further analysis of paired TOST test comparing the embedding dimension and complexity of HRV<sub>ep</sub> showed inequality in the optimal embedding dimension of these time-series and statistical equality ( $p < 0.01$ ) between the complexity of these time-series.

**CONCLUSIONS:** Epoch-by-epoch analysis of rMSSD<sub>ep</sub> and SDNN<sub>ep</sub> were not equal whereas SampEn<sub>ep</sub> was equivalent across epoching methods. Although the optimal embedding dimension of these time-series varied between epoching methods, the complexity of these time-series were similar between methods for all indices of HRV<sub>ep</sub>.

**2130 Board #49 May 28 3:00 PM - 4:30 PM**  
**Exercise Training Improves Cardiac Autonomic Responses In Obese Women Undergoing Bariatric Surgery**

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Obesity is associated with cardiovascular autonomic dysfunction. Bariatric surgery improves cardiovascular health, which might be partly attributed to alterations in the autonomic nervous system. However, the benefits from surgery are limited, and it is

currently unknown whether exercise training can further improve cardiac autonomic regulation in post-bariatric patients. **PURPOSE:** To examine the effects of exercise training on cardiac autonomic responses in women undergoing bariatric surgery. **METHODS:** Sixty-two obese women were randomly allocated to receive either bariatric surgery (RYGB) or bariatric surgery followed by exercise training (RYGB+ET). At baseline (PRE), and 3 (POST3) and 9 (POST9) months after surgery, we assessed chronotropic response to exercise (CR%) and heart rate recovery; i.e., the decay of heart rate after 30 (HRR30s), 60s (HRR60s) and 120s (HRR120s) after a maximal exercise test. The 6-month exercise intervention started at POST3 for RYGB+ET, while RYGB followed standard care.

**RESULTS:** Analysis of relative changes ( $\Delta$  from POST9-PRE) revealed higher CR% ( $\Delta=8.56\%$ , CI95% 0.22-19.90,  $P=0.0445$ ), HRR30s ( $\Delta=12.98$  beat/min, CI95% 4.29-21.67,  $P=0.01$ ), HRR60s ( $\Delta=22.95$  beat/min, CI95% 11.72-34.18,  $P=0.01$ ) and HRR120s ( $\Delta=34.54$  beat/min, CI95% 19.91-49.17,  $P<0.01$ ) in the exercised group. Both groups demonstrated similar reduction in the frequency of individuals showed incompetence chronotropic (defined as chronotropic response less than 80%) at POST3 and POST9). The proportion of participants with blunted HRR decreased at POST3 in both groups; interestingly, exercise training further decreased this proportion at POST9 from 56% to 5%. Moreover, the proportion of blunted HRR in RYGB+ET was significantly lower than in RYGB at POST9 (5% vs. 31%,  $P=0.045$ , respectively). **CONCLUSIONS:** A 6-month exercise training program is an effective strategy to improve cardiac autonomic responses during and post-exercise recovery in obese women undergoing bariatric surgery. These findings reinforce the relevant cardioprotective role of exercise for post-bariatric patients. Clinicaltrials.gov: NCT02441361

**2131 Board #50 May 28 3:00 PM - 4:30 PM**  
**Effects Of Weight Stigma On Cardiovascular Reactivity Among Women With High And Normal Blood Pressure**

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In a recent systematic review, we reported evidence that exercise and nutrition professionals stigmatize their patients due to their weight in 81% of 31 studies. Being weight stigmatized is associated with adverse cardiovascular health consequences for unclear reasons; but may be due to the heightened cardiovascular reactivity that accompanies obesity and hypertension. **PURPOSE:** We examined the influence of two video exposures, one containing scenes of weight stigma (STIGMA) and the other non-stigmatizing neutral (NEUTRAL) scenes, on cardiovascular reactivity assessed by resting and ambulatory blood pressure (ABP) and heart rate (HR), among women with obesity and high blood pressure (HBP;  $n=24$ ) or normal BP (NBP;  $n=25$ ). **METHODS:** Women completed a screening visit and two randomized visits which involved watching a 10-min STIGMA and NEUTRAL video exposure. Laboratory BP and HR were measured before, during, and after the videos. ABP and HR were measured upon leaving the laboratory for the awake (10hr), sleep (9hr), and 19hr. A repeated measures ANCOVA tested the difference in BP and HR changes from baseline between the BP groups after STIGMA vs NEUTRAL controlling for BMI and baseline BP and HR in the laboratory and over ambulatory conditions. **RESULTS:** Women with HBP (systolic/diastolic BP [SBP/DBP]= 122.9 ± 13.6/73.5 ± 11.2mmHg) were 37.5 ± 9.1yr and obese (Body Mass Index [BMI] = 37.8 ± 6.1kg·m<sup>2</sup>); women with NBP (SBP/DBP=106.9 ± 7.4/65.0 ± 7.1mmHg) were 34.1 ± 8.9yr and obese (BMI= 33.6 ± 4.9kg·m<sup>2</sup>). Laboratory SBP/DBP increased 5.5 ± 7.3/2.4 ± 8.8mmHg more in HBP than NBP after STIGMA vs NEUTRAL ( $P < 0.05$ ), with no difference in HR ( $P \geq 0.05$ ). ABP increased more in HBP than NBP over sleep (SBP / DBP= 4.2 ± 20.6/4.7 ± 14.2mmHg;  $P < 0.05$ ) and 19hr (SBP / DBP = 0.9 ± 15.2/0.4 ± 10.8 mmHg;  $P < 0.05$ ) after STIGMA vs NEUTRAL. During sleep, HR increased 7.5 ± 15.7bpm more in HBP than NBP after STIGMA vs NEUTRAL ( $P < 0.05$ ). **CONCLUSION:** Exposure to a weight stigma video resulted in greater cardiovascular reactivity in women with obesity and HBP than NBP in the laboratory and under ambulatory conditions, most notably during sleep. Our findings reveal the importance of educating health professionals about weight stigma, and its immediate, yet persistent adverse cardiovascular health effects, and developing interventions to mitigate weight stigma.

**2132** Board #51 May 28 3:00 PM - 4:30 PM  
**The Influence Of Social Evaluation On Heart Rate Variability And Motor Performance: A Study Of “Real-Life” Competition**

Kyle F. Pietro, Michelle E. Costanzo, Ronald N. Goodman, Li-Chuan Lo, Hyuk Oh, Jeremy C. Rietschel, Mark Saffer, Trent Bradberry, Jose Contreras-Vidal, Amy Hauffer, Bradley D. Hatfield, FACSM. *University of Maryland, College Park, MD.* (Sponsor: Dr. Bradley Hatfield, FACSM)  
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*(No relevant relationships reported)*

It is well known that stress affects performance. Heart rate variability (HRV), which has become a general indicator of stress, can be measured to examine autonomic balance. **PURPOSE:** To examine HRV in participants to determine how competitive stress affects performance. **METHODS:** Participants (n=17) from the University of Maryland Reserve Officers’ Training Corps (ROTC) program completed two testing sessions: a performance alone condition (PA) and a competition condition (C). Participants completed a dry-fire pistol shooting task of 40 shots per condition. PA condition was executed without any evaluation of performance. C condition involved direct comparison to another study participant as well as superior officer observation and monetary compensation. Electrocardiogram (EKG) was collected using a Thought Technology Procomp2 system. EKG was sampled at 256 Hz through a single chest lead. HRV was analyzed through QRSTool and Kubios HRV. HRV measures were SDNN and RMSSD. **RESULTS:** SDNN decreased by condition (F (1, 16) = 3.668, p = .074, d = 0.464). RMSSD decreased by block, but not by condition (F(1, 16) = 4.557, p < .05, d = 0.517). Cortisol response ANOVA revealed a significant main effect of condition (F (1, 16) = 12.02, p = .003, d = 1.05) such that cortisol was higher during C compared to PA. **CONCLUSION:** The decrease in SDNN indicates a decrease in HRV in response to increased stress. This decreased HRV reflects a change in autonomic balance which is negatively correlated with adaptability and resilience. The decrease in RMSSD represents decreased parasympathetic modulation of heart rate. Although not measured directly, it is likely that participants experienced moderate fatigue throughout blocks. As cerebral cortical activity increased during C, one can speculate that the difference observed was influenced by the shift toward lower parasympathetic activity (i.e. reduced afference to the cortex).

**2133** Board #52 May 28 3:00 PM - 4:30 PM  
**Caffeine In Conjunction With Resistance Exercise On Vagal Modulation In Resistance-trained Women**

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*(No relevant relationships reported)*

**PURPOSE:** To examine the effects of caffeine alone, or in conjunction, with acute resistance exercise, in resistance-trained women on performance and measures of vagal modulation.

**METHODS:** Eleven resistance-trained women (Age Mean±SD: 24±4yrs) consumed either a placebo (PL) or caffeine (4mg/kg) 72 hours apart, in a double-blind, crossover fashion. Forty-five minutes following supplementation, participants performed two sets of 10 repetitions at 75% 1-repetition maximum (1RM), and one set with repetitions to failure at 70% 1RM on the squat and bench press. Log transformed root mean square of successive differences (lnRMSSD), and high frequency power (lnHF), as well as sample entropy (SampEn), and Lempel-Ziv entropy (LZEn) were assessed at rest (Rest1), 45 minutes post-consumption (Rest2), immediately post-exercise (Post1), and 10 minutes post-exercise (Post2). Two-way ANOVAs were used to analyze the effects of condition (PL, caffeine), across time (Rest1, Rest2, Rec1, Rec2).

**RESULTS:** The repetitions on the fatiguing set were similar between conditions for the squat (p=1.0), and the bench press (p=0.7). There were no significant condition by time effects for vagal tone. There was a significant main effect of time (p=0.0001) for lnRMSSD (Rest1: 4.52±0.73ms; Rest2: 4.48±0.64ms; Rec1: 2.72±0.66ms; Rec2: 2.28±0.55ms) such that it significantly decreased during Rec1 and Rec2 compared to Rest1 and Rest2. There was a significant main effect of time (p=0.0001) for lnHF (Rest1: 8.12±1.23ms<sup>2</sup>; Rest2: 8.00±1.09ms<sup>2</sup>; Rec1: 4.79±2.50ms<sup>2</sup>; Rec2: 4.02±1.02 ms<sup>2</sup>) with it decreasing at Rec1, and Rec2, compared to Rest1 and Rest2. There was a significant main effect of time (p=0.0001) for SampEn (Rest: Rest1: 1.43±.19; Rest2: 1.40±0.19; Rec1: 1.09±0.32; Rec2: 1.09±0.31) such that SampEn was significantly decreased compared to Rest at Rest2, Rec1 and Rec2. Additionally, there was a significant main effect of time (p=0.004) for LZEn (Rest1: 0.73±.09; Rest2: 0.77±0.06; Rec1: 0.66±0.13; Rec2: 0.54±0.16) with Rec2 being significantly attenuated compared to Rest2.

**CONCLUSIONS:** These data demonstrate that 4mg/kg of caffeine consumption does not have an ergogenic effect. In addition, when performed in conjunction with resistance exercise, it does not further decrease measures of vagal modulation in resistance-trained women.

**2134** Board #53 May 28 3:00 PM - 4:30 PM  
**Sleep Quality Is Associated With Nighttime Heart Rate Variability In Young Adults**

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*(No relevant relationships reported)*

Heart rate variability (HRV) reflects autonomic nervous system function, and low nighttime HRV is linked to reduced parasympathetic control. Optimal parasympathetic function is important for the induction and maintenance of sleep, overall wellbeing, and is inversely associated with chronic disease. In young adults, 60% of whom report poor sleep quality, disrupted parasympathetic function may reflect suboptimal health and lifestyle behaviors. While there is an established relationship between physical activity (PA), stress, and nighttime HRV, the associations between HRV and other lifestyle-related factors such as sleep quality and social jet lag (SJL) in young adult populations are yet to be determined.

**PURPOSE:** The purpose of this study was to determine the relationship between nighttime HRV and sleep characteristics in young adults.

**METHODS:** Healthy young adults (n=33, 18.6 ± 0.7 years, 69.6% female) wore a chest-strap heart rate monitor for 24 hours and a triaxial accelerometer on the non-dominant wrist for 7 days during free-living PA and sleep. Average sleep duration and SJL were determined from objective sleep data, with SJL calculated as the difference in hours between the midpoint of sleep on weeknights (school) and weekend (free) nights. The Pittsburgh Sleep Quality Index (PSQI) and Perceived Stress Scale were used as subjective measures of sleep quality and stress. Nighttime HRV outcomes were calculated using R-R intervals between the hours of 1:00 AM - 5:00 AM. Linear regression assessed multivariate relationships among sleep duration, quality, SJL, and HRV while controlling for moderate-to-vigorous PA and perceived stress.

**RESULTS:** Independent of average sleep duration and SJL, perceived sleep quality was associated with the HRV outcomes low frequency (LF; B= -10.62 ± 4.85, 95% CI: -20.56, -.67) and high frequency power (HF; B= 10.55 ± 4.84, 95% CI: .61, 20.49). Following control for PA and stress, these relationships remained significant and the association between SJL and LF/HF ratio approached significance (B= -.33 ± .18, 95% CI: -.69, .04).

**CONCLUSIONS:** Our findings suggest that both LF and HF HRV components are related to sleep quality in young adults, highlighting a potential relationship between sleep quality and nighttime autonomic nervous system function.

**D-61** Free Communication/Poster - Cellular/Molecular

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
 Room: CC-Exhibit Hall

**2135** Board #54 May 28 3:00 PM - 4:30 PM  
**Racial Differences In Selected Mechano-sensitive Micro-RNAs**

Maitha Aldokhayyil, Dulce Gomez, Adelola Adeyemo, Michael Brown, FACSM. *Auburn University, Auburn, AL.*

*(No relevant relationships reported)*

Endothelial cells (ECs) are constantly exposed to hemodynamic shear stress that can influence vascular signaling. High laminar shear stress (HLSS), an exercise mimetic, upregulates atheroprotective genes such as Kruppel-like factor 2 (KLF2), whereas disturbed flow and oscillatory SS upregulate proatherogenic genes such as vascular adhesion molecule-1 (VCAM-1). Micro-RNAs (miRs) are small non-coding RNAs that regulate gene expression. Current evidence has identified mechano-sensitive miRs that regulate shear-induced gene expression and ultimately control endothelial function. Moreover, we have previously demonstrated the efficacy of HLSS in attenuating endothelial dysfunction predominantly seen in African American (AA) ECs compared to Caucasian (CA) ECs.

**Purpose:** To investigate potential racial differences in the expression of selected mechano-sensitive miRNAs in response to HLSS.

**Methods:** Human umbilical vein endothelial cells (HUVECs) from two AA donors and two CA donors were cultured and exposed to HLSS (20 dynes/cm<sup>2</sup>) for 24hr using a cone and plate viscometer. Total RNA was harvested to assess the effect of HLSS on the expression of miR-21, miR-126\* and miR-92-a.

**Results:** We report a significant increase in miR-92-a expression with HLSS in both AA and CA HUVECs (~ 2-fold difference, p= .005). Additionally, miR-92-a tended to be higher in AA ECs compared to CA ECs under both conditions. However, there was no significant difference in miR-21 or miR-126\* expression between AA and CA ECs nor control and HLSS conditions.

**Conclusion:** Despite the recognition of miRNAs as important regulators in vascular physiology, evidence is still lacking on their association with higher prevalence of endothelial dysfunction in AA. It is highly important to identify the role they play, as understanding the molecular mechanisms driving racial differences in endothelial function can help develop better targeted prevention and treatment strategies.

**2136 Board #57 May 28 3:00 PM - 4:30 PM**  
**Is The Hexosamine Biosynthesis Pathway Affected By Inflammation In Endothelial Cells?**

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Excessive addition of  $\beta$ -linked N-acetylglucosamine (O-GlcNAc) via the hexosamine biosynthesis pathway (HBP) occurs with diabetes and decreases in muscles with exercise. HBP flux increases inflammation and may be specifically important in the activation phase of the inflammatory response. Inflammation plays a key role in insulin resistance and hyperglycemia (HG), with the process contributing to the development of diabetes and associated complications.  $\beta$ -cell development and differentiation are affected by the HBP, and O-GlcNAc has been indicated in insulin secretion from the pancreas (1). **PURPOSE:** We explored whether in the absence of HG, an inflammatory insult, can affect key factors in this pathway and total O-GlcNAcylation within the endothelium. Because African Americans are overrepresented in conditions involving chronic inflammation, potential racial differences were also examined. **METHODS:** Human umbilical vein endothelial cells (HUVECs), n=6, were stimulated with 10ng/mL of tumor necrosis factor alpha (TNF $\alpha$ ) for 4 hours, or treated as a control. Western blot procedures were used to measure expression of the HBP rate-limiting enzyme (GFAT) and the transferase that adds the end-product onto proteins (OGT). Total protein O-GlcNAcylation (O-GlcNAc) was also measured. **RESULTS:** With TNF $\alpha$  stimulation, there was no difference in GFAT ( $0.63 \pm .09$  vs  $0.62 \pm .08$ , p=.89), OGT ( $0.49 \pm .09$  vs  $0.41 \pm .08$ , p=.56), nor total O-GlcNAc ( $1.56 \pm .38$  vs  $1.77 \pm .42$ , p=.71) expression compared to controls. There were no racial differences found among the various conditions (p>.05) with either of the proteins examined.

**CONCLUSIONS:** The HBP is not altered with acute inflammation in endothelial cells (ECs), with no racial differences additionally found. Low-grade inflammation vitally contributes to diabetes, atherosclerosis, and their complications, with the HBP playing a role in each. We conclude that HG may be necessary to work in conjunction with inflammation to increase protein O-GlcNAcylation in ECs. Although increased flux through the HBP has been shown to upregulate inflammation, the reverse relationship cannot be confirmed. Future research is needed to examine links between this pathway, various conditions, and the ability of exercise to alter it within the endothelium.

**2137 Board #56 May 28 3:00 PM - 4:30 PM**  
**Exercise Preconditioning Alleviate LPS Induced Acute Heart Injury Through GCN2 Pathway**

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Exercise preconditioning may protect against cardiac injury induced by lipopolysaccharide (LPS), but the mechanism is unresolved.

**PURPOSE:** This study aims to explore whether the general control nonderepressible 2 kinase (GCN2) gene is associated with the protective effect of exercise preconditioning.

**METHODS:** 8 weeks old male GCN2 knockout (KO, n = 40) and wild type control with C57BL/6J background (C57, n = 40) mice were respectively divided into 4 groups: control, LPS (L), exercise preconditioning (E) and exercise preconditioning LPS (EL). Mice in the exercise groups performed exercise for 8 weeks. After exercise, all mice were administered an equal volume of LPS (10  $\mu$ g/g body weight) or saline. Heart function were measured by Vevo1100 small animal echocardiography 6 hours later followed by immediately tissue collection for Western blots and histological analysis.

**RESULTS:** Exercise preconditioning was observed to improve cardiac dysfunction evaluated by ejection fraction (EF) value (C57 L:  $50.34 \pm 6.94$  vs. C57 EL:  $59.32 \pm 3.63$ , p<0.05) and also significantly decreased the expression levels of GCN2, phosphorylation of eukaryotic translation initiation factor 2 $\alpha$  (p-eIF2 $\alpha$ ) and activating transcription factor 4 (ATF4) in C57 mice induced by LPS (p<0.05). Moreover, GCN2 KO decreased cardiac dysfunction induced by LPS in sedentary mice. The cardiac dysfunction in the GCN2 KO EL group were lower than that in C57 EL group, and the expression of GCN2, p-eIF2 $\alpha$  and ATF4 in the GCN2 KO EL group was significantly lower than that in C57 EL group (p<0.05).

**CONCLUSION:** Exercise preconditioning alleviated cardiac injury induced by LPS. GCN2 KO also improved cardiac injury. Exercise preconditioning promoted the effect of GCN2 KO in alleviating cardiac injury, GCN2 and eIF2 $\alpha$ /ATF4 pathway play an important role in the process.

**2138 Board #57 May 28 3:00 PM - 4:30 PM**  
**Abstract Withdrawn**

**2139 Board #58 May 28 3:00 PM - 4:30 PM**  
**Postnatal Growth Restriction In Mice Alters Cardiac Mitochondrial Energetics**

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Postnatal growth-restriction (PGR) is associated with increased risk of cardiovascular mortality. We hypothesize that nutrient restriction alters metabolism leading to cardiac failure. **PURPOSE:** To determine the effect of PGR on mitochondrial respiratory capacity (JO<sub>2</sub>). **METHODS:** FVB mouse dams were fed a control(CON: 20% protein), or a low-protein(LP: 8% protein) isocaloric diet 2-weeks before mating. LP-dams produce 18% less milk and pups nursed by LP-dams undergo growth restriction. At postnatal day (PN) 1, pups born to dams fed the CON diet were crossed to LP-dams(PUN; postnatally undernourished) or a different CON-dam. At PN21, all mice were weaned to the CON-diet. On PN22 or PN80, mice were weighed, euthanized, and hearts removed. Hearts were weighed and cardiac mitochondria were isolated via differential centrifugation. Respiration was measured through high-resolution respirometry in the presence of 5 mM pyruvate and 1 mM L-malate(PM). Two-way ANOVAs were performed with the main effects of diet (CON vs. PUN) and age(PN22 vs. PN80) to compare, body-mass, heart-mass, and JO<sub>2</sub>. An  $\alpha$  level of 0.05 was set *a priori*, and if necessary, a Tukey's HSD post hoc test was used for multiple comparisons. **RESULTS:** PGR caused significant diet and age effects (p<.001) on final body-mass between CON (PN22:  $12.01 \pm 0.83$ g; PN80:  $23.51 \pm 2.95$ g) and PUN groups (PN22:  $8.45 \pm 0.61$ g; PN80:  $21.32 \pm 3.42$ g). Heart-mass was also significantly reduced (p<.001) in PUN (PN22:  $0.06 \pm 0.01$ g; PN80:  $0.11 \pm 0.012$ g) compared to CON (PN22:  $0.08 \pm 0.007$ g; PN80:  $0.12 \pm 0.01$ g) across the lifespan. LEAK state JO<sub>2</sub> was significantly higher (p<.001) at both time-points in PUN (PN22:  $46.48 \pm 4.25$ nmol/mg/min, PN80:  $48.74 \pm 8.34$ nmol/mg/min) compared to CON (PN22:  $36.15 \pm 5.60$ nmol/mg/min, PN80:  $38.23 \pm 2.74$ nmol/mg/min). The respiratory control ratio (RCR) was significantly reduced (p=0.0005) in PUN (PN22:  $7.81 \pm 0.48$ , PN80:  $7.32 \pm 1.48$ ) compared to CON (PN22:  $9.25 \pm 0.73$ , PN80:  $9.14 \pm 0.74$ ). **CONCLUSIONS:** PGR decreased body and heart-mass across the life span and increased LEAK state JO<sub>2</sub> in the presence of PM, indicating mitochondrial impairment at PN22 and PN80. PGR caused reductions in RCR, which may cause CVD, thus PGR increases CVD risk through uncoupling of mitochondria. Exercise may improve mitochondrial function in PGR mouse hearts.

**2140 Board #59 May 28 3:00 PM - 4:30 PM**  
**The Role Of Exercise Intensity In Cell Signaling: Is There A Repeated-bout Effect?**

Ciara Terry, Ethan Ostrom, Nora Dunbar, Tinna Traustadóttir. *Northern Arizona University, Flagstaff, AZ.*  
*(No relevant relationships reported)*

**PURPOSE:** Acute exercise elicits a temporary change in redox balance resulting in activation of antioxidant related gene expression and enzymes. We have previously shown in men that the type of acute exercise stimulus, constant workload (CW) vs. high intensity interval protocol (HIIP) results in different redox responses despite no differences in mean VO<sub>2</sub>. The present study tested whether these results translate to women. In addition, we asked whether the responses are amplified through a repeated bout effect, by comparing the responses after 1 bout to those after 3 bouts. It was hypothesized that HIIP would render greater cell signaling response compared to CW and that differences would be amplified after 3 sessions.

**METHODS:** Healthy women ages 30-45y participated in this study in a randomized, cross-over design (n=12, projected) with a 2-week washout period between trials. Each participant completed a VO<sub>2</sub>max on a cycle ergometer to establish the workload for the exercise trials. Subjects were randomized to complete either CW or HIIP sessions first. Each trial occurred every other day for 5 days. A second VO<sub>2</sub>max was performed prior to the second trial to ascertain that VO<sub>2</sub>max had not changed from baseline. CW consisted of 30-min of cycling at 70% VO<sub>2</sub>max. HIIP consisted of a 9-min ramp-up, 7 intervals of 1-min "all out" intervals at 90-100% VO<sub>2</sub>max followed by 2-min recovery for a total of 30-min of cycling. Blood draws were taken pre-, and 10- 30-, and 60-min post exercise during the first and third exercise session of each trial. Cell signaling was measured by nuclear localization of Nrf2 as well as protein abundance of GCLC and GSR in PBMCs. GR enzyme activity was measured in erythrocyte lysate.

**RESULTS:** To date, 5 women have enrolled in the study and testing is still underway. The average intensity of the CW trial is 70.3% and the average intensity of the HIIP intervals is 91.7%  $\dot{V}O_{2\max}$ . The early data show a trend for increased nuclear Nrf2 and GSR protein abundance HIIP compared to CW, and an amplification of the response after 3 sessions.

**CONCLUSION:** These preliminary data suggest that delivering an exercise stimulus in short "pulses" of high intensity such as the HIIP elicits a greater protective signaling response as compared to a block of moderate CW exercise, and furthermore that these effects are amplified by a repeated bout effect.

**2141 Board #60 May 28 3:00 PM - 4:30 PM**  
**Cholesterol Efflux Gene Expression In Peripheral Blood Mononuclear Cells Following High Intensity Interval Exercise**

Natalie Gadaleta, Danielle Martin, Carolyn Brandt, Grace Basralian, Matthew Barberio. *George Washington University, Washington, DC.* (Sponsor: Jennifer Sacheck, FACSM)

(No relevant relationships reported)

Reverse cholesterol transport (RCT) is critical to the regulation of blood cholesterol levels and prevention of macrophage foam cell formation. A critical step in RCT is the efflux of cholesterol from macrophages to high-density lipoprotein (HDL). Numerous studies have shown exercise to regulate HDL quantity and function, but little is known about how exercise affects the expression of cholesterol efflux genes in circulating monocytes. **Purpose:** To determine changes in mRNA expression of cholesterol efflux genes (ATP-Binding Cassette A1, ABCA1; ATP Binding Cassette G1, ABCG1; mitochondrial sterol 27-hydroxylase, CYP27A1) in peripheral blood mononuclear cells (PBMCs) following a single bout of high intensity interval exercise. **Methods:** Six (Female = 4, Male = 2) healthy participants (Age = 25 ± 6 yr, BMI = 26.1 ± 4.1 kg/m<sup>2</sup>,  $\dot{V}O_{2\text{peak}}$  = 36.4 ± 7.4 ml x kg x min<sup>-1</sup>) completed a single bout (work load = 300 kcal) of high intensity interval exercise (repeated intervals of 3 min @ 55%  $\dot{V}O_{2\text{peak}}$  + 1 min @ 110%  $\dot{V}O_{2\text{peak}}$ ). RNA was isolated from PBMCs from whole blood prior to (PRE), immediately following (POST), two hours following (POST-2) and 24 hours following (POST-24) exercise. Expression levels of ABCA1, ABCG1, and CYP27A1 were analyzed via RT-qPCR. Gene expression fold changes, in comparison to PRE, were determined via the delta-delta C<sub>t</sub> method and analyzed via Student T-Tests. Significance was set a priori as alpha = 0.01 to correct for multiple testing. **Results:** Exercise did not significantly modify ABCA1 (Fold Change = 0.8 ± 0.5 (POST), 0.9 ± 0.7 (POST-2), and 1.3 ± 1.1 (POST-24)) at any time point following exercise. ABCG1 expression was elevated POST (1.6 ± 0.9; p < 0.001), POST-2 (1.4 ± 0.8; p = 0.01), and POST-24 (1.5 ± 0.5, p = 0.001) following exercise. CYP27A1 expression was unaltered by exercise at all time points (0.8 ± 0.2, 1.4 ± 1.2, 1.5 ± 2.3; all p > 0.01). **Conclusion:** ABCG1 plays a significant role in maintaining cellular cholesterol levels through the efflux of cholesterol from the intracellular compartment to HDL. Our results show elevations in PBMC ABCG1 expression following a single bout of high intensity interval exercise. Along with improved lipid profiles (e.g. increased HDL concentrations), exercise may promote increased cholesterol efflux from monocytes and macrophages by upregulation of cholesterol efflux genes.

**2142 Board #61 May 28 3:00 PM - 4:30 PM**  
**Effect Of Cardiac Muscle Cells Secretome, With And Without Loading Preconditioning, On Hypoxia/Reoxygenation Injury**

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(No relevant relationships reported)

Reperfusion after myocardial infarction (MI) can worsen cardiac tissue damage and in vitro models of hypoxia/reoxygenation (H/R) have been developed to simulate the in vivo ischemia/reperfusion injury. Cardiac muscle stem cells have been used for regeneration after MI due to their paracrine actions in improving myocardial cell survival and function, while interestingly, mechanical loading of cardiac muscle cells may modulate their secretome. **PURPOSE:** The present study investigated the cardiac muscle cells' paracrine effects in H/R, by treating them with the secretome of mechanically loaded or unloaded cells, in vitro.

**METHODS:** H9C2 cardiomyoblasts were cultured on elastic membranes and underwent a cyclic stretching (12% elongation at 0.25 Hz for 12h) and then their secretome was collected (stretch media, SM). Secretome of unstretched cardiomyoblasts were also collected (non-stretch media, NSM). Cardiomyoblasts were subjected to 6 h of hypoxia followed by 8 or 4 h of reoxygenation (H/R) while during reoxygenation, they were treated either with SM or NSM. Cell apoptosis was subsequently assessed by MTT assay and flow cytometry.

**RESULTS:** After the hypoxia period, cell viability rate was 98±9%, without differing from the normoxia group (p>0.05). However, after 8 or 4 h of reoxygenation, the

viability rate was reduced to 51±10% (p<0.01) and 74±10% (p<0.001), respectively. In addition, the percentage of early apoptotic cells was 36% (p<0.001) after 6 h of hypoxia/4 h of reoxygenation (H/R) as assessed by MTT assay. The viability rates in the same H/R protocol increased from 74±10% to 92±10% and 80±2% in SM- and NSM-treated cells, respectively, without exhibiting differences with the normoxia group (p>0.05). Interestingly, a significantly higher viability was observed only in the cells treated with the SM compared to the non-treated cells after H/R injury (p<0.05). **CONCLUSIONS:** Our findings suggest that cardiomyocytes are susceptible to H/R-induced injury, while the cell death rate depends on the duration of reoxygenation. Moreover, cardiomyoblasts' secretome inhibits their apoptosis after H/R injury while their mechanical load "preconditioning" appears to boost the anti-apoptotic effects of their secretome, implying the beneficial paracrine action of cardiac muscle cells due to mechanical loading.

**2143 Board #62 May 28 3:00 PM - 4:30 PM**  
**EFFECT OF REGULAR EXERCISE ON EXPRESSION OF K<sub>ATP</sub> CHANNELS IN HEART OF DIABETIC RATS**

Silvestre Cardiel-Gutiérrez, Sergio Márquez-Gamiño, Karla S. Vera-Delgado, Victor H. Cordova-de los Santos, Fernando Sotelo-Barroso, Cipriana Caudillo-Cisneros, Elizabeth Sánchez-Duarte. *Universidad de Guanajuato, León, Mexico.*

(No relevant relationships reported)

There is abundant evidence that ATP sensitive potassium (K<sub>ATP</sub>) channels play cytoprotective role in cardiac myocytes, allowing the cell to couple metabolic state to electrical activity of the cell membrane. In cardiac myocytes Kir6.2/SUR2A are the major subunits expressed. However, expression or function of K<sub>ATP</sub> channels has been found to be impaired in the presence of persistent hyperglycemia in diabetes mellitus (DM). While regular exercise can improve hyperglycemic status in DM, its impact on the expression of KATP channels subunits in heart is unknown.

**PURPOSE:** To assess the effect of regular exercise on expression of K<sub>ATP</sub> channel subunits in heart of streptozotocin-induced diabetic rats.

**METHODS:** Male Wistar rats (25 days old) were randomly divided into four groups, among them: sedentary control, trained control, sedentary diabetic, trained diabetic. Diabetes was induced by a single streptozotocin injection (100 mg/kg body weight), animals with fasting blood glucose levels ≥ 300 mg/dL were considered as diabetic. Groups with training program performed exercise on a treadmill (30 minutes daily, 5 days/week) for 8 weeks. At the end of the intervention, two subunits of cardiac KATP channel (SUR2A and Kir 6.2) were analyzed as indicators and quantitative analysis of these subunits was achieved with real-time RT-PCR.

**RESULTS:** In control conditions, the regular exercise reduced Kir6.2 subunit mRNA levels significantly (76%; p=0.045) in heart. In diabetes, reduced Kir6.2 expression was also observed, and there was no difference in expression levels between sedentary diabetic and trained diabetic groups (P > 0.05). Otherwise, relative mRNA expression of the subunit SUR2A was increased in both sedentary diabetic and trained diabetic groups (80.33% and 86.08%, respectively).

**CONCLUSION:** Collectively, our data demonstrate that the regular exercise modifies expression of K<sub>ATP</sub> channel subunits of heart only in control conditions. However, the gene expression patterns of K<sub>ATP</sub> channel subunits are different during diabetes, by increased SUR2A and decreased Kir6.2, which was not modified by exercise. These results may provide an opportunity to understand mechanisms leading to diabetic cardiomyopathy during stress and exercise in DM.

**D-62 Free Communication/Poster - Health Interventions in Youth**

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
 Room: CC-Exhibit Hall

**2144 Board #63 May 28 2:00 PM - 3:30 PM**  
**PARENT-CHILD OBESITY PROGRAM CAUSES DELAYED BUT SIGNIFICANT IMPROVEMENT IN BODY COMPOSITION AMONG AT-RISK YOUTH**

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(No relevant relationships reported)

More than 13 million U.S. children are obese; complications are expected to progress throughout adulthood, increasing the risk of premature mortality. Although proper nutrition and exercise provide short and long-term health benefits, translating this information to a community-setting has been largely ineffective. It is important to identify programmatic variables that demonstrate success in weight management.

**PURPOSE:** To observe the effect of a family-oriented exercise and nutritional intervention on body composition in overweight and obese children and adolescents. **METHODS:** Twelve subjects (ages 7-16) were enrolled in a childhood obesity program upon referral by their primary care physician. Subjects engaged in 45 min of aerobic and flexibility training twice weekly for 18 weeks. Each exercise session was followed by 30 min of nutritional counseling. Body mass index (BMI), waist circumference (WC), hip circumference (HC), and body fat percent (BF%) were measured throughout the intervention. One-way repeated measures ANOVA determined anthropometric differences at baseline, midpoint, and at the end of the intervention. **RESULTS:** Subjects were 12.3±2.4 years old and 44.4% were obese, having a mean BMI of 29.8±4.5 kg/m<sup>2</sup>, BF% of 38.6±6.8%, HC of 99.85 cm, WC of 96.10 cm, and hip-to-waist ratio of 0.96. From baseline to follow-up, subjects decreased BMI by 1.0 kg/m<sup>2</sup> (p=0.011), WC by 4.69 cm (p=0.031), and hip-to-waist ratio by 0.05 (p=0.043); the reduction in BF% failed to reach significance (p=0.060). Repeated measures ANOVA identified reductions in bodyweight (1.09 kg; p<0.001), WC (3.44 cm; p=0.049), and hip-to-waist ratio (.05; p=0.037) between weeks 9 and 18. Differences for the same measurements between weeks 1 and 9 were insignificant (p>0.05). **CONCLUSION:** Despite our small sample, a combined exercise and nutritional counseling intervention improved anthropometric profiles of obese and overweight children and adolescents over the course of 18 weeks. The greatest improvements took place after 9 weeks, indicating the importance of perseverance when seeking body composition improvement in this demographic.

**2145** Board #66 May 28 2:00 PM - 3:30 PM  
**Influence Of Sports Games On Children's Coordination Ability And Lower Limb Muscle Strength**  
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 (No relevant relationships reported)

**PURPOSE:** to explore the influence of the developed sports game intervention programs on children's physical coordination and lower limb strength, and to compare the effects of routine gymnastics and sports game intervention, so as to better develop children's physical coordination and lower limb strength, and provide effective intervention programs in line with the characteristics of children's physical and mental development. **METHODS:** 48 children aged 4-5 were selected and randomly divided into two groups based on teaching classes - sports game group and gymnastics group - each with 24 children. The developed sports game programs were adopted to intervene children of the sports game group. The intervention period was 4 weeks, 3 times a week, 30 minutes each time. In the same intervention cycle and intervention time, children in the gymnastics group did basic gymnastics. **RESULTS:** repeated measures of variance were analysed to compare the changes of children's physical coordination and lower limb strength in different groups before and after the intervention. The results showed that both the children in the sports game group and the gymnastics group took less time in the continuous jumping test after the intervention than before the intervention (sports game group: 8.94s±1.86s vs. 5.78±0.99s, p<0.05; gymnastics group: 10.04s±2.66s vs. 7.74s±1.60s, p<0.05), but the sports game group took significantly less time for continuous jumping test after intervention than the gymnastics group (5.78s±0.99s vs. 7.74s±1.60s, p<0.05). **CONCLUSION:** compared with children's basic gymnastics, the developed sports game programs are more targeted to the development of children's physical coordination and lower limb strength, therefore more effective for that purpose.

**2146** Board #65 May 28 2:00 PM - 3:30 PM  
**ACUTE EFFECTS OF EXERGAMING ON URBAN MIDDLE SCHOOL CHILDREN'S AFFECTION BETWEEN SMALL-GROUP AND WHOLE-CLASS SETTINGS**  
 Wenxi Liu<sup>1</sup>, Daniel J. McDonough<sup>1</sup>, Xiwen Su<sup>1</sup>, Kyota Takami<sup>2</sup>, Zhan Gao, FACSM<sup>1</sup>. <sup>1</sup>University of Minnesota Twin Cities, Minneapolis, MN. <sup>2</sup>Hosei University, Tokyo, Japan. (Sponsor: Zhan Gao, FACSM)  
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 (No relevant relationships reported)

**PURPOSE:** With the goal of developing effective exergaming programs at school sites, the present study investigated the differences in urban middle school children's situational feeling states between small-group and whole-class settings. **METHODS:** Forty-seven participants (25 females; M<sub>BMI</sub> = 24.3 kg/m<sup>2</sup>, SD = 3.1) completed two separate 15-minute exergaming sessions on the same day: (1) Xbox One Kinect Just Dance in a small-group (n = 3-4) setting; and (2) Xbox One Kinect Just Dance in a whole-class (n = 23-24) setting. Participants' affection and emotional states were measured by the established Exercise-Induced Feeling Inventory (EFI) and Subjective Exercise Experience Scale (SEES). The 15-item EPI (5-point Likert scale ranged 0-4) included four constructs: positive affect, negative affect, fatigue, and tranquility, and the 12-item SEES (7-point Likert scale ranged 1-7) with included three

constructs: positive well-being, psychological distress, and fatigue. Dependent *t*-tests were used to detect mean differences for all outcomes between the two exergaming sessions, with the significance level being set at *p* < 0.05. **RESULTS:** Dependent *t*-test indicated significant differences on children's negative affect between two sessions (*t* = -1.77, *p* < 0.05, Cohen's *d* = 0.32). The lower mean score referred to less feeling of negative affect. Participants in small-group exergaming session (M = 0.20, SD = 0.44) experienced less negative affect in comparison to the whole-class session (M = 0.43, SD = 0.95). However, there was no significant difference in other feeling outcomes between two sessions. **CONCLUSIONS:** Findings indicated urban middle school children playing exergaming in small-group setting may experience fewer negative feelings such as crummy, discouraged, and miserable compared to the whole-class setting. Notably, there was no significant differences for other outcomes between two sessions. Future longitudinal studies are needed to examine long-term affection and emotional effects of exergaming across various settings.

**2147** Board #66 May 28 2:00 PM - 3:30 PM  
**The Relationship Between Physical Activity And Inflammatory Markers In Youth With Overweight/obesity**  
 Justin B. Moore, FACSM<sup>1</sup>, M. Rosa Bernal-López<sup>2</sup>, Joseph A. Skelton<sup>1</sup>, Andrew M. South<sup>1</sup>, Antonio Vargas-Candela<sup>2</sup>, Ricardo Gómez-Huelgas<sup>3</sup>, Javier Benítez-Porres<sup>4</sup>. <sup>1</sup>Wake Forest School of Medicine, Winston-Salem, NC. <sup>2</sup>University Hospital of Málaga, Málaga, Spain. <sup>3</sup>Carlos III Health Institute, Madrid, Spain. <sup>4</sup>University of Málaga, Málaga, Spain.  
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 (No relevant relationships reported)

While physical activity is known to have beneficial effects in youth, little is known about the mechanisms responsible for these effects, including how it affects inflammatory markers among youth. This is especially true in youth with overweight or obesity. Furthermore, it has not been definitively established that changes in physical activity can elicit changes in inflammatory markers among youth with overweight and obesity. **PURPOSE:** To determine the effect of a one-year lifestyle intervention on markers of inflammation in youth with overweight or obesity. **METHODS:** Eighty-three children (mean age 8.7 yrs ±1.2, 53% male, 46% with overweight, 53% with obesity) participating in a longitudinal intervention to increase physical activity and improve diet, provided data on physical activity (via accelerometer), body composition (via DXA), and fasting inflammatory markers (adiponectin, TNF-α, resistin, IL-6). *T*-tests were conducted to examine changes over time, and linear regression analyses were employed to assess the influence of changes over time [moderate-to-vigorous physical activity (MVPA), percent body fat] on year-one inflammatory marker values while controlling for baseline levels. **RESULTS:** Our results indicated significant decreases (all *p* < .001) at year-one from baseline in adiponectin (10.1 μg/mL to 6.6 μg/mL), TNF-α (22.1 pg/mL to 4.4 pg/mL), IL-6 (18.7 pg/mL to 10.7 pg/mL), while resistin increased significantly (3.7 ng/mL to 6.8 ng/mL). Changes in percent body fat did not significantly predict inflammatory markers at follow up. Increased MVPA over time predicted lower resistin levels at follow up. **CONCLUSIONS:** A physical activity intervention successfully reduced two inflammatory markers, and greater MPVA may protect against increases in resistin among youth with overweight or obesity.

**2148** Board #67 May 28 2:00 PM - 3:30 PM  
**Is It Possible To Increase Physical Activity Levels In Youth? A Randomized Controlled Trial**  
 Elin Kolle<sup>1</sup>, Runar B. Solberg<sup>1</sup>, Sigmund A. Anderssen<sup>1</sup>, Geir K. Resaland<sup>2</sup>, Sveinung Berntsen<sup>3</sup>, Sindre M. Dyrstad<sup>4</sup>, Jostein Steene-Johannessen<sup>1</sup>, May Grydeland<sup>1</sup>. <sup>1</sup>Norwegian School of Sport Sciences, Oslo, Norway. <sup>2</sup>Western Norway University of Applied Sciences, Sogndal, Norway. <sup>3</sup>University of Agder, Kristiansand, Norway. <sup>4</sup>University of Stavanger, Oslo, Norway.  
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 (No relevant relationships reported)

The potential of school-based interventions to positively impact young people's physical activity (PA) level is uncertain. A recent meta-analysis concluded that current school-based interventions do not positively impact young people's accelerometer assessed PA over the full day. **PURPOSE:** To investigate the effect of a school-based PA intervention on PA levels in 14-year-old adolescents. **METHODS:** In the School in Motion intervention study (ScIM), 29 secondary schools (N=2084) in Norway were cluster-randomized to the Physical active learning (PAL) group (n=10), the Don't worry-Be Happy (DWBH) group (n=10) or the control group (n=9). The target dose was 120 min of additional PA per week in both intervention groups. PA was assessed by ActiGraph accelerometers at baseline (spring 2017) and after one year (spring 2018). We used a linear mixed model with the means as a function of time and group-by-time interaction, with schools as random effects. **RESULTS:** No intervention effect

was observed on the students' PA level during the full day, however, an intervention effect was observed during school hours. Girls in the PAL-group, had a mean change in PA level during the intervention period that was 92 counts per minute (cpm) (95% CI: 52; 133,  $p < 0.001$ ) higher than the control group. Girls in the PAL-group increased time spent in moderate-to-vigorous intensity physical activity (MVPA) with 6.3 min/day (95% CI: 3.8; 8.8,  $p < 0.001$ ) more than the controls, and reduced time spent sedentary with 7.3 min/day (95% CI: -11.8; -2.8,  $p = 0.001$ ). Boys in the PAL-group increased their mean PA-level with 77 cpm (95% CI: 19; 134,  $p = 0.009$ ) and time spent in MVPA with 5.1 min/d (95% CI: 1.6; 8.6,  $p = 0.005$ ) more than control boys. In the DWBH-group, no intervention effect was observed on mean PA level or time spent in MVPA, however, the DWBH-group increased their sedentary time during school hours more than their counterparts in the control group. **CONCLUSIONS:** We found no effect of a nine-months PA-intervention on 14-year-olds PA level over the full day. However, we found an effect on PA during school hours for adolescents in the PAL-intervention. As both intervention models were targeting the school hours in particular, the results might indicate that future interventions need to target after school hours to increase adolescents' PA level over the full day.

**2149** Board #68 May 28 2:00 PM - 3:30 PM  
**Abstract Withdrawn**

**2150** Board #69 May 28 2:00 PM - 3:30 PM  
**Association Between Birth Weight, Physical Activity, Sedentary Time And Body Fat In 11-13-year-old Hispanic Children**  
Jose A. Martínez-Rodríguez<sup>1</sup>, Annette Jiménez<sup>1</sup>, Mercedes Rivera<sup>1</sup>, Ivys Figueroa<sup>2</sup>, Maribel Campos<sup>3</sup>, Farah A. Ramírez-Marrero, FACSM<sup>1</sup>. <sup>1</sup>University of Puerto Rico, Rio Piedras Campus, San Juan, Puerto Rico. <sup>2</sup>University of Puerto Rico, Mayaguez Campus, Mayaguez, Puerto Rico. <sup>3</sup>University of Puerto Rico, Medical Science Campus, San Juan, Puerto Rico. Email: martinezexercisephysiology@gmail.com  
(No relevant relationships reported)

Birth weight and gestational age are early life factors linked to health characteristics during childhood and adolescence, such as obesity, physical activity (PA), sedentary time (ST). It has been suggested that birth weight is not as important as PA in the prediction of childhood obesity. However, these associations have been inconsistent across different studies, and suggestions of potential population specific differences have been proposed. **PURPOSE:** To describe and compare birth weight, gestational age, percent body fat (% fat), PA, and ST in a group of 11-13-year-old Hispanic children in Puerto Rico; and evaluate associations between these variables. **METHODS:** Ninety-six children (boys=55, girls=41) volunteered to complete anthropometric measurements (height, sitting height, weight, % fat, and arm and waist circumferences), accelerometer-based PA and ST, and a nutrition and quality of life questionnaire. Also, parents completed a sociodemographic and family health questionnaire that included the children's birth weight and gestational age. Independent t-test and correlation analyses were conducted to detect sex differences, and determine associations between variables. **RESULTS:** Mean birth weight (7.0±1.4 lbs) and gestational age (37.5±3.8 weeks) were not different between sex ( $P > 0.05$ ), and fell within the normal range for growth standard. However, compared with boys, girls had higher % fat (17.2±1.0 vs. 28.0±1.1 %,  $P < 0.0001$ ), lower moderate to vigorous PA (264.2±22.7 vs. 132.6±14.9 min/week,  $P < 0.0001$ ), and higher ST (9.9±0.2 vs. 10.9±0.3 hrs/day,  $P = 0.001$ ). No association between gestational age, % fat, PA and ST was observed. Those with higher birth weight had higher ST ( $\rho = 0.22$ ,  $P = 0.04$ ), but PA and % fat were not associated with birth weight. Those with higher PA and lower ST had lower % fat ( $\rho = -0.34$ ,  $P = 0.001$ ;  $\rho = 0.24$ ,  $P = 0.02$ ; respectively). **CONCLUSIONS:** These preliminary observations suggest that body fatness is not influenced by birth weight (a biological factor) but by PA and ST (behavioral factors) in our Hispanic youth participants. Supported by UPRRP/DEGI and Puerto Rico Health Department.

**2151** Board #70 May 28 2:00 PM - 3:30 PM  
**Association Between Physical Activity, Sedentary Time, And BMI Percentile Among Hispanic Pre-school Children**  
Emmanuel Hernandez-Torres, Anthony Melendez-Nieves, Luis Estrada-Oliver, Farah A. Ramirez-Marrero, FACSM. University of Puerto Rico, Rio Piedras, Puerto Rico. Email: emmanuel.hernandez3@upr.edu  
(No relevant relationships reported)

For healthy growth and development, physical activity (PA) guidelines for preschool-aged children suggest at least 3 hours/day of combined structured and unstructured PA. Prevention of childhood overweight and obesity is another health priority in this population. Among 1-6-year-old Hispanic children in Puerto Rico, the prevalence

of overweight and obesity is approximately 60%. However, the association between obesity and accelerometer-based PA and sedentary time (ST) in this population have not been previously documented. **PURPOSE:** To describe PA and ST, and test the association between obesity and PA, and between obesity and ST in Hispanic pre-school children. **METHODS:** A group of 25 children (Boys = 10, Girls = 15, aged 3 to 5 years old) attending a pre-school at the University of Puerto Rico (UPR) and their parents volunteered to participate. Children's measures of height and weight, and 7-day waist-worn accelerometer data were obtained. Parents completed a socio-demographic, and family health and home environment questionnaire. Mann-Whitney U test, and Spearman correlation analyses conducted to test for sex differences and associations between variables. **RESULTS:** Light PA (1.6±0.4 hr/day), moderate PA (0.9±0.2 hr/day), vigorous PA (0.2±0.1 hr/day), ST (11.3±0.7 hr/day), and BMI percentile (63.8±30.6) were not different between boys and girls. Overweight (13%) and obesity (22%) was lower in our children participants compared to previous reports in pre-school aged Hispanic children. A significant and inverse correlation between BMI percentile and vigorous PA ( $\rho = -0.46$ ,  $P = 0.04$ ), and BMI percentile and number of household TV sets ( $\rho = -0.55$ ,  $P = 0.008$ ) was observed. **CONCLUSION:** Combining light, moderate and vigorous PA/day (2.7 hr/day); pre-school children in this study approached PA guidelines. Nonetheless, ST was high. Our results also show that those who engage in more vigorous PA have lower BMI percentile, suggesting that PA intensity might be relevant for obesity prevention in this young age group. The inverse association between number of TV sets per household and BMI percentile was unexpected; thus, requiring further analyses.

**2152** Board #71 May 28 2:00 PM - 3:30 PM  
**The Comparison Of Children Physical Activity Time In Different Parent Income Level**  
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(No relevant relationships reported)

There are enough researches that can prove the importance of physical activity for children's health. It's necessary to keep enough physical activity time during children's growth and development of their bodies. There are already have some researches about parent income and children's physical activity time, but those researches are all in developed countries and no studies in a developing country, such as China. **PURPOSE:** By comparing the physical activity time of children with the different parent income level and show the income level impact on children's physical activity time. **METHODS:** There are four schools selected in this study and every two schools from urban and suburbs areas in Beijing. We used the CLASS questionnaire (Children Leisure Activities Study Survey) to acquire the data about parent income (yuan/per month) and the time of children's physical activity (mins). All total of 408 students (boys=217, age=10.78±0.93yrs) and 384 parents (male=198, age=39.65±5.62yrs) are involved in this study. We divide the parent income into four levels: The low-income (0-5000yuan/per month), the middle-income (5000-10000yuan/per month), the high-income (10000-15000yuan/per month) and the highest-income (over 15000yuan/per month). The data were analyzed using one-way ANOVA. **RESULTS:** By comparing the children physical activity time in different parent income levels, with middle-income and low-income (146.43±92.94mins vs. 116.60±56.57mins,  $P < 0.05$ ); With middle-income and high-income (146.43±92.94mins vs. 112.11±61.48mins,  $P < 0.05$ ); With middle-income and highest-income (146.43±92.94mins vs. 105.83±62.50mins,  $P < 0.05$ ). **CONCLUSIONS:** Parent income may have an impact on children physical activity time, the children which their parent income at a middle level have the most physical activity time. This study was conducted in a developing country and the result may differ from the developed countries. In the future, the studies should consider more factors that may impact the children's physical activity time.

**2153** Board #72 May 28 2:00 PM - 3:30 PM  
**Associations Between Bedroom Television And Child Versus Parent-reports Of Youth Screen Time And Sleep Duration**  
Morgan T. Lavender<sup>1</sup>, Joey A. Lee<sup>1</sup>, Kelly R. Laurson<sup>2</sup>. <sup>1</sup>University of Colorado Colorado Springs, Colorado Springs, CO. <sup>2</sup>Illinois State University, Normal, IL. Email: mlavende@uccs.edu  
(No relevant relationships reported)

**INTRODUCTION:** Child self-report and parent proxy-report are frequently used for assessing youth sleep duration (SLP) and screen time (ST) behaviors; however, discrepancies in the reporting of youth SLP and ST between children and parents are not well understood. **PURPOSE:** The purpose of this study was to examine if family ST rules and child bedroom televisions (BTV) were associated with discrepancies between child and parent reports of youth SLP and ST behaviors.

**METHODS:** Children aged 8-11 self-reported their SLP and ST behaviors, if they had a BTV, and demographic information. Parents reported information about their child's SLP and ST behaviors, family ST rules, and family characteristics (i.e. income, marital status, etc.). The prevalence of parents reporting less healthy, similar, or healthier behaviors compared to child-reports was calculated. Separate linear regression models examined if BTV and family ST rules were predictive of the discrepancies in the reporting of youth's SLP and ST between parents and children.

**RESULTS:** Parents reported healthier child behaviors (less screen time and more sleep) compared to child reports. Linear regression models identified child BTV as a significant predictor of discrepancies in child-parent reporting for both, SLP and ST ( $p=.01$  and  $p=.03$ , respectively), but not family ST rules (both  $p < .05$ )

**CONCLUSIONS:** The presence of a child BTV contributes to discrepancies in child and parent reporting of youth's SLP and ST behaviors. Future work evaluating youth SLP and ST behaviors using survey tools and national data collection protocols should capture information about the presence of a child BTV.

2154 Board #73 May 28 2:00 PM - 3:30 PM

### Impact Of Situational Games Intervention On Fitness Outcomes Among 6-7 Years Old Chinese Children

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(No relevant relationships reported)

**PURPOSE:** To examine the impact of a 10-week situational games intervention on aerobic fitness, muscular strength and speed among 6-7 years old Chinese children. **METHODS:** A total of 128 6-7 years old Chinese children were randomly divided into intervention group (IG; 31 boys, 30 girls) and control group (CG; 31 boys, 36 girls). The IG received ten-week situational games (SG) lessons (35 mins per lesson, twice a week), including acting as a main character in the movie 'zootopia', offending and defending in ball games, and exploring in the forest, while CG took conventional PE lessons (35 mins per lesson, twice a week). Participants took 20-m shuttle run (20-m SRT), grip, vertical jump (for muscular strength) and 50-meter dash (for speed) tests before and after intervention. VO2max was estimated from 20-m SRT using Leger's equation. Mixed model Repeated Measures ANOVAs were conducted to determine differences in fitness variables from baseline to post-intervention across intervention groups.

**RESULTS:** The performance of 20-m SRT (laps), Grip(kg), Vertical jump (cm) and 50-meter dash(s) were significantly improved among IG while no change among CG after intervention in boys. There was also a significant group-by-time interaction was observed for Grip(kg), Vertical jump (cm) and 50-meter dash(s) in girls, no difference between IG and CG at baseline, but vertical jump performance was significantly improved among IG while no change among CG after intervention. Although 20-m SRT scores of both IG and CG participants increased from baseline to after intervention, there was no group difference in the improvement,  $p < 0.05$ . (Table 1)

**CONCLUSIONS:** Although both conventional PE and SG specific lessons can increase muscular strength and speed, 10-week SG training also effectively improves aerobic fitness among 6-7 years old Chinese children. There was different improvement between genders.

Table1 Comparison between IG and CG on Fitness

		CG Boys(n=31)	IG Boys(n=31)	CG Girls(n=36)	IG Girls(n=31)
20-m SRT(laps)	Pre	14.1±7.5	15.8±6.2	14.6±4.7	15.0±2.3
	Post	14.1±5.0	17.6±7.4*	15.3±4.3	15.5±3.5
Grip(kg)-left	Pre	7.5±1.9	7.2±1.8	6.7±1.6	6.5±1.5
	Post	7.5±2.1	7.7±1.7*	6.2±1.8	7.1±1.2*##
Grip(kg)-right	Pre	8.0±2.5	7.6±1.9	7.2±1.5	6.8±2.2
	Post	7.6±2.3	8.3±2.1*#	6.5±1.4	7.5±1.3*##
Vertical jump (cm)	Pre	23.2±6.4	23.3±6.1	23.8±4.2	23.4±4.1
	Post	23.8±7.8	27.0±7.5**	25.9±5.8*	27.1±5.1**
50-meter dash(s)	Pre	12.1±1.5	12.2±1.4	12.5±1.3	12.2±0.8
	Post	12.2±1.3	11.9±1.3*##	12.6±1.3	12.0±0.6*#

Note: the comparison between before and after, \* $p < 0.05$ , \*\* $p < 0.01$ ; the comparison between IG and CG, # $p < 0.05$ , ## $p < 0.01$

2155 Board #74 May 28 2:00 PM - 3:30 PM

### Genu Valgus Association Between Physical Activity Level Anthropometry And Sedentary Behavior In Schoolchildren From Ilhabela

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(No relevant relationships reported)

**Objective:** To analyze the relationship between the valgus knee and the level of physical activity and anthropometry in students of both sexes. **Methods:** In this cross-sectional study, 96 students with an average of  $9.75 \pm 0.78$  years-old, 56 female students ( $X \ 9.78 \pm 0.78$  years) and 40 males ( $X \ 9.7 \pm 0.78$  years) aged 9 to 11 years, residing in Ilhabela, São Paulo. The genu valgus was evaluated using the goniometer, classifying the intermalleolar distance (cm) as mild, moderate and severe. The level of physical activity was evaluated by accelerometer (ActiGraph GT3X-BT, Freedson P.S) given in counts per week, being classified into physical activity: mild, moderate, moderate to vigorous, vigorous and sedentary time. The anthropometric variables included: body weight (kg), height (cm), BMI ( $\text{kg} / \text{m}^2$ ), mean skinfold thickness (mm), femur diameter (cm), and waist circumference (cm), according to CELAFISCS standardization. **Statistical Analysis:** It was used the Person correlation, a software SPSS 20.0, adopting as significance level a  $p < .05$ . **Results:** Of the 96 students, 53% presented mild valgus, 21% with moderate valgus, and 22% with severe valgus, with positive and significant associations ( $p < .05$ ). In both sexes, there was no correlation between mild, moderate, moderate to vigorous, vigorous physical activity and sitting time. In girls there was a positive, moderate and significant correlation between genu valgus, weight, height and waist circumference and skinfolds. In boys there was a positive, weak, and significant correlation between genu valgus and femur diameter. **Conclusion:** it seems that the genu valgus was not associated with physical activity levels and sitting time, but shows that the greater the valgus, the greater the sedentary time. It was also observed an association with anthropometry in males, with femur diameter and in the female with the weight and waist and hip circumference.

Variables		Male Genu valgus		Female Genu valgus	
		r	p	r	p
LIGHT PHYSICAL ACTIVITY	(counts/sem)	-0,06	0,69	0,19	0,14
MODERATE PHYSICAL ACTIVITY	(counts/sem)	-0,06	0,68	-0,18	0,18
MODERATE VIGOROUS PHYSICAL ACTIVITY	(counts/sem)	-0,04	0,79	-0,17	0,19
VIGOROUS PHYSICAL ACTIVITY	(counts/sem)	0,03	0,83	-0,02	0,85
SAT TIME	(counts/sem)	0,08	0,61	0,05	0,69
WEIGHT	(Kg)	0,15	0,34	<b>0,54**</b>	0,00
BMI	(Kg/m <sup>2</sup> )	0,09	0,56	-0,05	0,69
WAIST CIRCUMFERENCE	(cm)	0,09	0,56	<b>0,36**</b>	0,008
HIP CIRCUMFERENCE	(cm)	0,09	0,56	<b>0,46*</b>	0,00
X 7 CUTANE FOLDS	(mm)	0,12	0,43	<b>0,32*</b>	0,01
FEMOR DIAMETER	(cm)	<b>0,31*</b>	<b>0,04*</b>	0,19	0,14

2156 Board #75 May 28 2:00 PM - 3:30 PM

### PHYSICAL ACTIVITY LEVEL SEDENTARY BEHAVIOR AND SLEEP TIME ASSOCIATED TO BODY COMPOSITION IN ILHABELA SCHOOLCHILDREN

Anderson Bastos Lopes, Luis Carlos de Oliveira, João Pedro da Siva Junior, Maurício dos Santos, Diana Carolina Gonzalez Beltran, Victor Keihan Rodrigues Matsudo. *CELAFISCS, São Caetano do Sul, Brazil.*

(No relevant relationships reported)

**Purpose:** To associate the physical activity level, sedentary behavior, and sleep time with the body composition of students. **Methods:** The study is part of the Ilhabela Mixed-Longitudinal Growth and Development Project. A convenience sample consisted of 97 schoolchildren, 50 boys, and 47 girls, 9 to 11 years-old ( $9.8 \pm .7$ ) with at least one complete evaluation in the analyzed period (2015 and 2019), all of them at pre-pubertal sexual maturation. The variables analyzed were: body weight (kg); body mass index BMI ( $\text{kg} / \text{m}^2$ ); average of 3 skinfolds: triceps, subscapular, and suprailiac, adiposity (mm); and waist-to-hip ratio WHR (cm). Physical activity level, sedentary

behavior, and sleep time were measured by accelerometer (ActiGraph GT3X, analyzed with Freedson 1998) given in counts per minute. Data normality was measured by Kolmogorov-Smirnov, and a Spearman rho correlation was used to determine the associations among variables. Level of significance adopted was  $p < .05$ . The software used was SPSS 20.0. **Results:** In boys, light physical activity presented a significant low to moderate correlations with BMI ( $r = .29$ ), adiposity ( $r = .29$ ), WHR ( $r = .39$ ). A correlation of ( $r = .39$ ) was observed between sedentary time, and WHR. Among girls, sedentary time correlated significantly with body weight ( $r = .41$ ), BMI ( $r = .29$ ) adiposity ( $r = .47$ ). Moderate to vigorous PA presented an inverse, significant, and moderate correlations with body weight ( $r = .39$ ), and adiposity ( $r = .40$ ). **Conclusion:** Present data suggest a significant association among light PA (in boys) and moderate/vigorous PA (in girls), and body composition, while sedentary time showed a significant association with body weight, BMI, and adiposity (in girls), and with WHR (in boys).

**Table:** Association between physical activity level, sedentary behavior and sleep time to body composition in students from Ilhabela

	Boys				Girls			
	Weight (kg)	BMI (kg/m <sup>2</sup> )	Adiposity (mm)	WHR	Weight (kg)	BMI (kg/m <sup>2</sup> )	Adiposity (mm)	WHR
Sedentary Time	.04	-.06	.01	.39*	.41*	.29*	.47*	.32
Light PA	-.24	-.29*	-.29*	.39*	-.04	.15	.03	-.06
Moderate/vigorous PA	-.20	-.11	-.15	.16	-.39*	-.11	-.40*	-.01
Sleep time (hours/day)	.14	.16	.05	-.19	-.07	-.06	-.13	-.15

Body Weight (Weight) Light physical activity level (Light PA) Moderate to vigorous physical activity level (Moderate/vigorous PA) \* $p < .05$ .

**2157 Board #76 May 28 2:00 PM - 3:30 PM**  
**Dissemination Of Motivational Interviewing Training: Use In Extension Outreach And School Health Programming**

Kathryn J. DeShaw<sup>1</sup>, Laura D. Ellingson<sup>2</sup>, Gabriella M. McLoughlin<sup>3</sup>, Gregory J. Welk, FACSM<sup>3</sup>. <sup>1</sup>Loras College, Dubuque, IA. <sup>2</sup>Western Oregon University, Monmouth, OR. <sup>3</sup>Iowa State University, Ames, IA. (Sponsor: Gregory J. Welk, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** Motivational interviewing (MI) is a popular conversational strategy used to evoke intrinsic motivation for behavior change. Although a number of training programs have been described to build MI skills, there are few that evaluate the fidelity of training. The present study evaluated MI fidelity following a brief online training. **METHODS:** This study was conducted as an ancillary component of a school wellness training initiative (SWITCH) that focused on building capacity for schools to plan and lead school wellness programming. A quasi-experimental design was used to evaluate the impact of brief MI training on a sample of 16 extension field specialists (EFS) that facilitated the SWITCH implementation process. EFS were provided guidelines and suggestions for using MI to elicit change talk and promote goal setting by school leaders. A subsample of 8 EFS voluntarily agreed to participate in supplemental MI training prior to interacting with the schools. All EFS recorded phone calls with the schools as part of the standard practice in the SWITCH project, and a trained assistant blinded from group allocation coded them for MI proficiency levels using the Motivational Interviewing Treatment Integrity Coding Manual 4.2.1. **RESULTS:** A one-way ANOVA followed by Bonferroni post-hoc corrections were conducted to examine differences in MI techniques between trained and untrained EFS. No statistically significant results were found. However, differences between groups for technical global scores ( $F(1, 14) = 8.9, p = 0.05, d = 1.5$ ) and reflection-to-question ratios ( $F(1, 14) = 5.3, p = 0.19, d = 1.15$ ) were approaching statistical significance with large effect sizes. Relational global components ( $d = 0.76$ ) and total adherence ( $d = 0.38$ ) demonstrated moderate group differences. **CONCLUSIONS:** This study indicates that a brief MI training protocol is effective for teaching the spirit and relational components of MI. Although proficiency levels were not achieved by the majority of EFS, trained individuals were better at using technical and relational aspects of MI than untrained individuals. Future work should focus on ways to enhance skill acquisition with this type of distributed online training model as well as testing applications with other professionals and diverse settings.

**2158 Board #77 May 28 2:00 PM - 3:30 PM**  
**Comparison Of Anthropometric Methods And Physical Activity In Preschoolers**

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 (No relevant relationships reported)

Previous work reports a counterintuitive finding that preschoolers categorized as overweight or obese engage in more physical activity (PA) than their healthy weight peers. The majority of studies with preschoolers however, used age- and sex-specific body mass index (BMI) percentiles to classify children according to their weight status. However, BMI may underestimate obesity prevalence. More recently, there has been an emphasis on anthropometric alternatives to BMI such as waist-to-height ratio. Waist circumference (WC) to height ratio (WC/HT) is relatively independent of gender, age, and race and may be more sensitive than BMI to identify those with central obesity, a cardiometabolic risk factor.

**PURPOSE:** Examine 1) the overlap of risk based on BMI and WC/HT and 2) the associations between preschoolers' PA and both BMI and WC/HT **METHODS:** Weight, height, and WC were obtained by trained study staff and PA was objectively measured by accelerometry during the school day for up to 10 days. BMI was calculated as body weight divided by height squared (kg/m<sup>2</sup>). Weight status was determined using age- and sex-specific Centers for Disease Control (CDC) BMI percentiles. Two BMI percentile overweight/obese risk categories were created based on CDC categories (not at risk:  $< 85^{th}$ ; at risk:  $\geq 85^{th}$ ). Two central obesity risk categories were created for WC/HT (not at risk:  $< 0.5$ ; at risk:  $\geq 0.5$ ). A total of 69 children ( $M_{age} = 3.95 \pm 0.6, 34$  males, 35 females) with  $\geq 3$  days of valid accelerometer data were included in analyses. Percentage of time spent in light, moderate-to-vigorous (MVPA) and total PA (light + MVPA) were calculated using the child's total wear time as the individual divisor. Significance was set at  $p < 0.05$ .

**RESULTS:** When comparing BMI and WC/HT risk categories, only 21 children (30%) were considered at risk using BMI whereas 40 (58%) were considered at risk using WC/HT. Significant, positive associations were observed between BMI percentile and light ( $r = 0.27$ ), MVPA ( $r = 0.25$ ) and total PA ( $r = 0.27$ ); no significant associations were observed between WC/HT and PA.

**CONCLUSIONS:** More preschoolers were identified at risk using WC/HT as compared to BMI. Moreover, higher levels of PA were only linked with risk based on BMI, not WC/HT. Future work with preschoolers should explore a variety of methods for measuring risk for obesity and PA.

**2159 Board #78 May 28 2:00 PM - 3:30 PM**  
**Abstract Withdrawn**

**2160 Board #79 May 28 2:00 PM - 3:30 PM**  
**Can We Play Outside? Social-emotional Learning And Preschooler Physical Activity**

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 (No relevant relationships reported)

Can we Play Outside? Social-Emotional Learning and Preschooler Physical Activity Marcia A. Rosiek, Benedict P. Dyson, Erin J. Reifsteck, & Diane L. Gill, FACSM Coastal Carolina University & UNC at Greensboro Despite the benefits of physical activity (PA) for their development, preschoolers (age 3-5) do not meet recommendations and spend the majority of their day indoors engaged in sedentary behaviors (Pate et al., 2008). Outdoor environments promote PA (Cerrin et al., 2016), and active play is considered important for social and emotional learning (SEL), which involves self-regulatory and problem-solving skills, making good decisions, and developing positive relationships. Early childhood SEL is associated with school readiness and academic achievement (Denham & Brown, 2010). Research on the role of outdoor play for SEL in early childhood development is limited. **PURPOSE:** To identify and describe PA and SEL behaviors practiced by preschoolers in the outdoor environment. **METHODS:** This case study used mixed methods to identify and describe SEL and PA behaviors in preschoolers (ages 3-5) at an early childhood education center (ECEC). Participants included 28 children, two teachers and the ECEC director. PA accelerometry data, daily observations, and teacher interviews were collected over 4 weeks. Inductive analysis and constant comparison were used to analyze the qualitative data (Miles, Huberman, & Saldana, 2014). **RESULTS:** Accelerometry data indicate that preschoolers were engaged in sedentary behavior 46.53%, MVPA 30.81%, and light activity 21.19% of the time when outdoors; on average, preschoolers were active for 29.34 minutes during an average 56.45-minute outdoor period. Qualitative data uncovered three themes: 1) the outdoor environment provides opportunities to practice SEL, 2) social interaction

during outdoor play promotes SEL, and 3) teachers support SEL during outdoor play.

**CONCLUSION:** The outdoor environment promotes PA through multiple forms of active play, providing an ideal setting for preschoolers to practice SEL in their preferred environment.

**2161 Board #80 May 28 2:00 PM - 3:30 PM**  
**Changes In Physical Health Status Of Students In China From 2016 To 2018**

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(No relevant relationships reported)

The Ministry of Education of China has carried out spot check and review of the test data of "National Standards for Students' Physical Health" for many years, however, the effect of the investigation and the changes of students' physical health are unclear. **PURPOSE:** To analyze the changing characteristics of students' physical health from 2016 to 2018.

**METHODS:** We used 2016-2018 National Students Physical Health Sample Survey data for students from grade one in primary school to senior student (N= 221,053; 220330; 227,160). National norm reference standard was adopted to evaluate students' test scores of various items in body shape, function, constitution, and the total score was calculated after the scores of all the items were weighted. According to the total score, students were evaluated by four grades (excellent, good, pass and fail), BMI was used for obesity evaluation, which was divided into obesity, overweight, normal and low weight.

**RESULTS:** (1) From 2016 to 2018, the overall failure rate decreased from 12.0% to 11.3%, the favorable rate increased from 21.9% to 24.1%, and the excellent rate rose from 4.6% to 6.2% year by year. (2) The average proportion of primary students who reached the standard within three years was 93.0%, middle school students was 88.0%, high school students was 89.1% and college students was 73.7%. (3) The average proportion of overweight and obese students in China in the past three years is 21.6%, among which the average proportion of overweight was 13% and the obese was 8.6%. As a result, more than one fifth of the students' BMI were overweight or obese. In addition, from 2016 to 2018, the proportion of students who are obese was 7.9%, 8.9% and 9.0%, and the proportion of students who are overweight was 12.3%, 13.4% and 13.4%, respectively. The proportion of students who are overweight and obese increased year by year.

**CONCLUSIONS:** In the past three years, students' physical health has been gradually improved. The overall level of students' physical health decreased with the increase of learning period. The proportion of overweight and obesity in Chinese students is on the rise year by year. **Acknowledgment:** This study was supported by special project and laboratory of Ministry of Education in BSU.

**2162 Board #81 May 28 2:00 PM - 3:30 PM**  
**Abstract Withdrawn**

**2163 Board #82 May 28 2:00 PM - 3:30 PM**  
**Moderate-to-vigorous Physical Activity Trajectories During Adolescence And Young Adulthood Predict Adiposity In Young Adulthood: The Iowa Bone Development Study**

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(No relevant relationships reported)

**Purpose:** The purpose of this study was to examine the association between MVPA patterns throughout adolescence described by trajectory models and adiposity indicators (i.e., fat mass index (FMI) and visceral adipose tissue (VAT) mass index) at young adults aged 23 years.

**Methods:** Study participants aged 15, 17, 19, 21, and 23 years from the Iowa Bone Development Study were included. Accelerometry-measured MVPA (min/day), and FMI (kg/m<sup>2</sup>) and VAT mass index (g/m<sup>2</sup>) derived from dual-energy X-ray absorptiometry scans were collected at each age. FMI and VAT mass index as outcome variables were converted to z-scores. Group-based trajectory analyses (N = 297; Females = 168; 94% white) classified the MVPA patterns into sub-groups (group 1: 'moderately active with decreasing MVPA' vs. group 2: 'consistently active and maintaining high MVPA') and sex (females vs. males).

**Results:** A trajectory model identified that MVPA levels declined over time in both males and females, and the decline was more remarkable in females. The multivariable linear regression analyses showed that trajectory group (either group 1 or 2) was associated with FMI ( $\beta = -.44$ ,  $p = .042$ ,  $R^2 = .64$ ) and VAT mass index ( $\beta = -.52$ ,  $p = .48$ ,  $R^2 = .47$ ) z-scores.

**Conclusion:** This study concluded that individuals who are consistently active with maintaining their MVPA during adolescence up until early young adulthood are less

likely to accumulate total body and visceral adiposities in young adulthood. This study suggests that adopting a consistently active lifestyle throughout adolescence to achieve healthy body compositions in emerging adulthood.

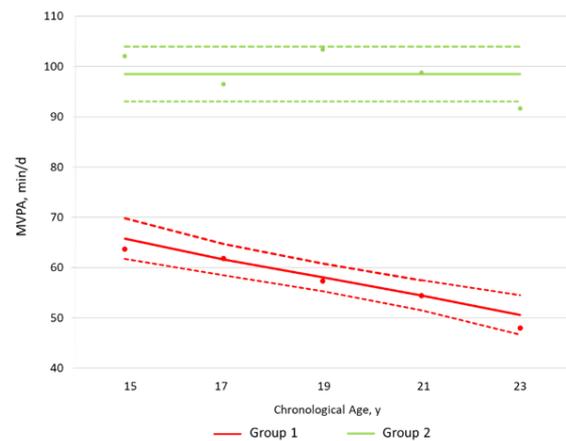
**Table 1.** Fat mass index z-score at age 23 years prediction multivariable linear regression model.

	$\beta$	SE	p-value	R <sup>2</sup>
Intercept	-1.14	.26	.000	
MVPA_Group	-.44	.21	.042	
Sex	-.35	.32	.278	.64
Group $\times$ Sex	.37	.26	.158	
FMI at wave 5	.25	.01	.000	

**Table 2.** Visceral adipose tissue mass index z-score at age 23 years prediction multivariable linear regression model.

	$\beta$	SE	p-value	R <sup>2</sup>
Intercept	-1.05	.32	.001	
MVPA_Group	-.52	.26	.048	
Sex	.10	.40	.801	.47
Group $\times$ Sex	.48	.32	.133	
FMI at wave 5	.21	.02	.000	

MVPA, Moderate-to-vigorous physical activity; MVPA\_Group, MVPA trajectory latent group (1 or 2); FMI, Fat mass index;  $\beta$ , Unstandardized coefficient; SE, Standard error.



**Figure 1.** Moderate-to-vigorous intensity physical activity trajectory groups. Dots indicate actual mean MVPA minutes, solid lines indicate estimated MVPA minutes, and dotted lines indicate 95% confidence intervals of estimated MVPA minutes. Group 1, Moderately active with decreasing MVPA levels; Group 2, consistently active and maintaining MVPA levels.

**2164 Board #83 May 28 2:00 PM - 3:30 PM**  
**The Association Of Fitness With Middle-distance Running Performance In Chinese Boys**

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(No relevant relationships reported)

There has been a paucity of evidence pertaining to the discussion whether the effect of fitness on CRF is independent of physical activity (PA).

**PURPOSE:** The objective of this study was to examine the association of fitness with middle-distance running performance (MDRP) in Chinese boys.

**METHODS:** A cross-sectional study was conducted among 180 (8<sup>th</sup> grade) boys recruited from 3 junior middle schools in Shanghai, China. Participants completed height and weight measurement, and MDRP (1000 m running). PA and sedentary behavior (SB) were measured in 7 consecutive days by accelerometers. Based on the criteria set by the Working Group on Obesity in China, the participants were categorized into either overweight and obese or normal weight according to the body mass index (BMI). Likewise, MDRP was categorized into pass or no pass by using the 2014 revised Chinese National Student Physical Fitness Standard. Independent *t* test was employed to compare the difference of the time to complete MDRP between

overweight and obese boys and normal weight boys. Correlation coefficients were computed to examine the relationship between BMI and the time to complete MDRP. The association of fatness and MDRP were examined, through multiple logistic regressions, after controlling for age and SB, light physical activity (LPA), moderate and vigorous physical activity (MVPA).

**Results:** 89 boys (age: 13.4±0.5 years, weight:59.3±12.7 kg, height:166.5±6.2 cm, BMI: 21.4±4.3 kg/m<sup>2</sup>) provided the valid accelerometer data (defined as ≥ 2 days, ≥10 h/day) and were included in the study. The time to complete MDRP of overweight and obese boys was significant longer than normal weight boys (320.1±42.1 s vs 270.8±35.3 s, P<0.001). BMI was significantly positively correlated with the time to complete MDRP (r=0.581, P<0.001). The overweight and obese boys were more likely to not pass the MDRP compared with the normal weight boys (adjusted odds ratio = 4.64; 95% confidence interval: 1.74-12.4), after adjusting age, SB, LPA, MVPA.

**CONCLUSION:** The results uncovered that boys' BMI was negatively correlated with MDRP. More importantly, compared with normal weight boys, overweight and obese boys had a higher risk to not pass the MDRP, independent of PA.

**2165** Board #84 May 28 2:00 PM - 3:30 PM

**COORDINATION IS NOT RELATED TO A PARENT'S PERCEPTION OF ABILITY OR SUPPORT FOR PHYSICAL ACTIVITY**

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*(No relevant relationships reported)*

**PURPOSE:** To examine the relationships between parental support for children's physical activity and perceptions of the child's athletic competence with their child's gross motor development.

**METHODS:** 28 parents (36 + 11 yrs) completed a survey to assess indicators of support for their child's physical activity and child's athletic competence in relation to the child's peers. 41 children (20 males, 20 females, 1 unreported gender, 6.72 + 3.13 yrs, BMI 16.43 + 2.85) completed the Test of Gross Motor Development (TGMD2) which was converted to an age adjusted percentile score for both locomotor ability and object control. Bivariate correlations and independent sample t-tests were performed to identify relationships between variables and child gender differences.

**RESULTS:** No relationship was found between parental perception of coordination and child's object control skills (r = -0.001) or locomotor ability (r = 0.069). Parental support for physical activity was not related to the child's object control (r = 0.016) or locomotor ability (r = -0.118). A moderate positive relationship exists between parental perceptions of boys coordination and their object control scores (r = 0.414) and a moderate negative relationship exists for girls (r = -0.497). There were no differences between boys and girls for object control scores (boys: 61.65 + 24.57; girls: 57.95 + 21.75; t = 0.504, df = 38, p = 0.617), locomotor ability (boys: 74.75 + 22.31; girls: 75.75 + 20.51; t = -0.148, df = 38, p = 0.883) or parental support (boys: 8.68 + 3.45, girls: 9.44 + 3.65; t = -0.651, df = 35, p = 0.519).

**CONCLUSIONS:** Parental support for physical activity and how parents perceive their child's ability are not reliable indicators of their child's demonstrated motor ability. This may be especially true for young girls whose parents perceive them as less coordinated than they are.

**D-63 Free Communication/Poster - Physical Activity and Health: Children and Adolescents**

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
Room: CC-Exhibit Hall

**2166** Board #85 May 28 2:00 PM - 3:30 PM

**Psychosocial Correlates Of Physical Activity In Children And Adolescents: A Meta-analysis**

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*(No relevant relationships reported)*

**PURPOSE:** This study investigated the association between physical activity (PA) and Theory of Planned Behavior (TPB, Ajzen, 1991)-based variables among children and adolescents.

**METHODS:** We evaluated the association between PA and TPB-based variables (intention, attitude, subjective norms, and perceived behavioral control / self-efficacy to engage in PA) among children and adolescents, and the moderation effects of geographical region of study between PA and TPB-based variables. A total of 36 articles met the inclusion criteria and were meta-analyzed. **RESULTS:** Intention

significantly correlated with and had a medium effect on PA in children. TPB displayed a good fit in path analysis. Moderator analyses showed that subjective norms and perceived behavioral control / self-efficacy had a larger effect on children in the rest of the world, compared to their North American counterparts.

**CONCLUSIONS:** The results provide a summary of current scientific findings about the association between TPB-based variables and PA in children and adolescents, and support TPB as a feasible conceptual framework to study psychosocial factors that underpin PA.

**2167** Board #86 May 28 2:00 PM - 3:30 PM

**Global Accelerometer-derived Physical Activity Levels From Preschoolers To Adolescents: A Meta-analysis And Meta-regression**

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**PURPOSE:** It is essential to document people's PA levels worldwide with accurate information. The importance needs to focus on understanding how PA pattern changes at different time periods. One of the major measurement issues of using accelerometers is the selection of cut points to determine PA intensity such as moderate to vigorous PA (MVPA). Studies calibrating accelerometers generated large variability in cut points especially for the intensity of MVPA which need to be controlled to generate more accurate and meaningful data. Thus, we systematically reviewed and meta-analyzed global MVPA change across different age groups (preschool ages to adolescence) using data derived from accelerometer while accounting for two most popular cut points [i.e., Freedson, 1998; Everson, 2008] and continents.

**METHODS:** We searched major data base from inception until Aug, 2019 including cross sectional or longitudinal PA tracking studies in which daily MVPA were measured by accelerometer and determined by the two aforementioned cut points for preschoolers, children, and adolescents. Random-effect models were used for meta analyses. Multiple meta regression analyses were conducted to investigate how age relates to daily MVPA from preschooler to adolescents while controlling for cut points and continents.

**RESULTS:** The final data includes 91 studies representing 42338 participants across six continents. Findings revealed that for the combined studies, participants accumulated 74.44 minutes of MVPA each day (95% CI = 68.86 - 80.02, p < .001). Findings from meta regression revealed that when cut points and continents were controlled, participants' daily MVPA levels tend to decrease significantly from preschool years to adolescents (β = -8.23, p < .0001, R<sup>2</sup> = 0.4), from preschool years to children (β = -11.54, p < .0001, R<sup>2</sup> = 0.39), or from children to adolescents (β = -6.83, p < .0001, R<sup>2</sup> = 0.48).

**CONCLUSIONS:** Globally, individuals' daily MVPA tends to decrease from a very young age after controlling for cut points and continents. These declines were more prominent from preschoolers to childhood.

**2168** Board #87 May 28 2:00 PM - 3:30 PM

**A Meta-analysis Protocol Among Active Healthy Kids Report Cards' Indicators In East Asian Regions**

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*(No relevant relationships reported)*

Insufficient physical activity (PA) is one of the leading risk factors for mortality. Evidence related to PA in children and youth has been assessed comprehensively in the Active Healthy Kids Report Cards worldwide. However, the association between influence indicators and behavioral indicators among Report Cards are yet to be critically appraised and synthesized using the method of meta-analysis. **PURPOSE:** We aim to perform meta-analyses for indicators in overall PA, sedentary behaviors, school, family & peers, and community & environment among East Asian regions with very high Human Development Indices.

**METHODS:** We conducted literature search in six international databases, including CENTRAL, MEDLINE, EMBASE, PsycINFO, Global Health, and BIOSIS. Observational studies with at least one influence indicator and one behavioral indicator will be considered eligible and data will be extracted for meta-analyses. The strength of association between influence indicators and behavioral indicators will be synthesized. The pooled effect sizes and their 95% confidence intervals for each association will be calculated. Newcastle-Ottawa Scale will be used for the risk of bias assessment among included observational studies. **RESULTS:** Twenty eligible observational studies including cohort studies and cross-sectional studies were included. From these 20 included studies, twelve, seven, and one were from Hong Kong, South Korea, and Japan respectively. Ten studies addressed behavioral indicators, e.g. the association

between screen time and obesity. The other ten studies addressed influence indicators, e.g. the association between parents' exercise frequency and the children's intention to participate in PA. **CONCLUSIONS:** Results of meta-analyses may inform better decision-making in tackling complex public health crisis created by physical inactivity and sedentary behaviors among children and youth in East Asian regions, triggering the engagement with relevant stakeholders among sectors of the community, as well as their joint cooperation in the development of a more friendly environment for children and youth to perform PA.

**2169** Board #88 May 28 2:00 PM - 3:30 PM  
**Accelerometer-measured Physical Activity And Sedentary Behavior In Chinese Children And Adolescents: A Meta-analysis**  
 Zhaohua Zhang, Hongjuan Li, Ting Zhang, Liu Zhang, Chunyan Gui. *Beijing Sport University, Beijing, China.*  
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 (No relevant relationships reported)

**PURPOSE:** To assess moderate-to-vigorous physical activity (MVPA) and sedentary behavior (SB) levels of Chinese children and adolescents using accelerometer and to examine the differences between different populations according to gender, age/grade, day (weekdays and weekends) and geographical region.  
**METHODS:** Four online databases were searched for studies published from January 2009 up to February 2019 (PROSPERO2019: CRD42019129888). These studies reported accelerometer-measured daily minutes of MVPA and/or SB among Chinese children and adolescents. Random-effects meta-analysis was used to separately pool the time spent in MVPA and SB.  
**RESULTS:** Out of 4754 records, 20 studies were considered to be suitable for inclusion in the meta-analysis. Sample sizes ranged from 96 to 2163. The meta-analysis found that Chinese children and adolescents spent 41.11 min/day, 529.83 min/day in MVPA and SB, respectively. Boys spent more time in MVPA compared with girls (boys' vs girls: 45.57 vs 36.37 min/day,  $p = 0.01$ ). Children accumulated significantly more minutes of MVPA than adolescents (children vs adolescents: 43.37 vs 37.52 min/day,  $p = 0.05$ ), and children spent less time in SB than adolescents (children vs adolescents: 508.79 vs 553.51 min/day,  $p = 0.05$ ). Unlike weekdays, SB was lower on weekends (weekdays vs weekends: 530.94 vs 486.57,  $p = 0.02$ ). There were significant differences in Children and adolescents' MVPA time in regions (Hong Kong vs North China vs South China: 60.55 vs 43.21 vs 36.49 min/day,  $p < 0.001$ ).  
**CONCLUSIONS:** While their SB level is high, MVPA level in Chinese children and adolescents is well below international recommendations. The analyses suggested that boys spent more time in MVPA compared to girls. The MVPA level of Children is higher than adolescents. Children and adolescents living in Hong Kong are more active than in North China and South China. SB level of children is lower than adolescents. Compared with weekdays, SB level of Chinese children and adolescents is lower on weekends.

**2170** Board #89 May 28 2:00 PM - 3:30 PM  
**The Effect Of Physical Exercise Intervention On Brain Development In Adolescent: A Systematic Review And Meta-analysis**  
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 (No relevant relationships reported)

The relationship between physical activity (PA) and exercise with brain development in adolescents has seen a growing interest during the past two decades. Previous systematic reviews and meta-analyses have shown the effectiveness of PA interventions on improving adolescents' brain cognition. **PURPOSE:** The study aimed to assess the effect of physical activity (PA) interventions and adolescents' brain development.  
**METHODS:** We systematically searched MEDLINE, Web of Science, and Pubmed database from their inception to June 30<sup>th</sup>, 2019. Intervention studies aimed at examining the exercise-brain interaction at a developmental age were included in this systematic review and meta-analysis. Random-effects models were used to calculate pooled effect size (ES) values and their corresponding 95% CIs. Subgroup analyses were conducted to examine the effect of participants' and PA programs' characteristics.  
**RESULTS:** A total of 25 studies were included in this systematic review and meta-analysis. Pooled ES estimations were as follows: working memory 0.45 (95% CI = 0.28-0.61), inhibition 0.08 (95% CI = 0.02-0.14), attention 0.61 (95% CI = 0.44-0.78) and brain psychological functions 1.05 (95% CI = 0.67-1.43).  
**CONCLUSIONS:** PA benefits several domains of working memory, inhibition, attention and brain neurophysiology functions in youth. Physical activity interventions and programs designed to increase the number of PA per day after school seems to be the most effective. (The last author as the corresponding author; This study was supported by the NPOPSS Grant 15CTY011)

**2171** Board #90 May 28 2:00 PM - 3:30 PM  
**The Effectiveness Of Physical Activity On Motor Skills In Children With Neurodevelopmental Disorders: A Meta-analysis**  
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**Background:** Researchers of epidemiological studies in recent years have witnessed the expansion of children with neurodevelopment disorders (NDDs), particularly of children with attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorder (ASD), Down syndrome (DS), developmental coordination disorder (DCD), Cerebral palsy (CP). Noticeable motor deficits are among common characteristics of children with NDDs, which indicate the need for interventions to promote optimal motor and overall development. While physical activity (PA) has been widely used in the rehabilitation of children with NDDs to improve their motor performance, questions remain whether or not the beneficial effects of PA are conclusive. The purpose of this study was to conduct a systematic review and meta analysis of the studies investigating the effects of PA on motor skill performance in children with NDDs. **Methods:** Relevant articles were sourced from PubMed, the Web of Science, EBSCO, the Cochrane Library, CNKI and Wanfang data. **Results:** Twenty studies with 269 subjects met inclusion criteria for this review and were included. Compared with pre-interventions, there was a significantly improve in motor skills (Fig.1 & 2), the gross motor skills (SMD [standardized mean difference] = 0.64, 95%CI [coefficient interval]: 0.29 to 0.99), fine motor skills (SMD = 1.33, 95%CI: 0.57 to 2.09) respectively. **Conclusion:** PA could effectively improve gross and fine motor skill performance in children with NDDs. Although the findings were based on a small number of studies, the results of this meta-analysis still suggest that researchers and clinicians should consider including PA in their rehabilitation programs for children with NDDs. Future studies should clarify which type and what intensity of PA intervention might be most effective in promoting motor development based on individual children's needs and treatment characteristics.

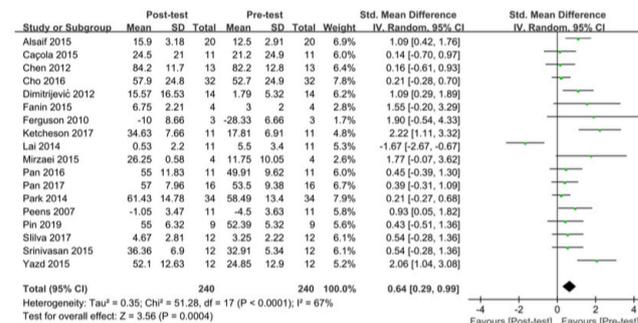


Fig. 1 Forest plot for change in gross motor skills

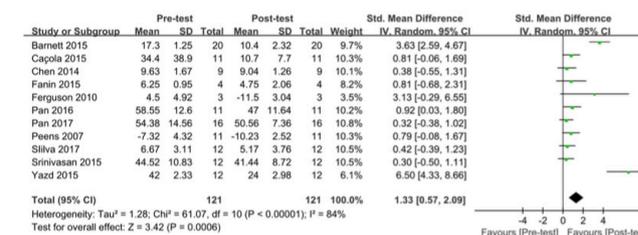


Fig. 2 Forest plot for change in fine motor skills

**2172** Board #91 May 28 2:00 PM - 3:30 PM  
**Prenatal Exercise And Cardiorespiratory Health And Fitness: Systematic Review And Meta-analysis**  
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**Purpose:** To examine the influence of prenatal exercise on maternal cardiorespiratory health and fitness during pregnancy. **Methods:** Online databases were searched up to February 25, 2019. Studies of randomized controlled trials (RCTs) were

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eligible, which contained information on the relevant population (pregnant women), intervention (subjective or objective measures of frequency, intensity, duration, volume, or type of exercise), comparator (no exercise intervention), and outcomes (maternal cardiorespiratory fitness, including  $VO_{2max}$ , submaximal  $VO_2$ ,  $VO_2$  at anaerobic threshold, and cardiorespiratory health, including resting heart rate, resting systolic and diastolic blood pressure during pregnancy). **Results:** From 2699 unique citations, 26 RCTs (N= 2292 women) were included. "Low" to "high" certainty evidence revealed that exercise was associated with improved  $VO_{2max}$  (five RCTs, n=430; mean difference [MD]=2.77 mL/kg/min; 95% confidence interval [CI]: 0.32 to 5.21,  $I^2=69\%$ ), reduced resting heart rate (nine RCTs, n=637; MD= -1.71 bpm; 95% CI: -3.24 to -0.19,  $I^2=13\%$ ), resting systolic blood pressure (16 RCTs, n=1672; MD: -2.11 mmHg, 95% CI: -3.71 to -0.51,  $I^2=69\%$ ) and diastolic blood pressure (15 RCTs, n=1624; MD: -1.77 mmHg, 95% CI: -2.90 to -0.64,  $I^2=60\%$ ). **Conclusion:** Prenatal exercise interventions improve maternal  $VO_{2max}$  and reduce resting heart rate and blood pressure. PROSPERO registration number: CRD42019131249.

**2173** Board #92 May 28 2:00 PM - 3:30 PM  
**Effects Of Multidimensional Lifestyle Interventions On Children's Body Composition And Blood Pressure: A Network Meta-analysis**

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**PURPOSE:** A variety of clinical trials with various lifestyle intervention programs are available to address pediatric obesity and chronic diseases. Yet, no known research has used network meta-analysis to synthesize the findings simultaneously. In response, this network meta-analysis aimed to compare the effectiveness of multiple lifestyle interventions on children's body composition and blood pressure changes. **METHODS:** A total of 312 published studies on lifestyle intervention programs were retrieved with 37 studies meeting the following inclusion criteria: (1) data-based articles published in English between 2009 and 2019; (2) used randomized controlled trial design; (3) subjects aged between 1 to 12 years old and did not suffer from any physical or mental illness; and (4) investigated some type of intervention on body mass index (BMI), BMI z-score (BMIz), body fat percentage, systolic blood pressure (SBP) and diastolic blood pressure (DBP) among children. Data extraction for comparisons was completed for 10 intervention categories: (1) control (T1; no intervention); (2) physical activity (PA)/exercise only (T2); (3) knowledge education in various dimensions (T3); (4) nutrition (T4); (5) environment changes (T5); (6) PA plus education (T6); (7) nutrition plus education (T7); (8) environment changes plus education (T8); (9) PA with nutrition and education (T9); and (10) PA with environment changes and education (T10). Package "pnetmeta" in R software was mainly used to carry out the analysis. **RESULTS:** Based on mean difference (MD) comparison, nutrition plus education and physical activity (PA)/exercise only appeared to be two most effective ways in reducing children's body fat percentage compared with treatments 3, 5, 6 and 10 (Effect Size(ES) = -2.33, 95%CI: (-4.17, -0.44); ES = -1.61, 95% CI: (-2.47, -0.68) respectively). For children's BMI, T9 was the most effective approach compared with seven other treatments. T2 demonstrated the best scores in both BMIz and SBP (ES = -5.57, 95%CI: (-8.37, -2.64)) in final estimation. **CONCLUSIONS:** PA intervention ranked top two of the most effective approaches among 9 types of lifestyle interventions in all 5 MD comparisons, suggesting that promoting PA participation is crucial in childhood obesity control.

**2174** Board #93 May 28 2:00 PM - 3:30 PM  
**Physical Activity, Sedentariness And Metabolic Risk In Portuguese Children**

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It has been suggested that physical activity (PA) and sedentariness are associated to metabolic risk (MR) factors in children.

**PURPOSE:** To study the relationship between different PA intensities [moderate to vigorous PA (MVPA) and light PA (LPA)] and sedentariness with children MR.

**METHODS:** The sample comprises 388 Portuguese children, from both sexes (219 girls; mean age 10.5 years). MR indicators included fasting glucose, triglycerides, HDL-cholesterol, as well as waist circumference and mean arterial blood pressure; MR score (zMR), adjusted for maturity offset, was computed. MVPA, LPA, and sedentariness were measured with the GT3X+ Actigraph accelerometer with at least 4 days (with one weekend day) of at least 10 hours/day of monitoring. Linear regression, by sex, was used to identify correlates of zMR. **RESULTS:** In girls, none of the variables included in the model were significantly related to zMR ( $p>0.05$ ); however, in boys a negative and significant effect of MVPA was observed ( $\beta=-0.026$ ;  $p=0.011$ ), where those who spent more time in MVPA had a better zMR profile, but no significant effect was observed for LPA or sedentariness. **CONCLUSIONS:** The role of PA on MR in children differs according to gender. In girls no significant link was observed, suggesting that other factors (namely biological and nutritional) may be associated with girls' metabolic health. In boys MVPA is a relevant predictor in their metabolic health, suggesting that MVPA should be promoted. Study funded by The Portuguese Foundation of Science and Technology (individual grant SFRH/BPD/1231452016).

**2175** Board #94 May 28 2:00 PM - 3:30 PM  
**Parent Physical Activity Is More Associated With Child Sport Participation Than Accelerometer-Assessed Child Physical Activity**

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Parent physical activity (PA) levels may influence the PA levels of their children, either through general activity or sport participation. However, the strength of those associations needs further exploration. Moreover, factors such as child PA self-efficacy, family support of PA, and family structure may also influence these associations and research is lacking among rural families. **PURPOSE:** To examine the associations between parent PA levels and child PA levels including sport participation, and to further explore the role of the aforementioned variables in the relationship. **METHODS:** Baseline data were analyzed on 105 child-parent dyads (child age =  $8.95\pm 1.1$  years, parent age =  $37.9\pm 5.4$  years) from the NU-HOME study, a childhood obesity prevention, RCT in a rural community. Data included parent self-reported PA (daily total PA and daily total moderate-to-vigorous PA (MVPA)), family structure (child to adult ratio), and child sport participation in the past year; child-reported PA self-efficacy and family support for PA; and objective child PA levels from accelerometry (daily total PA and daily total MVPA). Child daily total MVPA did not meet acceptable normality and was log transformed for analyses. Multivariate regression models controlling for economic assistance were analyzed using SAS 9.4. **RESULTS:** Children participated in  $2.4\pm 1.5$  sports in the past year. Mean child daily total MVPA was  $44.9\pm 18.6$  minutes, while mean parent daily total MVPA was  $25.5\pm 25.3$  minutes. Parent PA was not significantly associated with child daily total PA or child daily total MVPA. However, after adjusting for economic assistance, parent PA was significantly associated with child sport participation separately ( $p<0.005$ ) and in models that included child PA self-efficacy, family support of PA, and family structure ( $p<0.02$ ). **CONCLUSIONS:** Present study findings that parent PA was significantly associated with child sport participation, but not objective measures of child PA suggests that active parents may encourage and support their children's sport participation. Sport participation may provide personal, social, as well as physical benefits for children. The findings of this study highlight the importance of exploring sport participation when investigating activity behavior particularly among rural children.

**2176** Board #95 May 28 2:00 PM - 3:30 PM  
**DIABETES RISK STATUS AND PHYSICAL ACTIVITY IN WOMEN OF CHILDBEARING AGE: U.S. BRFS**

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 (No relevant relationships reported)

**PURPOSE:** Women of childbearing age with prediabetes (PD) or gestational diabetes (GD) can reduce their odds of diabetes by engaging in physical activity (PA). This study examined the odds of meeting the current United States aerobic activity (AA), muscle-strengthening activity (MSA), both, or neither recommendation(s), according to diabetes risk status (DRS).

**METHODS:** Women (N=282,302) ages 18-44 who participated in the 2011, 2013, 2015, or 2017 Behavioral Risk Factor Surveillance System survey were categorized by DRS: no diabetes (ND), diabetes (DM), or high risk for diabetes (HRD). Logistic

regression models stratified by body mass index (underweight [ $<18.5$ ], desirable weight [ $18.5-24.9$ ], overweight [ $25.0-29.9$ ], and obese [ $\geq 30.0$ ]) were fitted, controlling for potential confounders.

**RESULTS:** Compared to the ND referent group, overweight women with DM had significantly ( $p \leq 0.05$ ) lower odds of meeting the AA recommendation (OR 0.83, CI 0.67-1.00). Overweight women considered HRD were less likely to meet the MSA recommendation (OR 0.81, CI 0.68-0.97) and more likely to not meet either recommendation (OR 1.20, CI 1.03-1.40). Among women in the desirable weight group, those considered HRD had lower odds of meeting MSA only (OR 0.72, CI 0.61-0.85) or both recommendations (OR 0.77, CI 0.64-0.93). Desirable weight women with DM had greater odds of not meeting either recommendation (OR 1.43, CI 1.12-1.82). **CONCLUSIONS:** Increased AA and MSA in women at risk for diabetes may benefit maternal outcomes. Strategies targeting the determinants of PA should be considered to increase participation.

**2177** Board #98 May 28 2:00 PM - 3:30 PM  
**Exploring Associations Between Household Chaos With Sedentary Behavior And Screen Time In Rural Children**

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Household chaos is perceived home disorganization caused by noise, crowding, and traffic patterns. It has been shown to be linked to weight-related behaviors such as sleep and nutritional behaviors (i.e., family meals). However, the relationship between sedentary behavior and household chaos has not been explored. Examining this association could allow us to better understand how family milieu contributes to behavioral risk factors for childhood obesity. **PURPOSE:** To examine associations between household chaos with sedentary behavior and screen time in rural children. **METHODS:** Participants ( $n=105$  parent/child dyads) were enrolled in the NU-HOME study, a family-based, obesity prevention RCT in rural Minnesota. Parents reported baseline data on sociodemographics, household chaos, and child screen time. Household chaos was measured with a 15-item scale about home disorganization ( $\alpha=0.83$ ; higher scores indicate more chaos). Children's sedentary behavior was assessed via accelerometry. Regression analyses using SAS 9.4 were performed to assess associations between household chaos and sedentary behavior and screen time, controlling for child-parent ratio, economic assistance, child BMI z-score and age. Normality of screen time was not met, so a transformed variable was used in analyses. **RESULTS:** Child mean age was  $8.95 \pm 1.05$  years; 59% were female; mean BMI z-score =  $-0.92 \pm 0.94$ . Mean daily sedentary time and screen time were  $8.33 \pm 77.5$  and  $2.06 \pm 1.42$  hours, respectively. Household chaos scores had a mean of  $5.04 \pm 3.6$ , which is comparable to other studies. Household chaos scores were not significantly associated with child sedentary behavior but were positively associated with child screen time ( $p=0.002$ ). **CONCLUSIONS:** In other studies, household chaos has been associated with negative health behaviors, which aligns with our current findings. The association between screen time and household chaos may be explained by parents using electronics to entertain children in chaotic environments. Parents in chaotic homes may also have more difficulty managing a child's screen time than those in less chaotic homes. The relationship between household chaos and sedentary behavior should be further explored to increase our understanding of how the home environment may affect health-related behaviors.

**2178** Board #97 May 28 2:00 PM - 3:30 PM  
**Meeting 24-hour Movement Guidelines: Prevalence, Correlates And Relationships With Overweight And Obesity Among Chinese Children And Adolescents**

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There is a lack of research on meeting 24-hour movement guidelines, including physical activity (PA), sedentary time (ST) and sleep, among Chinese children and adolescents. **PURPOSE:** To investigate the prevalence of meeting the 24-hour movement guidelines, related correlates, or the relationships with body mass index (BMI) among Chinese children and adolescents. **METHODS:** Cross-sectional data were derived from the Physical Activity and Fitness in China—The Youth Study (PAFACTYS) 2017. A nationally representative sample with 114,072 children and adolescents (9-18 years-old, mean age 13.75 years, 49.2% boys) completed a self-report questionnaire regarding PA, ST and sleep. The prevalence of meeting the 24-hour movement guidelines and World Health Organization (WHO) weight status

categories was determined. Generalized linear models were used to determine the correlates of meeting the movement guidelines and the relationships of meeting the movement guidelines with overweight and obesity (OW/OB). **RESULTS:** Only 5.12% of Chinese children and adolescents met the 24-hour movement guidelines and 22.44% were classified as OW/OB. Children and adolescents meeting the 24-hour movement guidelines showed lower odds ratios for OW/OB. Compared with meeting the 24-hour movement guidelines, boys of 4-6th grades (9-12 years old) meeting none of the recommendations (OR = 1.22), ST recommendation only (OR = 1.13) and sleep recommendation only (OR = 1.14) had significantly higher odds ratios for OW/OB. Similar trends were observed in girls of 4-6th grades meeting none of the recommendations (OR = 1.35), sleep recommendation only (OR = 1.23) and PA + sleep recommendations (OR = 1.24), and in girls of 7-9th grades (13-15 years old) meeting none of the recommendations (OR = 1.30). **CONCLUSIONS:** Very few Chinese children and adolescents met the integrated health-related 24-hour movement guidelines. Age (negative), parental educational level and family income (both positive) were correlates of meeting the 24-hour movement guidelines. Children and adolescents meeting the 24-hour movement guidelines were more likely to have healthier body weight, especially in the youngest age group, and girls in middle age group. **Funding:** Supported by the General Project of the National Social Science Foundation of China (19BTY077).

**2179** Board #98 May 28 2:00 PM - 3:30 PM  
**The Association Between Socioeconomic Status And Access To Physical Activity Related Built Environment In Children**

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 (No relevant relationships reported)

Minorities and those with lower socioeconomic status (SES) are at higher risk for chronic diseases compared to their Caucasian counterparts and those with higher SES. Establishing life-long physical activity (PA) behavior in childhood could lower the risk for chronic disease in adulthood. Access to opportunities for PA in the built environments is associated with increased PA behavior in children. Understanding patterns of access to these opportunities for minority and low SES children would be useful in developing interventions to increase PA in these populations. **PURPOSE:** To investigate the relationship among race, SES, proximity to public parks for children and adolescents in a mid-sized city. **METHODS:** ArcGIS Online was used to map public parks with 10-minute walking buffers, census tract-level demographics (race of children and adolescents [ $\leq 19$  yrs], household poverty status, and population density). Central city neighborhoods were also mapped. Partial correlations between the variables were performed, controlling for all other variables. Hierarchical cluster analysis identified homogeneous census tracts with regard to race, SES, park proximity, and population density. One-way ANOVA measured differences in the variables used to construct the clusters. Significance was set at  $p < 0.05$ . **RESULTS:** Poverty correlated with black race ( $r^2=0.60$ ,  $p < 0.001$ ) and park proximity ( $r^2=0.53$ ,  $p=0.54$ ), but there was no significant correlation between race and park proximity. Population density correlated with black race ( $r^2=0.63$ ,  $p < 0.001$ ), but not with any other variables. Two census tract clusters were identified. Parks in cluster 1 corresponded with neighborhoods centrally located in the city. Compared to cluster 2, cluster 1 showed higher percentages of households below the poverty level ( $36.1 \pm 13.2$  vs  $4 \pm 8.6$ ), children and adolescents of black race ( $63.4 \pm 18.6$  vs  $30.3 \pm 18.3$ ), and children and adolescents living within 10-minute walking distance to a park ( $76.7 \pm 16.7$  vs  $8.0 \pm 11.4$ ). **CONCLUSIONS:** Abundant proximity to parks may provide opportunities for physical activity interventions for at-risk children and adolescents in urban areas. Future directions should include the investigation of additional aspects of access in these subgroups such as patterns of PA-promoting park amenities.

**2180** Board #99 May 28 2:00 PM - 3:30 PM  
**Association Of Household Food Security And Physical Activity Among Youth And Young Adults With Diabetes**

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Physical activity (PA) is so essential in diabetes management that it is usually prescribed as a lifestyle change in addition to medications. Food insecurity may cause youth and young adults (YYAs) with diabetes to be more fatigued, thereby negatively impacting their PA.

**PURPOSE:** The purpose of this study is to examine the association between household food security and PA in YYAs with diabetes.  
**METHODS:** Data from 2,195 YYAs with diabetes (1,855 type 1, 340 type 2, mean age: 21.4 years) were analyzed from the SEARCH for Diabetes in Youth Study. Household food security status was measured with the 18-item U.S. Household Food Security Survey Module by adult participants or parents of minors. Households that affirmed  $\geq 3$  food insecure conditions or behaviors were considered food insecure. PA was measured with the International Physical Activity Questionnaire Short Form. Walking, moderate (excluding walking) intensity physical activity (MPA), and vigorous intensity physical activity (VPA) minutes/week were multiplied by 3.3, 4.0, and 8.0, respectively, to obtain metabolic equivalent minutes (MET min/wk), and summed to calculate total PA MET min/wk. We conducted median regression analyses, adjusting for socioeconomic, demographic and clinical covariates, for both the full sample and by diabetes type.  
**RESULTS:** 20% of the sample (15% type 1, 5% type 2) was food insecure. The median amount of walking, MPA, VPA, and total PA were 991, 481, 955, and 2,967 MET min/wk, respectively. In the unadjusted analysis, food insecurity was significantly associated with less VPA ( $\beta$ : -480;  $p=0.0067$ ) and more walking ( $\beta$ : 399;  $p$ -value=0.0006) MET min/wk. The effect for walking persisted after covariate adjustment ( $\beta$ : 242;  $p=0.0238$ ). There was no significant difference observed by diabetes type.

**CONCLUSION:** Household food security was not associated with MPA, VPA, or total PA MET min/wk in adjusted analyses. Food insecurity was associated with more walking MET min/wk. Future research should consider walking for travel vs. walking for leisure among food insecure YYAs with diabetes. Future research should also consider use of an objective measure of PA in contrast to the present study which relied on subjective recall.  
 Supported by NIH Grant R01DK117461.

**2181** Board #100 May 28 2:00 PM - 3:30 PM  
**Metabolic Syndrome And Muscular Strength In Youth: NHANES 2011-2014**  
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 (No relevant relationships reported)

Muscular strength has recently been identified as a potential target of cardiometabolic risk-factor reduction strategies in youth. Initial explorations have indicated links between muscular strength and individual components of metabolic syndrome, but large, nationally-representative research on the topic is limited. **PURPOSE:** To investigate the relationship between metabolic syndrome and muscular strength in a nationally representative sample of U.S. youth. **METHODS:** The analysis included 409 boys and 415 girls from the 2011-2014 National Health and Nutrition Examination Survey between 12-18 years of age. Metabolic syndrome was defined by the Jolliffe and Janssen criteria and based on having 3 or more of the following components: abdominal obesity, high triglycerides, low HDL cholesterol, elevated blood pressure, or high fasting glucose. Muscular strength was assessed via handgrip dynamometer and expressed as age- and sex-specific z-scores of relative strength (kg strength/kg body mass). Low strength was defined as a relative grip strength below the 25th age- and sex-specific percentile. Logistic regression was used to estimate the odds of metabolic syndrome based on relative strength z-score. An additional model compared the odds of metabolic syndrome between youth in low and adequate strength groups. All analyses controlled for age, sex, race/ethnicity, physical activity status, and weight status. **RESULTS:** The prevalence of metabolic syndrome was 5.3% (95% CI 3.9% to 7.3%). The logistic regression indicated that for every 1 unit decrease in strength z-score, the odds of metabolic syndrome increased by 2.6 (95% CI 1.7 to 4.1). Further, adolescents with low strength were more likely to have metabolic syndrome than those with adequate strength (odds ratio = 2.2, 95% CI 1.1 to 4.3). **CONCLUSIONS:** Muscular strength is predictive of adolescent metabolic syndrome. Youth with low strength are more than twice as likely to have metabolic syndrome than those above the bottom strength quartile, irrespective of physical activity and weight status. These results highlight the relevance of muscular strength in the prevention of youth cardiometabolic disease and metabolic syndrome.

**2182** Board #101 May 28 2:00 PM - 3:30 PM  
**Physical Activity And Sedentary Behaviors Vary According To Fitnessgram Bmi Classification In Youth**  
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 (No relevant relationships reported)

FITNESSGRAM has established criterion standards for aerobic fitness, as well as body composition and body mass index (BMI) according to gender and age in youth. **PURPOSE:** The purpose of this study was to determine the variation in reported amounts of physical activity (PA) and sedentary behaviors (SB) according

to FITNESSGRAM BMI classification in youth. **METHODS:** Subjects were 1,643 boys and girls, ages 11-17 years, who participated in the 2014 FLASHE Study, a national epidemiological survey regarding psychosocial, general, and environmental factors of various health behaviors. Participants' responses regarding levels of PA and SB were compared across FITNESSGRAM BMI classifications, more specifically between participants categorized as either Very Lean (VL) or within the Health Fitness Zone (HFZ) versus those participants in the Needs Improvement (NI) categories. **RESULTS:** Participants classified as NI for BMI reported significantly less PA outside of school ( $p = .004$ ), as well as significantly greater sedentary time outside of school ( $p = .003$ ) than participants classified as either VL or within the HFZ. Participants classified as NI for BMI also reported significantly greater predicted time (minutes) per week in SB outside of school ( $p < .001$ ), significantly greater predicted time (minutes) per day in SB outside of school ( $p < .001$ ), and significantly greater predicted proportion of time (percentage) in SB outside of school ( $p < .001$ ) than participants classified as either VL or within the HFZ. No significant difference in responses between participants classified as NI compared to those classified as either VL or within the HFZ were observed for predicted time per day or week in moderate-to-vigorous PA at school or during the weekend. **CONCLUSIONS:** FITNESSGRAM BMI classifications have been shown to be consistent with ratings of aerobic fitness. These data suggest that youth classified as NI according to FITNESSGRAM BMI standards have similar in-school and weekend PA and SB patterns as youth classified as either VL or within the HFZ; however, youth classified as NI engage in less PA and more SB outside of school. To reverse the trend toward greater overweight and obesity among youth, it may be important to address PA and SB patterns.

**2183** Board #102 May 28 2:00 PM - 3:30 PM  
**What Determine Physical (In)Activity In Brazilian Adolescents?**  
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 (No relevant relationships reported)

Increases in physical inactivity has being pointed as one of the most relevant public health problems, especially among youth. Once physical (in)activity is a multifactorial trait, determined by different variables, such as biological and environmental, understanding the role of these variables in youth physical activity (PA) guidelines compliance seems to be of relevance, especially in Brazilian context, given the diversity observed among its region. **PURPOSE:** To describe differences in adolescent's PA guidelines compliance among Brazilian regions and to investigate the determinants related to these differences. **METHODS:** Data comes from the National Adolescent School-based Health Survey (PENSE). Sample comprises 99570 Brazilian students (51.7% girls), enrolled in the 9<sup>th</sup> grade of Elementary School (mean age 14.29±0.93y). Information related to daily PA guidelines compliance was self-reported (based on the number of days, in last week, adolescents were engaged in at least 60 minutes of moderate to vigorous PA), as well as mother educational level; further, school context information (school size and availability of sports court) was obtained. Logistic regression analysis was computed in SPSS 24, with a significance level of 95%. **RESULTS:** More than 2/3 of the adolescents did not comply the PA guidelines on any given day of the week; more, the North region presented the highest compliance percentage (9.8%), followed by the Midwest (9.6%), South (8.6%), Southeast (8.3%), and Northeast (7.8%) regions. Regarding predictors of PA guidelines achievement, boys (OR: 3.33,  $p<0.001$ ), older adolescents (OR: 1.08,  $p<0.001$ ), those with mother with higher educational level (OR: 1.33,  $p<0.001$ ), and those enrolled in schools without sports court (OR: 0.92,  $p=0.007$ ) were more prone to be active than girls, young adolescents, those with mothers with lowest educational level, and those enrolled in schools with sports court, respectively. No significant result was found for school size ( $p = 0.558$ ). **CONCLUSIONS:** Sex, age, mother educational level, and the presence of sports court at school were significant predictors for compliance of PA guidelines among Brazilian adolescents. These results reinforce that biological and environmental characteristics, namely school context, play important roles in youth health habits.

**2184** Board #103 May 28 2:00 PM - 3:30 PM  
**Physical Activities Status Of Yi Nationality Pupils In China**  
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 (No relevant relationships reported)

Regular physical activity in children and adolescents promotes health and fitness and youth who are physically active are healthier, have less body fat, and exhibit improved cognition and mental performance. Youth need at least 60 minutes of moderate-to-vigorous physical activity each day for good health. **PURPOSE:** Many researches have been done about physical activity levels among youth in China, but most of them

focused on urban children, less known about rural ones, especially minority in poverty areas in China. The main purpose of this article is to investigate the levels of physical activity among Yi nationality pupils in Sichuan province of China. **METHODS:** 7-Day Physical Activity Recall Questionnaires were used to investigate the amount of physical activities among 123 Yi Nationality Pupils (53 boys, 51 girls) aged 9 to 17 (born in 2002-2009) in grade 4 and grade 6.

**RESULTS:** For the participants, their average total amount of physical activities is 1088 minutes per week, and boys are more physically active than girls (boys in grade 6 is 1376 and girls is 791, boys in grade 4 is 1209 and girls is 979); their average total amount of physical activities at school is 375 minutes per week, and boys are relatively more physically active than girls at school (boys in grade 6 is 394 minutes per week and girls is 285, boys in grade 4 is 366 minutes per week and girls is 363); their average total amount of house work activities at home is 15 minutes per week, and boys are relatively more than girls (boys in grade 6 is 17 minutes per week and girls is 10, boys in grade 4 is 18 minutes per week and girls is 13); only there are 16.2% of pupils whose daily PA amount are below to the recommended daily physical activities of WHO and ACSM (boys in grade 6 is 6 and girls is 3, boys in grade 4 is 4 and girls is 5). **CONCLUSIONS:** Boys are more physically active than girls; Most of pupils reached the recommendation of daily physical activity.

**2185** Board #104 May 28 2:00 PM - 3:30 PM

### Behavioral Factors For Adolescents' Obesity And Overweight: Physical Activity, Sleep, Sedentary Behavior, And Diet

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(No relevant relationships reported)

**PURPOSE:** To investigate the risk factors in weight status among adolescents regarding dietary habits and movement behavior.

**METHODS:** Primary data were derived from the CDC Youth Risk Behavior Survey (YRBS), a nationally representative sample of 40,130 grade 9-12 students (N=20,340 boys and 19,790 girls) from 2011 to 2017. The prevalence of overweight and obesity was examined using BMI percentile and then compared based on various demographics (i.e., sex, age, race) and behavioral factors (i.e., physical activity, sedentary time, sleep, soda consumption). Logistic regression analysis was conducted to illustrate the differences in weight status within each group of physical activity levels after control the behavioral and demographic factors.

**RESULTS:** Overall, African-American adolescents had the highest prevalence of overweight or obesity (36%), followed by Hispanics (35%), others (29%), and White (27%). Female students had significantly lower obesity rate than male students (-6.4 ± 0.2%), but also spend less time for behavioral activities (e.g., sedentary time: -0.372 ± 0.015 hours, MVPA -20.4 ± 0.4%, and strength training -20.9 ± 0.3%). The self-diagnosis was relatively accurate, with 69% of true positive and 13% of true negative in comparison to actual overweight and obesity status. For the PA group, students who satisfied both PA recommendations had less likely to be obese compared to non-PA group: Odds Ratio (OR) for PA = 0.89, 95% CI [0.825, 0.961], p = 0.003; OR for strength training = 0.92, 95% CI [0.865, 0.996], p = 0.039. Students who consumed soda on more than one day were more likely to be obese (OR = 1.13, 95% CI [1.049, 1.223]), and students who had more sedentary time tended to be obese (OR=1.03, 95% CI [1.011, 1.041]).

**CONCLUSIONS:** Students who were meeting PA recommendations were less likely to be obese, while students who had more sedentary time and higher levels of soda consumption were more likely to be obese. In addition, African American and Hispanic students were more likely to be overweight and obese.

**2186** Board #105 May 28 2:00 PM - 3:30 PM

### Peak Height Velocity Maturity Offset Estimated From Cross-sectional Vs. Longitudinal Growth Data

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(No relevant relationships reported)

Appropriate evaluation of pediatric health indices relies on assessment based on physical maturity status. Regression equations have been developed to estimate maturity offset (MO) relative to age at peak height velocity (aPHV) using cross-sectional anthropometric data, with extensive application in pediatric exercise research.

**PURPOSE:** We evaluated agreement of these estimates against standards calculated using superimposition by translation and rotation (SITAR) models of longitudinal data, targeting specific time windows relative to PHV and menarche. **METHODS:** Height data were drawn from a longitudinal dataset evaluating female bone growth in 141 participants for whom SITAR-based aPHV had been calculated using  $\geq 3$

data points. Two subsamples were selected based on available repeated measures in target maturity ranges based on SITAR aPHV and menarche: prePHV (-2.5 to -1.5yr), postPHV (+1.5 to +2.5yr); circaPHV (-0.5 to +0.5yr) & postMEN (0 to +1.0yr). Mirwald et al. and Moore et al. regression equations were used to calculate aPHV and MO, yielding MO1 and MO2 (respectively) for comparison against sitarMO. Bland-Altman plots evaluated agreement with sitarMO in each target maturity range. **RESULTS:** For prePHV and postPHV comparisons, n= 58, with mean sitarMO -2.1yr (sd 0.3) and +2.1yr (sd 0.3), respectively. For circaPHV & postMEN comparisons, n=108, with mean gynecological ages -1.1yr (sd 0.7) and +0.6yr (sd 0.3) and mean sitarMO -0.1yr (sd 0.4) and +1.6yr (sd 0.7), respectively. Except postMEN, on average, MO<sub>1</sub> underestimated sitarMO [prePHV -1.5yr, postPHV -2.8yr; circaPHV = -2.3yr, postMEN = +0.5yr]. Mean discrepancies for MO<sub>2</sub> vs. sitarMO were subtle, near zero [prePHV = +0.4yr, postPHV = +0.1yr; circaPHV = -0.1yr, postMEN = -0.01yr]. **CONCLUSION:** MO<sub>1</sub> maturity estimates are flawed; <50% of estimates were within 1yr of sitarMO for assessed maturity ranges. MO<sub>2</sub> provides better sitarMO estimates using cross-sectional data. However, it is unclear whether MO<sub>2</sub> is an improvement over chronological age for most individuals, as MO<sub>2</sub> effectively assesses whether girls are short or tall for their age. In many cases, height for age may primarily reflect genetic height potential rather than maturity status, particularly at older maturity stages.

### D-64 Free Communication/Poster - Population-based Surveillance

Thursday, May 28, 2020, 2:00 PM - 4:30 PM

Room: CC-Exhibit Hall

**2187** Board #106 May 28 2:00 PM - 3:30 PM

### Extent Of Childhood Participation In Ultramarathon Running Does Not Negatively Impact Continued Running

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(No relevant relationships reported)

**PURPOSE:** It is unclear if "excessive" exercise is harmful, particularly at a young age. While childhood participation in ultramarathons has increased exponentially over the past 20 years, less than 25% of these individuals continue running ultramarathons in adulthood. This raises concern that childhood ultramarathon runners may suffer complications from their young participation in the sport. The purpose of this work was to examine if the extent of ultramarathon participation among those under 19 years of age is related to the cessation of running into adulthood due to running related injuries.

**METHODS:** Individuals having completed an ultramarathon when under 19 years of age were recruited via announcements on running-related websites and Facebook advertisements. Qualified participants were also identified from race results databases, and directly recruited when online publicly available contact information was found. Participants completed an online survey including questions on running history, whether or not they are currently running and reasons for not if that was the case, and their opinions about how childhood ultramarathon running had impacted their health. Group comparisons were made with an unpaired t-test or the Mann-Whitney test.

**RESULTS:** There were 69 participants (9 women and 60 men) completing the survey with median age of 34 years (range 18-67 years). Those who had stopped running regularly due to running-related injury (12%) had not completed more ultramarathons when under 19 years of age compared with those who had either stopped for other reasons (28%) or continued to run regularly (median 1 vs. 2, p=.13). The age of these two groups was also similar (p=.51). All but one respondent (1%) indicated that they believed running an ultramarathon as a child had either a positive (67%) or no (32%) effect on their physical health. **CONCLUSIONS:** Cessation of running into adulthood due to running related injuries was unrelated to the number of ultramarathons completed while under 19 years of age. Childhood ultramarathon runners also largely felt that ultramarathon running as a child had a favorable effect on their health. These findings suggest that the extent of childhood ultramarathon running does not adversely affect running into adulthood. Supported by the Ultra Sports Science Foundation

**2188** Board #107 May 28 2:00 PM - 3:30 PM  
**SLEEP DURATION AND OBESITY INDICES IN U.S. ADOLESCENTS (NHANES 2015-2016)**

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 (No relevant relationships reported)

Adolescent obesity continues to be a major public health concern among developed nations. Sleep duration has been hypothesized as a contributing factor to this increase. **PURPOSE:** This study examined the sleep-obesity relationship in U.S. adolescents. **METHODS:** Data from the 2015-2016 National Health and Nutrition Examination Survey ( $n=454$ ; ages 16-18 years) was used to consider the effect of sleep duration (hours) on body mass index (BMI) and waist circumference (WC) by gender. Linear regression was used to determine the relationship between sleep duration and BMI and WC. Sleep hours were then categorized as Under Recommended (<7 hours), Recommended (8-10 hours), and Over Recommended (>10 hours) and an ANCOVA was used to examine differences in BMI and WC by sleep category. Finally, logistic regression considered the influence of sleep category on overweight classification. **RESULTS:** Approximately 21% of the total participants were overweight or obese while 53.3% met the recommendations for sleep duration. Linear regression revealed a significant ( $p<0.05$ ) main effect across sleep duration categories in the total sample for WC only. Longer sleep duration was associated with an increased WC in both males ( $p=0.030$ ) and females ( $\beta=0.143-0.148, p<0.05$ ) and with an increased BMI in males ( $\beta=0.136-0.113, p<0.05$ ), but not females. Logistic regression analyses yielded no significant influence of sleep category assignment on overweight BMI classification. **CONCLUSIONS:** For both males and females, excessive sleep was related to higher WC. However, excessive sleep only impacted BMI in males. In contrast, the greater number of females achieving the recommended amount of sleep, and thus, smaller proportion getting insufficient or more than the recommended amount, may contribute to the absence of influence on BMI in females. Likewise, the categories used to classify sleep duration may not be sensitive enough to adequately identify risk differences weight-related maladies in females.

**2189** Board #108 May 28 2:00 PM - 3:30 PM  
**Association Between 90°Push-up And Cardiorespiratory Fitness: Cross-sectional Evidence Of Physical Fitness Surveillance In Youth**

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**PURPOSE** Musculoskeletal and cardiorespiratory fitness is strongly associated with better health among children, affecting mental and physical outcomes like depression, anxiety, cardiovascular disease risk and body mass indices. It has been shown that fit children with low abdominal adiposity had increased odds of superior academic achievement. To-date there is no adequate surveillance in the US when it comes to monitoring physical fitness. This study investigated associations between musculoskeletal fitness measures (including 90° push-up), cardiorespiratory fitness, and weight. **METHODS** Two hundred and ten students ( $9.7 \pm 1.08$  years;  $138.6 \pm 9.4$  cm;  $42.3 \pm 14.4$  kg) across third through fifth grades were tested for cardiorespiratory (i.e., Progressive Aerobic Cardiovascular Endurance Run (PACER)) and musculoskeletal (90° push-up, trunk lift, sit-and-reach and curl-up) fitness. The relationships between the two measures were modeled using a series of linear regression analyses. Models were adjusted for age, sex, and weight status. Significant two-tailed tests were set at  $P < .05$ . **RESULTS** Of the four musculoskeletal fitness measures, only 90° push-up was significantly associated ( $\beta = .35; P < .001$ ) with PACER test scores (i.e., cardiorespiratory fitness). The related model ( $R^2 = .32; F(4,205) = 26.1; P < .001$ ) accounted for 32% of the variance in cardiorespiratory fitness. 90° push-up was associated with sit-and-reach ( $\beta = .29; P < .001$ ) and curl up ( $\beta = .41; P < .001$ ) test scores. When individually modeled, 90° push-up ( $\beta = -.46; P < .001$ ) and PACER ( $\beta = -.44; P < .001$ ) were inversely associated with weight. **CONCLUSION** The 90° push-up test was associated with cardiorespiratory fitness, anterior trunk muscle strength, endurance, lower back and posterior thigh muscle flexibility. Our study concluded that the 90° push-up test is a tractable tool for physical fitness surveillance by clinicians, physical education teachers, parents, and children. We need more studies with larger samples from diverse settings and wider age range to support our findings. Incorporating a surveillance mechanism of fitness in schools, primary care settings and educating parents of its correct use can make an impact on the youth population and decrease the incidence of the growing pandemic of childhood obesity and its associated health risks.

**2190** Board #109 May 28 2:00 PM - 3:30 PM  
**Youth Sports Participation In The United States, 2016-2017**

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**PURPOSE:** The *National Youth Sports Strategy* was released in 2019 with an aim to expand participation in sports among US youth. Our study examines differences in the prevalence of youth sports participation by selected characteristics to better understand disparities in participation and how they may vary across age groups. **METHODS:** Nationally representative data from the 2016-2017 National Survey of Children's Health ( $N=49,952$ ) were analyzed. Parents with children aged 6-17 years were asked whether their child participated in a sports team after school or on weekends during the previous 12 months. Prevalence of participation was estimated overall, by age, and sex, race/ethnicity, highest level of parental education, and household income (percentage of the Federal Poverty Level [FPL]). Significant differences and trends, assessed using pairwise  $t$  tests and orthogonal polynomial contrasts, are reported ( $p<0.05$ ). **RESULTS:** Overall, 58.4% of youth aged 6-17 years participated in sports. Youth aged 10-13 years had the highest prevalence of sports participation (61.9%) compared to those aged 6-9 years (56.6%) and 14-17 years (56.5%). Prevalence of participation was higher among boys (61.3%) than girls (55.2%) and among non-Hispanic whites (65.4%) compared to non-Hispanic blacks (48.1%), Asians (55.6%), and Hispanics (49.8%). Prevalence increased with increasing parental education level (from 31.9% [highest education level of high school or less] to 73.1% [college degree or higher]) and household income (from 41.1% [household incomes <100% FPL] to 75.7% [ $\geq 400\%$  FPL]). Patterns were similar across age groups, although differences by race/ethnicity, parental education, and household income were generally more pronounced in the youngest age group. For example, among youth aged 6-9 years the range in prevalence of participation from lowest to highest income level was 35.4% to 80.6%, while among youth aged 14-17 years it was 43.2% to 68.5%. **CONCLUSION:** While about 6 in 10 youth in the United States participate in sports, important disparities exist particularly by household income and are generally more pronounced among younger children. Identifying and overcoming barriers, such as cost and accessibility, may help increase youth sports participation to support the aims of the *National Youth Sports Strategy*.

**2191** Board #110 May 28 2:00 PM - 3:30 PM  
**National Monitoring Of Youth Physical Activity With Two Surveillance Systems: Healthy People 2030**

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*Healthy People 2030* will include a new objective to increase the proportion of younger youth (6-13 years) who meet the aerobic physical activity guideline (guideline). The current objective monitors meeting the guideline in older youth (grades 9-12). Monitoring these two physical activity objectives necessitates the use of two surveillance systems: National Survey of Children's Health (NSCH) and the national Youth Risk Behavior Survey (YRBS). It is unclear how youth physical activity prevalence estimates compare in these surveillance systems. **PURPOSE:** To describe and compare prevalence estimates of youth meeting the guideline, particularly where ages overlap (14-17 years), in the NSCH and the YRBS. **METHODS:** Youth were classified as meeting the guideline if they exercised, played a sport, or participated in physical activity (adult proxy report, NSCH) or were physically active (self-report, YRBS) for at least 60 minutes/day during the past week (NSCH) or 7 days (YRBS). Data from 2016-2017 NSCH ( $n=50191$ , ages 6-17) and 2015-2017 YRBS ( $n=29483$ , grades 9-12) were analyzed to estimate prevalence of youth meeting the guideline overall and by age, sex, and race/ethnicity. **RESULTS:** Overall, 25.9% of children aged 6-13 (NSCH) and 26.6% of adolescents grades 9-12 (YRBS) met the guideline (Table). Prevalence differed by sex for all age groups. There were differences by race/ethnicity in youth 6-13 years (NSCH) but not in youth 14-17 years (NSCH and YRBS). When comparing youth 14-17 years, there was a 9.6 percentage point difference in prevalence; patterns by sex and race/ethnicity were similar.

Table. Prevalence with Standard Error (SE) of Youth Meeting Aerobic Physical Activity Guideline by Age Group, NSCH 2016-2017 and YRBS 2015-2017

Characteristics	NSCH, % Meeting Guideline (SE)		YRBS, % Meeting Guideline (SE)	
	6-13 years	14-17 years	Grades 9-12 <sup>a</sup>	14-17 years
Total	25.9 (0.6) <sup>b</sup>	17.4 (0.7)	26.6 (0.7)	27.0 (0.7)
Sex <sup>c</sup>				
Male	28.5 (0.8)	22.6 (1.1)	35.7 (0.8)	36.5 (0.9)
Female	23.2 (0.9)	11.9 (0.7)	17.6 (0.6)	17.9 (0.7)
Race/Ethnicity <sup>d</sup>				
White, non-Hispanic	<sup>v</sup> 27.7 (0.6)	16.5 (0.6)	28.1 (1.0)	28.5 (1.0)
Black, non-Hispanic	27.5 (1.8)	20.7 (2.3)	24.3 (1.2)	25.0 (1.5)
Hispanic/Latino	<sup>w</sup> 22.9 (1.7)	17.2 (2.0)	25.2 (0.9)	25.5 (0.9)
Other, non-Hispanic	<sup>w</sup> 22.5 (1.4)	16.9 (1.9)	25.3 (1.1)	25.7 (1.2)

Abbreviations: NSCH, National Survey of Children’s Health; YRBS, Youth Risk Behavior Survey

<sup>a</sup> Mostly aged 14-18 years, but also includes high school students 13 years or younger and over 18 years.

<sup>b</sup> Significant difference ( $p < 0.001$ ) between age groups 6-13 years and 14-17 years.

<sup>c</sup> Significant difference ( $p < 0.001$ ) between males and females overall and for each age group.

<sup>d</sup> Within subgroup, values with different superscript letters (v, w) are significantly different from each other (Bonferroni corrected  $p < 0.05$ ).

**CONCLUSION:** Our findings suggest similar sex and race/ethnicity patterns but different prevalence estimates of youth meeting the guideline in the NSCH and the YRBS, limiting direct comparability of estimates for the *Healthy People 2030* youth objectives. This could be due to methodological differences between the two systems, such as respondent and aerobic physical activity question.

**2192 Board #111 May 28 2:00 PM - 3:30 PM**  
**Higher Education And Income Level May Lead To A Better Chance Of Meeting The Physical Activity Guidelines**

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**PURPOSE:** Studies have shown that individuals that participate in physical activity on a daily basis are less likely to develop chronic illnesses than those who do not. The Physical Activity Guidelines for Americans is an essential resource for health professionals to provide recommendations on how everyone can improve their health through regular physical activity. However, little was known about its effectiveness and the factors behind meeting the physical activity guidelines. Thus, the aim of this study was to explore and determine the population that is more likely to meet the physical activity guidelines and offer practitioners and policymakers more insight.

**METHODS:** The data were derived from the California Behavioral Risk Factor Surveillance Survey (BRFSS). The percentage of adults meeting Aerobic Physical Activity guidelines in California were calculated and weighted to the 2010 California Department of Finance population statistics. Comparison analysis was conducted, and the factors associated with meeting the Physical Activity Guidelines were determined.

**RESULTS:** The results showed that there’s no significant difference in meeting the physical activity guidelines with respect to age, sex and other factors except education and income level. The percentage of the population meeting the physical activity guidelines increased with higher income and education level.

Factor		2013 Percentage (95%CI)	2015 Percentage (95%CI)	2017 Percentage (95%CI)
Education	Less than high school	50.99 (47.15, 54.84)	52.58 (46.95, 58.21)	49.57 (42.70, 56.44)
	High school graduate	64.58 (61.31, 67.85)	64.56 (60.32, 68.80)	63.74 (57.83, 69.65)
	Some college	70.94 (68.25, 73.64)	72.00 (68.49, 75.50)	71.19 (65.24, 77.13)
	College graduate	78.60 (76.47, 80.73)	81.48 (78.72, 84.24)	78.98 (75.33, 82.64)
Income	Less than \$20,000	58.28 (55.32, 61.25)	61.32 (56.93, 65.71)	60.04 (53.23, 66.84)
	\$20,000 to \$34,999	61.95 (58.18, 65.72)	62.79 (57.30, 68.28)	58.83 (51.54, 66.13)
	\$35,000 to \$49,999	66.57 (61.96, 71.19)	70.88 (65.20, 76.56)	59.37 (47.77, 70.97)
	\$50,000 to \$74,999	71.78 (67.81, 75.75)	69.87 (63.71, 76.03)	73.33 (66.58, 80.09)
	\$75,000 to \$99,999	78.16 (74.20, 82.13)	77.44 (72.30, 82.58)	77.92 (70.41, 85.44)
	\$100,000 and above	84.05 (81.36, 86.75)	85.34 (82.32, 88.36)	85.76 (82.33, 89.20)

**CONCLUSION:** More efforts should be put into improving the physical activity level of the population that has less income and lower education levels.

**2193 Board #112 May 28 2:00 PM - 3:30 PM**  
**Device-Assessed Sedentary Time Sex Comparison By Time Of The Day Analysis**

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Sedentary time (ST) has been linked with obesity in children and studies have shown that girls are more sedentary than boys. However, data about ST by specific periods of the day are necessary to determine when girls are more sedentary compared to boys. **PURPOSE:** To determine how US youth ST at different periods of the weekday (before school, during school, afterschool, and evening) and weekend day (morning, afternoon, and evening) differ by sex. **METHODS:** Youth between 6 and 18 years old from NHANES 2003 - 2006 (N = 2,972) were included. Accelerometry restricted dataset was used to determine ST; and to obtain hourly ST (min/hour) we used the Web App for processing NHANES accelerometer data. For the weekday we calculated a mean for the following periods: before school (6:00-7:59 am), during school (8:00 am-2:59 pm), afterschool (3:00-5:59pm), and evening (6:00pm-9:00pm). For the weekend day we calculated a mean for the morning (7:00 - 11:59 am), afternoon (12:00 - 5:59pm), and evening (6:00 - 10:00pm). T-tests were conducted to compare ST during each period for the weekday and weekend day. SAS 9.4 was used to conduct statistical analyses. **RESULTS:** US youth had 885.6 ± 137.1 min/week of ST. T-tests revealed no significant differences in ST before school (Boys: M=47.3±12.8 min/hour; Girls: M=47.0±12.9 min/hour; P = 0.8), afterschool (Boys: M=26.0±8.7 min/hour; Girls: M=28.3±8.6 min/hour; P = 0.7), and evening (Boys: M=28.0±9.0 min/hour; Girls: M=29.6±8.7 min/hour; P = 0.2) during the weekday; neither in the morning (Boys: M=33.6±13.9 min/hour; Girls: M=34.2±13.3 min/hour; P = 0.1), afternoon (Boys: M=26.6±10.0 min/hour; Girls: M=28.6±10.1 min/hour; P = 0.9), and evening (Boys: M=28.7±10.9 min/hour; Girls: M=30.0±10.6 min/hour; P = 0.2) during the weekend. A significant difference in ST was observed during school in which girls (34.4±8.1 min/hour) had more ST compared to boys (31.6±8.8 min/hour); t (2969) = -9.3, p = 0.003). **CONCLUSION:** Findings support the idea that differences in ST by sex in US youth occur during school time and suggest that school interventions may be a potential way to reduce this gap in girls.

THURSDAY, MAY 28, 2020

**2194** Board #113 May 28 2:00 PM - 3:30 PM  
**Social Jetlag And Cardiometabolic Disease Risk In Pre- Adolescents**  
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 (No relevant relationships reported)

**PURPOSE:** Social jetlag (SJL), the inconsistency between an individual's circadian clock and social clock, has been associated with cardiometabolic diseases (CMD) in adults. In pre-adolescents, SJL has been associated with overweight-obesity, but no previous studies have examined associations with CMD risk. The objective of the current study was to determine the associations between sleep duration, sleep disturbances and SJL with CMD risk among preadolescent children. **METHODS:** This cross-sectional study recruited 392 children (50% F) aged 8-10 years from three representative sample sites across New Zealand. Three sleep quality variables were measured: Sleep duration, as reported by caregivers for seven days; sleep disturbances, estimated by the Children's Sleep Habits Questionnaire; and SJL, measured as the absolute difference between midpoints of sleep on weekdays versus weekend days. Eleven CMD risk factors were measured: central and peripheral systolic blood pressure (BP), heart rate, augmentation index, diastolic BP, low density lipoprotein levels, high density lipoprotein levels, total cholesterol, triglycerides, fasting blood glucose, and glycated hemoglobin. Factor analysis identified underlying CMD risk factors. Linear regression models determined the associations between the sleep variables and the CMD risk factors. Models were adjusted for age, sex, and socio-economic status. Effects sizes (ES) were calculated by dividing the beta coefficient ( $\beta$ ) by the standard deviation of  $\beta$ , where  $<0.20$  was considered small,  $>0.20$  to  $<0.50$  moderate, and  $>0.80$  large. **RESULTS:** Complete data was available for 332 children (49% F, mean [SD] age = 9.6 [1.13] years old, WHO-BMI = 0.421 [1.17]). Factor analysis revealed four underlying CMD risk factors: blood pressure, cholesterol, vascular health, and carbohydrate-metabolism. Following adjustment for covariates, there was a small association between SJL and the cholesterol factor ( $P=0.025$ ,  $ES=0.11$ ), and a small association between SJL and the carbohydrate-metabolism factor ( $P=0.027$ ,  $ES=0.10$ ). In fully-adjusted multivariate models, sleep duration nor sleep disturbances associated with any CMD factor. **CONCLUSIONS:** Social jetlag is a modifiable and potentially important contributor to cardiometabolic risk in children.

**2195** Board #114 May 28 2:00 PM - 3:30 PM  
**Relationship Between Body Composition And Motor Skills In 3-5 Year Olds: National Youth Fitness Survey**  
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Factors such as obesity and motor skill development are associated with the health and development of young children and tend to track into adulthood. Early childhood is considered a critical time period for obesity incidence and motor skill development. **PURPOSE:** This study examined the associations between weight status and motor skills in children. **METHODS:** Data from 3-5 years old children (N=342, 51% males) who participated in the 2012 National Youth Fitness Survey were analyzed. Body mass index (BMI), along with age- and sex-adjusted BMI percentiles were calculated. Scores were placed into categories of underweight/healthy weight, overweight, or obese. Skinfold measurements (calf and triceps) were taken and percent body fat (%BF) was calculated using sex-specific equations. Motor skills were determined by the Test of Gross Motor Development-2<sup>nd</sup> Edition. Linear regression analyses were performed to determine the associations among BMI category and Locomotor, Object Control, and overall Gross Motor Quotient (GMQ) controlling for sex, race, and poverty index ratio. Regression analyses were also conducted between %BF and Locomotor, and Object Control Motor Skills and GMQ controlling for sex, race, and poverty index ratio. **RESULTS:** Most children were classified as underweight/healthy weight (69%) and 31% were overweight or obese. Average BF% was (M(SE)=17.02 (0.27)). In regard to GMQ, the mean percentile was 41.43 (1.36). Neither BMI category or BF% was related to Locomotor, Object Control, or GMQ ( $p=0.32-0.71$ , and  $p=0.18-0.63$ , respectively). **CONCLUSIONS:** Given the inconsistent findings in the literature, additional research is needed to elucidate these relationships between body composition and motor skill development. Using different measures of weight status may provide additional insight into associations between weight status and motor skill development in young children.

**2196** Board #115 May 28 2:00 PM - 3:30 PM  
**Abstract Withdrawn**

**2197** Board #116 May 28 2:00 PM - 3:30 PM  
**Abstract Withdrawn**

**2198** Board #117 May 28 2:00 PM - 3:30 PM  
**High Relative Handgrip Strength Is Inversely Associated With The Incidence Of T2DM In Adults**  
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Several studies indicated that handgrip strength, which is a measuring tool for muscle strength, is associated with type 2 diabetes mellitus (T2DM). However, the results have been conflicting and few studies that used data from adults in Korea have been conducted. In addition, an increase in body weight usually precedes the development of DM and research an adjustment of handgrip strength to body weight is needed. **Purpose:** We investigated whether relative handgrip strength (RHS) is associated with development of type 2 DM in a subset of data with Korean Genome and Epidemiology Study. **Method:** We included 76,465 participants (25,870 male) aged between 40 and 79 years who had undergone a handgrip test from 39 community health examination centers located in 14 urban areas in Korea between 2004 and 2013. DM was defined as an fasting blood glucose  $\geq 126$  mg/dl or use of an oral hypoglycemic agent as diagnosed by a physician. The RHS was calculated by dividing maximal handgrip strength by body mass index and further grouped into age- and sex-specific tertiles. **Result:** During an average follow-up 5 years, 1,214 (1.7%) of the 69,725 participants with normoglycemia at baseline had newly developed DM. The hazard ratio and 95% confidence interval (CI) of incident DM in the lowest tertiles of RHS versus the middle and highest were 0.82 (95% CI 0.67 to 0.99) and 0.69 (95% CI 0.55 to 0.86) in male and 0.84 (95% CI 0.70 to 1.00) and 0.56 (95% CI 0.45 to 0.69) in female, respectively, after adjusting for potential confounders, including age, family income and education level, marry status, smoking, alcohol consumption, hypertension, baseline fasting blood glucose, family history of diabetes and physical activity. The participants with sustained high RHS had significant 50% lower risk of DM incidence (male, HR 0.50, 95% CI : 0.35-0.71, female HR 0.49, 95% CI : 0.36-0.67) compared with the those with the remained low RHS during 5 years of follow-up. **Conclusion:** The current finding suggests that RHS predicts incidence of type 2 DM independent of potential confounders in Korea middle-aged and older adults and maintaining of high RHS may be important for prevention of the development of the DM.

**2199** Board #118 May 28 2:00 PM - 3:30 PM  
**Comparing And Explaining Membership Length And Attendance Behaviour Of Women In Female-only And Mixed-gender Gyms**  
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**PURPOSE:** Physical inactivity is a global health concern, further magnified by gender disparity, with women being less active than men. Gyms may be optimal environments to engage in physical activity, however, perceived gendering describe a major barrier for women to become and stay members. Therefore, our aim was to compare attendance behaviour over the first 12 months and membership length (ML) of female gym members in mixed-gender gyms to a female-only gym, to identify factors explaining both behaviours. **METHODS:** Data from one female-only (n=1,881) and eight mixed-gender gyms (n=21,133 women) across England were analysed, including demographics, membership characteristics, and each member's visits at the gym between 2008-2019. Data were analysed via t-tests and mixed-effect regression analyses using SPSS and R, with significance set at  $p=0.05$ . **RESULTS:** Women in female-only gyms showed a higher average ML (19.59 $\pm$ 21.91 v. 14.30 $\pm$ 16.03 months,  $p<0.001$ ) and higher average attendance frequency (4.33 $\pm$ 3.29

v. 2.70±3.15 visits/month,  $p<0.001$ ), compared to women in mixed-gender gyms. In female-only gyms, monthly visits and ML were inversely related ( $r=-0.441$ ,  $p<0.001$ ) and the calendar month in which the membership commenced ( $r=-0.065$ ,  $p<0.001$ ), while a higher age increased attendance ( $r=0.031$ ,  $p<0.001$ ) ( $R^2=0.147$ ). An increase in ML was associated with a higher number of membership freezes ( $r=3.660$ ,  $p<0.001$ ), and higher attendance frequency during the 11<sup>th</sup> ( $r=0.619$ ,  $p<0.001$ ) and 12<sup>th</sup> ( $r=0.598$ ,  $p<0.001$ ) month of membership ( $R^2=0.191$ ). In mixed-gender gyms, attendance also decreased with ML and increased with age ( $r=-0.217$ ,  $p<0.001$  and  $r=0.011$ ,  $p<0.001$ ). A multitude of factors were associated with ML in women in mixed gender gyms, including age ( $r=-0.006$ ,  $p<0.001$ ), attendance frequency during the first month ( $r=-0.062$ ,  $p<0.05$ ), month 11 ( $r=0.241$ ,  $p<0.001$ ) and month 12 ( $r=0.400$ ,  $p<0.001$ ) ( $R^2=0.103$ ). **CONCLUSIONS:** Women in female-only gyms show a higher attendance frequency during the first 12 months and a longer ML than women in mixed-gender gyms. Demographic and membership-related factors only explained a small proportion of the heterogeneity in both outcomes. However, observed  $R^2$ 's were higher in female-only gyms, indicating that other factors have a stronger impact on women in mixed-gender gyms.

**2200** Board #119 May 28 2:00 PM - 3:30 PM  
**Lifestyle Risk Factors Associated With Non-Alcoholic Fatty Liver Disease (NAFLD) Among Mexican-Origin Men**

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**Background:** Mexican-origin men have the highest rates of non-alcoholic fatty liver disease (NAFLD) among men in the U.S. Current evidence regarding the effects of lifestyle behaviors and risk for NAFLD among Mexican-Origin men is scarce. **Purpose:** To assess the influence of lifestyle behaviors risk for NAFLD, in a sample of Mexican-origin men from the Cameron County Hispanic Cohort (CCHC). **Methods:** The CCHC is a randomly selected cohort of community-dwelling Mexican Americans living in the U.S-Mexico border. Participants completed physical assessments and questionnaires on demographics, medical/medication use history, and lifestyle factors. Liver elastography (FibroScan®) was performed for the assessment of liver steatosis based on controlled attenuation parameters (CAP, dB/m) scores. Survey-based linear regression for CAP score or logistic regression analyses for mild steatosis (CAP  $\geq$  260) were conducted to examine the relationships of lifestyle and cardiometabolic factors to NAFLD. **Results:** 207 Mexican-origin men (mean age: 53.5 (SE 2.5) years; mean BMI: 31.4±0.5. kg/m<sup>2</sup>; 43.9 % Spanish monolingual; 44.0 % born in U.S.) were included in the analysis. Mean CAP score was 290.4 (SE 7.3) dB/m and the prevalence of steatosis was 66.9% (SE 4.5%). There was no significant relationship of education, marital and uninsured status, smoking history, healthy/unhealthy eating indices, and physical activity levels to steatosis ( $p$ -values  $>0.05$ ). There were significant associations between cardiometabolic risk factors including log transformed glucose OR= 8.20, 95%CI 1.63-41.25,  $p=0.0108$ ), HbA1c (OR=1.43, 95%CI 1.08-1.90,  $p=0.013$ ), HDL-C (OR=0.96, 95%CI 0.93-0.996,  $p=0.029$ ) and log transformed triglyceride levels (OR=7.21, 95%CI 2.58-20.16  $p<0.001$ ), and steatosis. A one-unit increase in BMI was significantly associated with 36% increase in odds of steatosis (OR=1.36, 95%CI 1.18-1.55,  $p<0.001$ ). Having metabolic syndrome (OR=4.93, 95%CI=1.84-13.19,  $p=0.0016$ ) was significantly associated with steatosis in age- and BMI adjusted models. **Conclusion:** NAFLD was associated with cardiometabolic risk factors among Mexican-origin men in a community-based sample. Efforts to develop health promotion programs to address these risk factors, particularly body weight, are warranted.

**2201** Board #120 May 28 2:00 PM - 3:30 PM  
**The Association Between Hydration And Obesity Is Dependent On How Hydration Status Is Assessed**

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**PURPOSE:** Several studies have reported obesity is associated with hypohydration at the population level. However, these studies typically used simple urine osmolality thresholds to assess hydration, which may be inappropriate given that the amount of body mass a person has impacts urine solute (creatinine, uric acid) levels. To address this issue, our study compared differences in hypohydration prevalence using common urine methods (osmolality, flow rate, their combination) and examined whether obesity was differentially associated with these measures. **METHODS:** Data of 6,999 adults from the 2009-2012 National Health and Nutrition Examination Survey (NHANES) were analyzed. Hypohydration status was categorized using five thresholds; 1) absolute

urine osmolality (850 mOsm/L), 2) age-specific urine osmolality, 3) urine flow rate (850 mL/day), 4) a combination of absolute urine osmolality and flow rate, and 5) a combination of age-specific urine osmolality and flow rate. Logistic regression was used to examine whether body mass index  $\geq 30$  kg/m<sup>2</sup> (vs. less) was associated with the various hypohydration definitions. **RESULTS:** The prevalences of hypohydration were as follows: 21.7% (absolute urine osmolality), 36.8% (age-specific urine osmolality), 37.1% (urine flow rate), 13.0% (absolute urine osmolality and flow rate combined), and 21.1% (age-specific urine osmolality and flow rate combined). Obesity was associated with increased likelihood of hypohydration when using absolute (odds ratio [OR]: 1.63; 95% confidence interval [95CI]: 1.39, 1.92), and age-specific (OR: 1.78; 95CI: 1.48, 2.13) urine osmolality. However, associations were not significant when using urine flow rate (OR: 0.95; 95CI: 0.81, 1.12) or the combination of absolute urine osmolality and flow rate (OR: 1.26; 95CI: 0.98, 1.60). The association was weak, but significant, when using the combination of age-specific urine osmolality and flow rate (OR: 1.29; 95CI: 1.06, 1.58). **CONCLUSIONS:** Common methods used in epidemiological research to assess hydration status result in substantially different prevalences of hypohydration. The association between hypohydration measures and obesity is strongest for urine osmolality measures, though this is perhaps a product of increased urine solutes and not actual differences in hydration.

**2202** Board #121 May 28 2:00 PM - 3:30 PM  
**Abstract Withdrawn**

**2203** Board #122 May 28 2:00 PM - 3:30 PM  
**Predicting Gross Motor Skills In Children: Data From The 2012 NHANES National Youth Fitness Survey**

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 (No relevant relationships reported)

Gross motor skills are a key component of childhood development and are characterized by locomotion (movement of the body through space) and object control (manipulation of objects). Collectively, these constructs provide a representation of overall gross motor skill ability. Various factors may influence gross motor skills, specifically measures of fatness and muscular fitness. **PURPOSE:** Determine if measures of fatness, birth weight, and muscular fitness are significant predictors of gross motor skills in children 3-5 years old. **METHODS:** Data from 177 boys and 178 girls from the 2012 National Health and Nutrition Examination Survey National Youth Fitness Survey were used in the analysis. Waist-to-height (WtHR) ratio, sum of skinfolds, and BMI were calculated and used as measures of fatness, birth weight was obtained from parent report, and a timed plank test was used as a proxy measure of fitness. Locomotor (LOC) and object control (OC) skills were evaluated through the Test for Gross Motor Development-2 (TGMD-2). The sums of the standard scores obtained from LOC and OC were then converted to the gross motor quotient which is used as a representation of overall gross motor skill ability. Multiple linear regression models were used with age, standing height, race/ethnicity, and annual household income (AHI) as co-variables. WtHR, sum of skinfolds, BMI, birth weight, and muscular fitness were used as predictor variables. **RESULTS:** After adjustment for age, race/ethnicity, and AHI, birth weight was a significant predictor of the GMQ in young girls ( $\beta=1.74$ ,  $p=.044$ ). In the fully adjusted model, muscular fitness was a significant predictor of the gross motor quotient in both young girls and boys ( $\beta=450$ ,  $p<.001$ ;  $\beta=375$ ,  $p<.001$ , respectively). **CONCLUSION:** Our results revealed that birth weight was a significant predictor of overall gross motor skill ability in young girls. Additionally, in both young girls and boys, muscular fitness was a significant predictor of overall gross motor skill ability, which further highlights the important role that physical fitness plays on gross motor skills in children. However, the association found between birth weight and gross motor skills is not well known and should be examined further.

**2204** Board #123 May 28 2:00 PM - 3:30 PM  
**A Standardized Model Of Bodyweight Classification For European-american Adults From The 20012006 National Health And Nutrition Examination Survey**

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 (No relevant relationships reported)

**BACKGROUND:** Obesity is a major public health issue in the United States (US) that affects an estimated 78 million US adults each year. Since the 1970's, obesity rates have more than tripled and have been associated with a higher prevalence of developing cardiometabolic and renal disease. However, body mass index (BMI) alone may be an imprecise measurement of body weight classification as it does not account for either visceral or total body fat. Furthermore, the current fitness categories for body composition are not standardized to the World Health Organization's (WHO) general population guidelines and limit their use in clinical practice.

**PURPOSE:** To perform a large-scale population-based cross-sectional analysis from the (2001-2006) National Health Assessment and Nutrition Examination Survey (NHANES). **METHODS:** Our population included 12,667 European-American men and women who self-reported their age and sex, and who had complete anthropometric and body composition data from NHANES. Body composition variables included BMI, waist circumference, and total body fat percentage, measured with dual-energy x-ray absorptiometry (DXA). All study participants provided written informed consent prior to enrollment. Descriptive statistics, frequency distributions and percentiles were computed for the total population, and by age, sex and BMI.

**RESULTS:** Of the included population, 48.8% were men and 51.2% were women. Those with a BMI between 18.0-24.9 kg/m<sup>2</sup> (normal weight) had a total body fat between 19.6-31.8% and a waist circumference between 64.5-88.0 cm (18<sup>th</sup> - 54<sup>th</sup> percentile). Those with a BMI between 25.0-29.9 kg/m<sup>2</sup> (overweight) had a total body fat between 31.9-39.3% and a waist circumference between 88.1-102.3 cm (55<sup>th</sup> and 78<sup>th</sup> percentile). Those with a BMI  $\geq$  30 kg/m<sup>2</sup> (obese) had a total body fat  $\geq$  39.4% and a waist circumference  $\geq$  102.4 cm (79<sup>th</sup> - 99<sup>th</sup> percentile).

**CONCLUSIONS:** We performed a large-scale population-based cross-sectional analysis from NHANES to standardize metrics of waist circumference and body fat percentage to the WHO's general population guidelines for body weight classification. Our findings may provide healthcare practitioners with a more comprehensive assessment of body composition and serve as a supplemental resource to BMI when determining body weight status for Americans.

**2205** Board #124 May 28 2:00 PM - 3:30 PM  
**Longitudinal Changes Of Kindergarten Children's Physical Fitness In Japan Across Three Years**

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**PURPOSE:** The physical fitness of Japanese children has shown a downward trend after its peaking after 1985. Because of implementing various fitness programs, it has been increasing since 2007, but it has not yet recovered to the previous level. Bipolarization in fitness has also been identified as a new issue. Therefore, it is imperative to promote efforts that lead to increased children's health and fitness status. The purpose of this study, therefore, was to examine the longitudinal changes in health-related physical fitness to inform future intervention programs aimed at improving children's fitness. **METHODS:** A total of 273 kindergarten children (boys: 138, girls: 135, Mean age = 4.6) were analyzed. Height and weight, and physical fitness (25m run, standing long jump, ball throw, body support continuation time, both feet consecutive jump time, ball catch) were measured for 3 consecutive years. The longitudinal changes were analyzed by paired t-tests. The statistical significance level was 5%. **RESULTS:** All of children's fitness outcomes improved significantly as they aged for both boys and girls. From 3 years old to 4 years old, boys and girls showed significant improvements in 25m run (-2.6+0.2 vs. -1.1+0.1, t=-5.47, p<0.05, -3.0+0.2 vs. -1.0+0.1, t=-8.36, p<0.05) and standing long jump (26.8+2.1 vs. 20.3+1.5, t=2.15, p<0.05, 26.2+1.8 vs. 17.8+1.3, t=3.17, p<0.05). Girls increased in height (6.9+0.1 vs. 6.3+0.1, t=2.92, p<0.05) and improved both feet consecutive jump time (-2.1+0.3 vs. -1.2+0.2, t=-2.64, p<0.05). From 4 to 5 years old, the boys' ball throw and body support continuation time improved significantly. Yet, there was no differences in the amount of changes in weight and ball catch between boys and girls. **CONCLUSION:** Children's fitness in early childhood was highly correlated with physical development. However, the time of improvement was quite different. Therefore, although it is not necessary to train children based on physical fitness factors, we may consider age and gender differences in physical fitness while planning intervention programs in kindergarten children.

**2206** Board #125 May 28 2:00 PM - 3:30 PM  
**The Influence Of Weather Conditions, Ambient Air Temperature On Sedentary Time In Chinese Adults**

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**PURPOSE:** This study aimed to quantify the association between weather conditions, ambient air temperature and sedentary time in Chinese adults.

**METHODS:** The participants were 3270 Chinese users of a wrist-worn activity tracker. The data of participants' daily activities were collected from July to October 2015 in 33 out of 34 provinces, autonomous regions and municipalities in China. The inclusion standards for data analysis were set as: 1) aged 18 or above; 2) without disability and critical diseases; 3) wear time  $\geq$  18 h per day and  $\geq$  4 consecutive days; 4) Global Positioning System (GPS) data are available; 5) meteorological data are available. Two-level linear regression analyses were conducted to investigate the association between weather condition, ambient air temperature and sedentary time.

**RESULTS:** The results of two-level linear regression analyses showed that weather conditions had a significant but weak influence on sedentary time in Chinese adults after adjusting for some covariates. If the weather condition changes from rainy days to sunny days and cloudy days, sedentary time may decrease by about 6.89 minutes (95%CI: 11.45-2.34) and 5.60 minutes (95%CI: 9.33-1.86) respectively. The sedentary time would decrease by 6.12 minutes (95%CI: 9.33-1.86) if air temperature changed from  $\geq$  25°C to < 22.1-24.9°C. However, the influence was not significant if gender, air quality and weather condition was adjusted.

**CONCLUSIONS:** In conclusion, weather conditions have significantly but weakly influence on sedentary time in Chinese adults. Compared with the rainy days, the daily sedentary time was shorter in sunny and cloudy days. When other environmental and individual factors were adjusted, no significant association between ambient air temperature and sedentary time was found.

**2207** Board #126 May 28 2:00 PM - 3:30 PM  
**Prevalence And Risk Factors For Premenstrual Syndrome In Korean Female National Athletes**

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Premenstrual syndrome is common in female athletes, and related symptoms, such as anxiety, anxiety, breast tenderness, and bloating, can negatively affect performance. However, there are very few studies on premenstrual syndrome in female athletes worldwide. A survey of PMS is needed to provide proper medical support and to improve performance. **Purpose :** The purpose of this study was to investigate the prevalence of premenstrual syndrome and related risk factors in elite female athletes. **Methods :** A survey about premenstrual syndrome was conducted among female athletes training at national training centers. Premenstrual syndrome was diagnosed using the Premenstrual Symptom Screening Tool (PSST). Mann-Whitney test was performed to determine differences in age, training time, and body mass index (BMI) according to premenstrual syndrome. The chi-square test was performed to investigate differences in alcohol and coffee intake, diet for weight loss, stress fracture, and menstrual regularity according to premenstrual syndrome. **Results :** The average age of 124 female athletes across 17 sports was 24.36 ( $\pm$  4.68) years, and the mean BMI was 22.19 ( $\pm$  3.81). Of the 124 patients, 17 met criteria for moderate to severe PMS, and one met the criteria for premenstrual discomfort. Athletes diagnosed with moderate to severe PMS complained of fatigue (100%), irritability (78%), difficulty concentrating (78%), joint and muscle pain (56%), bloating (56%), and weight gain (56%). Age, type of sport, BMI, training time per week, menarche age, and coffee and alcohol consumption were not significantly related to the prevalence of premenstrual syndrome. Overall, 76.6% of the female athletes felt that premenstrual symptoms interfered with their performance; however, only five out of the 18 athletes with moderate to severe PMS visited their doctors to discuss it. **Conclusions :** This cross-sectional study of the prevalence of and risk factors for premenstrual syndrome in Korean female athletes found that 18 (14.55%) of 124 athletes had moderate to severe PMS, and no risk factors for developing premenstrual syndrome were discovered.

**2208** Board #127 May 28 2:00 PM - 3:30 PM  
**Levels And Patterns Of Physical Activity And Sedentary Time Among Low Income Brazilian Preschoolers**

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Knowledge of physical activity in preschool populations is important for public health promotion. However, little is known about physical activity and sedentary patterns in low-income children, suggesting an urgent need for data covering this population. Purpose: to describe physical activity levels and sedentary time of low-income preschool children during preschool time; to describe physical activity patterns of actives during preschool time at public preschools in João Pessoa/Brazil. Method: a representative sample of 237 preschool was randomly selected and 204 provided valid accelerometer measurements (boys: 4.5 $\pm$ 0.8years, girls: 4.5 $\pm$ 0.7years). Measured levels of physical activity and sedentary time, and physical activity patterns were observed during preschool time (7am to 5pm) (Actigraph, WGT3-X). Data were presented in quartiles of total physical activity by sex and age. Univariate General Linear Model with Bonferroni's post-hoc was used to analyze differences between the quartiles. Data were performed using SPSS (version 25, Inc., Chicago, USA), level of significance: 95%. Results: physical activity at preschool range from 68 to 114% of total physical activity daily's recommendation and from 28 to 83% of moderate

to vigorous physical activity recommendation. For the two most active quartiles, the daily total physical activity recommendation was achieved during preschool time. Physical activity patterns were similar between the least and the highest actives, and all the evaluated children were more active outdoors than indoors. For the least actives, preschool time correspond 30% of daily moderate to vigorous physical activity recommendation. Physical activity patterns are quite similar between the least and the highest actives. Conclusion: this information is important for tailoring interventions.

**2209** Board #128 May 28 2:00 PM - 3:30 PM  
Abstract Withdrawn

## D-65 Free Communication/Poster - Carbohydrate Metabolism

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
Room: CC-Exhibit Hall

**2210** Board #129 May 28 3:00 PM - 4:30 PM  
**The Effects Of High Molecular Weight Carbohydrate Supplementation On Skeletal Muscle Performance**

T. Brock Symons<sup>1</sup>, Franklin Muntis<sup>2</sup>, Tom Collins<sup>2</sup>, Keith Gworek<sup>2</sup>, Kathleen A. Carter, FACSM<sup>3</sup>, John F. Caruso<sup>2</sup>. <sup>1</sup>Texas A&M University - San Antonio, San Antonio, TX. <sup>2</sup>University of Louisville, Louisville, KY. <sup>3</sup>Central State University, Wilberforce, OH.

(No relevant relationships reported)

Athletes continue to seek new and improved strategies to preserve skeletal muscle strength and attenuate effects of skeletal muscle fatigue during resistance training. The ingestion of carbohydrates prior-to and during resistance training was hypothesized to improve both skeletal muscle performance and attenuate fatigue. VitargoS2™ is a high molecular weight carbohydrate supplement that promotes enhanced performance with its consumption prior-to and during physical activity. **PURPOSE:** To examine the influence of high molecular weight carbohydrate (HMC) consumption on skeletal muscle performance and fatigue following exhaustive lower-limb resistance training exercise. **METHODS:** Five-female and seven-male (n = 12) healthy college-aged individuals participated (26.1 ± 3.8 yrs) in a double-blinded crossover trial. Participants took part in three sessions across the study period: familiarization, Test Day 1 and Test Day 2. Participants were randomly assigned to one of two conditions [control (CON) or high molecular weight carbohydrate supplement (HMC)] for each of the two testing sessions. Lower-limb isometric and isokinetic concentric strength was assessed prior-to and immediately following a resistance-training session on two occasions. Outcome measures included lower-limb isometric and isokinetic concentric peak torque, blood glucose concentration, and rate of perceived exertion (RPE). **RESULTS:** The HMC condition elicited a significant increase in blood glucose concentration from Pre-Workout to Post-Workout (Pre-Workout: 92.1 ± 14.4 mg/dl and Post-Workout: 118.3 ± 15.2 mg/dl) compared to the control condition (Pre-Workout: 95.6 ± 15.6 mg/dl and Post-Workout: 108.1 ± 14.5 mg/dl). Isometric strength was reduced by 25.4 Nm (HMC) and 35.0 Nm (CON) following the lower-limb resistance training session; however, no ergogenic effect was found (p > 0.05). Isokinetic concentric strength did not differ (p > 0.05) following the HMC supplementation compared to the CON condition. No difference was found in RPE between the HMC and CON condition (p > 0.05). **CONCLUSIONS:** The consumption of HMC supplementation prior to and during resistance-training exercise did not improve skeletal muscle performance and attenuated skeletal muscle fatigue following a lower-limb resistance-training exercise session.

**2211** Board #130 May 28 3:00 PM - 4:30 PM  
**Effect Of Pre-Sleep Low Glycemic Modified Starch On Morning Metabolism And Endurance Running Performance**

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(No relevant relationships reported)

Consumption of carbohydrates (CHO) likely influences athletic performance, and further evidence suggests that pre-sleep nutrition may positively affect subsequent morning physiologic responses and exercise performance. **PURPOSE:** To determine the effects of pre-sleep ingestion of a novel low glycemic index (LGI) CHO supplement on next morning endurance running performance, substrate utilization,

and gastrointestinal distress (GID). **METHODS:** Using a double-blind, randomized, crossover design, 14 endurance athletes (age, 28 ± 9 yrs; peak oxygen consumption (VO<sub>2peak</sub>), 55 ± 7 ml/kg/min) consumed either a high GI (HGI), LGI, or placebo (PLA) beverage ~30 min prior to sleep and 7-9hrs before a morning exercise trial. Resting energy expenditure (REE), gas exchange derived substrate utilization (%FAT, %CHO), blood glucose (BG), heart rate (HR), satiety (SAT), and GID were assessed at baseline. After a warmup, an incremental exercise trial (IET) was performed at 55, 65, and 75% VO<sub>2peak</sub>, while HR, GID, rating of perceived exertion (RPE), and substrate utilization were obtained. After a 3-min recovery, participants completed a 5km treadmill time trial (TT), during which HR, RPE, and GID were recorded. HR, RPE, GID, satiety, and BG were assessed immediately post TT, and BG was recorded again 10min post TT. **RESULTS:** No differences were found in baseline REE, BG, GID, HR, or SAT (all, p > 0.05). At rest, there was an interaction of supplement and sex for substrate utilization (CHO and FAT, p < 0.05). During IET, LGI tended to utilize less FAT (HGI, 40 ± 12, PLA, 44 ± 11, LGI, 38 ± 11%FAT, p = 0.06) and more CHO (HGI, 60 ± 12, PLA, 56 ± 11, LGI, 63 ± 12%CHO, p = 0.08). There was no effect of condition on GID at any point (p > 0.05). There was no effect of condition on 5km TT (PLA, 21.6 ± 9.6; HGI, 23.0 ± 7.8; LGI, 24.1 ± 4.5 min, p > 0.05). **CONCLUSIONS:** The current study demonstrates that pre-sleep CHO supplementation did not affect resting substrate utilization, BG, GID, or 5km TT performance, though effects on substrate utilization might be sex specific. The trend towards higher CHO utilization after pre-sleep LGI CHO consumption might suggest that pre-sleep LGI CHO supplementation increases morning CHO availability, though more research is needed.

**2212** Board #131 May 28 3:00 PM - 4:30 PM  
**Carbohydrate Before Resistance Exercise Doesn't Alter Performance, Blood Glucose, Or Muscle Glycogen Despite Hormonal Changes**

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(No relevant relationships reported)

**Purpose:** The purpose of this study was to investigate changes in resistance exercise performance, serum insulin, epinephrine, glucose, and muscle glycogen from carbohydrate supplementation. **Methods:** Participants completed four sets to failure at 70% of 1-RM with 45s rest on angled leg press with or without pre-exercise carbohydrate (2g/kg) after a 3hr fast. Serum glucose, epinephrine, and insulin were assessed at baseline, 30 min post-ingestion, immediately after, and 1hr post-exercise with or without carbohydrate supplementation. Muscle glycogen was measured at baseline, immediately after exercise, and 1hr post exercise. **Results:** There was no main effect of supplement on resistance exercise performance (F = 2.169, p = .18). There was a main effect for set on repetitions showing a decrease over sets completed (F = 26.18, p < .001) There was no interaction between supplement and set on reps to fatigue (F = .337, p = .79). There was a time effect showing glycogen decreased immediately post-exercise for both groups and remained lower than baseline after 1hr (F = 14.305, p < .001). No main effect of supplement on glycogen concentration was found (F = 2.847, p = .13). No supplement time interaction was found on glycogen (F = 1.191, p = .33). There was an interaction showing pre-exercise carbohydrate supplementation led serum glucose to be utilized more during exercise (F = 3.791, p = .026). No main effect for supplementation on blood glucose was found (F = .072, p = .79). Pairwise comparisons indicated no time effect on serum glucose (p > .05). An interaction occurred showing insulin decreased during exercise in the carbohydrate condition (F = 47.14, p = .003). Also, there was a main effect of insulin being elevated with carbohydrate consumption (F = 7.72, p = .027). Pairwise comparisons indicated there was no time effect on insulin concentration (p > .05). There was a main effect of carbohydrate supplement decreasing epinephrine (F = 7.924, p = .023). No time effect was found on epinephrine concentration (F = 1.475, p = .258). No interaction effect was found on epinephrine (F = 1.94, p = .181). **Conclusions:** Carbohydrate supplementation before resistance exercise does not improve leg press performance to fatigue or glycogen recovery during 1hr rest despite increased glucose availability.

**2213** Board #132 May 28 3:00 PM - 4:30 PM  
**Effect Of Different Glycemic Index Beverage On Substrate Oxidation During Moderate Intensity Exercise.**

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(No relevant relationships reported)

**PURPOSE:** To investigate the effect of low or high glycemic index (GI) beverage on substrate utilization during moderate intensity exercise.

**METHODS:** This research design utilized a randomized and counterbalanced crossover approach with ten male participants (Age: 24.6 ± 0.8 yr; BMI: 22.8 ± 1.3 kg/m<sup>2</sup>;

) engaged in three times (separated by 1 week) of 1-hour ergometer cycling (Monark 839E, Sweden) at 60%  $\dot{V}O_{2max}$  intensity while ingesting two types of beverages with different GI values (LGI=47, HGI=90), and water only. Carbohydrate intake was set at 0.2g/kg every 15 minutes, and blood samples were collected pre-exercise and 0h-, 1h-, 2h-post-exercise for glucose, insulin, free fatty acid (FFA) and triglyceride analyzing. Substrate utilization was measured using metabolic cart (Cortex MetaLyzerII-R2, Germany) at 5min, 30min, 50min during exercise.

**RESULTS:** There was no significant difference of carbohydrate oxidation rate between LGI and HGI beverage treatment ( $p=0.36$ ). Fat oxidation rate was significantly higher in LGI ( $0.22\pm 0.08$ g/min) compared to HGI treatment ( $0.18\pm 0.07$ g/min) and water ( $0.16\pm 0.06$ g/min) at 30 minutes during exercise ( $P<0.05$ ). Blood glucose concentration was higher in HGI ( $5.64\pm 0.72$ mmol/L) and LGI ( $5.35\pm 1.06$ mmol/L) compared with water treatment ( $4.82\pm 0.76$ mmol/L) 0h-post-exercise ( $P<0.05$ ). Plasma insulin concentration in HGI treatment increased significantly 1h-post-exercise ( $15.11\pm 5.94\mu\text{U/mL}$ ) compared with LGI ( $9.64\pm 2.10\mu\text{U/mL}$ ) and water ( $3.53\pm 1.22\mu\text{U/mL}$ ) ( $P<0.05$ ). Plasma triglyceride ( $0.97\pm 0.30$ mmol/L) and FFA ( $0.48\pm 0.18$ mmol/L) concentration were lower in LGI treatment compared to water treatment 0h-post-exercise ( $P<0.05$ ), but not in HGI treatment ( $P>0.05$ ).

**CONCLUSIONS:** Compared with HGI beverage before and during exercise supplementation, LGI beverage consumption may elevated fat substrate utilization during moderate intensity exercise.

**2214** Board #133 May 28 3:00 PM - 4:30 PM  
**Effects Of Carbohydrate-Electrolyte Solution Supplementation On Fluid Retention And Aerobic Capacity After Exhaustive Exercise**

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 (No relevant relationships reported)

Rehydration, or restoration of fluid spaces, is important when exhaustive endurance exercise (EEE) has compromised hydration status. Previous studies only investigated the effects of carbohydrate-electrolyte solution (CE) supplementation to facilitate replacement after exercise induced dehydration. CE supplementation for 1 hour before and 1 hour after EEE may play an important role in fluid retention and enhancing aerobic capacity.

**PURPOSE:** To examine the effects of CE supplementation on fluid retention and aerobic capacity after EEE.

**METHODS:** In a double-blind, crossover and counterbalanced designed study, nineteen health male participants were asked to intake ORS-SH<sup>®</sup>, an oral rehydration solution, (150 mL four times within an hour) or placebo (water) for 1 hour before and 1 hour after EEE. All participants completed graded exercise test to exhaustion on treadmill for determination of maximal oxygen consumption ( $\dot{V}O_{2max}$ ) before supplementation, and then completed the exhaustive endurance exercise test at the intensity of 70%  $\dot{V}O_{2max}$  for 60 min. Then, the exercise intensity increased at 90%  $\dot{V}O_{2max}$  until exhaustion after supplementation. The average heart rate, maximal heart rate, running time to exhaustion and peak oxygen uptake were recorded during the exercise period. The body weight was recorded 15-min, 30-min, 45-min and 60-min of after EEE to calculate the dehydration rate and beverage hydration index (BHI).

**RESULTS:** The dehydration rates in participants with ORS-SH<sup>®</sup> treatment at 15-min, 30-min and 45-min of after EEE were significantly lower than with placebo treatment ( $-1.77\pm 0.50\%$  vs.  $-2.06\pm 0.66\%$ ;  $-1.69\pm 0.54\%$  vs.  $-1.95\pm 0.66\%$ ;  $-1.48\pm 0.51\%$  vs.  $-1.76\pm 0.65\%$ , respectively,  $p < .05$ ). In addition, the BHI in participants with ORS-SH<sup>®</sup> treatment at 15-min, 30-min and 45-min of after EEE ( $1.19\pm 0.36$ ,  $1.22\pm 0.43$  and  $1.27\pm 0.54$ ) were significantly higher than with placebo treatment ( $p < .05$ ). However, there were no significant differences in other variables between treatments.

**CONCLUSIONS:** ORS-SH<sup>®</sup> supplementation can effectively enhance fluid retention after EEE. However, ORS-SH<sup>®</sup> supplementation had no benefits on aerobic capacity. Supported by Panion & BF Biotech Inc. (Grant No: A-107-077)

**2215** Board #134 May 28 3:00 PM - 4:30 PM  
**Effects Of Repeated Carbohydrate Rinse On Lacrosse Performance**

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 (No relevant relationships reported)

While carbohydrate rinse has been demonstrated to be an effective strategy for improving endurance performance, the effects of rinse on anaerobic performance, particularly within team sport athletes, are equivocal. Additionally, it is not yet known whether repeated carbohydrate rinses in the context of a high intensity training session may provide additional benefit. **PURPOSE:** The purpose of this investigation was to determine the effect of repeated carbohydrate rinse during a typical lacrosse

team practice on lacrosse performance. **METHODS:** A randomized, double-blind, placebo-controlled design was used to determine the effects of carbohydrate rinse on 11 male, division I lacrosse players. Shot velocity and accuracy, 40-yard dash time, and concentration (measured via Trail Making Test) were assessed prior to a typical practice, and the test battery was completed again following practice on two subsequent days of similar intensity/duration. During both practice sessions, the athletes completed 4 rinses (carbohydrate- CHO or placebo-PLA), equally spaced throughout the session, and practice intensity was measured using RPE and HR. Changes from pre-post were calculated for each test and paired t-tests were used to determine differences between groups. **RESULTS:** Shot velocity and accuracy were significantly reduced following practice, however the reduction in shot accuracy was blunted in the CHO v. PLA ( $9.01\%\pm 14.4$  v.  $19.49\%\pm 21.7$ ,  $p = 0.01$ ). 40-yard dash was not significantly reduced by the training session, and no differences were detected between groups (CHO:  $5.057\pm 0.25$  sec v PLA  $5.051\pm 0.27$  sec). RPE was significantly lower for CHO ( $9.90\pm 3.41$  v.  $12.72\pm 2.76$ ,  $p=0.04$ ) at timepoint 2, but not at any other time. Changes in TMT following practice were not significantly different between groups. **CONCLUSION:** When used during a typical lacrosse practice, repeated carbohydrate rinse may reduce the effects of fatigue on shot accuracy and perceived exertion, however it does not appear to effect other performance measures.

**2216** Board #135 May 28 3:00 PM - 4:30 PM  
**Glucose Mouth Rinse And Mouth Spray Enhance Prolonged Exercise Performance In Healthy Male College Students**

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 (No relevant relationships reported)

**PURPOSE:** Research supports the ergogenic effects of glucose mouth rinse (GMR) during prolonged performance, however, the effects of glucose mouth spray (GMS) is limited. The aim of this study was to investigate the effects of GMR and GMS on prolonged exercise. **METHODS:** Nine male college students (age,  $22.2\pm 1.1$  years; height,  $172.0\pm 4.7$  cm; body weight,  $66.4\pm 6.1$  kg;  $\dot{V}O_{2peak}$ ,  $3014.9\pm 251.6$  ml/min) performed constant load exercise using an electromagnetic brake-type bicycle ergometer (PowerMax VIII; Combi Wellness, Japan). The participants performed constant load exercise for 60 min (intensity 40%  $\dot{V}O_{2max}$ ) and then, four sets of the Wingate test (three 30-s Wingate tests with 4 min recovery period between each test) while they were performing constant load exercise for 30 min (intensity 40%  $\dot{V}O_{2max}$ ). Each trial lasts for 4.8 hrs. All participants completed a total of four experimental trials: (1) ingesting glucose (G) solution (500 ml) at the beginning, (2) 15 GMR, (3) 15 GMS - 5 times rinse or spray during each 30 min constant load, and (4) water (control) ad libitum during the entire trial. The exercise max power value, blood glucose levels, and rating of perceived exertion, were measured. Repeated two-way analysis of variance (ANOVA) was used for comparison of the data among G, GMR, GMS and water. **RESULTS:** The % value of the average max power at the 3rd and 4th sets for each trial (G, GMR, and GMS) were significantly higher compared to the control (water): 3rd set;  $95.0\pm 1.5\%$ ,  $96.9\pm 1.5\%$ ,  $96.5\pm 1.4\%$ , and  $90.2\pm 1.5\%$  (control),  $p < 0.01$ , respectively, and 4th set;  $89.8\pm 1.5\%$ ,  $92.8\pm 1.5\%$ ,  $92.9\pm 1.5\%$ , and  $85.1\pm 1.5\%$  (control),  $p < 0.01$ , respectively. Blood glucose level at the 3rd and 4th sets of G, GMR, GMS were significantly higher compared to the control: 3rd set;  $80.7\pm 4.5$ mg/dl,  $81.4\pm 2.5$  mg/dl, and  $78.3\pm 2.9$  mg/dl,  $71.3\pm 3.7$  mg/dl (control),  $p < 0.05$ , respectively, and 4th set;  $81.8\pm 5.9$ mg/dl,  $81.4\pm 2.5$ mg/dl,  $78.3\pm 2.9$ mg/dl, and  $71.0\pm 2.8$  mg/d (control),  $p < 0.01$ , respectively. During the 3rd and 4th sets, all G, GMR and GMS showed significantly lower rating of perceived exertion compared to water (control),  $p < 0.05$ . **CONCLUSION:** GMR and GMS resulted in improved endurance performance. The role of G receptors in the mouth during prolonged exercise warrants further investigation.

2217 Board #136 May 28 3:00 PM - 4:30 PM  
**A 16% Carbohydrate-hydrogel Beverage Reduces Gastrointestinal Permeability And Enterocyte Damage After Cycling In Hot-humid Conditions**

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(No relevant relationships reported)

**Background.** Carbohydrate ingestion during exertional heat stress can reduce enterocyte damage and preserve gastrointestinal permeability. Athletes have begun to use drinks which encapsulate carbohydrate within a pectin-alginate hydrogel, yet little evidence exists to support their preferential use versus traditional carbohydrate-gels and/or beverages with multiple transportable carbohydrates. **Purpose.** To compare the effects of consuming a 16% carbohydrate-hydrogel drink to a nutrient matched maltodextrin-fructose (MF) drink on enterocyte damage and gastrointestinal permeability after cycling in hot and humid conditions. **Methods.** Fourteen endurance trained cyclists (7 men, age 27 ± 8 yr, 176 ± 10 cm, 74 ± 11 kg,  $\dot{V}O_{2max}$ : 55.2 ± 9.5 ml·kg<sup>-1</sup>·min<sup>-1</sup>) cycled (45%  $\dot{V}O_{2max}$ ) for 90 minutes before completing a 15-minute time trial in hot humid conditions (32°C, 70%) on 3 occasions separated by 7 days. During trials participants consumed either water (W), a traditional MF drink, or an encapsulated carbohydrate hydrogel drink (HYDRO) in a randomised order. Each CHO drink provided 90 g CHO·hr (16% w/v). Twenty minutes into exercise a 50 mL drink containing lactulose (L; 5 g) and rhamnose (R; 2 g) was provided and intestinal permeability determined by the percent ratio of lactulose to rhamnose recovered in post exercise urine samples. Venous blood samples were obtained before and 5 minutes after the time trial for assessment of intestinal fatty acid binding protein (IFABP), and data analysed using mixed linear models with fixed effects for condition (W/MF/HYDRO) and time (before and after exercise). **Results.** L:R was greatest in W, and lower in both HYDRO [by 0.019 (95% CI: 0.010 to 0.027), p = 0.0003], and GF [by 0.014 (95% CI: 0.006 to 0.022), p = 0.0018]. No differences in L:R were found between the H and GF conditions (p = 0.083). Post-exercise IFABP concentrations were greater in W compared to HYDRO [by 349 pg·mL<sup>-1</sup> (95% CI: 137 to 561 pg·mL<sup>-1</sup>), p = 0.007] and GF [by 427 pg·mL<sup>-1</sup> (95% CI: 152 to 701 pg·mL<sup>-1</sup>), p = 0.018]. There was no difference in post exercise IFABP concentrations between H and GF (p = 0.90). **Conclusion.** Both CHO drinks preserved intestinal permeability and reduced the appearance of circulating IFABP compared to W. HYDRO offered no additional benefit beyond those achieved with a traditional MF drink.

2218 Board #137 May 28 3:00 PM - 4:30 PM  
**Effects Of Weight Regain In Obese Individuals With Nafld Following A Low Carbohydrate Diet**

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(No relevant relationships reported)

**PURPOSE:** We determined the effects of weight regain in individuals with NAFLD following a low carbohydrate diet (LC). **METHODS:** Twelve obese subjects (body-mass index, 36.5 ± 1.0 kg/m<sup>2</sup>) with NAFLD (10.3 ± 2.8%) followed a LC (<60g/d) energy-deficit diet (1,200kcal/day) for 12 weeks. Participants were followed-up at 9 months after the end of the weight loss (WL) phase. DXA, Magnetic resonance spectroscopy, muscle biopsies, and a euglycemic-hyperinsulinemic clamp were used to determine body composition, intrahepatic triglyceride content (IHTG), and insulin action before, after ~12 weeks of caloric restriction using a LC diet, and 9 months follow-up (post weight loss). **RESULTS:** Participants lost a significant (p<0.05) amount of body weight from baseline (101.9 ± 4.0kg) to 12 weeks WL (93.4 ± 4.0kg) but regained most of the body weight body at 9 months follow-up (97.5 ± 5.5kg, p>0.05 compared to baseline). IHTG significantly (p<0.05) decreased from baseline (12.4 ± 2.9%) to 12-weeks WL (8.9 ± 7.3%) but returned to baseline values at 9 months follow-up (11.5 ± 8.9%, p>0.05 compared to baseline). Basal glucose rate of appearance significantly decreased from baseline (14.2 ± 0.4 μmol/kgFFM/min, p<0.001) to WL (11.7 ± 0.3 μmol/kgFFM/min) but returned to baseline values at 9 months follow up (13.2 ± 1.5 μmol/kgFFM/min, p>0.05 compared to baseline). Homeostasis model assessment (HOMA-IR) significantly (p<0.01) decreased from baseline (4.9 ± 0.7) to WL (2.7 ± 0.5) but returned to baseline values at 9 months follow up (4.6 ± 1.6, p>0.05 compared to baseline). **CONCLUSIONS:** Weight regain results in the metabolic profile of obese individuals with NAFLD to return to pre-weight loss levels; emphasizing the need for effective approaches to prevent weight regain following clinically significant weight loss.

2219 Board #138 May 28 3:00 PM - 4:30 PM  
**Effects Of Low-carbohydrate And Caloric Restriction Diets On Mental Status And Physical Performance**

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Low-carbohydrate diets (LCD) for weight reduction and the management of the metabolic syndrome are increasingly popular, but there is a paucity of research about the negative effects of LCD on mental status and physical fitness. **PURPOSE:** We examined the effects of LCD vs. caloric restriction on mental status and physical performance in untrained subjects with overweight and/or glucose intolerance. **METHODS:** We recruited 24 sedentary young subjects (20 ± 2 yrs) and randomly assigned them to an LCD group (carbohydrate intake <40 g) and a caloric restriction (CR) diet group (ideal weight × kcal). We measured the subjects' body composition, blood metabolic parameters (fasting glucose, insulin, lipids, uric acid, liver enzymes, ketone bodies, C-reactive protein, adiponectin, growth hormone, testosterone and dehydroepiandrosterone), mental status (State-Trait Anxiety Inventory [STAI] and brain-derived neurotrophic factor) and various physical performance aspects (leg extension, handgrip dynamometry, sit-up, and bicycle ergometer) before and after 1 month of the diets. **RESULTS:** The ketone bodies value rose remarkably in the LCD group from before the diet to 1 month on the diet (64.9 ± 33.0 vs. 962.1 ± 1047.0 μmol/L, p=0.017) but was unchanged in the CR group (64.8 ± 10.2 vs. 239.0 ± 336.9 μmol/L, p=0.107). The body mass index decreased significantly in both the LCD (24.9 ± 3.5 vs. 23.5 ± 3.5 kg/m<sup>2</sup>, p<0.001) and CR (24.7 ± 3.8 vs. 24.1 ± 3.8 kg/m<sup>2</sup>, p=0.026) groups. Waist circumference significantly decreased in the LCD group (84.9 ± 3.5 vs. 81.1 ± 10.2 cm, p=0.001) but did not change significantly in the CR group (83.8 ± 12.0 vs. 82.6 ± 11.8 cm, p=0.145). The physical performance aspects were similarly maintained in both groups. Other blood parameters and the mental status did not change significantly in either group. **CONCLUSIONS:** Our results demonstrated that an LCD for a relatively short term can decrease obesity measures more effectively than caloric restriction, without negative effects on mental status or physical performance.

2220 Board #139 May 28 3:00 PM - 4:30 PM  
**Short-term Caloric Restriction With Low Carbohydrate Intake Augmented Baseline Hepcidin Level In Young Females**

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(No relevant relationships reported)

Hepcidin is a liver-derived hormone to attenuate iron metabolism. Recent studies suggest that negative energy balance promotes hepcidin elevation. **PURPOSE:** The purpose of the present study was to examine the effect of caloric restriction (CR) with low carbohydrate intake on hepcidin responses. **METHODS:** Twenty-two young females (age: 21.2 ± 0.2 yrs, body weight: 54.6 ± 1.3 kg) were divided into two different groups, either CR with low carbohydrate intake group (LCHO; 22%PRO, 39%FAT, 39%CHO, 1123kcal) or CR with neutral carbohydrate intake group (NCHO; 18%PRO, 19%FAT, 63%CHO, 1162kcal). During three consecutive days of CR program, subjects consumed only the prescribed diet and maintained their usual physical activity levels. Before and after intervention, body composition, basal hepcidin levels or iron status were evaluated following the overnight fast. Six subjects (LCHO: n = 3, NCHO: n = 3) were excluded from data analysis due to severe iron deficiency (serum ferritin < 10 ng/mL) or infection. **RESULTS:** After intervention, body weight and fat mass were significantly decreased (P < 0.05), with no significant difference between groups. Following the intervention, blood glucose level significantly decreased in LCHO group (P < 0.05). Serum iron and ferritin levels were significantly elevated following the intervention (P < 0.05). Moreover, the magnitude of increased serum iron level tended to be higher in LCHO group than in NCHO group (P = 0.06). In contrast, total iron-binding capacity (TIBC) did not differ following the intervention in either group. Also, plasma IL-6 level did not change following the intervention (LCHO: before 0.84 ± 0.14 pg/mL, after 0.66 ± 0.06 pg/mL, NCHO: before 1.09 ± 0.23 pg/mL, after 0.93 ± 0.19 pg/mL). Serum hepcidin level significantly increased after the intervention in both groups (LCHO: before 13.11 ± 4.16 ng/mL, after 29.9 ± 4.76 ng/mL, NCHO: before 13.03 ± 3.10 ng/mL, after 19.94 ± 4.41 ng/mL, P < 0.05). In addition, the relative change in hepcidin level was significantly higher in LCHO group (264.3 ± 87.2%) than in NCHO (68.9 ± 22.1%, P < 0.05). **CONCLUSIONS:** Three consecutive days of CR with low carbohydrate intake augmented basal hepcidin level compared with CR with neutral carbohydrate intake. Supported by Urakami Foundation for Food and Food Culture Promotion

**2221** Board #140 May 28 3:00 PM - 4:30 PM  
**Long Term Habituation To Carbohydrate-Restricted Diet Preserved Performance And Central Drive After 2 Hours Of Running: A Case Study**

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**PURPOSE:** While the brain is usually wholly dependent on glucose for fuel, prolonged carbohydrate deprivation results in adaptations that allow the brain to access fat via ketone bodies. Given the depletion of carbohydrate that takes place during prolonged exercise, a shift toward ketone bodies may maintain central nervous system function, preventing the central fatigue observed during long-duration exercise. In addition, enhancing peripheral muscle's use of free fatty acids and intra-muscular lipids might prolong contractions. Thus, high fat/low carb diets have been proposed to delay fatigue during endurance exercise. However, studies utilizing periods of 1 to 5 weeks of adaptation to high fat diets have shown equivocal changes in performance at moderate or high intensities. We compare endurance and time trial performance of a keto-adapted male runner (KETO) to 8 subjects (NORM) on whom we have previously reported.

**METHODS:** We measured peripheral and central fatigue in 8 men runners (38±2 yrs; VO<sub>2peak</sub> 59±3 ml/kg/min) who habitually ate a carbohydrate-liberal diet (NORM) and in a runner (41 yrs, 70 ml/kg/min) who followed a high fat/low carb diet for >2 years. Water was provided at 1% of body mass/hr, during a 2-hr run at ventilatory threshold (~65% VO<sub>2peak</sub>), followed by a self-paced 2-km time trial (TT). RPE and respiratory measures were determined every 20 minutes. Strength was tested in a semi-reclined position [75° hip flexion, to facilitate femoral nerve stimulation] pre-exercise, after the 2-hr run and post-time trial as follows: voluntary isometric quad strength was measured on the Biodex with the knee flexed 60°, and with superimposed peripheral magnetic stimulation of the femoral nerve to determine central activation (CAR).  
**RESULTS:** Respiratory exchange ratio indicated that KETO (0.78) used less carbohydrate than NORM (0.86±0.01) during the 2-hr run. While we measured no fatigue of any kind in KETO, NORM declined in voluntary strength (-16±5%) and experienced loss of central drive to the muscle (CAR decreased from 0.85±0.04 to 0.76±0.05). KETO ran the TT at a mean pace of 16.4 km/hr compared to 14.8±0.7 km/hr in NORM.

**CONCLUSIONS:** Our KETO runner did not display strength loss and may have had better TT performance after exhausting exercise as compared to our NORM runners who exhibited central fatigue.

**2222** Board #141 May 28 3:00 PM - 4:30 PM  
**Impact Of Cardiorespiratory Fitness On Carbohydrate Utilization In Overweight And Obese Adults**

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 (No relevant relationships reported)

Obese individuals have impaired metabolic flexibility compared to lean individuals. During exercise, this population relies more heavily on fat oxidation than carbohydrate oxidation for energy even at higher intensities. Although increased fat oxidation during exercise can be beneficial in lean individuals, increased fat oxidation during exercise in obese populations is a paradox. Examining the relationships of fat versus carbohydrate oxidation in obese subjects with different cardiorespiratory fitness levels, may help to explain these differences further. **PURPOSE:** To determine whether overweight and obese (OW/OB) individuals with higher versus lower cardiorespiratory fitness differ in their carbohydrate and fat utilization at 35, 50, 65, and 80% of VO<sub>2max</sub> during a graded exercise test. **METHODS:** Adults (n=34), 28-55 years old with BMI 27-36 kg·m<sup>-2</sup> were measured for their age-predicted VO<sub>2max</sub> using a modified Bruce protocol on a treadmill to 85% of age predicted heart rate maximum. Participants were first split into group based on sex and then divided for comparison into upper and lower halves based on age-predicted VO<sub>2max</sub>. After they were split into within sex low and high groups, their carbohydrate and fat utilizations were compared at 35, 50, 65, and 80% of VO<sub>2max</sub> and normalized to body mass. **RESULTS:** An intensity by fitness group interaction (p<0.05) was measured for both sexes. For women (n=10 per group), the low and high fitness groups were similar in carbohydrate oxidation at 35 and 50 of VO<sub>2max</sub> and the high fitness women oxidized more (p=0.05) carbohydrate at 65% (mean +/- SD, 0.08 +/- 0.02 vs 0.06 +/- 0.03 kcal/kg/min) and 80% (0.20 +/- 0.09 vs 0.12 +/- 0.05 kcal/kg/min) VO<sub>2max</sub>. For men (n=7 per group), both groups had similar carbohydrate oxidation at 35, 50, and 80% of VO<sub>2max</sub> and the high fitness men oxidized more (p<0.05) carbohydrate (0.16 +/- 0.07 vs. 0.09 +/- 0.02 kcal/kg/min) at 65% VO<sub>2max</sub>. Fat utilization did not differ between groups for either males or females. **CONCLUSIONS:** OW/OB adults with better cardiorespiratory fitness utilized more carbohydrates for energy during a graded exercise test at moderate or

moderate to high intensity and did not differ in fat utilization. Supported by Montana State University Research Initiative 51040-MUSRI2015-03 and USDA-NIFA 2017-67018-26367.

**2223** Board #142 May 28 3:00 PM - 4:30 PM  
**Effects Of Low-load, High-repetition Exercise And Sex On Metabolic Properties Of Skeletal Muscle**

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**INTRODUCTION.** During exercise women are better able to initiate aerobic metabolism and are less reliant on anaerobic energy stores. Whether this metabolic difference persists during resistance exercise remains unknown. **PURPOSE.** To characterize fuel utilization patterns during a bout of low-load, high-repetition (LL-HR) resistance exercise and determine whether sex influences the fuel utilization pattern. **METHODS.** Twenty young, healthy participants (n=10 men and women) were recruited and matched for VO<sub>2peak</sub> relative to fat-free mass and habitual resistance training. The LL-HR bout consisted of a circuit of chest press, leg extension, lat pulldown, hamstring curl, shoulder press, and leg press for 25-35 repetitions at 30% of 1RM with 30s rest between each exercise and 2 minutes rest between circuits. Muscle biopsies were taken prior to and following exercise and finger prick assessment of blood lactate was taken during the exercise bout. Western blot analysis was completed for assessment of the high-energy phosphate transfer (CK, phosphorylated CK, AMPD2) and glycolytic (GP, PFK, LDH H and M, PDHE1 $\alpha$ , PDHK4, MCT 1 and 4, phosphorylated PDHE1 $\alpha$ ) pathways. Muscle content of creatine, ATP, lactate, P<sub>i</sub>, pyruvate, and glycogen were also determined. Muscle fibre type was determined using myosin heavy chain immunofluorescence staining. **RESULTS.** Women had a higher proportion of type I muscle fibres than men (p=0.007). There were no sex differences in the protein content of any of the enzymes at rest. Men had higher content of muscle glycogen (p=0.001), lactate (p=0.02), ATP (p=0.01), and P<sub>i</sub> (p=0.007) than women. Glycogen, ATP, and phosphorylation of CK and PDHE1 $\alpha$  decreased in men and women with exercise (p<0.001). Phosphorylation of CK decreased to a greater extent in women (p=0.023) and women tended to use more glycogen (p=0.081) during exercise. Alternatively, creatine increased to a greater extent in men (p=0.026) and men tended to have a greater lactate concentration at the end of the exercise bout (p=0.097). **CONCLUSION.** Sex differences in fuel metabolism during LLHR resistance exercise exist. While women tend to utilize more glycogen during LLHR, men have a higher muscle lactate content, suggestive of a greater reliance on anaerobic metabolism.

**2224** Board #143 May 28 3:00 PM - 4:30 PM  
**POST BREAKFAST RESISTANCE EXERCISE AND REDOX STATUS RESPONSES IN PATIENTS WITH BETA THALASSEMIA MAJOR EXHIBITING INSULIN RESISTANCE**

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Beta-thalassemia major is an inherited hemoglobin disorder that manifests within the first few months of life. Especially insulin resistance and diabetes mellitus are common consequences of iron overload in the pancreas. **PURPOSE:** To examine whether a session of resistance exercise can affect the redox status and improve postprandial hyperglycaemia in patients with beta-thalassemia major exhibiting insulin resistance. **METHODS:** Six patients (weight: 66.0 ± 16.6 kg, body fat: 37.6 ± 5.1 %, SBP: 104.5 ± 9.7 mmHg, DBP: 67.5 ± mmHg) underwent two trials (exercise and control) following breakfast meal ingestion, in a counterbalance order, separated by at least three days. In exercise trial, patients performed chest and leg press (3 sets of 10 maximal repetitions), while in control trial they rested. Blood samples were obtained in both trials: pre-meal, 45 min post-meal, immediately post, 1 hour post, 2 hours post and 24 hours post. Blood was analysed for TBARS, catalase, total antioxidant capacity (TAC) and glucose. **RESULTS:** No time or condition interaction was found for TBARS, catalase and TAC (Table 1). Blood glucose levels increased significantly following breakfast meal ingestion and were not differed between trials at the same time points.

**Table 1:** Redox and glucose responses following a post-breakfast resistance exercise session

**CONCLUSIONS:** A session of resistance training consisting of two major muscle exercises is not enough to influence changes in redox status or glucose metabolism in patients with beta-thalassemia major exhibiting insulin resistance.

*Supported by the Postgraduate Program of Study "Exercise & Health: Testing & Prescription", School of P.E. & Sports Science, University of Thessaly, GREECE*

**2225** Board #144 May 28 3:00 PM - 4:30 PM  
**Effect Of Wearing Lower-body Compression Garments During Prolonged Running On Substrate Oxidation And Running Kinematics**

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Lower body compression garments (CG) have been suggested previously to provide favorable effects during running. One of explanation for the benefits of wearing CG might be explained by augmented arterial blood flow by external pressure applied. Enhanced muscle perfusion can increase oxygen delivery to exercising muscle, thereby affecting oxygen uptake and substrate oxidation. Furthermore, wearing CG might assist the propulsive force by optimizing running kinematics as a result of the elastic nature of the garment, leading to less metabolic cost of running at a given speed. These insights may be advantageous in situation with prolonged running, which is required large metabolic demand under development of fatigue. However, little information is available for effect of wearing CG during prolonged running (> 1h) on energy metabolism and running kinematics. **PURPOSE:** To determine influence of wearing CG on energy metabolism and running kinematics during prolonged running. **METHODS:** Eight physical active male (24 ± 2 yrs, 168.4 ± 5.0 cm, 63.9 ± 5.0 kg, VO<sub>2</sub>max; 54.8 ± 4.3 mL·kg<sup>-1</sup>·min<sup>-1</sup>) completed 2 exercise trial in the different days. The exercise consisted of 120 min of uphill running (7% gradient) at 60 % of VO<sub>2</sub>max (6.8 ± 0.6 km·h<sup>-1</sup>). The exercise trials included 1) wearing CG with exerting 15 mmHg [CG]; and 2) wearing garment with exerting below 5 mmHg [CON] to thigh and calf. Respiratory gas variables (carbohydrate oxidation) and running kinematics (step length and frequency, ground-contact time, flight time, joint angles) were assessed every 30 min of exercise. Blood samples were collected to determine blood glucose and lactate, and plasma IL-6 as indication of carbohydrate metabolism. *P* < 0.05 was considered to be statistically significant. **RESULTS:** Time course of changes in carbohydrate oxidation, running kinematics and blood glucose and lactate did not differ between the two trials (*P* > 0.05). Area under the curve (AUC) of plasma IL-6 concentration for 120 min of exercise tended to be lower in the CG trial (803 ± 452 pg·mL<sup>-1</sup>) compared with in the CON trial (1,219 ± 842 pg·mL<sup>-1</sup>, *P* = 0.07). A positive relationship was observed between the AUC of plasma IL-6 concentration and the total carbohydrate oxidation (*r* = 0.5, *P* = 0.049). **CONCLUSION:** Wearing CG did not alter energy metabolism and running kinematics during prolonged running.

**2226** Board #145 May 28 3:00 PM - 4:30 PM  
**Comparing The Effects Of Different Modes Of Exercise On Glucose Handling In Young Recreationally Active Men**

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**PURPOSE:** The prevalence of type 2 diabetes (T2D) is increasing dramatically and is characterized by insulin resistance (IR). Exercise training is an effective modality to improve IR and acutely can increase post-exercise glucose handling for up to 72 hours. However, there is conflicting evidence as to which mode of exercise elicits the greatest positive effect on glucose handling. The purpose of this study was to compare the effectiveness of different modes of exercise on post-exercise glucose handling in young recreationally active men. **METHODS:** Twelve (age: 22±3 years) recreationally active men completed 4 separate oral glucose tolerance tests (OGTT) either at rest, or 1.5 hours after moderate-intensity continuous exercise (MICE; 30 min @ 65% VO<sub>2</sub>peak), low-load high-repetition resistance exercise circuit (LLHR; 20-25 reps/set for 3 sets at 30% 1RM) and high-intensity interval training bout (HIIE; 10x1min at 90% HR<sub>max</sub>). Heart rate and blood lactate were taken throughout the exercise bouts. Blood was analyzed for total plasma glucose concentration (mmol/L), c-peptide concentration (ng/mL) and blood insulin concentration (μIU/mL). **RESULTS:** Average blood glucose concentration during the OGTT was lower following LLHR (6.386 ± 0.261mmol/L, *p* = 0.03) as compared with MICE (6.839 ± 0.256 mmol/L, *p* = 0.03) with no differences between baseline (6.625 ± 0.333 mmol/L) and HIIE (6.737 ± 0.267 mmol/L). Glucose area under the curve (AUC) was lower following LLHR (781.76 ± 36.08) as compared

to MICE (842.81 ± 35.8; *p* = 0.033) with no difference compared to baseline glucose AUC (804.61 ± 46.7, *p* = 0.475). Blood c-peptide concentrations were not significantly different between baseline, MICE, HIIE or LLHR average concentrations. Similar to c-peptide there were no significant differences between blood insulin concentrations post exercise. **CONCLUSION:** In young, healthy men none of the exercise modes improved glucose handling as compared with baseline. However, LLHR resistance exercise did result in greater glucose clearance than MICE, suggesting that it may be a better modality to improve glucose control. Future work should examine the acute and chronic effects of LLHR resistance exercise on glucose handling in individuals with IR to determine the potential effectiveness of this exercise modality to improve insulin sensitivity.

**2227** Board #146 May 28 3:00 PM - 4:30 PM  
**The Effect Of Arm Versus Leg Dominant Physical Activity On Postprandial Blood Glucose Levels**

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 (No relevant relationships reported)

**PURPOSE:** The aim of this investigation was to assess the effects of two different exercise trials that used different amounts of muscle mass on postprandial blood glucose levels. **METHODS:** Subjects (*n* = 8) participated in a series of three tests after ingesting a 75g 100% glucose solution: a control, a bout of arm-only exercise, and a bout of leg-only exercise following the standard OGTT protocol. Each exercise bout was thirty minutes in length, the intensity of which was matched at 0.5 watts/ kg of body weight between trials. **RESULTS:** The average postprandial blood glucose was significantly different between conditions (Two Way Repeated Measures ANOVA, *p* < 0.05). At 20 minutes blood glucose was significantly lower in legs conditions versus the arm condition (*p* = 0.003). There was no difference in mean HR or RPE between trials. **CONCLUSION:** The data suggests that when factors such as workload are matched, the amount of muscle mass recruited for light physical activity can impact postprandial blood glucose control. The results of this pilot study help to further define the role exercise could play in the prevention of increasingly prevalent metabolic disorders, helping people to live longer, healthier lives utilizing exercise as medicine.

**2228** Board #147 May 28 3:00 PM - 4:30 PM  
**Does Energy Expenditure Of Activity Interruptions In Prolonged Sitting Impact On Glycemic Responses?**

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**PURPOSE:** To explore the impact of energy expenditure (EE) on glycemic responses when prolonged sitting is interrupted by three regular activity bouts.

**METHODS:** Fourteen healthy, sedentary, inactive adults (8 women; age 23.7±2.9 y; BMI, 22.2±2.4 kg/m<sup>2</sup>; VO<sub>2</sub> max, 38.5±5.2 mL·kg<sup>-1</sup>·min) completed four 26 h interventions in randomized order, including 22.5 h in an EE-testing calorimeter chamber. The four 9 h intervention periods were as follows: uninterrupted sitting (SIT); 30 min sitting/3 min brisk treadmill walk (60% VO<sub>2</sub>max, WALK3); 45 min sitting/5 min brisk treadmill walk (WALK5); or 60 min sitting/8 min brisk treadmill walk (WALK8). Meals and meal times were standardized across the trials for all participants. After adjustment for age, sex, percent of body fat, relative VO<sub>2</sub>max, treatment order, and corresponding baseline interstitial glucose concentrations, the relationship between EE and the incremental area under the curve (iAUC) for interstitial glucose was examined during the whole 26 h observation period and each segmentation period (intervention period, evening period, and sleep period). The interstitial glucose was obtained via continuous glucose monitoring. Random effects mixed model analyses were performed and data were represented as unstandardized coefficients with 95% confidence intervals.

**RESULTS:** Model parameter estimates revealed that EE was negatively associated with glucose iAUC during the intervention period ( $\beta = -1.87 \text{ mmol} \cdot \text{h} \cdot \text{L}^{-1} \cdot \text{MJ}^{-1}$  [-3.68 - -0.05], *P* = 0.04) and positively associated with glucose iAUC during the 2 h post-dinner period immediately following the intervention period ( $\beta = 0.64 \text{ mmol} \cdot \text{h} \cdot \text{L}^{-1} \cdot \text{MJ}^{-1}$  [0.27 - 1.00], *P* = 0.001). There was no significant association between EE and glucose iAUC during the entire 26 h observation or the other segmentation periods. The 2 h post-dinner iAUC was higher in men than in women (mean difference: 0.74 mmol·h·L<sup>-1</sup> [0.16 - 1.33], *P* = 0.01).

**CONCLUSIONS:** Higher EE after the interruption of sitting time was associated with lower interstitial glucose responses during the intervention period in healthy, sedentary adults, but the opposite was true in the 2 h postprandial period immediately following the intervention period.

**2229** Board #148 May 28 3:00 PM - 4:30 PM  
**Males And Females Exhibit Similar Muscle Glycogen Recovery Across Varied Diets**

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Research has demonstrated that post exercise glycogen recovery is altered by varied macronutrient intake and timing and in response to ambient or skeletal muscle temperatures. However, research has minimally considered the implications of glycogen recovery in females and has mostly focused on commercial sport nutrition products. **PURPOSE:** To determine the effects of varied mixed macronutrient feedings on glycogen recovery and subsequent exercise performance in both sexes. **METHODS:** Males (n=8) and females (n=8) participated in a counter-balanced crossover study. Subjects completed a 90-minute cycling glycogen depletion trial then rested for 4 hours. Two carbohydrate feedings (1.6 g kg<sup>-1</sup>body weight each) of either sport supplements or potato-based products were delivered at 0 and 2 hours post exercise. Muscle biopsies and blood samples (glucose, insulin) were collected during the recovery. Following the 4-hour recovery period, subjects completed a 20km cycling time trial. Data were analyzed using 2 and 3 way ANOVA with repeated measures with statistical significance established at p<0.05). **RESULTS:** There was no difference between sexes or dietary sources for glycogen recovery rates (male: 7.9±2.7, female: 8.2±2.7, potato-based: 8.0±2.5, sport supplement: 8.1±3.1 mM · kg wet wt<sup>-1</sup> · hr<sup>-1</sup>, p>0.05). Potato based feedings resulted in higher ratings for taste, satisfaction and acceptability (p<0.05). Time trial performance was not different between diets (38.3±4.4 and 37.8±3.9 minutes for potato and sport supplement, respectively, p>0.05). **CONCLUSION:** These results indicate that food items, such as potato-based products, can be as effective as commercially marketed sports supplements when developing glycogen recovery oriented menus and that carbohydrate dose recommendations (g kg<sup>-1</sup>body weight) can be universally applied to both males and females. Supported by the Alliance for Potato Research and Education

**2230** Board #149 May 28 3:00 PM - 4:30 PM  
**Interrupting Sitting With Short Walks Or Repeated Chair Stands Improves Glycemic Control In Healthy Adults**

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Uninterrupted sedentary time is an independent risk factor for the development of metabolic diseases. Interrupting prolonged sitting with brief, intermittent walks can improve postprandial glucose metabolism; however, the efficacy of other types of exercise that do not require equipment nor space beyond one's immediate sedentary area remain to be investigated. **PURPOSE:** To determine the impact of interrupting prolonged sitting with practical 'activity snacks' on postprandial glycemia and insulinemia in healthy adults. **METHODS:** Fourteen participants (7 males, 7 females; 23±5yr; 24±5kg/m<sup>2</sup>; 40±8ml/kg/min; 4587±1231steps/d) completed three 7.5hr trials in a randomized order consisting of uninterrupted sitting (SIT), sitting with intermittent (every 30 min) walking (WLK; 2min at 3.1mph) or sitting with intermittent squats (SQT; 15 'chair stands with calf raise'). Mixed-macronutrient liquid meals (~55:30:15% carbohydrate:fat:protein) provided 20% ('breakfast'; 406±87kcal) and 30% ('lunch'; 609±130kcal) of daily energy needs to mimic traditional Western meal patterns. Blood was obtained every 30min and analyzed for plasma glucose and insulin concentration. Positive incremental area under the curve (iAUC) for glucose, insulin and insulin:glucose ratio were calculated 1 and 3h postprandially using the trapezoidal rule. **RESULTS:** Postprandial glucose and insulin did not differ across conditions following breakfast. After lunch, peak insulin concentration was lower in SQT (51.6±26.7, p<0.001) and WLK (62.2±34.9, p<0.05) compared to SIT (78.9±43.0µIU/ml). The insulin:glucose iAUC 3h following lunch was also reduced by the activity snacks (SQT: 489±300; WLK: 541±401) compared to SIT (700±398, p<0.05). Insulin iAUC 1h following lunch was lower in SQT (1412±902, p<0.01) and WLK (1575±1145, p<0.05) relative to SIT (2231±1540µIU/ml x 1h, p<0.01), however 3h insulin iAUC was only reduced in SQT (SQT: 2992±1735 vs. SIT: 3954±2261µIU/ml x 3h; p<0.05). **CONCLUSION:** Interrupting prolonged sitting with short walks or repeated chair stands reduces postprandial insulinemia following lunch in healthy adults. Our results add to the evidence suggesting that short 'activity snacks' can help mitigate cardiometabolic risk factors associated with prolonged sitting. Supported by ACSM Research Endowment Grant.

**2231** Board #150 May 28 3:00 PM - 4:30 PM  
**Abstract Withdrawn**

**2232** Board #151 May 28 3:00 PM - 4:30 PM  
**Passive Stretch Improves Insulin-stimulated Glucose Transport Together With Downregulation Of TXNIP In Rat Soleus Muscle**

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 (No relevant relationships reported)

**PURPOSE:** Although passive stretch is known to stimulate muscle glucose transport independently of insulin action, it is unclear whether stretch increases susceptibility of glucose transport to insulin and improves insulin resistance in skeletal muscles. Therefore, we examined the effect of stretch on insulin-stimulated glucose transport in insulin resistant soleus muscles of immobilized rats. In addition, we examined the possibility that stretch decreases protein expression of TXNIP which is known to be a key negative regulator of insulin signaling.

**METHODS:** Rats were divided into non-immobilized control and immobilized groups. Non-immobilized control rats were allowed to move freely in their cages. Immobilized rats were anesthetized and their both hindlimbs were immobilized for 6 h. Unilateral soleus muscles of immobilized rats were shortened by plantarflexing the ankle joint throughout 6 h immobilization. Contralateral muscles were stretched for 1 h by dorsiflexing the ankle joint following 5 h shortening by plantarflexing. We measured basal and insulin (50µU/ml) stimulated 2-deoxyglucose (2DG) uptake rate in isolated soleus muscles. Moreover, TXNIP protein expression was evaluated in these muscles.

**RESULTS:** Although insulin (50µU/ml) increased glucose transport by 1.9-fold in soleus muscles of non-immobilized control rats (p<0.05), insulin did not significantly increase glucose transport in shortened muscles of immobilized rats. This result shows that insulin resistance is induced in these shortened muscles. On the other hand, 1 h passive stretch restored insulin resistance of glucose transport in muscles of immobilized rats (insulin-stimulated 2DG uptake in control, 3.12±0.29; shortened, 1.73±0.17; stretched, 3.04±0.31µmol/g muscle/20min). In addition, TXNIP protein was increased in shortened muscles of immobilized rats as compared with muscles of control rats (p<0.05). Moreover, elevated TXNIP expression in these muscles was returned to control level after 1 h passive stretch (TXNIP in control, 100±9; shortened, 166±8; stretched, 107±9 arbitrary units).

**CONCLUSIONS:** Passive stretch improves insulin-stimulated glucose transport in insulin-resistant soleus muscles of immobilized rats. This may be due to stretch-induced downregulation in TXNIP protein expression.

**2233** Board #152 May 28 3:00 PM - 4:30 PM  
**Acute Hypoxia Suppresses Exogenous Glucose Rate Of Appearance And Metabolic Clearance Rate During Steady-state Aerobic Exercise**

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 (No relevant relationships reported)

**BACKGROUND:** Previously, we observed that exogenous carbohydrate oxidation is reduced when lowlanders perform steady-state aerobic exercise after 5 h exposure to high altitude (HA). However, the underlying glucose kinetics that may contribute to the reduction in exogenous carbohydrate oxidation during steady-state aerobic exercise performed at HA have not been explored.

**PURPOSE:** Determine glucose turnover responses to exogenous carbohydrate ingestion during metabolically-matched, steady-state aerobic exercise at HA and sea level (SL).

**METHODS:** Using a randomized, crossover design, lowlanders (n = 8 males, mean ± SD, age: 23 ± 2 yr, body mass: 87 ± 10 kg, and VO<sub>2peak</sub>: SL 4.3 ± 0.2 L/min and HA 2.9 ± 0.2 L/min) consumed 145 g (1.8 g/min) of glucose while performing 80 min of metabolically-matched (SL: 1.66 ± 0.14 L/min VO<sub>2</sub>, 329 ± 28 kcal; HA: 1.59 ± 0.10 L/min VO<sub>2</sub>, 320 ± 19 kcal) treadmill exercise at SL (757 mmHg) and after 5 h of simulated HA (hypobaric hypoxia, 460 mmHg) exposure. Glucose rate of appearance (Ra), disappearance (Rd), and metabolic clearance rate (MCR), were determined during the last 40 min of exercise using primed, constant [6,6-<sup>2</sup>H<sub>2</sub>] glucose infusions and <sup>13</sup>C glucose-labeled drinks.

**RESULTS:** Exogenous glucose oxidation rate was lower ( $P < 0.05$ ) at HA ( $0.35 \pm 0.07$  g/min) compared to SL ( $0.44 \pm 0.05$  g/min). Total glucose  $R_a$  was lower ( $P < 0.05$ ) at HA ( $12.3 \pm 1.5$  mg/kg/min) compared to SL ( $13.8 \pm 2.0$  mg/kg/min). Exogenous glucose  $R_a$  was lower ( $P < 0.05$ ) at HA ( $8.9 \pm 1.3$  mg/kg/min) compared to SL ( $10.9 \pm 2.2$  mg/kg/d), but there was no difference between endogenous glucose  $R_a$  at HA compared to SL. Glucose  $R_a$  and MCR were lower ( $P < 0.05$ ) at HA ( $12.7 \pm 1.7$  mg/kg/min and  $9.0 \pm 1.8$  mg/kg/min) compared to SL ( $14.3 \pm 2.0$  mg/kg/min and  $12.1 \pm 2.3$  mg/kg/min).

**CONCLUSION:** Ingesting carbohydrate during steady-state aerobic exercise performed 5 h after arriving at HA is associated with lower exogenous glucose  $R_a$ , glucose  $R_a$ , and MCR compared to SL. These data suggest that altered glucose kinetics, indicative of either a reduction in exogenous glucose absorption or release from the gut, may contribute to lower exogenous carbohydrate oxidation during exercise upon initial exposure to HA.

**2234** Board #153 May 28 3:00 PM - 4:30 PM  
**Relationship Of Glucose Kinetics With Exercise Capacity, Body Composition, And Mitochondrial Function With Aging**

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 (No relevant relationships reported)

Aging is commonly associated with decreases in aerobic capacity, skeletal muscle mass and function, as well as metabolic dysregulation including insulin resistance. **PURPOSE:** We sought to investigate relationships between these aforementioned hallmark traits of aging. **METHODS:** Young healthy adults (24-34 years; n=16; 7F/9M; BMI:  $25 \pm 3$  kg/m<sup>2</sup>) and older adults (65-79 years; n=39; 20F/19M; BMI:  $27 \pm 4$  kg/m<sup>2</sup>) were recruited as a part of this investigation. Subjects completed a graded maximal exercise test ( $VO_{2peak}$ ) on a treadmill, a dual-energy X-ray absorptiometry scan, measurement of single-leg knee extension power, a mixed meal tolerance test upon which blood glucose was monitored throughout the next 5 hours, and a resting vastus lateralis biopsy to measure ATP production from permeabilized muscle fibers. **RESULTS:** Young had a 38% greater aerobic capacity and 45% greater knee extensor maximal power/lean mass. Fasting plasma glucose was lower ( $P < 0.05$ ) in young ( $86 \pm 7$  mg/dL vs.  $93 \pm 8$  mg/dL in young and old, respectively), as well as young had 31% lower plasma glucose area above baseline (AAB) in response to the mixed meal tolerance test compared to old ( $P < 0.05$ ). No differences between young and old were observed in lean body mass, fasting plasma insulin, or maximal mitochondrial ATP production (state III). Interestingly, AAB was not significantly correlated with phenotypic characteristics (BMI or lean body mass), fasting plasma glucose or insulin, or maximal ATP production. However, AAB was significantly ( $P < 0.05$ ) inversely correlated with  $VO_{2peak}$  relative to body mass ( $r = -0.38$ ) and knee extensor power/lean mass ( $r = -0.47$ ). **CONCLUSIONS:** These data suggest that glucose tolerance may be a function of skeletal muscle quality rather than total lean mass. However, the inverse relationship with AAB and measurements of whole body functional tests do not appear to be related mitochondrial energy production, suggesting the need for further mechanistic investigations. Supported by NIH grant R01AG054454

**2235** Board #154 May 28 3:00 PM - 4:30 PM  
**Hand Heating Lowers Fasting And Postprandial Blood Glucose**

Jeff Moore, Jochen Kressler, Michael Buono, FACSM. *San Diego State University, San Diego, CA.* (Sponsor: Dr. Michael Buono, FACSM)  
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 Reported Relationships: J. Moore: Industry contracted research; AVACEN Medical.

**Purpose:** Examine the effect of hand heating with negative pressure on postprandial blood glucose (PBG) and fasting blood glucose (FBG). **Methods:** Design: Double-blind randomized controlled trial. Subjects: PPG experiment: 13 healthy subjects (2 males). FBG experiment: 17 healthy subjects (4 males). Interventions: Devices included one providing heat only, one heat and negative pressure, and one acting as a sham. For the PPG experiment the devices were used for one hour during an oral glucose tolerance test (75 grams dextrose). For the FBG experiment the devices were used for 30 minutes. Outcome Measures: Blood glucose measurements were used to determine peak PBG, area under the curve (AUC), incremental AUC (iAUC), and change in FBG. **Results:** PBG: Compared to the sham device the heat plus vacuum and heat only device lowered peak blood glucose by  $16 \pm 31$  mg/dL,  $p = 0.092$  and  $18 \pm 28$  mg/dL,  $p = 0.039$ , respectively. AUC and iAUC: Compared to the sham device, the heat plus vacuum device and heat only device lowered the AUC by  $3.7 \pm 14\%$ ,  $p = 0.234$  and  $7.7 \pm 11\%$ ,  $p = 0.024$  respectively and iAUC by  $17.2 \pm 53\%$ ,  $p = 0.178$  and  $20.5 \pm 34\%$ ,  $p = 0.054$ , respectively. FBG: The decrease in fasting blood glucose from 0 min to 30 min for the heat plus vacuum device and heat only device was  $1.8 \pm 4.8$  mg/dL,  $p = 0.07$  and  $3.2 \pm 5.3$  mg/dL,  $p = 0.01$ , respectively. The sham device had no effect on

mean resting blood glucose as it was 92.6 mg/dL both pre and post-treatment ( $p = 0.47$ ).

**Conclusions:** Local hand heating combined with negative pressure lowers fasting and postprandial blood glucose in healthy subjects.

**2236** Board #155 May 28 3:00 PM - 4:30 PM  
**EFFECTS OF INTERMITTENT LOW DOSE CARBON MONOXIDE INHALATION ON BLOOD GLUCOSE REGULATION IN OVERWEIGHT ADULTS: A RANDOMIZED CONTROLLED CROSSOVER TRIAL**

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 (No relevant relationships reported)

**PURPOSE:** Low dose carbon monoxide (CO) inhalation upregulates several proteins important for glucose metabolism. However, it is not known whether CO's ability to upregulate proteins associated with glucose metabolism has consequences for whole body glucose metabolism which could have implications for both research and clinical fields. We hypothesized that low dose CO inhalation would improve the glucose and insulin responses to ingestion of an oral glucose bolus in overweight humans.

**METHODS:** Eleven young adults (5 male, 6 female; body mass index:  $25-35$  kg/m<sup>2</sup>) were included in this randomized, placebo-controlled, single blinded crossover study. Following screening, subjects completed two 7-day protocols, separated by at least 4 weeks. Prior to (24-hours) and following 5 consecutive days of either once daily CO (males:  $1.2$  mL kg<sup>-1</sup> body mass; females:  $1.0$  mL kg<sup>-1</sup> body mass) or placebo (room air) inhalation, subjects underwent two-hour oral glucose tolerance tests (OGTT).

**RESULTS:** Although blood glucose was on average 5 mg/dl lower post-intervention compared to pre-intervention ( $p < 0.001$ ), there were no significant main effects or interactions across experimental conditions for any OGTT parameters (presented as overall average and [95% CI]), including fasting glucose ( $84.0$  [78.8-89.2] mg/dL; intervention x pre/post interaction  $p = 0.53$ ), two hour post glucose ( $96.9$  [87.2-107.0] mg/dL;  $p = 0.71$ ), fasting insulin ( $4.82$  [2.63-7.00]  $\mu$ U/mL;  $p = 0.33$ ), the homeostatic model of insulin resistance ( $1.04$  [0.53-1.55];  $p = 0.45$ ) or the Matsuda Index ( $17.3$  [6.24-28.3];  $p = 0.60$ ). **CONCLUSION:** 5 days of low dose CO administration did not influence the glucose and insulin responses to an OGTT in overweight adults. Since low dose CO inhalation is used in the assessment of hemoglobin mass and other physiological parameters, these findings allow researchers to utilize these procedures without concern of altering glucose metabolism.

**2237** Board #156 May 28 3:00 PM - 4:30 PM  
**Effects Of 12-weeks Of Post-meal Walking On Glycemic Control And Body Composition In Older Adults**

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 (No relevant relationships reported)

There is strong evidence that short bouts of light-intensity post-meal exercise are effective at lowering post-prandial and 24-h glucose concentrations in older people with impaired glucose tolerance (IGT). It is unknown, however, whether these transient benefits result in more enduring improvements in glycemic control after training.

**Purpose:** To determine the effects of a home-based, 12-week post-meal walking program on improvements in glucose metabolism, as well as on changes in body composition in overweight (BMI =  $30 \pm 1.8$  kg/m<sup>2</sup>) older adults (N=6;  $72 \pm 5.3$  years) with IGT. **Methods:** Participants performed three 15-minute bouts of low-intensity (3 METs) walking beginning 30 minutes after each meal on five days per week for 12 weeks. Glucose and insulin responses to an oral glucose tolerance test were determined 48 h after the last exercise bout before and after training. Changes in body composition were determined using iDXA. **Results:** Overall adherence to the total training program (180 post-meal walking bouts) was 65%; however, participants reported completing an average of 82% of the post-dinner walks across the 12 weeks. Total areas under the curve for both glucose [ $29.5 \pm 9.3$  vs.  $29.5 \pm 8.9$  (mg·dL<sup>-1</sup>)·3h·10<sup>3</sup>] and insulin [ $9.2 \pm 5.4$  vs.  $9.0 \pm 4.4$  (mg·dL<sup>-1</sup>)·3h·10<sup>3</sup>] responses did not change between baseline and follow-up; however, HbA1c levels (6.45% vs. 5.86%) and the Whole Body Insulin Sensitivity Index ( $4.5 \pm 3.6$  vs.  $5.8 \pm 8.7$ ) showed promising improvements following training. There were no changes to body weight, body fat, or lean mass; however, visceral fat volume decreased ( $688.7 \pm 311.4$  vs.  $584.3 \pm 306.0$  cm<sup>3</sup>), and four of the six participants reduced their visceral fat mass by over 37g. **Conclusions:** Data from this pilot study suggest that the benefits of regular, low-intensity post-meal walking on glycemic control may not last beyond 24h in older adults with IGT. On the other hand, if

performed consistently over time, the transient benefits may result in more enduring improvements in HbA1c and particularly in visceral fat mass. Supported by NIH/NIA R56 AG050661

**D-66 Free Communication/Poster - Energy Availability in Athletes**

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
Room: CC-Exhibit Hall

**2238 Board #157 May 28 3:00 PM - 4:30 PM Examination Of Energy Needs Across 2-week High-Intense Functional Exercise Program In Recreational Athletes**

Erin M. Moore<sup>1</sup>, Toni M. Torres-McGehee<sup>2</sup>, Justin M. Goins<sup>2</sup>, Samantha R. Weber<sup>2</sup>, Tim Bailey<sup>2</sup>. <sup>1</sup>University of South Florida, Tampa, FL. <sup>2</sup>University of South Carolina, Columbia, SC.  
(No relevant relationships reported)

Increases in physical activity without proper nutritional knowledge may expose recreational athletes to compromised energy needs and macronutrient profiles. **Purpose:** To examine the energy needs across a 2-week high intense functional exercise program in female and male recreational athletes. **Methods:** Thirty adults (age: 31.2 ± 8.1; females: 164.7 ± 7.1 cm, 69.9 ± 11.1 kg; body fat%: 29.2 ± 5.5%; males: n=12, 176.9 ± 6.2 cm, 89.5 ± 15.1 kg, body fat%: 22.3 ± 8.8%) participated in a larger cross-sectional study. Participants completed a demographic survey, a 7 day online dietary and exercise log across 2 weeks. Measurements included; height, weight, and DXA scan (body fat%) at the beginning of the study. Exercise energy expenditure (EEE) was calculated using Ainsworth/Heyward equations, energy availability (EA) was calculated by EA = ((EI - EEE)/FFMkg<sup>1</sup>) and energy balance (EB) was calculated by EB = (EI - TDEE = 0). Macronutrients (CHO, PRO, and fats) were assessed using ACSM recommendations (recs.). Low EA (LEA) was defined at >30 kcal/FFMkg<sup>1</sup> and EB was defined as negative, balanced, or positive, and Macros were defined as low, within or above recs. **Results:** Results yielded LEA (week 1: 73.3%, n = 22, week 2: 80% n=24) and negative EB (week 1: 94.4%, n=17; 75.0%, n=9) across the two weeks. No significant differences were found between gender or training weeks for energy needs and Macros. Over the 2 weeks, participants demonstrated similar energy needs including: EI (week 1: 1752.3 ± 599.8 kcals, week 2: 1831.2 ± 634.4 kcals), EEE (week 1: 310.7 ± 63.7 kcals, week 2: 302.7 ± 62.1 kcals), EA: (week 1: 25 ± 10.1 kcal/FFMkg<sup>1</sup>, week 2: 25.1 ± 9.8 kcal/FFMkg<sup>1</sup>), TDEE (week 1: 2518.5 ± 266.1 kcals, week 2: 2543.1 ± 286.1 kcals), and EB (week 1: -766.2 ± 627.4 kcals, week 2: -712 ± 652.3 kcals). Macronutrients were also similar between weeks; with PRO intake within recommendations (week 1: 50%, n=15; week 2: 63%, n=17, n=6), CHO intake was extremely low (week 1: 96.7%, n=29; week 2: 93.3%, n=28), and fats were within recs. (week 1: 62.1%, n=18; week 2: 46.7%, n=9). **Conclusion:** Participants demonstrated consistent EI and EEE habits over the 2 weeks, however, the recreational athletes under consumed CHO and presented at risk for LEA and negative EB. This leads to compromised fueling for the EEE utilized during training.  
Funded by Avadim Technology

**2239 Board #158 May 28 3:00 PM - 4:30 PM BODY COMPOSITION AND ENERGY BALANCE CHANGES IN FEMALE RUGBY ATHLETES ACROSS ONE COMPETITIVE SEASON**

Johnathan L. Boring, Jessica M. Moon, Anthony M. Hagele, Travis Russo, Kayla M. Ratliff, Blumkaitis C. Julia, Richard A. Stecker, Petey W. Mumford, Richmond Scott, Kyle L. Sunderland, Chad M. Kerksick, FACSM. Lindenwood University, Saint Charles, MO.  
(No relevant relationships reported)

Achieving and maintaining energy balance (EB) is a key nutritional goal for competing athletes. Recently published formulas have allowed for the estimation of EB using measured body composition values, but limited data is available in team sport athletes, particularly female rugby athletes. **PURPOSE:** To determine the changes in EB in female rugby athletes across an entire competitive season by assessing body composition using DEXA at three time points: pre-season, post-season and off-season. **METHODS:** Female rugby athletes (Mean ± SD; 18.5 ± 0.8 yrs, 166.8 ± 4.0 cm, 73.7 ± 9.73 kg, 28.9 ± 4.3 % fat, n=8) had three DEXA scans completed during pre-season (day 0-30), post-season (day 100 - 120), and off-season (day 300-365) for determination of fat mass (FM), fat-free mass (FFM), and percent body fat. Changes in FFM and FM between scans were assessed for changes across the season in addition to estimating EB (EB (kcal•d<sup>-1</sup>) = 1.0 + 9.5 ). Data was analyzed using factorial ANOVA

with repeated measures on time with paired samples t-test being used for post-hoc comparisons. A p-value of 0.05 was used for statistical determinations. **RESULTS:** No statistically significant changes were noted for fat mass (p = 0.83), fat-free mass (p = 0.76), or percent body fat (p = 0.53) were observed across the competitive season (see Table 1). In addition, EB did not exhibit any changes (p = 0.77) across the season (EB = -9.96 ± 69.3 kcals/day). **CONCLUSIONS:** Over the measured time period, female rugby athletes were found to largely be in energy balance as no statistically significant changes were observed for body composition or EB. These data help to inform coaches and athletes about the anticipated energy needs within the sport of rugby.

Table 1: Body composition and energy balance in female rugby athletes.

	PRE	POST	OFF
DXA Fat Mass (kg)	20.6 ± 5.7	20.7 ± 4.7	20.2 ± 6.2
DXA Fat-Free Mass (kg)	47.5 ± 4.5	47.2 ± 4.1	47.5 ± 4.7
DXA % Fat	28.9 ± 4.3	29.3 ± 3.8	28.5 ± 4.4
	PRE vs. POST	POST vs. OFF	PRE vs. OFF
EB (kcal/day)	2.42 ± 153.1	-17.9 ± 83.8	-9.96 ± 69.3
Days between DXA scans	136 ± 4	242 ± 84	378 ± 6

**2240 Board #159 May 28 3:00 PM - 4:30 PM Comparison Of Energy Expenditure Observed Between Scheduled Activities In Female Collegiate Basketball And Lacrosse Athletes**

Jessica M. Moon<sup>1</sup>, Hannah Zabriskie<sup>2</sup>, Bre R. Zanders<sup>1</sup>, Patrick S. Harty<sup>3</sup>, Brad S. Currier<sup>4</sup>, Richard A. Stecker<sup>1</sup>, Petey W. Mumford<sup>1</sup>, Andrew Jagim<sup>5</sup>, Chad M. Kerksick, FACSM<sup>1</sup>. <sup>1</sup>Lindenwood University, St. Charles, MO. <sup>2</sup>Towson University, Towson, MD. <sup>3</sup>Texas Tech University, Lubbock, TX. <sup>4</sup>McMaster University, Hamilton, ON, Canada. <sup>5</sup>Mayo Clinic Health System, Onalaska, WI. (Sponsor: Chad Kerksick, FACSM)  
(No relevant relationships reported)

Specific energy needs of team-sport female athletes have been understudied, particularly with regard to scheduled daily activities. **PURPOSE:** To examine the difference between energy expenditure changes in NCAA Div II female basketball (BBALL) and lacrosse (LAX) athletes depending on scheduled team activities. **METHODS:** All athletes (BBALL: n=10; 19.8±1.3 yrs, 173.9±13.6 cm, 74.6±9.1 kg, 27.1±3.2 % fat; LAX: n=20; 20.4±1.8 yrs, 168.4±6.6 cm, 68.8±8.9 kg, 27.9±3% fat) were outfitted with heart rate and activity monitors during four consecutive days on five different occasions (20 days total) across their competitive seasons to assess differences in activity energy expenditure (AEE), total daily energy expenditure (TDEE) and physical activity level (PAL). Data collected was categorized by type of scheduled daily activities: Practice, Game, Conditioning or Off. All dependent variables were analyzed using a mixed factorial ANOVA with paired sample T-Tests as post-hocs when necessary. **RESULTS:** All results are outlined below in Table 1. Independent of day type, TDEE, AEE, and PAL levels were greater (p<0.05) in LAX athletes. Changes between day types for each sport were significantly different (p<0.05) for TDEE, AEE, and PAL. **CONCLUSION:** Calculated levels for TDEE, AEE, and PAL in female collegiate BBALL and LAX athletes were determined to all be different, irrespective of the scheduled daily activity. LAX athletes, regardless of scheduled activities, had greater TDEE, AEE, and PAL compared to BBALL athletes. Caloric expenditure in female collegiate athletes varies significantly depending on scheduled team activities with energy needs progressively increasing between Off, Conditioning, Practice, and Games.  
Table 1: TDEE, AEE, and PAL, in practice, game, conditioning, off, and combined days, in female collegiate BBALL and LAX athletes.

Variable	Sport	Type of Day
Total Daily Energy Expenditure (kcal/day)	Basketball (n=10)	Practice: 3094 ± 250 <sup>B,D</sup>
		Game: 3564 ± 609 <sup>A,D</sup>
		Conditioning: 3079 ± 684 <sup>D</sup>
		Off: 2497 ± 281 <sup>C,D</sup>
		All Days: 3020 ± 620
	Lacrosse (n=20) <sup>†</sup>	Practice: 3717 ± 625 <sup>B</sup>
		Game: 4018 ± 591 <sup>A</sup>
		Conditioning: 3359 ± 652 <sup>C,B</sup>
		Off: 3140 ± 747 <sup>A,D</sup>
		All Days: 3559 ± 727
Activity Energy Expenditure (kcal/day)	Basketball (n=10)	Practice: 1179 ± 211 <sup>B,D</sup>
		Game: 1611 ± 489 <sup>A,D</sup>
		Conditioning: 1169 ± 549 <sup>D</sup>
		Off: 644 ± 270 <sup>C,D</sup>
		All Days: 1126 ± 525
	Lacrosse (n=20) <sup>†</sup>	Practice: 1824 ± 501 <sup>B</sup>
		Game: 2099 ± 553 <sup>A</sup>
		Conditioning: 1505 ± 522 <sup>C</sup>
		Off: 1298 ± 621 <sup>B</sup>
		All Days: 1681 ± 622
Physical Activity Levels (PAL)	Basketball (n=10)	Practice: 1.94 ± 0.18 <sup>B,D</sup>
		Game: 2.22 ± 0.32 <sup>A,D</sup>
		Conditioning: 1.92 ± 0.34 <sup>D</sup>
		Off: 1.56 ± 0.22 <sup>C,D</sup>
		All Days: 1.89 ± 0.36
	Lacrosse (n=20) <sup>†</sup>	Practice: 2.44 ± 0.35 <sup>B</sup>
		Game: 2.67 ± 0.44 <sup>A</sup>
		Conditioning: 2.21 ± 0.36 <sup>C</sup>
		Off: 2.14 ± 0.47 <sup>C</sup>
		All Days: 2.37 ± 0.45

<sup>†</sup>Significantly different between sports (p<0.05); Different letters denote statistical differences between days.

**2241** Board #160 May 28 3:00 PM - 4:30 PM  
**Examination Of Low Energy Availability And Sleep In High-intensity Functional Exercise Program Athletes**  
 Samantha R. Weber<sup>1</sup>, Toni M. Torres-McGehee<sup>1</sup>, Justin Goins<sup>1</sup>, Tim Bailey<sup>1</sup>, Erin Moore<sup>2</sup>, Jacob Kay<sup>1</sup>. <sup>1</sup>University of South Carolina, Columbia, SC. <sup>2</sup>University of South Florida, Tampa, FL.  
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 Reported Relationships: S.R. Weber: Industry contracted research; Study was funded by Avadim Technology.

Low energy availability (LEA) affects the body's physiological systems, which can negatively affect an athlete's performance and recovery. Athletes that participate in high-intensity functional exercise may not have adequate dietary intake to match energy needs or obtain optimal amount of sleep to recover fully.

**PURPOSE:** To examine the low energy availability (LEA) and sleep among male and female recreational athletes who engage in high-intensity functional exercise programs. **METHODS:** Thirty adults (age: 31.2 ± 8.1; males: n = 12, 176.9 ± 6.2 cm, 89.5 ± 15.1 kg; females: 164.7 ± 7.1 cm, 69.9 ± 11.1 kg) participated in a larger cross-sectional study. Participants completed a demographic survey, Pittsburgh Sleep Quality Scale, a 7-day online dietary and exercise log. Participants were measured for height, weight,

DXA scan (BMD), and RMR through indirect calorimetry (MedGem). ANOVAs examined differences between gender and energy needs, and Chi-squared analysis examined differences between gender and risk for LEA and Poor Sleep. **RESULTS:** Significant differences were found between gender and RMR (males: 2296.7±400.3 kg; females: 1761.7±341.6 kg; P=0.001), EI (males: 2027.5±694.5 kg; females: 1568.9±461.1 kg; P=0.038) and EEE (males: 357.8±60.3 kg; females: 279.3±44.4 kg; P≤0.01). No significant differences were found between gender and LEA (males: 24.8.7±12.2 kg; females: 25.0±8.9 kg). Overall risk for LEA was 66.7% (n = 20); however independently LEA was 50% (n=6) for males and 77.8% (n=14) for females. Overall, 63.3% (n=19) recreational athletes report poor sleep. No significant differences were found across gender and poor sleep, independently poor sleep for males was 50% (n=6) and females 72.2% (n=13). No significant differences were found between gender, poor sleep, and LEA. Of those at risk for LEA (n=20), 60% (n=12) also had reported poor sleep. **CONCLUSIONS:** Recreational athletes were at risk for both LEA and poor sleep, with a majority at risk for both. A combination of LEA and poor sleep can lead to poor performance and recovery from high-intensity exercises. Therefore, education to recreational athletes on the importance of dietary intake to match energy needs and encouragement for positive sleeping habits is imperative to optimize physiological recovery.

**2242** Board #161 May 28 3:00 PM - 4:30 PM  
**Effects Of Relative Energy Deficiency On Metabolism And Biomarkers In Korean Male Athletes**

Sihyung LEE<sup>1</sup>, Kuniko Moto<sup>1</sup>, Seungah Han<sup>2</sup>, Taewoong Oh<sup>2</sup>, Motoko Taguchi<sup>1</sup>. <sup>1</sup>Waseda University, Tokorozawa-shi, Japan. <sup>2</sup>Yongin University, Yongin-si, Korea, Republic of.  
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 (No relevant relationships reported)

2014 International Olympic Committee (IOC) consensus statement suggested the concept of 'Relative Energy Deficiency in Sport' (RED-S) presenting impaired physiological function caused by inadequate energy availability (EA) and it has been studying in many athletes. However, there are limited studies on Asian and male athletes.

**PURPOSE:** To investigate EA and its relationship with metabolic status, bone health, and endocrine changes which have been studied for RED-S consequences in Korean male collegiate soccer players during regular training season. **METHODS:** Twelve male athletes from the University soccer team in Korea participated in this study. The subjects completed subjective condition check form for one month and dietary record for energy intake (EI) with heart-rate monitoring for exercise energy expenditure (EEE) during one week. Body composition was measured using dual-energy x-ray absorptiometry (DXA) and physiological biomarkers were analyzed using blood and urine samples. Resting energy expenditure (REE) was measured using the Douglas bag method and predicted REE was calculated for REE<sub>ratio</sub> (measured REE/predicted REE) to evaluate metabolic status. The subjects were categorized into two groups by EA level as having relative energy deficiency (RED; EA <30 kcal/kg FFM/d, n=5) or moderate energy status (MES; EA ≥30 kcal/kg FFM/d, n=7).

**RESULT:** Total mean EA was 31.9 ± 9.8 kcal/kg FFM/d and the RED group showed significantly lower EA (22.4 ± 2.9 vs 38.7 ± 6.6 kcal/kg FFM/d, p<0.05) with lower REE<sub>ratio</sub> (0.96 ± 0.07 vs 1.09 ± 0.06, p<0.05) and REE/FFM (26.0 ± 1.7 vs 28.8 ± 1.4 kcal/kg/d, p<0.05) than the MES group. There was no difference in bone turnover markers. FSH was higher in the RED group (5.50 ± 1.01 vs 3.64 ± 1.41 mIU/mL, p<0.05) and IGF-1 was higher in the MES group (248.6 ± 51.2 vs 318.9 ± 43.4 ng/mL, p<0.05). The regression analysis showed that the athletes with lower EA were more likely to have the lower REE<sub>ratio</sub> and IGF-1 levels.

**CONCLUSION:** Relative energy deficiency can result in lower metabolic status and IGF-1 levels, but there are no relations with bone health status and other endocrine status in Korean male collegiate soccer players.

**2243** Board #162 May 28 3:00 PM - 4:30 PM  
**Energy Requirements And Intake Of Collegiate Athletes**

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Nutrition is an important aspect of sport performance, yet many athletes are unaware of how many calories they should, or do, consume on a daily basis. Limited literature exists comparing perceived energy requirements with actual energy requirements based on body composition. **PURPOSE:** To determine student athletes' awareness of energy requirements based on their body composition and physical activity level. **METHODS:** Athletes (N=41; 20 male and 21 female) were recruited from 7 of the 11 existing sports at a NCAA Division II institution. Knowledge of daily energy

requirements, estimated caloric intake, and a subjective indicator of physical activity level were assessed. Body composition, resting metabolic rate (RMR), and energy requirements were assessed via displacement plethysmography (ADP) (Bod Pod). Comparisons of in-season and out of season perceived caloric needs, estimated caloric intake, and actual energy requirements were made using paired sample T-tests. **RESULTS:** For males, significant difference were found between estimated caloric intake during in-season and energy requirements, if very active (2745 ± 973 vs. 4339 ± 564),  $t(20) = -6.21, p < .001$ , and if active (2745 ± 973 vs. 3672 ± 395),  $t(20) = -3.70, p = .002$ , and estimated intake out of season and energy requirements if very active (2627 ± 917 vs. 4339 ± 564),  $t(20) = -7.21, p < .001$ , and if active (2627 ± 917 3672 ± 394),  $t(20) = -4.51, p < .001$ . Significant differences were also found between in-season perceived and estimated intake (3085 ± 698 vs. 2745 ± 973),  $t(20) = 2.89, p = .009$ . For females, significant differences were also found between estimated intake during in-season and energy requirements if very active (2376 ± 653 vs. 3184 ± 378),  $t(21) = -4.32, p < .001$ , and estimated intake out of season and energy requirements if very active (1971 ± 880 vs. 3184 ± 378),  $t(21) = -5.42, p < .001$ , and if active (1971 ± 880 vs. 2676 ± 318)  $t(21) = -3.30, p = .004$ . **CONCLUSIONS:** Student athletes have limited knowledge of caloric needs as they relate to energy requirements as active or very active athletes. If estimated caloric intake represents actual daily intake, student athletes are not consuming adequate calories to meet energy needs. A follow-up study, using a three-day diet record, is being conducted and will be added to present study for further analysis.

**2244** Board #163 May 28 3:00 PM - 4:30 PM  
**Risk Factors For Relative Energy Deficiency In Sport In Costa Rican Female Runners**  
 Andrea Calvo-Castillo, Paula Delgado-Valverde, Catalina Capitán-Jiménez. *Hispanoamerican University, San José, Costa Rica.* (Sponsor: Anita M. Rivera-Brown, FACSM)  
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 (No relevant relationships reported)

Competing in weight sensitive sports increases the risk for low energy availability (EA) which is associated with health impairments. Most of the available evidence on syndromes that result from low energy availability is in female athletes. **PURPOSE:** To identify body composition, caloric intake, physical activity, and other risk factors for developing the syndrome of Relative Energy Deficiency in Sport (RED-S) in female runners. **METHODS:** 31 female recreational runners completed a sociodemographic and an adaptation to the RED-S CAT tool to evaluate 12 risks factors for RED-S, a 7-day weekly exercise record based on calories spent on training sessions using their heart rate monitor, a 3-day dietary record (two work days and one weekend day) completed with the app "My Fitness Pal" and a body composition evaluation by bioimpedance. Energy availability was calculated and classified as: No risk ( $\geq 45$  kcal/kg LBM/day); Moderate risk (30-45 kcal/kg LBM/day); and At risk ( $\leq 30$  kcal/kg LBM/day). **RESULTS:** Age of 33±6.0 years with experience of 7 to 9 years. The average personal record in 10 kilometers was 40:24:48±2.0 minutes. The average body mass was 53±5.3 kg, BMI=20.9±1.6 kg/m<sup>2</sup>, a percentage of body fat=26.4±3.7% and lean body mass=38.9±3.1 kg. The average reported daily exercise caloric expenditure was 529.5±176.4 kcal and daily caloric intake was 1679.5±327.7 kcal. Results showed an EA of 1147.7±343.3 kcal/day, or 29.6±9.1 kcal/kg of LBM/day. Only 6% of the runners were classified as no risk, 42% as moderate risk and 52% as at risk. Other risk factors were history of interrupted menstrual cycles (42%), birth control pills (29%), non-nutritional technique to lose weight (22%), history of eating disorder (16%), stress fracture (10%), hormonal disorder (7%). There was a weak and non-significant correlation between EA and personal best ( $r = -0.45, p = 0.811$ ). **CONCLUSION:** This group of Costa Rican runners demonstrate energy availability that is far below from the optimal and various risk factors to develop the syndrome of Relative Energy Deficiency in Sport.

**2245** Board #164 May 28 3:00 PM - 4:30 PM  
**A Nutritional Intervention In Exercising Women With Oligo/Amenorrhea Improved Energy Availability**  
 Kristen J. Koltun, Rebecca Mallinson, Nancy I. Williams, FACSM, Mary Jane De Souza, FACSM. *Penn State University, University Park, PA.* (Sponsor: Mary Jane De Souza, FACSM)  
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 (No relevant relationships reported)

Reduced energy availability (EA) suppresses reproduction and induces oligo/amenorrhea (O/A) in exercising women. Treatment goals are to increase energy intake (EI) to improve EA and restore menstrual function. **Purpose** Determine if a nutritional intervention that increased EI in exercising women with O/A improved EA and energetic status. **Methods** A 12 month randomized controlled trial designed to increase energy intake 20-30% above baseline energy needs in exercising women with O/A randomized participants into O/A+CAL (n=13) and Control (n=10) groups. EI and exercise energy expenditure (EEE) were assessed throughout the intervention. EA was calculated as EI-EEE/fat free mass (FFM). Fasting blood samples were collected to

assess TT<sub>3</sub> and leptin. Independent t-tests/Mann-Whitney U tests compared differences between groups and correlations were run between changes in energy and hormones. Data are mean ± SE. **Results** Subjects were 22±1 yr, BMI 20.0±0.4 kg/m<sup>2</sup>. Menstrual recovery was observed and previously reported. There were no pre intervention differences in EI (1837±95 kcal/d), EEE (390±40 kcal/d), FFM (41.5±0.8 kg) or EA (37.2±2.7 kcal/kg FFM/d) between groups. During the intervention there were greater absolute and percent increases in EI in O/A+CAL vs Control (448±170 vs -117±147 kcal/d,  $p=0.02$ ; 23.6±8.6 vs -4.6±8.4%,  $p=0.03$ ). There were no differences between groups in absolute or percent change for EEE (133±46 kcal/d,  $p=0.07$ ; 38.8±11.3%,  $p=0.10$ ) or FFM (0.6±0.3kg,  $p=0.60$ ; 1.6±0.7%,  $p=0.51$ ). Absolute increase in EA was greater in O/A+CAL vs Control (10.8±5.5 vs -6.0±3.9 kcal/kg FFM/d,  $p=0.03$ ), but no difference in percent change (29.2±13.4 vs -6.7±12.5%;  $p=0.07$ ). Absolute and percent increase in fat mass (2.3±0.3 vs 0.7±0.5,  $p<0.01$ ; 20.6±3.1 vs 5.4±3.2%,  $p<0.01$ ) and body mass (3.2±0.3 vs 0.8±0.8,  $p<0.01$ ; 6.1±0.7 vs 1.5±1.3%,  $p<0.01$ ) were greater in O/A+CAL vs Control. O/A+CAL had larger absolute and percent increases in TT<sub>3</sub> (10.3±5.0 vs -6.7±5.3 ng/dL,  $p=0.03$ ; 17.2±7.4 vs -8.3±5.5%,  $p=0.02$ ) and percent increase in leptin (85.1±24.0 vs -13.3±18.0%) vs Control. Changes in EI and EA were not associated with changes in hormonal markers. **Conclusion** An intervention designed to improve EI can be considered an effective nutritional intervention for managing oligo/amenorrhea in exercising women.

**2246** Board #165 May 28 3:00 PM - 4:30 PM  
**Body Composition And Energy Balance Changes In Collegiate Female Swimmers**  
 Kayla M. Ratliff, Julia C. Blumkaitis, Johnathan L. Boring, Anthony M. Hagele, Jessica M. Moon, Richard A. Stecker, Petey Mumford, Kyle S. Sunderland, Scott Richmond, Chad M. Kerkisick, FACSM. *Lindenwood University, St. Charles, MO.* (Sponsor: Dr. Chad Kerkisick, FACSM)  
 (No relevant relationships reported)

Maintaining energy balance (EB) throughout training and competition should be a primary goal for competing athletes. Female athletes, in particular, may be prone to low energy availability which can reduce performance and negatively impact training adaptations observed. Regular determination of EB is challenging due to the need for accurate dietary intake and energy expenditure. However, recently published formulas have allowed for the estimation of energy balance using body composition derived computation, but comparisons across competitive seasons in various sports are limited. **PURPOSE:** To examine the changes in body composition and EB in collegiate female swimmers across an entire competitive season. **METHODS:** Thirteen female NCAA Division II swimmers (mean ± SD: 19.5 ± 1.2 years; 68.9 ± 8.6 kg; 169.9 ± 8.8 cm) were evaluated annually at the beginning of two competitive seasons. Fat mass (FM), fat-free mass (FFM), and body fat percentage (BF%) were evaluated with dual-energy x-ray absorptiometry (DEXA) and changes in energy balance (EB) were calculated as 1.0(ΔFFM/Δtime) + 9.5(ΔFM/Δtime). Data was analyzed using paired samples t-tests. A p-value of 0.05 was used for statistical determinations. **RESULTS:** Approximately 406 days separated each DEXA scan. Although body mass was not significantly affected (Year 1: 68.9 ± 8.9 kg vs. Year 2: 69.4 ± 8.2 kg,  $p > 0.05$ ), a negative EB was observed (-67.0 ± 51.3 kcal·day<sup>-1</sup>) across the season. Significant changes ( $p < 0.001$ ) in FM (Year 1: 18.6 ± 5.0 kg vs. Year 2: 15.4 ± 5.1 kg), BF% (Year 1: 28.0 ± 4.9%; Year 2: 23.4 ± 5.7%), and FFM were observed across time (Year 1: 47.0 ± 5.3 kg vs. Year 2: 50.2 ± 4.8 kg). **CONCLUSION:** Assessments of changes in body composition and energy balance are important considerations for athletes and coaches regarding the health and performance of athletes. From Year 1 to Year 2, female swimmers were largely successful at maintaining their energy balance while significantly improving FM, FFM, and %BF. Body composition derived assessment of energy balance can be used to provide general indications of energy balance status in athletes across large periods of time.

**2247** Board #166 May 28 3:00 PM - 4:30 PM  
**Examination Of Low Energy Availability (LEA) And Macronutrient Intake Among Beach Volleyball Players**  
 Stephanie A. McKeen<sup>1</sup>, Toni M. Torres-McGehee<sup>1</sup>, Dawn M. Emerson<sup>2</sup>, Kelly Pritchett<sup>3</sup>, Allison B. Smith<sup>1</sup>, Meaghan Minori<sup>1</sup>. <sup>1</sup>University of South Carolina, Columbia, SC. <sup>2</sup>University of Kansas, Lawrence, KS. <sup>3</sup>Central Washington University, Ellensburg, WA.  
 (No relevant relationships reported)

Low energy availability (LEA) may be prevalent in female collegiate beach volleyball players, which can be a catalyst for negative health consequences. Athletes can present in a state of LEA as a result of inadequate intake of the recommended macronutrients; those being proteins (PRO), carbohydrates (CHO), and fats. **Purpose:** Examine the prevalence of LEA and macronutrient intakes (PRO, CHO, and fats) among NCAA Division I female collegiate beach volleyball players.

THURSDAY, MAY 28, 2020

**Methods:** Data from a larger cross-sectional study was used to examine recreational athletes (n=18; age: 19.8±1.4 years; height: 174.4±5.5 cm; weight: 63.2±5.1 kg). Athletes were moderately trained (exercised a minimum of 3-4 days/week). Data collection consisted of anthropometric data, surveys (e.g., demographics, age, gender, etc.), resting metabolic rate (RMR), a 7-day online dietary log to measure energy intake (EI), and exercise logs to measure exercise energy expenditure (EEE). Basic descriptive statistics, Chi-squares, and cross-tabulations were used to examine the proportion of participants classified as "at risk" for LEA (<30 kcal/kg/FFM) and the proportion that met the macronutrient recommendations.

**Results:** Overall, beach volleyball players demonstrated the following, with 94.4% (n=17) being identified as at risk for LEA: Average energy availability (EA): 12.4±9.6 kcal/kg FFM and average EEE: 1108.7±157.6 kcals. RMR recommendations for average minimal caloric intake for the sample was 1477.7±272.3 kcals; however, 55.6% (n=10) did not meet the recommendations. Recommended CHO and PRO macronutrient intake were not met by 100% and 61.1% of the sample, respectively. Overconsumption of fat compared to the recommendation was found in 33.3%.

**Conclusions:** Beach volleyball athletes in this sample were severely and alarmingly at risk for LEA. Most of the athletes demonstrated low CHO and PRO intake while overconsuming fat compared to the recommendations. These athletes would benefit from nutrition education focused on properly fueling and macronutrient intake, which are both essential for elite performance in the athletic arena.

**2248 Board #167 May 28 3:00 PM - 4:30 PM**  
**Body-composition Derived Energy Balance Changes Across An Entire Female Division II Basketball Season**

Anthony M. Hagele, Travis Russo, Johnathan L. Boring, Jessica M. Moon, Julia C. Blumkaitis, Richard A. Stecker, Kyle L. Sunderland, Petey W. Mumford, Scott Richmond, Chad M. Kerksick, FACSM, *Lindenwood University, St. Charles, MO.* (Sponsor: Chad Kerksick, FACSM)  
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 (No relevant relationships reported)

Limited data is available using body composition-derived metrics to establish energy balance (EB) in team-sport athletes, especially female athletes. Tracking EB is important for coaches and athletes to understand how well the energetic demands of training and competing are being met by the diet. **PURPOSE:** The purpose of this study was to determine and track changes in energy balance across an entire competitive season in female Division II basketball athletes. **METHODS:** Eight female NCAA Division II basketball athletes (mean ± SD: 19.3 ± 0.9 yrs.; 72.8 ± 7.7 kg; 176.0 ± 7.4 cm; 24.8 ± 3.2 % body fat) underwent three dual-energy x-ray absorptiometry (DXA) scans over approximately 12 months, separating the season into two phases (in-season, [IS, Week 1-24], offseason [OS, Week 24-49]) and combined to form a full season (FS, Week 1-49). Body composition derived energy balance (kcal·d<sup>-1</sup>) was estimated from changes in fat free mass (FFM) and fat mass (FM) between scans using the formula: EB (kcal·d<sup>-1</sup>) = 1.0 + 9.5 · Δ. Data was analyzed using factorial ANOVA with repeated measures on time. A p-value of 0.05 was used for statistical determinations. **RESULTS:** Across the FS, a positive EB of 87.4 ± 36.4 kcal·d<sup>-1</sup> was observed (P > 0.05), which tended to decrease across the entire season (p = 0.06). A net decrease in FFM (-0.52 ± 0.10 kg) and increase in FM (3.2 ± 0.5 kg) was observed. During IS, EB was greater (137.6 ± 29.1 kcal·d<sup>-1</sup>) due to significant changes (p<0.05) in FM (2.7 ± 0.5) and FFM (-2.6 ± 0.4). During the OS, EB was 39.6 ± 81.0 kcal·d<sup>-1</sup>, with an increase in mean FFM (2.0 ± 0.38 kg, P < 0.05) and FM (0.5 ± 0.5 kg, P > 0.05). **CONCLUSIONS:** Results from this study suggest that female collegiate basketball athletes were largely able to maintain energy balance across an entire season. A mean positive EB observed over the season which overlapped with negligible changes in FM and FFM suggest a suitable matching of energy intake and energy demands across the FS. This information is useful for athletic performance staff, who should be aware of EB when providing athletes with proper nutrition and fueling strategies, particularly during the IS period to maintain appropriate energy balance when travel, classes, and food access may complicate energy intake and also during OS when training goals should be achieved.

**2249 Board #168 May 28 3:00 PM - 4:30 PM**  
**Changes In Body Composition And Energy Balance In Collegiate Female Gymnasts Over Multiple Competitive Seasons**

Travis Joseph William Russo, Anthony M. Hagele, Johnathan L. Boring, Petey Mumford, Julia Blumkaitis, Kayla M. Ratliff, Jessica M. Moon, Richard A. Stecker, Scott Richmond, Kyle Sunderland, Chad M. Kerksick, FACSM, *Lindenwood University, St. Charles, MO.* (Sponsor: Chad Kerksick, FACSM)  
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The maintenance of energy status is an important dietary goal for competing athletes to properly fuel efforts, promote recovery, and prevent onset of illness or decrements in performance. Recent work in competing male athletes has reported on energy balance using body-composition derived parameters, but limited data is available highlighting changes in female athletes, and in particular female athletes who participate in physique sports. **PURPOSE:** To assess the changes in body composition and energy balance in female collegiate gymnasts over multiple competitive seasons. **METHODS:** 19 NCAA Division II collegiate female gymnasts (Mean ± SD; 18.4 ± 0.68 yr, 59.4 ± 4.5 kg, 160.9 ± 5.4 cm, 22.6 ± 2.2 % fat, 18.0±1.2 kg/m<sup>2</sup> fat free mass index) underwent dual-energy x-ray absorptiometry (DEXA) scans at the start of each season. Data was collected on all 19 subjects over three years with nine subjects being extended to a fourth year. Energy balance (EB) was calculated using a previously validated equation (EB= 1.0(Δ FFM/Δ Time) + 9.5(Δ FM/Δ Time) using fat free mass (FFM), time (days between scans) and fat mass (FM). A factorial ANOVA with repeated measures on time was conducted for changes in FFMI and Δ EB. Individual paired samples T-Tests were conducted when significance was found. **RESULTS:** Significant differences (p<0.05) between EB at year 1 (26.1 ± 46.7 kcals/day) and year 2 (-20.3 ± 57.9 kcals/day). Differences were also found (p<0.05) between years 2 (-20.3 ± 57.9 kcals/day) and year 3 (48.9±59.7) among the 9 subjects whose data extended to a fourth scan. No statistical significance was found (p > 0.05) between FFMI levels between year 1 (18.0 ± 1.2 kg/m<sup>2</sup>), year 2 (18.1 ± 0.8 kg/m<sup>2</sup>), and year 3 (18.3 ± 1.3 kg/m<sup>2</sup>). **CONCLUSION:** Changes in energy balance were largely stable in competitive female gymnasts across three years periods of time. Additionally and in concert, FFMI levels were also found to be stable across the measurement period. While statistically significant differences were present, the practical significance of these differences is not deemed to be relevant. Additional research is needed in all female athlete population to help identify and understand what dietary changes may be needed to best promote health, performance, and recovery.

**2250 Board #169 May 28 3:00 PM - 4:30 PM**  
**Examination Of Energy Availability And Hydration Status Among University Marching Band Artists**

Toni Marie Torres-McGehee<sup>1</sup>, Dawn M. Emerson<sup>2</sup>, Samantha R. Weber<sup>1</sup>, Nancy Uriegas<sup>1</sup>, Allison B. Smith<sup>1</sup>, Rebecca Hirschhorn<sup>1</sup>, Susan Yeargin<sup>1</sup>, Cormac Cannon<sup>1</sup>. <sup>1</sup>*University of South Carolina, Columbia, SC.* <sup>2</sup>*University of Kansas, Lawrence, KS.*  
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 (No relevant relationships reported)

Marching band (MB) members rehearse for pre-game and half-time performances outdoors for several hours a day starting at the end of July or beginning of August. There is lack of research on energy needs (e.g., energy availability) and proper hydration in MB during these hot months. **PURPOSE:** To examine energy availability and hydration status among MB members. A secondary purpose was to examine differences between sex. **METHODS:** We utilized data from a larger cross-sectional study. MB artists (n=37, Males: n=12, age: 19.8±1.4 years, height: 177.1±7.8 cm, weight: 74.6±23.8 kg; Females: n=25, age: 20.0±1.1 years, weight: 68.4±16.4 kg; height: 163.3±4.6 cm) from an NCAA Division I institution completed a survey (eg, basic demographics, band background, etc.) and were measured for height, weight, body composition, and resting metabolic rate (RMR). For 7-days, participants completed an online dietary log to measure energy intake (EI), wore a Polar m200 watch to estimate exercise energy expenditure (EEE) during rehearsals and gameday performances, and provided a morning urine sample to measure urine specific gravity (Usg). Low energy availability (LEA) was defined as <30 kcal/kg FFM/day and hypohydration was Usg >1.025. Basic descriptive statistics examined all energy needs and Usg. Chi square were used to identify proportions of members "at risk" for LEA and hypohydration and compared the differences across sex. **RESULTS:** Significant differences were found for EI for males and females respectively (2090.2±676.7 kcal, 1531.0± 460.8 kcals, P=.002). No significant differences were found for EEE and EA for males and females (335.5±66.0 kcal, 333.8± 66.9 kcals and 23.6±11.0 kcal/kg FFM, 22.9± 10.1 kcal/kg FFM). Overall, 73.7% (n=28) were at risk for LEA. No significant differences were found for Usg and sex (Males: 1.022±.006, Females: 1.022±.005), however 36.8% (n=14) reported chronically hypohydrated (≥ 4/7 days >1.025). Of those with LEA (n=28), 31.6% (n=12) also reported to be chronically

hypohydrated. **CONCLUSION:** The majority of MB members had LEA and over a third were also chronically hypohydrated. Due to performances in hot and humid environments, as well as the physical demands associated with MB, healthcare professionals should provide resources and education on hydration and proper fueling for MB artists.

**2251** Board #170 May 28 3:00 PM - 4:30 PM  
**Abstract Withdrawn**

**2252** Board #171 May 28 3:00 PM - 4:30 PM  
**Evaluation Of The Assessment Of Energy Availability In The Field**

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(No relevant relationships reported)

**PURPOSE:** The current study aimed to evaluate Sports Dietitian's methods of assessing energy availability (EA) in the field.

**METHODS:** Eligible participants were provided with a detailed web-based survey evaluating relevant elements of the assessment of EA among other related indicators.

**RESULTS:** A total of 112 Sports Dietitians (n= 105, 93.8% female) participated. Over half (n= 62, 55.4%) were Board Certified Specialists in Sports Dietetics (CSSD), with a majority practicing in a collegiate (n= 41, 36.6%), private practice (n= 31, 27.7%), or professional team (n= 31, 27.7%) setting. While 67% (n= 75) reported measuring energy balance while assessing athletes, only 41% noted evaluating energy availability. A higher proportion of Sports RDs practicing  $\geq 7$  years compared to  $< 7$  years acknowledged assessing EA (59.5% vs. 27.6%,  $p = 0.001$ ,  $X^2 = 10.3$ ). Sports RDs used a variety of methods to evaluate energy intake, including evaluation of "typical intake" during one-on-one session (n= 54, 48.2%), food log(s) (n= 30, 26.8%), 24-hour recall (n= 15, 13.4%), a combination (n= 5, 4.5%), or "other" method (n= 8, 7.1%), exercise energy expenditure, including activity factor estimates (n= 58, 51.8%), exercise logs (n= 32, 28.6%), a combination (n= 11, 9.8%), heart rate monitor (n= 6, 5.4%), or "other" methods, and body composition, including bioelectrical impedance analysis (n= 15, 13.4%), air displacement plethysmography (n= 15, 13.4%), dual energy x-ray absorptiometry (n= 14, 12.5%), and skinfold thickness (n= 11, 9.8%)

**CONCLUSIONS:** A majority of Sports Dietitians did not report regularly evaluating energy availability in their assessments of athletes. The variables used to calculate EA (i.e. EE, EEE, fat free mass) were evaluated using a variety of methods ranging in their level of potential error. Due to the potential difficulty and limitations of evaluating EA, development of a protocol for assessing EA may aid in increasing frequency and accuracy EA assessments in the field.

## D-67 Exercise is Medicine®/Poster - EIM: Exercise and Cognitive Function, Psychological Conditions and Sleep

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
Room: CC-Exhibit Hall

**2253** Board #172 May 28 2:00 PM - 3:30 PM  
**Number Of Inactive Adults With Arthritis Who Can Improve Their Anxiety And Depression By Exercising**

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State-level estimates of the number of physically inactive adults with arthritis and other rheumatic and musculoskeletal diseases (RMDs) who can improve their anxiety and depression is currently unknown but important given that national data may not be appropriate for the conditions observed in each state. **PURPOSE:** Provide state-level estimates of the number of physically inactive adults in the United States with RMDs who could improve their anxiety and depression by exercising. **METHODS:** Utilizing (1) number-needed-to treat (NNT) data from two prior meta-analyses of randomized controlled trials addressing the effects of exercise on anxiety and depression in adults with RMDs, (2) recent age-adjusted, state-level prevalence estimates on arthritis and physical inactivity in adults with arthritis and other RMDs, and (3) state-level 2000 US Census population data, the number of physically inactive adults with RMDs who could improve their anxiety and depression by exercising was estimated. **RESULTS:** Across all states, the number of adults with RMDs who could improve their anxiety and depression by starting an exercise program was estimated at 2,622,907 for anxiety

and 2,245,962 for depression. For anxiety, numbers ranged from 3,583 (95% CI = 2,592 - 4,863) in the District of Columbia to 201,173 (95% CI = 156,923- 254,135) in Texas. For depression, numbers ranged from 3,068 (95% CI = 2,219 - 4,164) in the District of Columbia to 172,262 (95% CI = 134,37 - 217,613) in Texas.

**CONCLUSIONS:** These findings provide important state-level information regarding the number of physically inactive adults in the United States with RMDs who could improve their anxiety and depression by exercising. This information should be useful to both interventionists and decision-makers.

**2254** Board #173 May 28 2:00 PM - 3:30 PM  
**12 Weeks Of Maximal Strength Training Restores Muscle Force-generating Capacity In Patients With Schizophrenia**

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Patients with schizophrenia spectrum disorders (ICD-10) suffer from impaired muscle force-generating capacity (MFGC) and functional performance of the lower extremities. **PURPOSE.** To investigate if 12 weeks of maximal strength training (MST) would restore MFGC and functional performance. **METHODS.** Forty-eight outpatients (28 men, 35±10 yrs; 20 women, 35±12 yrs) were randomized to a training group (TG) or control group (CG). Forty-eight age and gender matched healthy controls (28 men/20 women, 35±11 yrs) were tested to establish reference values. TG performed leg press MST (4x4 repetitions) 2d/week for 12 weeks at ~90% one repetition maximum (1RM). CG received two sessions of MST and encouragement to follow traditional physical activity guidelines. **RESULTS.** 17/24 patients in the TG (12 men/5 women, 34±11 years) completed 79% of training sessions and 19/22 patients in the CG (9 men/10 women, 37±12 years) completed the study. TG improved 1RM (28%, 12.6±4.1 to 16.2±5.0 Kg·m<sup>-0.67</sup>,  $p < 0.01$ ) and rapid force development (20%, 18.6±8.6 to 22.4±10.8 N·m·s<sup>-1</sup>·m<sup>-0.67</sup>,  $p < 0.01$ ), reaching 106% and 85% of healthy reference values, respectively. TG improvements differed from CG ( $p < 0.01$ ) where no changes occurred (1RM; 11.4±3.0 to 12.0±2.7 Kg·m<sup>-0.67</sup>, rapid force development 16.4±6.9 to 17.3±6.5 N·m·s<sup>-1</sup>·m<sup>-0.67</sup>). Both TG and CG improved 30-second sit-to-stand test (30sSTS) performance (15±3 to 17±4 stands and 13±3 to 14±3 stands, respectively,  $p < 0.05$ ). Changes were not apparent as between group difference nor close the gap to reference levels (27±5 stands). **CONCLUSION.** MST restored the patients' lower extremity MFGC and improved 30sSTS performance. Supported by grants from the Norwegian ExtraFoundation for Health and Rehabilitation, The Liaison Committee between the Central Norway Regional Health Authority and the Norwegian University of Science and Technology, and The Norwegian Directorate of Health.

**2255** Board #174 May 28 2:00 PM - 3:30 PM  
**Exercise Is Medicine For Mental Illness: Insights From Mental Health Professionals**

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**PURPOSE:** Serious mental illness (SMI) is a major public health concern linked with adverse outcomes (premature mortality, cardiovascular disease, obesity).<sup>1,2</sup> Physical activity (PA) has effectively reduced health risks,<sup>3-6</sup> yet challenges exist for effective PA treatment delivery and sustainability in SMI populations.<sup>7,8</sup> Certified peer specialists (CPSs), trained persons with lived recovery experience working in mental health settings, offer a potentially sustainable and reimbursable delivery mechanism for Exercise Is Medicine (EIM) PA interventions.<sup>9</sup> This study examined CPSs' insights on the feasibility and acceptability of an EIM intervention in adults with SMI delivered in peer group settings. **METHODS:** Qualitative data were collected Spring/Summer 2018 through 4 focus groups of 3-6 people per group. CPSs were recruited through two behavioral health facilities in Kansas (n=11) and Georgia (n= 8). Semi-structured focus group guides elicited information regarding knowledge of PA, current PA with SMI peers, role of the CPS to promote PA, and feasibility of administering a PA intervention. Audio files were transcribed verbatim and analyzed with NVivo11 using qualitative content analysis with an inductive approach.<sup>10,11</sup> **RESULTS:** Focus groups averaged 49±8 minutes. Data were coded into four themes: knowledge of PA, current PA with SMI peers, role of the CPS to promote PA, and PA intervention administration. CPSs stated their knowledge of PA is general and mostly comes from personal experience or internet searches. CPSs agreed their role covers Whole Health Action Management principles including promoting and participating in PA with SMI peers. CPSs were eager to participate in a PA intervention and willing to complete PA

training or certification. PA intervention administration included input on PA duration, frequency location, time of day, resources needed, motivators (e.g., buddy systems, competitions, rewards) and overcoming common SMI barriers (e.g., transportation). **CONCLUSIONS:** CPSS were willing to facilitate EIM interventions and offered valuable insights on current practices, program feasibility and administration. Findings will aid development of a PA intervention delivered through mental health services to address low rates of PA and reduce health disparities in adults with SMI.

**2256** Board #175 May 28 2:00 PM - 3:30 PM  
**Effects Of Taichi-qigong Exercise On Mental Health Of Nasopharyngeal Carcinoma Survivors**

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The incidence of nasopharyngeal carcinoma (NPC) is high in endemic areas. The long-term chemotherapy and radiotherapy cause bodily dysfunction and extended psychological stress in NPC cancer survivors. The meditative exercise, especially Taichi-Qigong exercise (TQE), are getting more common and continues to grow among cancer survivors. Empirical evidence found positive effects in improving side effects induced by cancer therapy from practicing TQE, however, scientific evidence is still lacking. **PURPOSE:** to evaluate the effects of a 10-weeks TQE, as a non-pharmacological treatment, on mental health of NPC survivors. **METHODS:** 43 NPC survivors (age 32-79 yrs-old; men 45.5%) recruited from the Cancer Patient Resource Centers of a local hospital, were randomly assigned into either a TQE (n=23) or a control group (n=20). The TQE group practiced TQE for at least 3 times a week (one 60-min instructor-led session and two 30-min self-practice sessions) for 10 weeks, whereas control group maintained usual care. Both TQE and control groups received health & diet education once a month. The pre- and post-outcome measures included: questionnaires on cancer-related quality of life (FACT-G), cancer-related fatigue (Brief Fatigue Inventory; BFI), depression (Center for Epidemiologic Studies Depression Scale; CES-D) and sleep quality (Pittsburgh Sleep Quality Index; PSQ). Same measures were obtained 3-months after the intervention (maintenance tests). **RESULTS:** Two-way (group x pre-post) repeated measure ANCOVA with age, gender, and body mass index (BMI) as covariates, found TQE exhibited significant better overall quality of life (FACT-G) ( $p \leq .05$ ), and emotional sub-scale of FACT ( $p < .10$ ). The benefits did not change at maintenance ( $p > .05$ ). The TQE group also demonstrated improved PSQ after intervention ( $p < .10$ ). There were no group difference in BFI and CES-D. ( $p > .05$ ) **CONCLUSIONS:** The present study provides preliminary findings to suggest that, Taichi-Qigong exercise, as a typical mind-body exercise, may contribute to better quality of life, emotion, and sleep quality during the course of NPC rehabilitation. Further study with longer intervention is needed to examine the effects of TQE on other mental health outcomes of cancer survivors such as fatigue and depression, as well as physical health outcomes.

**2257** Board #176 May 28 2:00 PM - 3:30 PM  
**Common Experiences And Beliefs Among Highly Active, Older Adults: Implications For Psychological Satisfaction And Frustration**

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**PURPOSE:** The prevalence of physical inactivity (PA) has remained largely unchanged in the USA, despite extensive informational campaigns calling for individuals to participate in more PA. Self Determination Theory (SDT) provides a well-researched framework for understanding motivation, and proposes that the satisfaction of three primary psychological needs (autonomy, competence, and relatedness) fuels motivation for physical activity and promotes wellness. This mixed-methods study used SDT to identify experiences and beliefs that affect individual motivation for physical activity in older adults. **METHODS:** The International Physical Activity Questionnaire was used to establish a moderate-high level of PA for all participants (3 males, 2 females; age range: 58-78). The Basic Psychological Needs Satisfaction and Frustration Scale (BPNSFS), and Motives for Physical Activities Measure Revised (MPAM-R) were used along with semi-structured interviews to elucidate the experiences and beliefs of the participants A Wilcoxon signed rank test was used to evaluate BPNSFS data for psychological satisfaction/frustration with the alpha-value set at 0.05. Researchers independently coded interview responses for motivational type (Competence, Social, Interest/Enjoyment, Fitness, Appearance) as well as statements of satisfaction and frustration. MPAM-R data identified motivational priorities and were compared with coding results to establish consistency.

**RESULTS:** Participants' scores indicated greater life satisfaction than frustration ( $p = 0.042$ ) for each of the three basic psychological needs. Qualitative analysis confirmed predominance of psychological satisfaction, as well as motivation driven by a need for competence, interest, and relatedness. Fitness was the highest scoring motivational construct on the MPAM-R, but was not frequently cited as motivational during the interviews. **CONCLUSIONS:** Active older adults showed greater satisfaction than frustration with the basic psychological needs, suggesting a potential association with moderate-high levels of PA. Motivational factors influencing PA varied among participants, but they shared many common beliefs (e.g., high value of PA and fitness) and experiences (e.g., free play as children).

**2258** Board #177 May 28 2:00 PM - 3:30 PM  
**Trainuvimab: Impact Of High-intensity Exercise On Cognition In Multiple Sclerosis - Interim And Subgroup Analysis**

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Cognitive impairment is a common symptom of Multiple Sclerosis that directly impacts patients' quality of life. Yet, evidence of treatments is mixed. Exercise reveals high potential as a supportive non-pharmacological therapy.

**PURPOSE:** To investigate the effects of a three-week high-intensity interval training (HIIT) on processing speed, verbal and visual-spatial memory in cognitive impaired persons with MS (pwMS).

**METHODS:** 66 persons with relapsing-remitting (RR) or secondary-progressive (SP) MS were randomly assigned to an intervention (HIIT: 5x 1.5min intervals at 95-100% HF<sub>max</sub>, 3x/week) or an active control group (CG: 24min continuous exercise at 65% HF<sub>max</sub>, 3x/week). For subgroup analysis participants with cognitive impairment were identified (deviation of  $\leq 1.5$  SD from normative test data from at least one test). Cognitive performance was assessed pre and post to the intervention period with the Brief International Cognitive Assessment for Multiple Sclerosis (BICAMS). Potential within (pre vs. post) - and between -subject (group, MS-type) effects and their interactions were investigated by analysis of variance (ANOVA) with repeated measures. Post-hoc tests (Bonferroni) were conducted for significant main effects of within or between-subjects.

**RESULTS:** 28 pwMS were identified as cognitively impaired. ANOVA revealed no significant interactions for any outcome and showed no significant main effects for visual-spatial memory. Significant main effects (factor time) were observed for processing speed ( $F(1, 24)=15.65, p=.001$ ) and verbal memory ( $F(1, 24)=4.85, p=.037$ ). In the HIIT-group participants with RRMS significantly improved processing speed over time (MD: -4.67, 95%-CI [34.41, 43.81],  $p=.023$ ), whereas no changes ( $p=.051$ ) were shown for participants with SPMS. No improvements were observed for the CG. Pairwise comparisons revealed no significant changes for verbal memory.

**CONCLUSION:** Compared to the CG, HIIT shows stronger impact on processing speed for RRMS. SPMS-type showed no changes. However, results should be interpreted cautiously, as the data set reveals no significant main effects for group and MS-phenotypes.

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**2259** Board #178 May 28 2:00 PM - 3:30 PM  
**Effect Of A Multicomponent Exercise Program On Functional Capacity And Cognitive Function In Frail Community Elders With Cognitive Decline**

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**PURPOSE:** Both frailty and mild cognitive impairment are prevalent issues among the geriatric population but have traditionally been evaluated on separate terms. Given the growing evidence that these two conditions might share a biological substrate, interventions aiming to improve physical function might as well induce benefits on cognitive function. The main objective was to test the effect of a multicomponent

exercise program (VIVIFRIL) on both domains in frail and pre-frail patients (according to Fried criteria) with evidence of mild cognitive impairment or mild dementia (Reisberg GDS 3 and 4).

**METHODS:** We performed a preliminary analysis of 96 recruited patients (mean age 83±5) from three Spanish hospitals (San Sebastian, Pamplona and Getafe). Subjects were randomized to a control or an intervention group, the last one undergoing a 12-week multicomponent exercise program (VIVIFRIL). Changes in functional capacity were evaluated through Short Physical Performance Battery (SPPB), one leg press repetition maximum strength (1-RM) and Barthel index, and those in cognitive function with the Montreal Cognitive Assessment test (MOCA), verbal fluency and the Mini Mental State Examination (MMSE).

**RESULTS:** Significant improvement was found in the following variables: SPPB improved in 1.14 points ( $p=0.002$ ), 1-RM improved in 12 points ( $p=0.035$ ), MOCA test improved in 3.32 points ( $p=0.033$ ) and verbal fluency improved in 2 points ( $p=0.028$ ) in the intervention group versus the control group.

**CONCLUSIONS:** A multicomponent exercise intervention program using the VIVIFRIL methodology improves both functional capacity and cognitive function in frail and prefrail elderly patients who exhibit mild cognitive impairment and mild dementia.

**2260** Board #179 May 28 2:00 PM - 3:30 PM  
**Exercise Is Associated With Decreased Fracture Odds In Young Adults With Attention Deficit Hyperactivity Disorder**

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Young adults with Attention Deficit Hyperactivity Disorder (ADHD) have higher fracture rates than healthy adults. While exercise is recommended for people with ADHD to alleviate hyperactivity-impulsivity, little is known about the relationship between exercise and fracture in this population. **PURPOSE:** To explore the association between exercise and fractures in young adults with ADHD, not using medication. **METHODS:** We performed a retrospective analysis of data of young adults with ADHD treated at the University of Alabama at Birmingham Health Systems. We selected a case if an individual was previously diagnosed with ADHD using ICD-10 code F90 and ages between 21 and 35 years. The comparison group were individuals with ADHD and have not had a fracture within the same age limits. The outcome variable was whether a patient with ADHD diagnosed with a fracture or not during this period. Exercise files included data about exercise status (i.e., yes or no), frequency (i.e., low, moderate, or high), and type (i.e., aerobics or non-aerobics). Exercise assessment was within the year before the fracture date for fracture group and within the year before data acquisition for the non-fracture group. We ran a multivariable logistic regression analysis to test the association between fractures and 1) exercise status, 2) exercise frequency, and 3) exercise type, controlling for sex. We analyzed the data using STATA SE 15.1. **RESULTS:** Our analyses included 296 persons with a mean age of 27.29 ± 4.17 years for the comparison group and 28.0 ± 3.58 years for the fracture group. The mean age of fracture in the fracture group was 25.09 ± 3.45. Also, the logistic regression that was controlled for sex, showed that individuals who exercised had significantly lower odds of having a fracture compare to those that reported no exercise [OR: 0.14, 95% CI: 0.08, 0.27]. Of those, females compared to males, were also significantly associated with sustaining fewer fractures, controlling for exercise status [OR: 2.86, 95% CI: 1.53, 5.35]. Finally, exercise frequency and exercise type were not significantly associated with fracture risk. **CONCLUSIONS:** Engaging in exercise might decrease the odds of sustaining a fracture in young adults with ADHD. Exercise needs to be studied more in young adults with ADHD to determine how exercise may protect against fractures.

**2261** Board #180 May 28 2:00 PM - 3:30 PM  
**Physical Activity Is Critical To Preserve Cognitive Function In Nephrology Patients**

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Chronic kidney disease (CKD) associates with earlier onset of cognitive impairment. Physical activity (PA) improves neuronal plasticity and cognitive function among older adults. However, limited data exist exploring the effect of PA on cognitive function in CKD patients. **PURPOSE:** To investigate the effect of regular physical activity on cognitive function in CKD patients. **METHODS:** We analyzed 68 patients with CKD admitted to a Midwestern hospital between January 2017 and

July 2018. All subjects provided a health history, had a comprehensive metabolic panel with estimated glomerular filtration rate (eGFR), and reported whether they engaged in regular physical activity (PA). Cognitive impairments, including dementia, Alzheimer's, and Parkinson's disease were documented. Independent-samples t-tests and chi-squared tests compared patient profiles between sedentary and active patients. Logistic regression analyses tested the effect of PA on cognitive impairments holding constant other significant predictors. **RESULTS:** Patients were 64.7 ± 17.4 years old, had an eGFR of 24.7 ± 13.8 mL/min, 66.2% were sedentary, and 25.0% had a cognitive impairment. Older subjects were more likely to have a diagnosis of cognitive impairment ( $p=0.051$ ) and the prevalence was higher in sedentary patients (33.3%) than in those who were physically active (8.7%;  $p=0.026$ ). Holding constant the age of the patient and the stage of CKD, engagement in PA shared a trending association with mental impairment ( $p=0.056$ ), predicting a 79.8% reduction in the likelihood of diagnosis (Pseudo  $R^2 = 0.187$ ; 95% CI of OR: 0.039 to 1.040). Similarly, controlling for eGFR rather than CKD stage, the significance of PA as a predictor remained stable ( $p=0.057$ ; 95% CI of OR: 0.039 to 1.052). **CONCLUSIONS:** Patients with CKD experience a higher risk of cognitive impairment than age-matched controls. In our sample, engagement in regular physical activity demonstrated a protective effect, and sedentary behavior influenced diagnosis more than age.

**2262** Board #181 May 28 2:00 PM - 3:30 PM  
**Exercise And Geriatric Depression: A Scoping Review Of The Research Evidence**

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Geriatric depression is a common late-life mental health disorder that increases morbidity and mortality. It has been shown that exercise is effective in alleviating symptoms of geriatric depression. However, inconsistencies across studies and lack of optimal dose-response of exercise for improving geriatric depression have made it challenging to draw solid conclusions on the effectiveness of exercise in late-life depression. **Purpose:** To further investigate the moderators of the effectiveness of exercise on geriatric depression across the current body of evidence. **Methods:** Based on the Arksey and O'Malley framework, an extensive search strategy was performed by exploring PubMed, Scopus, Sport Discus, PsycInfo, ERIC, and IBSS without limitations in the time frame. Eight systematic reviews with empirical results and evaluated the effect of exercise on depression among people aged 60 years and older were identified, and their individual studies were screened for inclusion. One additional study was found through the hand searching of reference lists. After full-text screening and applying inclusion and exclusion criteria, 21 studies were retained. **Results:** The review revealed high variability in characteristics of the exercise interventions and outcome measures. Sample characteristics, nature of comparators, main outcome assessment, and baseline severity of depression also varied notably. Mind-body and aerobic exercises were found to significantly reduce geriatric depression. However, results on the relationship between resistance training and improvements in geriatric depression were inconsistent, and results of the intensity-related antidepressant effects of exercise interventions were mixed. Extensive use of self-reported questionnaires for the main outcome assessment and lack of evidence on the relationship between depression severity and observed effect were of the other important highlights of the review. **Conclusion:** Several literature gaps were found regarding the potential effect modifiers of exercise and geriatric depression. While acknowledging the complexity of establishing recommendations on the exercise variables and geriatric depression, future studies are required to understand the threshold effect of exercise for treating geriatric depression.

**2263** Board #182 May 28 2:00 PM - 3:30 PM  
**Effect Of 1 Year Of Qigong Exercise On Cognitive Function Among Older Chinese Adults**

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**Objectives.** To compare the effectiveness of a tailored qigong exercise versus stretching and toning exercises in the maintenance of cognitive abilities in Chinese elders at risk of cognitive decline. **Design.** A 1-year, single-blind, cluster randomized controlled trial. **Method.** Seventy-four older Chinese adults with risk of cognitive decline were enrolled in the study. They were cluster randomized to the qigong group and to the stretching and toning control exercise group. Cognitive and functional performance were assessed at baseline and at 1 year as measured using the Chinese version of Montreal Cognitive Assessment-Basic (MoCA) test and the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). **Results.** At 1 year, 25 of 33 participants (75.8%) in the qigong group and 26 of 33 participants (78.8%) in the control group completed the exercise intervention. A bivariate correlation test indicated a good correlation between the MoCA test score and the

RBANS total score after the intervention ( $r = 0.517, p < 0.01$ ). Generalized estimating equations revealed that those in the qigong group had lower risk of progression of cognitive decline at 1 year (odds ratio, 0.314; 95% confidence interval, 0.103-0.961;  $p = 0.04$ ). Two-way repeated-measures analyses of variance followed by post hoc  $t$ -tests with Bonferroni corrections indicated that performances on the MoCA test and the RBANS were significantly better in the qigong group than in the control group for the MoCA score ( $p < 0.01$ ) and the RBANS cognitive domains of global cognition ( $p < 0.01$ ), memory ( $p < 0.01$ ), visuospatial/constructional ( $p < 0.01$ ), and language ( $p < 0.01$ ) abilities, but not for attention ( $p > 0.05$ ). **Conclusions.** Performance of qigong for 1 year was significantly superior to stretching and toning exercises not only for preventing progression of cognitive decline but also for improving several cognitive functions among older Chinese adults at risk of cognitive decline.

**2264** Board #183 May 28 2:00 PM - 3:30 PM  
**A 6-week Aquatic Exercise Improve Accelerometer-measured Sleep Efficiency Among Adults With Chronic Musculoskeletal Pain**

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To investigate the effect of a 6-week moderate-intensity aquatic exercise program on sleep efficiency, sleep quality, pain, stress and physical activity among adults. **METHODS:** A quasi-experimental trial was conducted with a sample of 30 adults with chronic musculoskeletal pain, assigned to two groups (Intervention Group and Control Group). Subjects were recruited by convenience sampling through a community physiotherapy Centre in Hong Kong. Subjects allocated to the intervention group followed a structured, 6-week, bi-weekly, 60-minute aquatic exercise program. The 12 sessions were supervised by a qualified aquatic fitness instructor in a 20x10m pool with water temperature controlled. Six exercises were performed in each session with one old exercise replaced by a new one in each session. During the session, heart rate and RPE were monitored. Control Group was reminded to not change their exercise habits or medication regimen. Data regarding sleep efficiency by ActiGraph, sleep quality by Chinese version of the Pittsburgh Sleep Quality Index (CPSQI), pain by numeric pain rating scale were collected before and after the 6-week aquatic exercise program. Data were analyzed with SPSS 25 and a  $p$ -value less than 0.05 indicated statistical significance of results. **RESULTS:** No statistically significant differences on all demographic data and outcome measures between intervention and control group in the baseline measurement, except there was significantly higher average BMI ( $p \leq 0.05$ ) and fewer total true sleep hours ( $p \leq 0.001$ ) in intervention group. Significantly longer total true sleep time (27 minutes,  $p \leq 0.01$ ), greater sleep efficiency (3% improvement,  $p \leq 0.01$ ), less pain ( $p \leq 0.05$ ) and better sleep quality ( $p \leq 0.05$ ) were found in intervention group. Significant group-time interaction found only in total true sleep time ( $p \leq 0.001$ ). **CONCLUSION:** Aquatic exercise has been proven effective in improving sleep. From the within-group pre-post result, it shows that there is a statistically significant improvement in term of sleep efficiency and reduction of pain. This study helps to extend the work by studying the effect of aquatic-based exercise on adults with chronic musculoskeletal pain.

**2265** Board #184 May 28 2:00 PM - 3:30 PM  
**Meta-analysis Of Ba Duanjin In The Treatment Of Insomnia**

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Meta-analysis of Ba Duanjin in the treatment of insomnia  
 Abstract:

**Objective:** Insomnia is the most common diseases. Long-term insomnia can seriously affect normal life , even lead to a serious accident. Ba Duan Jin is a traditional Chinese exercise, which can regulate meridians qi -blood-body fluid, and improve the quality of sleep. This article comprehensively evaluates the effect of Ba Duan Jin on insomnia by meta-analysis.

**Methods:** Searching Wanfang platform, VIP consulting platform , CNKI, Pubmed and Springer on Ba Duanjin in the treatment of insomnia Randomized controlled trial (RCT) . Meta-analysis was performed using revman5.3 software. The main indicators were the number of recovered patients ,effective patients and invalid patients, the Pittsburgh sleep quality score (PSQI).

**Results:** A total of 98 articles were retrieved by searching in computer . Excluding the literature which is repeated or with incomplete date , the final including was 9 RCT.A total of 789 patients were included in the analysis. Meta-analysis showed that the number of patients with recovery was higher in the experimental group than in the control group. [OR=3.14, 95% CI (2.18, 4.52),  $p < 0.00001$ ], and the number of invalid

patients was lower. [OR=0.19 , 95% CI (0, 12, 0.31),  $p < 0.00001$ ], the difference was statistically significant. There was no statistical difference between the effective groups. PSQI were not statistically different due to excessive heterogeneity. **Conclusion:** This meta-analysis showed that in the treatment of insomnia, the clinical efficacy of the group with Ba Duan Jin intervened was better than the group with the conventional drug, and the difference was statistically significant.

**D-68** Free Communication/Poster - Cognition and Emotions

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
 Room: CC-Exhibit Hall

**2266** Board #185 May 28 2:00 PM - 3:30 PM  
**The Effect Of Brief Mindfulness Intervention As Adjuvant Of Fluid Intake On Athletes' Cognitive Function**

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 (No relevant relationships reported)

**PURPOSE:** The present study investigated the effect of combined fluid intake and brief mindfulness intervention (MBI) in a simulative half-time break of soccer competition on athletes' cognitive function.

**METHODS:** In a 3 (treatments)  $\times$  2 (times) double-blinded cross-over design, fourteen male athletes (age: 24.3 $\pm$ 3.7 yr, height: 173.8 $\pm$ 4.5 cm, weight: 68.3 $\pm$ 5.1 kg,  $VO_{2max}$ : 47.0 $\pm$ 4.4 ml/kg/min) received three treatments (Control: non-carbohydrate (CHO) electrolyte solution + traveling introduction audio; CHO: CHO-electrolyte solution + travelling introduction audio; and CHO\_M: CHO-electrolyte solution + MBI) in a simulative half-time break. Cognitive function performance (assessed by Stroop Test, Corsi Block Test, Rapid Visual Information processing task (RVIP)), mindfulness level, blood glucose and lactic, rating of perceived exertion was tested at different time points during the trial.

**RESULTS:** Major findings include: (1) CHO\_M trial obtained a better score in post Stroop colour test when compared with Control trial (CHO\_M vs. Control: 17813.87  $\pm$  3706.98 vs. 22990.43  $\pm$  6665.36;  $p = .04$ ); (2) a significant interactive effect was observed on the performance of Corsi block test ( $p = .03$ ). Specifically, the reaction time decreased from pre-trial to post-trial in CHO\_M and Control trials (pre vs. post: 826.88  $\pm$  384.67 vs. 667.49  $\pm$  331.56 ms,  $p < .01$  for CHO\_M; pre vs. post: 1085.43  $\pm$  388.51 vs. 798.36  $\pm$  253.28 ms;  $p < .01$  for Control), but not in CHO trial (pre vs. post: 832.68  $\pm$  296.37 vs. 810.11  $\pm$  347.70 ms,  $p = .66$ ); (3) CHO trial spent less time on missing numbers in post RVIP test than the other two trials (Control vs. CHO vs. CHO\_M: 5939.57  $\pm$  2100.27 vs. 3316.79  $\pm$  2716.73 vs. 6201.43  $\pm$  4013.58 ms;  $p = .03$ ), given that their performance in pre-test were statistically the same ( $p = .13$ ).

**CONCLUSIONS:** In conclusion, a positive effect of the combined fluid intake and brief MBI on athlete's cognitive function was revealed, while both positive and negative effect was revealed for fluid intake only.

**2267** Board #186 May 28 2:00 PM - 3:30 PM  
**Preschoolers Demonstrate Similar Learning And Enhanced On-task Behavior Following Physically-active Lessons On Emerging Numeracy Skills**

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Previous studies demonstrate variable effects of physically-active instruction on academic achievement and classroom behavior. The utility of such approaches to train the approximate number system—a foundational construct underlying later mathematics achievement—in preschoolers remains unclear.

**PURPOSE:** To determine the acute effects of physically-active lessons on acuity of the approximate number system and on-task behavior in preschoolers.

**METHODS:** Using a randomized within-participants repeated-measures crossover design, children ( $N = 51$ ; 3-5 y) completed a computerized approximate number system task before and after engaging in either 20-min of either physically-active or conventional sedentary instruction during two separate, counterbalanced sessions. The conventional sedentary lessons consisted of activities previously shown to strengthen approximate number representations (i.e., number line estimation, counting, and magnitude estimation) at an intensity of approximately 12% heart rate reserve whereas the physically-active lessons consisted of comparable activities integrated with

movement corresponding to 30% heart rate reserve. Separate univariate multi-level models were constructed. Difference in pedometer step count between conditions was analyzed using independent t-test.

**RESULTS:** Although no significant differences were observed in behavioral task performance at posttest between conditions,  $F_s(2,49) \leq 1.0, p_s \geq 0.434, f^2_s < 0.02$  [95% CI: 0 to 0.08], fewer experimenter redirections were required following the physically-active lessons ( $2.5 \pm 2.8$ ) relative to following the conventional sedentary lessons ( $5.0 \pm 3.6$ ),  $F(1, 49) = 20.7, p < 0.001, f^2 = 0.61$  [95% CI: 0.24 to 1.29]. On average, children accrued  $931.3 \pm 8.2$  more steps during the physically-active lessons relative to the sedentary lessons,  $t(95) = 19.1, p < .001, d_s = 3.91$  [95% CI: 3.19 to 4.55].

**CONCLUSION:** Physically-active lessons on emerging numeracy skills do not impede training of the approximate number system and result in greater on-task behavior relative to conventional sedentary lessons in preschoolers. Future studies should explore the integration of such approaches into early childhood education.

**Funding:** Supported by funds from the Department of Kinesiology at Michigan State University.

**2268 Board #187 May 28 2:00 PM - 3:30 PM**  
**History Of Heading In Soccer Impairs Cognition But Not Cerebral Perfusion In Young Amateur Players**

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 (No relevant relationships reported)

Heading the ball in soccer has been linked to impaired cognition and may increase the risk of neurodegenerative disease. This may be explained by an accelerated decline in cerebral perfusion, a major risk factor for cognitive impairment, stroke and dementia, for reasons that remain unclear.

**Purpose** To determine if a history of recurrent heading of a football predisposes to cerebral hypoperfusion and cognitive impairment.

**Methods** Twenty-nine amateur male soccer players (age:  $28 \pm 6$  yrs) with a playing history of  $15 \pm 6$  yrs and a self-reported heading frequency of  $9 \pm 4$  balls per game were recruited for the study. They were compared to 32 age and fitness-matched controls who had not participated in contact sports with no history of concussion. All participants completed a battery of psychometric tests that assessed learning and memory (Rey-Auditory Verbal Learning Test), working memory (Repetition of Digits Backwards; Trail Making Test B) and attention and information processing (Repetition of Digits Forwards; Trail Making Test A; Digit Symbol Substitution Test). A sample of the soccer players ( $n = 13$ ) and controls ( $n = 22$ ) also completed a cerebrovascular screening whereby middle cerebral artery velocity (MCAv) and mean arterial blood pressure (MAP) were assessed using transcranial Doppler ultrasound and finger photoplethysmography, respectively. Cerebrovascular conductance/resistance were calculated as MCAv/MAP and MAP/MCAv.

**Results** Soccer players were characterized by impaired learning and memory, and attention and information processing compared to controls ( $P < 0.05$ ; Table 1). However, no between group differences were observed in MCAv, CVC or CVR between groups ( $P > 0.05$ ; Table 1).

**Conclusion** Heading the ball in soccer is associated with impaired cognition that appears to be independent of cerebral hypoperfusion.

**Table 1.** Cognitive function and cerebral perfusion

	Controls	Soccer Players	P Values
MCAv (cm.s <sup>-1</sup> )	59 ± 12	61 ± 10	0.587
MAP (mmHg)	88 ± 20	90 ± 11	0.620
CVC (cm.s <sup>-1</sup> .mmHg)	0.71 ± 0.20	0.69 ± 0.15	0.959
CVR (mmHg.cm.s <sup>-1</sup> )	1.49 ± 0.32	1.51 ± 0.33	0.922
Rey Auditory Verbal Learning Test A1-A5 (n)	53 ± 8	46 ± 9*	<b>0.002</b>
Rey Auditory Verbal Learning Test B1 (n)	7 ± 2	5 ± 2*	<b>0.001</b>
Rey Auditory Verbal Learning Test A6 (n)	12 ± 3	10 ± 2*	<b>0.002</b>
Rey Auditory Verbal Learning Test A6-A5 (n)	-1 ± 2	-1 ± 1	0.450
Repetition of Digits Backwards (n)	6 ± 2	5 ± 2	0.429
Trail Making Test B (s)	57 ± 14	62 ± 13	0.186
Repetition of Digits Forwards (n)	8 ± 2	6 ± 2*	<b>0.001</b>
Trail Making Test A (s)	26 ± 6	30 ± 9	0.066
Digit Symbol Substitution Test (n)	61 ± 10	57 ± 10	0.134

**2269 Board #188 May 28 2:00 PM - 3:30 PM**

**Exercise Affect And Cardiac Vagal Tone: A Psychophysiological Connection**

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(No relevant relationships reported)

**INTRODUCTION:** Evidence suggests vagal tone may be a viable physiological marker of exercise readiness and recovery. However, whether vagal tone is associated with feeling states (i.e., affect) prior-to, during, and following exercise is poorly understood. Consistent with psychological hedonism, individuals will pursue exercise that elicits pleasure while avoiding displeasure. Thus, it is of interest whether an index of physiological readiness is associated with dis/pleasure while engaging in high-intensity interval exercise. **PURPOSE:** Explore the psychophysiological relationship between reactivity and recovery of phasic vagal tone and affect occurring during high-intensity interval exercise (HIIE). **METHODS:** Participants (N= 25, 13 females, 23.3±4.0 yrs) completed a 20-minute session of HIIE (5-blocks of 3-min exercise to 1-min rest) where vagal tone (i.e., High Frequency Power) and affect (via Feeling Scale) was recorded prior to, during (vagal tone recorded during rest-intervals), and up to 15-min post-exercise. **RESULTS:** Prior to exercise, vagal tone ( $6.5 \pm 1.6$ ) and affect ( $2.4 \pm 1.4$ ) were positively related ( $r = 0.58$ ). Upon HIIE initiation, both vagal tone and affect significantly declined during Block 1 ( $1.6 \pm 1.7, P < 0.001; 1.7 \pm 2.0, P < 0.001$ , respectively). Vagal tone remained withdrawn (Rest-2:  $-1.2 \pm 1.5; R3: 0.8 \pm 1.5; R4: 1.3 \pm 1.5; P_s > 0.05$ ) until post-15 ( $4.1 \pm 2.9$ ). Affect significantly declined during each exercise block (Block 1Δ:  $-0.6; B2Δ: -0.7; B3Δ: -1.1; B4Δ: -1.6; B5Δ: -1.0; P_s < 0.05$ ), but also significantly increased following each rest-interval (Rest-1Δ:  $+0.4; R2Δ: +0.5; R3Δ: +0.7; R4Δ: +1.3; P_s < 0.05$ ), with post-15 affect ( $3.0 \pm 1.9$ ) significantly exceeding pre-affect ( $P < 0.01$ ). Time-lagged correlations suggested small-to-moderate relationships between vagal tone and affect during the HIIE ( $r_s = 0.22-0.47$ ), with a disconnection at post-15 ( $r = -0.03$ ). **CONCLUSIONS:** As expected, participants experienced vagal tone withdrawal at HIIE initiation and a decline in pleasure during high-intensity exercise blocks, with affective rebounds during recovery. This suggests vagal tone can be a psychophysiological marker of affective readiness and displeasure experienced during exercise, but not as an index of affective recovery.

**2270 Board #189 May 28 2:00 PM - 3:30 PM**

**The Effect Of Mind-body Exercise On Working Memory: Differences Between Experts And Novices**

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**BACKGROUND:** Working memory is one of the sub-abilities of executive function and plays an important role in the entire cognitive process. However, working memory decline in aging seriously impairs the living ability of older people. Therefore, how to mitigate the decline of working memory function in older adults has become a focal point of current research. Mind-body exercise (MBE) is considered an effective

way to delay cognitive decline in older adults, but the effects of MBE on working memory function and mechanisms by which MBE may improve cognition in older adults remain unknown. **PURPOSE:** This study explores whether long-term MBE will influence working memory function by comparing MBE experts with novices. These findings will provide theoretical and empirical basis for maintaining the cognitive function of older people. **METHODS:** A total of 39 healthy older people (all female, mean age = 65.23 ± 2.43 years) from a community in Beijing participated in this experiment. 13 subjects in the Tai Chi group (TC) experienced more than 5 years of TC exercise. 13 subjects in the Baduanjin group (BD) experienced more than 5 years of BD exercise, and 13 subjects without systematic MBE were assigned to the control group. Each participant was administered the N-back task to evaluate working memory function. The primary outcome was reaction time (RT) and accuracy rate (AR) for the N-back task. **RESULTS:** the TC group and BD group had faster RT for N-back task compared with the novice group ( $p < 0.05$ ). The RT of the BD group was faster than the TC group, but the difference was not significant ( $p > 0.05$ ). The TC group and BD group had higher AR for the N-back task compared with the novice group ( $p < 0.05$ ). The AR of TC group was higher than BD group, but the difference was not significant ( $p > 0.05$ ). **CONCLUSION:** Different BMEs are beneficial to the working memory function of the elderly. Compared with the novices, long-term BME can significantly improve the working memory function of older adults, which is an effective exercise to maintain the cognitive function of the elderly.

**2271** Board #190 May 28 2:00 PM - 3:30 PM  
**Influence Of Single Bouts Of Different Exercise Intensities On Dual-tasking Efficiency In Healthy Individuals**

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**PURPOSE:** Dual-tasking refers to concurrent performance of two physical or mental tasks. Considering the critical role of dual-tasking in daily life, it is important to develop interventions to improve its efficiency or slow down its decline with age or disease. The specific purpose of this research was to study the effects of single bouts of a moderate-intensity (MI) or high-intensity interval training (HIIT) exercise on the efficiency of the extended cognitive Timed Up and Go (ETUGcog) test, which involves concurrent performance of physical and mental tasks.

**METHODS:** 17 males and females aged 23-35 years underwent two different single bouts of exercise sessions, a HIIT and a MI, on separate occasions, based on established protocols. Each session began with ETUGcog prior to exercise as pre-test. ETUGcog involves simultaneous performance of an extended version of Timed Up & Go test (the physical task), while counting backwards by sevens starting from a given number (the mental task). The post-tests were administered immediately after the exercise when the subject cooled down to 10% above resting HR (10%aHR), and 24 hours later. The test parameters that were recorded are the number of correct responses while counting backwards until test completion, and time to complete test.

**RESULTS:** Correct responses after a HIIT session were significantly higher than pre-test responses when tested at 10%aHR ( $5.18 \pm 1.43$  vs  $4.24 \pm 1.82$ ,  $p = 0.02$ ), and 24 hours later ( $5.82 \pm 2.24$  vs  $4.24 \pm 1.82$ ,  $p = 0.002$ ). No such improvements were seen after a MI session, as correct post-test responses at 10%aHR ( $5.18 \pm 2.98$ ) and 24 hours later ( $5.06 \pm 2.75$ ) were similar to pre-test responses ( $4.79 \pm 2.47$ ), with  $p > 0.05$  in both paired comparisons. Also, the times to complete ETUGcog tests were not significantly different when comparing the pre-test to both post-test times, with  $p > 0.05$ , in both types of exercise sessions.

**CONCLUSIONS:** A single bout of high-intensity, but not moderate intensity exercise, might improve dual-tasking efficiency by increasing cognitive processing speeds, without delaying activity completion times, and improvements can last a full day. This could be due to neuroplastic improvements in brain's cognitive areas in the prefrontal cortex, caused by blood flow increases sufficient with high intensity, but not with lower intensity exercise.

**2272** Board #191 May 28 2:00 PM - 3:30 PM  
**Effects Of Acute Caffeine Ingestion Following A Period Of Sleep Loss On Cognitive And Physical Performance: A Systematic Review And Meta-analysis**

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**PURPOSE:** This systematic review and meta-analysis examined the impact of acute caffeine consumption on cognitive and physical performance in sleep deprived/

restricted individuals. **METHODS:** Electronic databases were searched for studies measuring cognitive and/or physical performance following *sleep restriction* ( $\leq 6$ h sleep within 24h) or *deprivation* ( $\geq 24$ h wakefulness) under control (placebo) and intervention (caffeine) conditions. Studies were included if performance was assessed within 6h of caffeine consumption. Individual effect estimates (EEs) were calculated as Hedges' *g* for independent groups. Random effects meta-analyses were performed to determine intervention efficacy. Statistical significance was attained if the 95% CI did not include zero. Multiple meta-regression analysis was conducted to determine effects of caffeine dose and period of wakefulness on the magnitude of the effect. **RESULTS:** 36 publications providing 250 EEs were included. Caffeine improved performance on reaction time tasks (12 EEs;  $g = 1.11$ ; 95% CI: 0.75-1.47) and both response time (44 EEs;  $g = 0.86$ ; 95% CI: 0.53-0.83) and accuracy (27 EEs;  $g = 0.68$ ; 95% CI: 0.48-0.88) on attention tasks. The magnitude of the effect increased as caffeine dose increased, but was not influenced by the period of wakefulness for either task. Caffeine improved executive function (38 EEs;  $g = 0.35$ ; 95% CI: 0.15-0.55) and the magnitude of the effect increased as caffeine dose increased ( $p = 0.007$ ) and period of wakefulness decreased ( $p = 0.021$ ). Caffeine also improved response time (20 EEs;  $g = 1.95$ ; 95% CI: 1.39-2.52) and accuracy (34 EEs;  $g = 0.43$ ; 95% CI: 0.30-0.55) on information processing tasks, but neither caffeine dose ( $p = 0.785$ ) nor period of wakefulness ( $p = 0.373$ ) influenced the magnitude of the effect. No other performance outcomes were appropriate for meta-analysis. However, studies typically indicated a benefit of caffeine on memory (25 EEs), crystallized intelligence (11 EEs) and physical (39 EEs) performance. **CONCLUSION:** Caffeine is an effective counter-measure to the cognitive and physical impairments associated with sleep loss.

**2273** Board #192 May 28 2:00 PM - 3:30 PM  
**Impact Of 45 Minutes Of Daily Pe On Fitness And Processing Speed Overtime**

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Research has demonstrated higher cognitive abilities are often linked to physical activity participation. **PURPOSE:** To examine the impact that 45 minutes of daily physical education on the aerobic capacity and perceptual speed of elementary school children. **METHODS:** An analysis of variance (ANOVA) mixed effect linear model was used to evaluate the effectiveness of 45 minutes of daily physical education on fitness and perceptual speed among youth in grades 6<sup>th</sup>-8<sup>th</sup> attending Legacy Early College, a Title I school in the southeastern US. Gain scores (final post-test assessment in May 2019 - original pre-test assessment in September 2017) were calculated and analyzed for significance. The interaction between school and time was estimated for each outcome. Each analysis was stratified by gender and adjusted by age to control for baseline differences by school. A Title I control school that provided physical education once per week was utilized as a comparison. **Summary of RESULTS:** Legacy Early College children significantly improved on perceptual speed compared to controls. A significant gain increase at post-test for sections 1, 2, 3 and the Total score ( $p = .002$   $F = 9.27$ ,  $p = .020$   $F = 5.45$ ,  $p = .019$   $F = 5.54$ ,  $p = .003$   $F = 9.17$ ) respectively, was found. Legacy females had significant gains for sections 1 and 2 compared to controls ( $p = .041$   $F = 4.25$ ,  $p = .010$   $F = 6.68$ ). Legacy males had a similar trend with significantly higher gains for sections 1, 3, and Total ( $p = .041$   $F = 4.26$ ,  $p = .030$   $F = 4.80$ ,  $p = .038$   $F = 4.38$ ) compared to controls. Additionally, Legacy children improved significantly on PACER laps compared to controls (8.64 vs. 2.08;  $p = 0.000$ ,  $F = 23.77$ ) over time. Legacy females had significantly higher gains in PACER laps compared to controls ( $p = 0.000$ ,  $F = 34.30$ ). Legacy males also had significant gains in PACER laps over time compared to controls ( $p = .010$   $F = 6.86$ ). **CONCLUSIONS:** 45 minutes of daily physical education led to increases in fitness and processing speed over time. Supported by Campbell Young Leaders

**2274** Board #193 May 28 2:00 PM - 3:30 PM  
**Baseline Cognitive Performance Moderates The Benefits Of Regular Exercise On Cognition In Children**

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Although a growing number of studies have examined the effects of regular exercise on cognition and academic performance in children, the findings have remained controversial due to divergent experimental approaches. **PURPOSE:** The present study investigated baseline cognitive performance as a moderating factor underlying the effects of regular exercise intervention on cognition, with the goal of determining whether baseline variance may account for the lack of consensus in the literature.

**METHODS:** We reanalyzed data from three randomized controlled trials in which the effects of regular exercise intervention on cognition were examined using executive function tasks (e.g., flanker task), with a cumulative total of 292 participants (9-13 years). To test the moderation effects of baseline performance on the relationship between exercise intervention and changes in cognitive performance, we used hierarchical generalized multiple regression analysis predicting pre-post changes in cognitive performance. **RESULTS:** Results indicated that the beneficial effects of regular exercise intervention on cognitive performance were greater in lower baseline performers. Additionally, the pre-post changes in cognitive performance did not differ between the control and intervention groups, even for high baseline performers. **CONCLUSIONS:** These findings suggest that baseline cognitive performance is an individual difference variable that moderates the effects of regular exercise intervention on changes in cognition. Thus, future studies should account for baseline cognitive performance when examining the exercise - cognition relationship. The present study also supports recent views that increased time spent in physical exercise does not detract from cognitive performance and academic achievement in children. Supported by NICHD Grant R01 HD055352 and the Gottfried and Julia Bangerter-Rhyner-Foundation (8472/HEG-DSV).

**2275** Board #194 May 28 2:00 PM - 3:30 PM  
**The Effects Of High-altitude Mountaineering On Cognitive Function In Mountaineers: A Meta-analysis**  
 Lun Li<sup>1</sup>, ShiSi Zou<sup>1</sup>, Yong'Tai' Wang, FACSM<sup>2</sup>. <sup>1</sup>China University of Geosciences (Wuhan), Wuhan, China. <sup>2</sup>The University of Texas at Tyler, Tyler, TX.  
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**PURPOSE:** Nowadays, high altitude mountaineering is increasingly popular among different populations with a dream to challenge high-altitude exercises facilitated by the convenience of global traveling. In view of this, the authors performed a meta-analysis in the hope of finding the effects of high-altitude mountaineering on cognitive function in mountaineers prior to and after the climbing.

**METHODS:** After a thorough electronic literature search and selection, eight studies were included in this meta-analysis, and test cycle ranged from 8 to 140 days. The eight variables included in this meta-analysis were: trail-making test part B (TMB), finger tapping test-left (FTL), finger tapping test-right (FTR), digit span test forward (DSF), digit span test backward (DSB), wechsler memory scale visual (WMSV), aphasia screening test-visual motor errors (AST-vis), aphasia screening test-verbal items (AST-ver). The effect sizes and Forest Plots of these eight variables were generated. **RESULTS:** Five variables (trail-making test part B (TMB), ES = 0.39; digit span test forward (DSF), ES = 0.57; finger tapping test-right (FTR), ES = 0.50; finger tapping test-left (FTL), ES = 0.16; wechsler memory scale visual (WMSV), ES = 0.63; ) out of eight were significantly improved after high-altitude mountaineering, while ES values of digit span test backward (DSB), aphasia screening test-verbal items (AST-ver) and aphasia screening test-visual motor errors (AST-vis) did not show significant improvement after the mountaineering.

**CONCLUSIONS:** Our findings have some limitations arising from methodological issues inherent in the meta-analysis and we could not explain the high heterogeneity between studies. Despite such limitations, the current study has the strength of being the first meta-analysis trying to specify cognitive function of mountaineers compared with before and after high-altitude mountaineering. High-altitude mountaineering, as a short-term plateau exercise, has no significant negative impact on the cognitive function of climbers. Future research is needed for a long period of high-altitude mountaineering.

**2276** Board #195 May 28 2:00 PM - 3:30 PM  
**Excess Body Mass Attenuates The Effects Of Acute Exercise On Preadolescent Brain Function And Cognition**  
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 (No relevant relationships reported)

**Purpose**

This study investigated the transient effects of an acute bout of aerobic exercise and excess body mass on cognitive and brain function in preadolescent children.

**Methods**

Thirty-nine children (8-10yrs; 16 females) completed baseline and demographic questionnaires, and dual-energy X-ray absorptiometry and VO2max tests. Children were randomly allocated into a within-subjects crossover intervention design including 20-minutes of restful reading and 20-minutes of treadmill walking. Children completed post-intervention cognitive tasks that tap inhibition (Go-NoGo, flanker) with EEG (P3-ERP), and standardized tests of academic achievement in reading and math.

**Summary of Results**

Following the treadmill walking intervention, children of normal weight (NW) demonstrated improved response accuracy ( $p \leq 0.05$ ), shorter reaction times ( $p \leq 0.05$ ), and larger P3-ERP amplitudes ( $p \leq 0.05$ ) during the Go task, relative to children with obesity (OB). Additionally, after the walking intervention, NW children demonstrated a trend for larger P3 amplitude ( $p = 0.068$ ) during the NoGo task. NW children also demonstrated shorter reaction times ( $p = .041$ ), and reduced perceptual interference ( $p = 0.039$ ) compared to OB children during the flanker task. Lastly, NW children demonstrated improved performance on academic achievement tests of reading and math after the walking intervention, compared to OB children ( $p \leq 0.05$ ).

**Conclusion**

These findings indicate that the beneficial effects following an acute bout of aerobic exercise on cognitive and brain function may be attenuated in children with obesity. These results provide evidence indicating that neuroelectric and behavioural indices of attention, inhibition, and academic achievement are influenced by aerobic exercise and body mass in children. Given that childhood obesity is a public health concern with an array of health complications, these results have important implications for the physical and cognitive health of children.

**Grant Funding**

Supported by NIH Grant R01 HD094054

**2277** Board #196 May 28 2:00 PM - 3:30 PM  
**Effect Of Mental Fatigue Induced By A Cognitive Task On A Subsequent Handgrip Endurance Exercise**  
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Mental fatigue is commonly observed when using the sequential task protocol. In this protocol, participants perform a first task that requires effortful control or that does not. Then, they have to perform a second task that systematically requires effortful control. Participants generally give up earlier the second task when they have exerted effortful control in the first task. Despite an extensive literature on this phenomenon, researchers still debate about its real existence and failed to define its conditions of occurrence.

**PURPOSE:** To replicate the mental fatigue effect with a long cognitive task tapping executive functions on a subsequent effortful physical task. **METHODS:** Fifty-five young adults completed 4 sessions separated by a minimum of 48h. The first session was a learning session in which participants familiarize with the Stroop task and the handgrip task. During the second session, participants only performed the endurance handgrip task at 13% voluntary maximal contraction until exhaustion. During the third and fourth sessions, participants performed a 30-min cognitive task (modified Stroop task vs. Video task) followed by the same handgrip task than in the 2nd session. The order of sessions 2 and 3 were counterbalanced across participants. **RESULTS:** As expected, participants squeezed the handgrip during a shorter time (5.36 min) after the Stroop task than after watching an emotionally neutral movie (5.82 min). In addition, there was a significant difference between the performance of the second session (5.80 min) and the performance after the Stroop task. **CONCLUSION:** This study clearly shows that a long task overloading execution functions leads to an early disengagement of mental effort in a subsequent effortful physical task. The cause of this earlier dropout is explained in different ways: (1) a quicker depletion of brain resources, (2) energetic and computational costs higher than the benefits associated with the achievement of the task goal, or (3) a reorientation of attention and intention to more pleasant tasks. Further studies are needed to confront these different explanations and manipulate the difficulty of the first task (duration and effortful control load) to determine the conditions of occurrence necessary to induce mental fatigue.

**2278** Board #197 May 28 2:00 PM - 3:30 PM  
**Abstract Withdrawn**

**2279** Board #198 May 28 2:00 PM - 3:30 PM  
**Effect Of Intermittent Isometric Handgrip Exercise On Cognitive Function**  
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Previous study reported that an isometric handgrip (IHG) exercise improves cognitive function. However, an isometric exercise may increase the risk for cardiovascular disease because of a larger increase in arterial blood pressure (ABP) compare with dynamic exercise, especially in elderly patients. **PURPOSE:** The purpose of the present study was to examine the effect of acute intermittent IHG exercise without a large

increase ABP on cognitive function. **METHODS:** Five healthy subjects performed a cognitive task (Go/No-go task) before and immediately after IHG exercise protocols; 16 sets of 30-s IHG at 30% of maximum voluntary contraction and 45-s recovery. ABP was measured continuously throughout the experiment. Cognitive function was evaluated by the Go/No-go task. **RESULTS:** Mean arterial pressure at the end of IHG exercise protocol ( $92 \pm 12$  mmHg) was not significantly different from the baseline ( $86 \pm 4$  mmHg,  $P > 0.05$ ). Also, the number of error trials in the Go/No-go task was unchanged; however, the reaction time was decreased in four out of five subjects after IHG exercise. **CONCLUSION:** These results provided the possibility that intermittent isometric exercise may improve cognitive function without an elevation in ABP. However, further investigation with large sample size is needed to identify our questions.

**2280** Board #199 May 28 2:00 PM - 3:30 PM  
**Relationship Between Aging-related Declines In Leg Muscle Volume And Quality And Cognitive Functions**

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**PURPOSE:** Aging is associated with declining in not only skeletal muscular function but also cognitive function including speed of processing, working memory, and long-term memory. However, it remains unclear whether aging-related decline in muscular function is related to impaired cognitive function. In addition to decreased muscle volume, aging-related decline in muscular function can be attributed to impaired muscle quality such as increased intramuscular fat and connective tissue (Akima et al, 2018; Goodpaster et al, 2006). The aim of the present study was to examine whether the aging-related declines in lower body muscle volume and quality are associated with cognitive function in Japanese adults. **METHODS:** The participants in this study were 86 adults (43 males, 43 females; age range 30 to 77 years old). The participants' thigh muscle volume was assessed by bioelectrical impedance analysis. Muscle quality (i.e., levels of intra- and extra-myocellular lipid and connective tissue) of the vastus lateralis was determined using 1H-magnetic resonance spectroscopy at 3T MR system and echo intensity measured with ultrasound. Cognitive functions (inhibitory control, short memory, working memory) were determined with the color-word Stroop task, Face-name matching task and Reading Span Test, respectively. **RESULTS:** Aging was associated with a decline in muscle volume and an increase in echo intensity ( $p < 0.05$ ). The aging-related decline in muscle volume was correlated to impaired inhibitory control score in both male and female ( $p < 0.05$ ). In addition, aging-related increase in echo intensity was correlated to impaired inhibitory control score ( $p < 0.05$ ). There were no relationships between those muscle properties and short memory score or working memory score.

**CONCLUSIONS:** These findings suggest a link between aging-related impairment in inhibitory control and reduction in muscle volume and quality. Further studies are needed to determine whether ameliorating muscular function can be a therapeutic target against the aging-related decline in cognitive function.

**2281** Board #200 May 28 2:00 PM - 3:30 PM  
**Effectiveness Of Modeling Videos On Psychological States Of Patients Undergoing Rehabilitation Following ACL Reconstruction**

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To date, much of the rehabilitation following anterior cruciate ligament reconstruction (ACLR) has centered on physical components. However, return to sports depends on not only physical recovery but also psychological readiness. According to a systematic review published in 2017, there is limited evidence on the efficacy of psychological interventions. **PURPOSE:** To examine the effectiveness of modeling videos to reduce preoperative kinesiophobia and fear of reinjury as well as to increase postoperative self-efficacy after ACLR. **METHODS:** Following baseline assessment of psychological states through ACL-Return to Sport after Injury (ACL-RSI), Knee Self Efficacy Scale (K-SES), and Tampa Scale of Kinesiophobia (TSK) and knee function (International Knee Documentation Committee [IKDC] system), patients scheduled for ACLR were randomly assigned to intervention, placebo, or control group. Six modeling intervention videos were developed by the investigators to represent six different periods: pre-operation, during hospitalization, 2 weeks, 6 weeks, 3 months, and 6 months post operations. Another six videos were developed to serve as placebo. Intervention and placebo groups watched their respective videos during

their follow-up visits while control group did not. All groups completed psychological and functional assessments during their follow-up visits. **RESULTS:** Ten patients were assigned to intervention group, 11 to placebo group, and 11 to control group. No significant changes in ACL-RSI, K-SES, and TSK scores over six-month period were found among groups ( $p = 0.574$ ,  $p = 0.808$ ,  $p = 0.888$ , respectively). Although three groups all showed improvement in ACL-RSI, K-SES, and TSK at six months, their improvements were not linear ( $p = 0.467$ ,  $0.364$ ,  $0.274$ , respectively). All groups demonstrated temporary decrease in ACL-RSI and TSK scores at three months. **CONCLUSIONS:** Watching modeling videos compared to placebo and control did not reduce kinesiophobia or fear of reinjury as well as improve self-efficacy after ACLR. However, there may be potential room for psychological intervention at three months, and it is important to recognize psychological readiness for successful return to sports.

**2282** Board #201 May 28 2:00 PM - 3:30 PM  
**Abstract Withdrawn**

**2283** Board #202 May 28 2:00 PM - 3:30 PM  
**Semantic Memory Activation After Training Cessation In Master Athletes**

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**PURPOSE:** Despite a robust body of literature demonstrating the salutary effects of exercise on memory, we have yet to learn the link between exercise training cessation and memory in the aging brain. The aim of this study was to examine the effects of 10-day training cessation on semantic memory-related functional activation using task-activated functional magnetic resonance imaging (fMRI) in master athletes.

**METHODS:** Twelve master athletes ( $62.6 \pm 7.0$  years) with long-term endurance training histories ( $\geq 15$  years), were recruited from Washington DC area running clubs. Participants were instructed to remain sedentary and perform only activities of daily living for 10 days. Before and immediately after the training cessation period, fMRI semantic memory activation was measured during performance of a Famous and Non-Famous name discrimination task.

**RESULTS:** There were no significant differences in behavioral performance including response time and accuracy between pre- and post-training cessation. The 10-day training cessation was associated with greater semantic memory activation (Famous > Non-Famous) in five out of ten semantic memory-related regions (voxel-wise  $p < 0.001$ , FWE  $p < 0.05$ ).

**CONCLUSIONS:** The present results provide evidence that even a relatively short period of exercise training cessation results in changes in semantic memory network function and suggests reduced neural efficiency during memory retrieval. This study also indirectly indicates potentially detrimental effects of sedentary behavior in older adults and highlights the importance of sustained participation in exercise.

**2284** Board #203 May 28 2:00 PM - 3:30 PM  
**Transient Effects Of Acute Aerobic Physical Activity On The Pupillary Response And Inhibitory Control**

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**Purpose:** Acute bouts of aerobic exercise have been found to transiently improve executive function and its neural underpinnings. Moderate activation of the locus coeruleus-norepinephrine (LC-NE) system increases attention toward goal-directed behaviors, yet non-optimal activation may promote distractibility. Pupillary responses are believed to be a marker of the LC-NE system, and tasks requiring greater amounts of inhibitory control modulate baseline (*tonic*) and task-evoked (*phasic*) pupil dilation. The purpose of this study was to examine the pupillary response as a LC-NE biomarker to understand the mechanisms underlying the effect of acute exercise on inhibitory control.

**Methods:** Twenty-six participants ( $19.7 \pm 1.8$  yr, 17 female) performed 20 min interventions (seated rest/moderate intensity exercise) followed by Simon and modified flanker tasks. Participants' eyes were tracked during the tasks using a tabletop eye imaging camera at a 500hz sampling rate.

**Results:** RM-ANOVAs assessed intervention and inhibitory control (congruency/compatibility) effects on behavior and pupillary outcomes. Incongruent flanker trials resulted in longer reaction times and lower response accuracy,  $p$ 's  $\leq 0.001$ . While incompatible Simon trials also resulted in longer reaction times,  $p = 0.01$ , there was no difference in response accuracy across compatibility conditions,  $p = 0.11$ . Peak phasic pupil dilation was also greater in incongruent flanker trials as well as incompatible Simon trials,  $p = 0.003$ . While behavior and phasic pupil dilation in both tasks did not

differ across the exercise vs. rest interventions,  $p$ 's  $\geq 0.18$ . Tonic pupil diameter was larger for the exercise intervention in the flanker task,  $p = 0.04$ , and at trend level in the Simon task,  $p = 0.09$ .

**Conclusion:** The tonic pupillary response may be a sensitive biomarker for examining transient changes in LC-NE activity as a function of acute exercise bouts. Moderate intensity exercise did not significantly affect phasic pupillary response. These findings indicate that the pupillary response can be manipulated by aspects of inhibitory control and physical activity, which suggests it may be a sensitive biomarker for examining changes in LC-NE activity.

**2285** Board #204 May 28 2:00 PM - 3:30 PM  
**Perception Of Trust In Physicians Based On Somatotype: A Student And Non-student Comparison**  
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 (No relevant relationships reported)

Appearance is the first piece of information available that can powerfully influence perception. Credibility, which includes trust, has been shown to be impacted by a person's somatotype. **PURPOSE:** The purpose of this study was to determine students and non-students perception of trust of a physician based on the physician's somatotype. **METHODS:** A survey was administered to 1,631 students, faculty, and staff at a small Midwestern university using Formstack. Images of an endomorph, mesomorph, and ectomorph somatotype were displayed along with a 5-point Likert scale with 1 meaning "would not trust this physician" to 5 meaning "would completely trust this physician". Participants were asked to select the answer that best correlated with the perceived trust they would have in a physician who had the somatotype shown. **RESULTS:** There were 1,631 emails sent with 333 (20%) responses collected. Of the 333 respondents, 189 (57%) were students and 144 (43%) were non-students (faculty and staff). Perceptions of trust were analyzed using a repeated measure ANOVA which determined there is a significant difference in rank order of the three somatotypes ( $p$ -value  $< .0001$ ). A Tukey post-hoc test was then conducted to compare the three somatotypes. When comparing the means for endomorph ( $M = 2.7$ ,  $SD = 1.1$ ) and mesomorph ( $M = 3.8$ ,  $SD = .7$ ), the endomorph somatotype was ranked lower than the mesomorph somatotype ( $t = -19.756$ ,  $p$ -value  $< .0001$ ). When comparing the means for the endomorph and ectomorph ( $M = 3.6$ ,  $SD = .9$ ) somatotypes, the endomorph somatotype was ranked lower than the ectomorph somatotype ( $t = -15.583$ ,  $p$ -value  $< .0001$ ). Lastly, when comparing the mesomorph and ectomorph somatotypes, the mesomorph somatotype ranked higher than ectomorph somatotype ( $t = 4.173$ ,  $p$ -value  $< .0001$ ). **CONCLUSION:** This study indicated that both status groups (students and non-students) ranked the mesomorph somatotype as most trustworthy for a physician, the ectomorph somatotype as second most trust worthy for a physician, and the endomorph somatotype as least trustworthy for a physician. Further research is needed to determine the influencing factors of somatotype perceptions.

**2286** Board #205 May 28 2:00 PM - 3:30 PM  
**Primes For The Mind: Additive Effects Of Verbal Priming And Acute Exercise On Convergent Creativity**  
 Emily Frith, Stephanie E. Miller, Paul D. Loprinzi. *University of Mississippi, University, MS.* (Sponsor: Dr. Jeremy P. Loenneke, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** The Remote Associates Test (RAT), assesses creative convergence on a single solution. The effects of physical exercise on convergent creativity are equivocal; although, priming has been shown to improve convergent thinking. To this end, we hypothesized that acute, moderate-intensity treadmill-walking while solving anagram primes would stimulate additive effects capable of facilitating convergent creativity, relative to priming alone.

**METHODS:** Participants ( $n=45$ ) completed two laboratory visits in this within-subject experiment. Six anagram lists were presented during each visit (twelve total lists), with the order of the twelve lists counterbalanced across conditions. Participants randomly assigned to the anagram priming + exercise visit first, performed fifteen minutes of moderate-intensity treadmill-walking (moderate-intensity; 40-45% of heart-rate reserve while solving anagrams). Participants, randomized into the anagram only visit first, sat on a stool placed on the treadmill for fifteen minutes while solving anagrams. Following fifteen minutes of exercise + anagram-solving or seated rest + anagram-solving, participants were escorted to a quiet room, free of distraction, where they solved RAT problems. After a minimum 24-hour interval, participants returned for the second visit. Paired t-tests were used to test differences between both conditions. Post-hoc Bayesian analysis was also performed to quantify evidence for or against the null hypothesis.

**RESULTS:** A significant difference was evident between exercise + anagram-solving ( $= 10.51$ ,  $SD = 3.25$ ) and seated rest + anagram-solving ( $= 9.29$ ,  $SD = 4.12$ ),  $t(44) = 2.385$ ,  $p = .021$ ,  $d = 0.36$ , 95% confidence interval for the effect size = 0.052 - 0.655).

Post-hoc Bayesian analysis indicated that the data were 2.05 times more likely under the alternative hypothesis (median  $\delta = 0.46$ , 95% credible interval for the effect size = 0.053 - 0.86).

**CONCLUSION:** This experiment offers a novel contribution to the exercise and creativity domains, suggesting a potential additive effect of exercise plus verbal priming on convergent creativity. Continued empirical research is warranted to identify precise mechanisms underlying these additive effects, and to establish novel exercise and priming strategies that may benefit creative thinking.

**2287** Board #206 May 28 2:00 PM - 3:30 PM  
**Parent-report Of Children's Motor Skills Are Selectively Related To Interference Control Among School-aged Children**

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 (No relevant relationships reported)

**PURPOSE:** Previous research has demonstrated that aerobic fitness and adiposity impact children's cognitive function. However, whether children's motor skills independently impact childhood cognition remains unclear. This study examined relationships between children's motor skills and executive function, relational memory, and academic achievement among school-aged children without diagnosed coordination disorder. **METHODS:** Participants were children ages 7-12 years old ( $N=90$  [46 females]). Intellectual abilities and academic achievement were measured using the Woodcock-Johnson IV Test (WCJ). Selective attention was assessed using a Flanker task, and relational memory was assessed using a spatial reconstruction task. Aerobic fitness and whole-body adiposity (%Fat) were assessed using a VO2max test and DXA, respectively. Parents completed the Developmental Coordination Disorder Questionnaire (DCDQ) as an assessment of the child's current motor skill abilities. Spearman and partial spearman correlation tests were conducted to explore potential relationships. **RESULTS:** 14% of participants indicated a possible developmental coordination disorder and 50% had a score of 67 and above on the DCDQ. Covariates adjusted for included sex, IQ, socioeconomic status (SES), fitness, and %Fat. Following adjustment, higher scores on the control during movement subscale of the DCDQ were related to greater performance in story recall ( $Rho = 0.29$ ;  $P = 0.039$ ), a subscale of the WCJ. There was no significant relationship between relational memory and any of the DCDQ outcomes. However, higher scores on the control during movement subscale were related to lower accuracy interference during the Flanker task ( $Rho = -0.25$ ;  $P = 0.03$ ), indicating that children who had higher motor control while moving exhibited greater selective attention, compared to those who had poorer control abilities during movement. **CONCLUSION:** Motor control abilities were associated with recall memory and attentional abilities in school-aged children, independent of aerobic fitness and adiposity.

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**2288** Board #207 May 28 2:00 PM - 3:30 PM  
**Influence Of Acute Resistance Training On Memory, Executive Function, And Mood**

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(No relevant relationships reported)

Acute exercise has been shown to improve performance on several domains of cognitive function. The majority of research has focused on the benefits of aerobic exercise, but research on the cognitive and mood effects of acute heavy resistance training (RT) is limited. **PURPOSE:** To determine how an acute bout of RT affects cognitive function and mood. **METHODS:** This was a within subjects design. College-aged males ( $n=21$ ) visited the laboratory on 3 days, separated by at least 1 week. During session 1, subjects were tested for their 5 repetition maximum (5RM) on the box squat, bench press, and lat pulldown. During sessions 2 and 3, participants completed a rest or RT condition in a counterbalanced order. Prior to both sessions, participants completed trials 1-6 of the Rey Auditory Verbal Learning Task (RAVLT). During the RT session, participants completed 3 sets of 8-12 repetitions at 70% of estimated 1RM on the box squat, bench press, and lat pulldown. Training took ~40 minutes (including warm-up and cool-down). After the RT or 40 min seated rest, participants completed the recall and recognition trials of the RAVLT and a cognitive test battery in the Automated Neuropsychological Assessment Metrics (ANAM) Test System. The test battery included 10 tests that assessed memory, processing speed, executive function, and mood. Comparisons in cognitive performance and mood were made using a paired t-test. **RESULTS:** Higher scores on the color subtest of the Stroop Task, a test of processing speed, were found after RT compared to rest

(training=69.57±2.03; rest=65.43±2.01; p=0.01). Better performance was observed in the Matching-to-Sample task, a spatial working memory task, after rest compared to RT (training=41.33±2.77; rest=45.33±2.53; p=0.03). There were no other differences in cognitive performance between conditions (p>0.05). After RT, participants had higher anger (training=11.05±3.34; rest=5.62±1.81; p=0.04), depression (training=6.43±2.22; rest=2.57±1.08; p=0.02), restlessness (training=32.33±4.15; rest=14.58±3.18; p=0.0001), and vigor (training=55.62±3.63; rest=48.24±3.90; p=0.04). **CONCLUSION:** Acute RT has limited effects on cognitive function in college-aged males, but increases anger, depression, restlessness, and vigor when assessed after cognitive tasks.

**2289** Board #208 May 28 2:00 PM - 3:30 PM

### Psychological State Of A World-Class Ultramarathon Runner: A Case Study

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**PURPOSE:** While previous studies have revealed various physiological effects of ultramarathon running, the psychological profile and well-being of ultramarathon runners is less often examined and therefore inadequately understood. According to Self-Determination Theory (Ryan & Deci, 2000; 2002), an individual's well-being can be enhanced by participating in activities that support, not thwart, their basic needs of competence, autonomy, and relatedness. Psychological constructs of basic needs satisfaction, well-being, and mental toughness can be considered relatively stable. Yet, it is unknown whether these constructs vary before and after a highly intense exercise bout such as an ultramarathon. In previous studies, the timing of assessing endurance athletes varied from 5 minutes to 4 weeks post-event (Holt, Lee Kim, & Klein, 2014; Micklewright et al., 2009). This case study examined the pre- and post-race psychological profile of a male top-ten finisher of the Western States Endurance Run (WSER), a 100-mile (161 km) foot race over mountainous trails of Northern California in the United States. **METHODS:** The 32-year old participant was a highly-trained ultramarathon runner. At 20 hours prior to the race, the participant completed a quantitative survey about basic needs satisfaction, basic needs thwarting, self-esteem, mental toughness, and affect. When asked to complete the same survey 100 minutes post-race, the participant said he could not focus and asked to complete the survey later at 34 hours post-race. **RESULTS:** Results revealed an adaptive psychological profile that was stable from pre- to post-race; very high scores on basic needs satisfaction ( $M_{pre} = 6.9$ ,  $M_{post} = 6.85$  on a 7-point scale), self-esteem ( $M_{pre} = 4.0$ ,  $M_{post} = 4.0$  on a 4-point scale), mental toughness ( $M_{pre} = 6.5$ ,  $M_{post} = 6.63$  on a 7-point scale), and positive affect ( $M_{pre} = 4.9$ ,  $M_{post} = 5.0$  on a 5-point scale), combined with very low scores on basic needs thwarting ( $M_{pre} = 1.0$ ,  $M_{post} = 1.0$  on a 7-point scale) and negative affect ( $M_{pre} = 1.2$ ,  $M_{post} = 1.2$  on a 5-point scale). **CONCLUSIONS:** While survey results indicated stability in the athlete's psychological state, future research should explore the optimal post-event window to assess psychological constructs of ultra-marathon runners as well as other endurance athletes.

**2290** Board #209 May 28 2:00 PM - 3:30 PM

### Long-term Exercise Training Prevents Anxious-depressive-like Behavior In Transgenic Alzheimer Rats

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(No relevant relationships reported)

**PURPOSE:** This study examined the effects of long-term treadmill exercise training on the anxious-depressive-like behavioral phenotype of transgenic Alzheimer rats in the early stage of Alzheimer's disease (AD) development and provided evidence that exercise alleviated fear-avoidance behavior deficits. **METHODS:** 2-month-old Male TgF344-AD and wild-type (WT) rats were separated into WT (n = 9), AD (n = 8), and AD + treadmill exercise (Exe) groups (n = 12). Following 8 months of exercise, the passive avoidance test, Barnes maze task, novel object recognition test, and object location test were used to measure learning and memory function. The open field test, elevated plus maze, sucrose preference test, and forced swim test were conducted to measure anxious-depressive-like behavior of AD rats. Immunofluorescence staining, Western blot analysis, enzyme-linked immunosorbent assay (ELISA) analysis, and related assay kits were used to measure levels of inflammatory cytokines, oxidative stress, amyloid-beta production, and tau hyperphosphorylation. **RESULTS:** Behavioral tests indicated that AD rats aged 12-months did not exhibit spatial learning and memory deficits, but did display anxious-depressive-like behaviors (open field, Center time:  $P = 0.008$ ; Center entries:  $P = 0.009$ ; Line crossings:  $P = 0.001$ ). Long-term exercise significantly prevented anxious-depressive-like behaviors in AD rats (Center

time:  $P = 0.016$ ; Center entries:  $P = 0.004$ ; Line crossings:  $P = 0.033$ ). In addition, AD animals displayed enhanced A $\beta$  deposition ( $P < 0.001$ ), Tau hyperphosphorylation ( $P < 0.001$ ), microglial activation ( $P < 0.001$ ), inflammatory cytokine release ( $P < 0.05$ ), and oxidative damage ( $P < 0.05$ ) that was attenuated significantly after long-term exercise training ( $P < 0.05$ ). **CONCLUSIONS:** Long-term exercise training ameliorated anxious-depressive-like behaviors and improved fear-avoidance behavior in transgenic AD rats, supporting exercise training as an effective strategy to prevent or reduce anxiety, depression and fear-avoidance behavior deficits in the early stages of AD pathogenesis.

**2291** Board #210 May 28 2:00 PM - 3:30 PM

### The Effect Of Treadmill Desk Walking On Creative Thinking

Rebecca R. Rogers, Daphne Schmid, Christopher G. Ballmann. *Samford University, Birmingham, AL.*  
(No relevant relationships reported)

**PURPOSE:** Most research on treadmill desks in the workplace report no significant change in productivity. However, most of these studies focused on cognitive performance measured by tests in attention, memory or reasoning. While aerobic exercise has been linked to producing a positive effect on creative potential, few studies have tested workplace creativity thinking. The purpose of this study was to examine the effect of treadmill desk walking on convergent and divergent creative thinking.

**METHODS:** Twelve (n=12) male and female college-age students were recruited and completed three tests of creative function: the verbal Guilford's Alternate Uses Task (VGAT) of divergent thinking, written Guilford's Alternative Uses Task (WGAT), and the Remote Associations Task (RAT) of convergent thinking. Participants completed all tests while seated at a traditional desk and while walking on a treadmill desk at 1.5 mph. Step length, stride length, and gait cycle were assessed by the OptoGait gait analysis system. A paired sample t-test was used to compare creative test scores and gait variables.

**RESULTS:** There were no significant differences between any test scores while seated and walking (p>0.05). There was no significant difference between baseline gait and divergent thinking (VGAT, WGAT) task gait in any variable (p>0.05). There was a significant increase in step length (p=0.049), stride length (p=0.046), and gait cycle (p=0.039) between the walking only condition and the treadmill desk walking during the RAT. **CONCLUSIONS:** Results of this study suggest neither convergent nor divergent creative thinking are improved when walking on a treadmill desk. While gait patterns are not changed during divergent thinking, this study suggests gait during convergent thinking may be altered.

**2292** Board #211 May 28 2:00 PM - 3:30 PM

### Acute But Not Chronic Aerobic Exercise Enhances Attention And The Neuroelectric Mismatch Negativity Among Fatigued Individuals

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**PURPOSE:** Symptoms of fatigue are a public health burden, comorbid with both cardiovascular disease and cancer. While exercise requires considerable energy expenditure, both acute and chronic aerobic exercise reduce feelings of fatigue. However, the brain mechanisms underlying this effect are not well-understood. To explore the neural mechanisms of this effect, we examined EEG correlates of attention before and after acute and chronic aerobic exercise. We hypothesized that the lo-intensity acute and chronic effects of exercise would produce increased attentiveness. **METHODS:** In this pilot study, 13 students, ages 18-36, with elevated levels of fatigue, were randomly assigned to: lo-intensity, hi-intensity, and a no exercise control. Each participant was evaluated pre- and post-exercise three times (e.g., baseline, week 3, and post-intervention) during the 6-week study. At each session participants were outfitted with hi-density EEG and completed an auditory odd-ball task that resulted in a mismatch negativity (MMN). The MMN is an index of pre-attentive change detection, and its amplitude decreases with fatigue. EEG was analyzed via established guidelines including ICA algorithms for artifact-removal. To extract the MMN, the N1 was located in each recording and a difference wave was calculated by subtracting the electrocortical activity to the standards minus targets, in the 100ms after the N1 (120-220ms). **RESULTS:** A repeated-measures, mixed model ANOVA (3 Group (lo-intensity, hi-intensity, control) x 2 Time (pre/post intervention) x 3 Week (baseline, week 3, post-intervention)) revealed a marginally significant interaction between Group, Time, and Week [ $F(4,16)=2.79$ ,  $p=0.06$ ,  $\eta^2=0.41$ ] such that the MMN was reduced after hi-intensity exercise at the final session. In addition, the 2-way interaction between Group and Time [ $F(2,8)=4.05$ ,  $p=0.06$ ,  $\eta^2=0.50$ ]

revealed a marginally significant interaction such that the lo-intensity group showed an increased MMN amplitude post exercise, the hi-intensity group showed a decrease, and the control group showed no change. No other effects were significant (all  $p > 0.24$ ,  $\eta^2 < 0.29$ ). **DISCUSSION:** Our data suggest that automatic pre-attentive change detection is only altered after lo-intensity acute aerobic exercise among our sample of fatigued individuals.

**2293** Board #212 May 28 2:00 PM - 3:30 PM  
**Fitness Related Differences And Neuroelectric Indices Of Arithmetic Approximation In College-aged Adults**  
 Oksana Ellison, Morgan S. Ham, Madison C. Chandler, Matthew B. Pontifex, Amanda L. McGowan. *Michigan State University, E. Lansing, MI.*  
*(No relevant relationships reported)*

As a growing body of literature supports a positive association between aerobic fitness and mathematics achievement, it has been suggested that individuals higher in aerobic fitness may use strategies, such as arithmetic approximation, that are more efficient during mathematical reasoning. **Purpose:** To understand how individuals at extremes of the aerobic fitness spectrum differ on numerical approximation. **Methods:** A sample of higher- and lower-fit college-aged adults was recruited to participate in the study based on maximal oxygen consumption ( $VO_{2max}$ ). Participants performed a complex arithmetic approximation task presenting operands  $a + b$  and were instructed to indicate whether the sums were greater than or less than 100. Problems were equally distributed across conditions that varied in the extent to which the operands required arithmetic approximation: extra small split (i.e.,  $\pm 2\%$  or  $3\%$ ;  $63+39$ , medium split (i.e.,  $\pm 5\%$  or  $8\%$ ;  $69+26$ ), large split (i.e.,  $\pm 10\%$  or  $15\%$ ;  $48+62$ ), and massive split (i.e.,  $\pm 50\%$  or  $55\%$ ;  $64+86$ ). To determine the extent to which arithmetic strategy differed between fitness groups, behavioral and neural indices of cognitive processing were assessed. **Results:** Numerical conditions requiring relatively lower levels of arithmetic approximation were not observed to differ between higher-and lower-fit participants whereas the numerical conditions requiring arithmetic approximation exhibited fitness-related differences. **Conclusion:** These findings suggest that high-fit individuals may engage in more efficient mathematical reasoning strategies relative to their low-fit counterparts. Therefore, fitness-related differences in mathematics achievement may result from differences in strategy execution. Future research should examine the degree to which physical activity interventions designed to enhance aerobic fitness also result in shifts in arithmetic approximation strategy.

**2294** Board #213 May 28 2:00 PM - 3:30 PM  
**Pre-Competition Emotions In Cheerleading Sport: Differences Across Gender And Association With Final Results**  
 claudia Dias Leite<sup>1</sup>, Ana Carolina V. Moraes<sup>2</sup>, Filipe M L Rezende<sup>2</sup>, Róbson C. Silva<sup>2</sup>, Isabela A. Ramos<sup>1</sup>. *Universidade Católica de Brasília and Centro Universitário UniProjeção, Brasília, Brazil.* <sup>2</sup>Centro Universitário UniProjeção, Brasília, Brazil.  
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Although cheerleading's history is long until relatively recently it was not considered a sport. The evaluation is based on an assessment of strength, flexibility, and perfection of routine. Despite positive energy, charisma, and joy, during a competition, athletes can experience positive and negative emotions that could influence performance. **PURPOSE:** to analyze pre-competition emotions in a final cheerleading university games participation, assessing differences between male and female cheerleaders and associating positive and negative emotions with the score obtained in the competition. **METHODS:** From six universities 40 cheerleaders (n=22 male; n=18 female), mean age was 21.03 yr (SD 1.51), participated in the study, they competing at the National University Games in Bahia, Brazil. The teams were finalists in the first time of cheerleading participation in 67 editions of this competition. The twenty-two items of the Pre-Competitive Emotion Scale in the Portuguese language were selected from the original scale developed earlier (Jones et al., 2005). This scale has positive (e.g., happy, excited, enthusiastic) and negative (e.g., angry, sad, tense) emotions. Athletes were asked to rate how intense they were experiencing the emotions through self-evaluation 30min before the competition, on a scale in Likert format anchored by 1 (not at all) to 5 (very much so). **RESULTS:** Cheerleaders athletes experienced positive emotions ( $3.82 \pm 0.69$ ) more intensely than negative emotions ( $1.94 \pm 0.44$ ). In gender comparison, the independent sample t-test showed a significant difference in negative emotions (m.  $1.78 \pm 0.36$  vs f.  $2.14 \pm 0.46$ ;  $p=0.009$ ) and a non-significant difference in positive emotions (m.  $3.91 \pm 0.64$  vs f.  $3.72 \pm 0.76$ ;  $p=0.42$ ). Pearson correlation also indicated a significant, weak, positive correlation ( $r=0.35$ ;  $p=0.02$ ) between positive emotions and final score, while the negative emotions demonstrated a non-significant correlation ( $r=-0.03$ ;  $p=0.81$ ). **CONCLUSIONS:** Cheerleaders experienced both, positive and negative pre-competitive emotions. As well, female athletes experienced

more intense negative emotions than male athletes, and the intensity of positive emotions was related to the final score. This information may be useful for training psychological aspects and emotional control.

**2295** Board #214 May 28 2:00 PM - 3:30 PM  
**The Mechanism Of Dance Training Regulating Emotion Of College Students: A FMRI Study**  
 Rou Wen<sup>1</sup>, Lijuan Hou<sup>2</sup>, Jilong Shi<sup>2</sup>, Jingjing Xue<sup>1</sup>, Mi Zhang<sup>2</sup>. *<sup>1</sup>Beijing Dance Academy, Beijing, China. <sup>2</sup>Beijing Normal University, Beijing, China.*  
*(No relevant relationships reported)*

**PURPOSE:** The purpose of the study is to evaluate the effect of dance training on emotion regulation of college students and explore the possible mechanism by using a magnetic resonance imaging (MRI) technique.

**METHODS:** 30 healthy college students were selected, 15 majored in classical Chinese dance (Dance Training group, DTG) and 15 (Control Group, CG) have no previously experience of regular training. MRI technique was used to observe the effect of dance training on the structure and function of emotion related brain areas. Siemens MAGNETOM Trio 3.0t MRI was selected and data analyzed by ALFF/FC with GREYNA.

**RESULTS:** Compared with CG, whole brain ( $1366 \pm 88$ ml), gray matter ( $674 \pm 49$ ml), white matter ( $488 \pm 39$ ml) was no significant difference with DTG ( $P > 0.05$ ). The structural of left BA20 of DTG was increased significantly (voxels=142,  $t=5.91$ ). The structural of left anterior cingulate gyrus, right central cingulate gyrus and insula gray matter decreased significantly in DTG ( $P < 0.05$ ). With the increase of training years, the structural volume of BA20 gray matter increased significantly (voxels=420,  $r=0.80$ ). In DTG the ALFF value and ReHo value in BA48 and BA23 were significantly increased ( $P < 0.05$ ). The functional connections between the left insula and the right transverse temporal gyrus and the left superior temporal gyrus were enhanced ( $P < 0.05$ ). Also right insula and the left amygdala, transverse temporal gyrus, superior temporal gyrus, middle temporal gyrus, inferior temporal gyrus and transverse temporal gyrus were significantly enhanced ( $P < 0.05$ ).

**CONCLUSIONS:** The possible mechanism of dance training regulating emotion of college students may be relevant to the changes of structure, function and functional connections of emotion related brain areas. The effect of dance training on emotion regulation is highly related to the years of dance training (Supported by The Innovation ability promotion Plan Foundation of Beijing Municipal Education Commission No.TJSH20161005101).

**2296** Board #215 May 28 2:00 PM - 3:30 PM  
**Cognitive Response And Motor Speed Before And After A Sustained Endurance Run**  
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*(No relevant relationships reported)*

There has been some controversy regarding the effects of physically exhausting the human body through endurance exercise. When it comes to the fatigue of the muscular system and being "physically tired", there is a question of the mental fatigue that such sustained physical exercise can take on the body.

**PURPOSE:** To test the differences in quick thinking tasks and reaction time before and after a 3-hour treadmill run, in trained endurance males.

**METHODS:** 10 male endurance runners ( $32 \pm 6.0$ yr;  $161.3 \pm 20.7$  lb,  $68 \pm 1.6$  in;  $14.7 \pm 6.6\%$  body fat) ran for 3-hours on the treadmill ( $6.1 \pm 0.2$  mph,  $57 \pm 0.9\%$   $VO_{2max}$ ) for  $18.3 \pm 0.6$  miles, on 3 separate occasions and performed a STROOP interference test, Reaction time test, and a 30 second finger-tapping test pre-run (PRE) and immediately after the treadmill run (POST).

**RESULTS:** There was a significant improvement in the cumulative time it took for successful responses in the STROOP test POST vs. PRE ( $24.36 \pm 0.68$ ;  $28.44 \pm 1.09$  sec;  $p < 0.05$ ). There was a significantly slower average response time when responding to different word colors, vs. the same color for the word ( $p < 0.05$ ). There was a significant improvement in reaction time POST vs. PRE ( $0.44 \pm 0.004$ ;  $0.48 \pm 0.006$  sec;  $p < 0.05$ ). There was no significant difference between PRE and POST 3-hr run finger tapping score ( $209.1 \pm 4.6$ ;  $211.1 \pm 4.7$  taps;  $p=0.45$ ).

**CONCLUSIONS:** These results provide support to indicate that even after a fatiguing 3-hr treadmill run, at a moderate intensity, mental response time to cognitive tasks and the reaction time of trained, male endurance runners is not diminished, and is even significantly improved.

**2297** Board #216 May 28 2:00 PM - 3:30 PM  
**The Effect Of Behavioral Automaticity On Behavior Is Moderated By Cognitive Self-control Abilities**  
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 (No relevant relationships reported)

**PURPOSE:** Dual-process theories assume that physical activity (PA) behavior is regulated by two different processes: *implicit* (i.e., automatic, unconscious) and *explicit* (i.e., effortful, conscious) processes. In this study we examined the interaction of implicit (i.e., behavioral *automaticity*) and explicit (i.e., cognitive self-control abilities) processes on PA behavior. We expected significant interaction effects between behavioral automaticity and cognitive self-control abilities (i.e., inhibition): highly automatized behaviors will prevail when inhibition abilities are poor, while high inhibition abilities might help to inhibit unwanted automatic behavioral tendencies (e.g., highly automatized sedentary behaviors [SB]).

**METHODS:** A prospective study with two points of measurement ( $N = 114$  undergraduate and graduate students) was conducted. At t1 age, sex, past PA behavior (control variables) and *automaticity* of a) PA and b) SB were assessed with standardized questionnaires. Inhibition was assessed with a computerized Stop-Signal and a Go/No-Go task. At t2 (4 weeks later), PA behavior was measured as dependent variable with a standardized questionnaire. Hierarchical multiple linear regression analyses with interactions *Automaticity* x *Inhibition* on PA behavior and subsequent moderation analyses were calculated for *automaticity* of a) PA and b) SB respectively. **RESULTS:** The expected interaction effects *Automaticity* x *Inhibition* on PA behavior were significant for *automaticity* of a) PA ( $b = 55.23, p < .01$ ) as well as b) SB ( $b = -27.40, p < .05$ ). Moderation analyses revealed that *PA automaticity* was a significant positive predictor of PA behavior when inhibition abilities were poor ( $b = 105.75, SE = 23.13, t = 4.57, p < .001$ ), but not when they were high ( $b = -11.10, SE = 24.71, t = -0.45, p = .65$ ). Furthermore, *automaticity* of SB was a significant negative predictor of PA behavior when inhibition abilities were poor ( $b = -42.83, SE = 20.87, t = -2.05, p < .05$ ), but not when they were high ( $b = 13.67, SE = 17.61, t = 0.77, p = .44$ ).

**CONCLUSIONS:** In line with theoretical assumptions, automatic behaviors prevailed when the ability to inhibit prepotent responses was poor. However, higher inhibition abilities erase the significant associations between automaticity and behavior for both, PA and SB automaticity.

**2298** Board #217 May 28 2:00 PM - 3:30 PM  
**Preschoolers' Self-regulation, Fine Motor Skills, And Performance On A Standardized Literacy Assessment**  
 Madison C. Chandler<sup>1</sup>, Kyla Z. McRoy<sup>1</sup>, Sarah Goodwin<sup>1</sup>, Ryan P. Bowles<sup>1</sup>, Gary E. Bingham<sup>2</sup>, Hope K. Gerde<sup>1</sup>, Matthew B. Pontifex<sup>1</sup>. <sup>1</sup>*Michigan State University, East Lansing, MI.*  
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In early childhood, both self-regulation and fine motor skill proficiency are positively related to academic achievement – and recent research suggests that these two factors are interrelated and co-develop such that skill in one may make up for deficiencies in another. **PURPOSE:** The aim of the present investigation was to determine the extent to which fine motor skill moderates the relationship between self-regulation and performance on a standardized literacy assessment in a sample of preschoolers. **METHODS:** Three hundred forty children from Head Start programs in Michigan and Georgia ( $M_{age} = 3.76$  years; 172 females; 64% African-American) completed assessments of self-regulation (the Head-Toes-Knees-Shoulders task; McClelland et al., 2014), fine motor skills (the Early Skills Inventory – Revised; Meisels et al., 1997), and emergent literacy skills (the Test of Preschool Early Literacy; Lonigan et al., 2007). Hierarchical regression analyses were conducted to examine the potential moderating association between fine motor skill and self-regulation on emergent literacy skills. **RESULTS:** Replicating extant literature, self-regulation was a statistically significant predictor of emergent literacy skills,  $\beta = 0.51, R^2_{adj} = 0.26, p < 0.001$ . Novel to the current investigation, fine motor skills were found to moderate this relationship ( $\beta_{self-regulation} = 0.53, \beta_{fine\ motor\ skills} = 0.42, \beta_{interaction} = -0.22; R^2_{change} = 0.10; p \leq 0.03$ ) such that higher fine motor skills were associated with enhanced emergent literacy skills in children with lower levels of self-regulation, but the impact of fine motor skills was attenuated for children with higher levels of self-regulation. **CONCLUSION:** These findings suggest that physical activity interventions designed to enhance fine motor skills could be beneficial in populations with low self-regulatory abilities, given the compensatory relationship between self-regulation and fine motor skills.

**2299** Board #218 May 28 2:00 PM - 3:30 PM  
**Association Of Physical Health And Exercise Intervention With Stress, Depression And Life Satisfaction Among Chinese College Students**  
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 (No relevant relationships reported)

**PURPOSE:** This study explores the relationship between Chinese college Students' different levels of physical health and their perceived stress, depression and life satisfaction, then to analyze the impact of university exercise intervention courses on the above-mentioned mental health. **METHODS:** The sample consisted of 991 college students (Males:  $N=371$ , Age:  $M=19.07$  years old) who were voluntarily enrolled in a 10-week weekly exercise intervention course in a famous university of china fitness courses, personal net-separating courses, collective antagonism courses. Before exercise intervention, they uniformly scored physique tests according to the requirements of the National Standards for Physical Health of Students. Perceived Stress Scale (Sheldon Cohen, 1994), Center for Epidemiological Studies Depression (Hann, Winter & Jacobsen, 1999) and Life Satisfaction Scale (Dew & Huebner, 1994) were filled in before and after exercise intervention. **RESULTS:** The better the physical health of College students, the higher their life satisfaction ( $R=-0.121, P<.01$ ), and the lower their perceived stress ( $R=-0.085, P<.01$ ) and depression level ( $R=-0.052, P<.05$ ). Significant decreases were observed for depression in genders, grades and sports courses ( $T=12.056, P<.01$ ). The students whose physical health level are "excellent" ( $F=-3.421, P<.05$ ), "good" ( $F=-1.728, P<.01$ ) and "pass" ( $F=-1.003, P<.05$ ) have lower perceived stress level than the students whose physical health level is "failed". And whose physical health level are "excellent" ( $F=4.598, P<.01$ ), "good" ( $F=2.592, P<.01$ ) and "pass" ( $F=1.859, P<.01$ ) have better life satisfaction than those whose physical health level is "failed". **CONCLUSIONS:** Students with better physical health have significantly higher life satisfaction, lower perceived stress and depression. Physical education course plays an active role in regulating the perceived depression of College students.

**2300** Board #219 May 28 2:00 PM - 3:30 PM  
**Coping Skills Of Wildland Firefighters**  
 L. Donovan Robinson, Michael C. Meyers, FACSM, Shad K. Robinson. *Idaho State University, Pocatello, ID.*  
 (No relevant relationships reported)

Nearly 14,000 firefighters are employed to combat wildland fires resulting in 13 fatalities and 270 injuries per year. Their ability to cope during stressful situations is critical for optimal performance to prevent morbidity and mortality. **PURPOSE:** To quantify the coping skills of wildland firefighters. **METHODS:** Following written informed consent, a modified Athletic Coping Skills Inventory (ACSI): coping with adversity (COPE), peaking under pressure (PEAK), goal setting/mental preparation (GOAL), concentration (CONC), freedom from worry (FREE), confidence and achievement motivation (CONF), coachability (COACH), and personal coping resources (PCR) and a modified Sports Inventory for Pain (SIP): direct coping (COP), cognitive (COG), catastrophizing (CAT), avoidance (AVD), body awareness (BOD), and total coping response (TCR) were completed by 140 wildland firefighters (mean age =  $28.5 \pm 13.9$  yrs). Data were grouped by occupation (hotshot, smokejumper), job description (supervisor, manager, worker), and years of experience (1-9, 10-19, 20+). Raw ACSI and SIP scores were converted to normalized standard scores (T-scores; mean = 50, SD = 10). **RESULTS:** MANOVAs (Wilks'  $\lambda$  criterion) had a significant main effect by job description ( $F_{8,139} = 1.919, p = .019$ ) and years of experience, ( $F_{8,139} = 1.835, p = .027$ ) but not occupation ( $F_{8,139} = 1.53$ ). Post hoc analysis indicated that supervisors scored significantly higher on PEAK ( $p = .028$ ) than managers and workers, respectively. Post hoc analysis indicated 20+ yrs of experience scored significantly higher on FREE ( $p = .031$ ), while 10-19 yrs scored significantly higher on PEAK ( $p = .045$ ). In terms of pain coping, MANOVA indicated a significant main effect by occupation ( $F_{6,139} = 3.104, p = .011$ ). Post hoc analysis indicated that hotshots scored significantly higher on CAT ( $p = .014$ ) AVD, ( $p = .002$ ) but lower BOD ( $p = .008$ ) than smokejumpers, respectively. No other significant main effects were observed. T-scores indicated average to lower than average (39-56) responses from wildland firefighters. **CONCLUSIONS:** It is recommended that occupational psychologists be employed to enhance the coping skills training involving wildland firefighters.

2301 Board #220 May 28 2:00 PM - 3:30 PM

**Sentiment Analysis Of Journal Articles, Press Releases, And News Articles Pertaining To Chronic Traumatic Encephalopathy**Kaitlyn S. Todd<sup>1</sup>, Andrew P. Lapointe<sup>2</sup>, Steven P. Broglio, FACSM<sup>1</sup>. <sup>1</sup>University of Michigan, Ann Arbor, MI. <sup>2</sup>University of Calgary, Calgary, AB, Canada. (Sponsor: Steven Broglio, FACSM)

(No relevant relationships reported)

**PURPOSE:** Previous research has called for media balance when reporting on chronic traumatic encephalopathy (CTE) in order to avoid harmful bias towards readers. This call is raised from concerns that the media's representation of CTE has moved beyond what science has proven. The purpose of this study was to use word sentiments to directly compare journal articles with corresponding news articles to evaluate these concerns. The news articles were split into three groups: press releases reporting the articles' findings, news articles about CTE from upper tier news outlets, and articles from lower tier news outlets.

**METHODS:** Research articles (n=10) directly associated with CTE that were heavily covered in the media were selected for this sample. An equivalent number of press releases (n=10), upper tier articles (n=10), and lower tier articles (n=10) were collected in order to compare semantics. The "AFINN" sentiment analysis dictionary rates the emotional valence of each word with an integer between minus three (negative connotation) and plus three (positive connotation). Words not recognized by the dictionary or with a zero weight were omitted from the analyses. Mean sentiment score was adjusted for total word count.

**RESULTS:** The mean sentiment scores, adjusted were words count, were as follows: 0.086 for journal articles, -0.096 for press releases, -0.122 for upper tier sources, and 0.026 for lower tier sources. An analysis of variance calculation yielded no significant differences between the groups (F = 1.058, p = 0.379).

**CONCLUSIONS:** Despite recent calls for a less biased reporting of CTE in mainstream media, our analysis indicates essentially equal sentimental weighting between peer-reviewed journal articles and news reports on CTE, whether the report was a press release, an article from an upper tier source, or from a lower tier source. Additionally, these sentiment weights each approached a value of zero (true neutrality). Future research should take into account the context in which the words appears in the articles in addition to using sentiment averages.

2302 Board #221 May 28 2:00 PM - 3:30 PM

**Abstract Withdrawn**

2303 Board #222 May 28 2:00 PM - 3:30 PM

**Does ACL-reconstruction Lead To Higher Use Of Neural Resources To Prepare & Initiate Challenging Jump-landings?**Florian Giesche<sup>1</sup>, Solveig Vieluf<sup>2</sup>, Jan Wilke<sup>1</sup>, Tobias Engeroff<sup>1</sup>, Daniel Niederer<sup>1</sup>, Winfried Banzer, FACSM<sup>1</sup>. <sup>1</sup>Goethe University, Frankfurt, Germany. <sup>2</sup>Paderborn University, Paderborn, Germany. (Sponsor: Winfried Banzer, FACSM)  
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(No relevant relationships reported)

Increased cortical motor planning has been suggested to compensate the loss of mechanoreceptors after anterior cruciate ligament (ACL) injury in simple motor tasks. **PURPOSE:** To investigate the cortical processes associated with more sports- and injury-related movements. **METHODS:** Ten males with ACL-reconstructed knee (28±4 yrs., 25±3 kg/m<sup>2</sup>, 63±35 months since surgery; ACLR) and 17 knee-injury free controls (28±4 yrs., 26±3 kg/m<sup>2</sup>; all males) completed 70 counter-movement jumps with single-leg landings on a pressure plate. Pre-planned (landing leg shown before take-off; PP) and non-pre-planned (visual cue during flight, 360 ms prior ground contact; NPP) landings (35 each) were performed in random order. Movement-related cortical potentials (MRCPs) were analysed to quantify the neural involvement needed to initiate the jump (higher negative potentials indicate more motor planning) using electroencephalography. The mean activity was calculated for fronto-central (FC1, FC2) and central electrodes (C3, C4, CZ) in three successive epochs prior to movement onset (acceleration sensor): Early (-1.500 to -1.000 ms; RP1), late readiness potential (-1.000 to -500 ms; RP2) and negative slope (-500 to 0 ms/movement onset; NS). **RESULTS:** In both groups, MRCPs occurred at CZ only. A 3 x 2 ANOVA revealed a main effect for a significant increase of negativity (ACLR: F(16)=36, p<0.001, eta=0.8; controls: F(9)=22, p<0.001, eta=0.6) across the three epochs (ACLR<sub>pp</sub>: RP1:-0.8, RP2:-1.8, NS:-5.8 μV, p<0.01; ACLR<sub>npp</sub>: RP1:-0.9, RP2:-3.2, NS:-8 μV, p<0.01; controls<sub>pp</sub>: RP1:-0.2, RP2:-1.8, NS:-5.9 μV, p<0.01; controls<sub>npp</sub>: RP1:-0.2, RP2:-1.1, NS:-4.3 μV, p<0.01). Between groups, no significant effects were found for time (F(26)=0.2, p=0.9), landing condition (F(26)=1.3, p=0.3) nor the interaction of both factors (F(26)=2.0, p=0.2). However, the ACLR-group showed a moderate effect for a higher negativity at all epochs in the NPP condition (d≥0.5). **CONCLUSION:** Our

jump-landing task evoked MRCPs irrespective from group and condition. The trends in our data suggest that ACLR-individuals may use more motor planning resources to initiate a challenging motor task. Research is warranted to elucidate the possible implications of such potential central compensations for injury risk. No funding.

2304 Board #223 May 28 2:00 PM - 3:30 PM

**Study On Correlation Between Cognitive Function And Exercise Intensity, Frequency And Types Of People At Advanced Age**

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(No relevant relationships reported)

**PURPOSE:** To explore the correlation between cognitive function and exercise intensity, frequency and type of people at advanced age.

**METHODS:** 418 elderly people aging from 80 to 85 were recruited from Shangdi community, Haidian District, Beijing, China from April to August 2019. Based on scores of Mini-Mental State Exam (MMSE) of the elderly, the elderly were divided into normal group (≥ 27 points), cognitive impairment group (< 27 points), dementia group (Reference MMSE). To investigate sports in the past five years by surveying the elderly and their family members. Exercise intensity (refer to the "metabolic equivalent table of common daily life, entertainment and work activities") classification: 1-1.9met (eating, dressing, washing hands), 2-2.9met (walking less than 3km / h, simple housework), 3.0-4.4met (cooking, housekeeping, medium speed walking, Tai Chi), 4.5-5.9met (fast walking, jogging), > 6met (running); exercise type: housework exercise, leisure sports, sports; sports frequency: 1-2 times / week, 3-4 times / week, ≥ 5 times / week. **RESULTS:** A total of 401 effective questionnaires (96%) were collected. Except 91 of them who had interrupted their normal exercise habits due to emergencies such as diseases in the past five years, the rest 310 were investigated, including 95 cases in the normal group, 168 cases in the cognitive impairment group and 47 cases in the dementia group (mild, moderate and severe); The rate of exercise in MMSE score normal group with metabolic equivalent between 2-4.5MET was high, compared with that of cognitive impairment group and dementia group (P<0.05). Frequency of exercise in MMSE score normal group and cognitive impairment group was high, compared with that of dementia group (P<0.05). There was no correlation between the MMSE score and the type of exercise.

**CONCLUSIONS:** Long-term participation in the exercise with metabolic equivalent between 2-4.5met/people at advanced age can slow down the occurrence of cognitive dysfunction, so does the high exercise frequency (≥ 5 times / week). There is no evident correlation between exercise type and cognitive function of people at advanced age.

2305 Board #224 May 28 2:00 PM - 3:30 PM

**Exercise's Effect On Reaction Time And Answer Accuracy During Memory Recall**

Lucas Van Horn. West Chester University of Pennsylvania, West Chester, PA. (Sponsor: Dr. William A. Braun, FACSM)

(No relevant relationships reported)

Short and long-term memory recall can be improved by regular exercise, based on rat and human brain studies. Regular exercise, by promoting brain blood flow, has been shown to decrease the rate of decline of memory consolidation and recall in adults. Acute exercise can cause an immediate increase of blood flow to the brain thus potentially increasing oxidative supply for memory encoding. Conversely, a hyperglycemic state may interfere with memory encoding. **PURPOSE:** To determine the effects of light exercise (LEC), heavy exercise (HEC), and exogenous glucose (GLU) on reaction time and response accuracy during a computer-based memory recall test. **METHODS:** 15 subjects (20.80±1.26 yr) completed four trials: resting control (CON), low-intensity cycling (LEC), heavy cycling (HEC), and resting glucose (GLU): a 25% glucose solution supplied at 1g/kg of body mass followed by a 25 min rest. For each trial, subjects observed 75 images prior to the assigned treatment and were then asked to recall the images after the treatment. During the post-test, 25 images were replaced with new images; subjects were then asked to recall whether the images had been viewed during the pre-test. Accuracy and reaction time (RT) were assessed. Exercise trials (20 min) were conducted using 20% (LEC) and 40% (HEC) of Wingate anaerobic test work rate. Blood lactate, glucose, and heart rate were collected at specific time points throughout. **RESULTS:** Mean HR was significantly increased during LEC and HEC (117 ± 14.4 bpm and 161 ± 16.5 bpm, respectively) (p < 0.05) vs. CON (68.0±9.4 bpm) and GLU (67.8±7.7 bpm). Blood glucose was significantly increased during GLU (p < .001) and blood lactate significantly increased during HEC (p < .001) vs. all conditions. Despite these physiologic alterations, no main treatment effects were observed for reaction time (RT), or accuracy. However, RT was significantly faster for correct responses (1005.10 ± 22.0 ms) compared to incorrect responses (1328.2±46.5 ms) across all treatments vs. CON (p < .001).

**CONCLUSION:** Based on the study results, different physiologic stressors resulting from acute exercise or hyperglycemia elicited no positive or adverse effects on short-term memory recall. Though, treatments were associated with a greater RT in selecting correct responses.

**2306** Board #225 May 28 2:00 PM - 3:30 PM  
**A Single Bout Of Aerobic Exercise Improves Cognitive Function In Older Adults**  
 Haley O. Norris, Trevor M. Price, Lisa K. Sprod. *University of North Carolina at Wilmington, Wilmington, NC.*  
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 (No relevant relationships reported)

A Single Bout of Aerobic Exercise Improves Cognitive Function in Older Adults  
 Changes in cognitive function commonly occur in older adults. These changes can range from mild cognitive impairment to dementia. With the number of older adults projected to double in the next 30 to 40 years, it is important to determine interventions capable of improving cognitive function in this sector of the population. **PURPOSE:** To determine if a single bout of moderate intensity aerobic exercise improves cognitive function in older adults. **METHODS:** Older adults were recruited from an independent living community to participate in a single 20-minute bout of moderate intensity exercise performed on a recumbent stepper. Immediately before and 10 minutes after the bout of exercise, participants completed the pattern comparison cognitive assessment to determine the impact of a single bout of aerobic exercise on cognitive function. This instrument includes 30 problems with two patterns side by side per problem where participants denote whether the patterns are the same "s" or different "d" during the 30 second time limit given. Results were scored as correct or incorrect and a higher overall score reflects better cognitive functioning. A paired-samples t-test was used to compare pre- to post-exercise cognitive function scores. Results were considered significant at  $p < 0.05$ . **RESULTS:** Participants included 23 adults between the ages of 69 and 94, with an average age of 81.91. Of those, 5 were males and 18 were females. There was a significant improvement from pre to post aerobic exercise in the number of correct responses on the cognitive assessment ( $pre = 11.95 \pm 3.60$ ,  $post = 13.13 \pm 2.80$ ,  $p < 0.01$ ). **CONCLUSION:** A single 20-minute bout of moderate intensity aerobic exercise can improve cognitive function in older adults. With a dramatic increase in the number of older adults in the United States, research on mitigating the decline in cognitive function, such as through exercise, is imperative to meet the needs of this growing segment of the US population.

## D-69 Free Communication/Poster - Neuroscience

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
 Room: CC-Exhibit Hall

**2307** Board #226 May 28 2:00 PM - 3:30 PM  
**Assessment Of Neurologic Function In Mixed Martial Arts Fighters Following A Single Competition**  
 Thayne A. Munce, FACSM, Daniel N. Poel. *Sanford Sports Science Institute, Sioux Falls, SD.*  
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 (No relevant relationships reported)

Head strikes are legal and commonly used in mixed martial arts (MMA) competitions, putting MMA fighters at substantial risk for brain injury. Following a knockout (KO) or technical KO (TKO), fighters typically receive time-based medical suspensions that do not include objective determinations for safe return-to-play. Fighters who do not suffer a KO or TKO may not receive any medical suspensions, even though they may have incurred an undiagnosed concussion or subconcussive brain injury. **PURPOSE:** To determine if participating in a single MMA competition is associated with impaired neurologic function of MMA fighters. **METHODS:** Neurologic function of ten amateur and professional MMA fighters (9 men, 1 woman;  $26.1 \pm 2.6$  yr) was assessed before ( $61 \pm 91.8$  days; T1) and after ( $3.8 \pm 1.3$  days; T2) competition. Control participants (9 men, 1 woman;  $27.1 \pm 2.7$  yr) were assessed on two separate occasions,  $38 \pm 15.2$  days apart (T1, T2). All participants were evaluated for static balance (Wii Balance Board; SB), dynamic balance (Y Balance Test; DB), eye movement speed and accuracy (King-Devick test; KD), near point of convergence (Vestibular / Ocular-Motor Screening; NC), hand-eye reaction time (FITLIGHT Trainer; RT), visuomotor ability (FITLIGHT Trainer, VM), and multiple object tracking speed (NeuroTracker, MOT). **RESULTS:** Two MMA participants lost their competition by KO/TKO (one due to strikes). DB, KD and NC improved significantly in control subjects relative to MMA fighters ( $\beta = -0.019$ ,  $P = 0.005$ ;  $\beta = 2.874$ ,  $P = 0.039$ ; and  $\beta = 5.662$ ,  $P = 0.002$ , respectively). However, SB, RT and VM improved significantly in MMA fighters relative to control subjects ( $\beta = -1.042$ ,  $P < 0.001$ ;  $\beta = -0.017$ ,  $P = 0.037$ ;  $\beta = -0.062$ ,  $P = 0.015$ , respectively). Changes in MOT between T1 and T2 were not significantly different between groups ( $\beta = 0.257$ ,  $P = 0.285$ ). **CONCLUSION:** MMA fighters

had deficits in some assessments of neurologic function a few days after competition, yet they seemed to improve in other aspects. Measures of dynamic balance and eye function were impaired relative to control subjects, whereas static balance and reactive movement skills were improved in MMA fighters. Overall, it appears that some aspects of neurologic function may be more susceptible to impairment following MMA competition, though general abnormalities were not present.

**2308** Board #227 May 28 2:00 PM - 3:30 PM  
**Assessment Of Neurological Function In Mixed Martial Arts Fighters Following A Single Training Session**  
 Daniel N. Poel, Thayne A. Munce, FACSM. *Sanford Sports Science Institute, Sioux Falls, SD.*  
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 (No relevant relationships reported)

Mixed martial arts (MMA) is a combat sport that utilizes a variety of striking, grappling, and submission techniques in training and competition. Consequently, MMA fighters routinely incur head impacts that may put them at risk for mild traumatic brain injury (mTBI) and/or neurodegenerative brain disease later in life. Fighters compete rather infrequently, though often train year-round; thus, cumulative exposure to injury is higher during training than competition. However, the neurologic effects of MMA training sessions are unknown. **PURPOSE:** To determine if a single MMA training session is associated with impaired neurologic function of MMA fighters. **METHODS:** Ten amateur and professional MMA fighters (8 men, 2 women;  $26.3 \pm 2.6$  yr) were evaluated at baseline and immediately following an MMA training session (post-training), using several objective assessments of neurologic function. Participants were evaluated for eye movement speed and accuracy (King-Devick test; KD); VOMS, near point convergence (Vestibular / Ocular-Motor Screening; NC), hand-eye reaction time (FitLight Trainer; RT), visuomotor ability (FitLight Trainer; VM), static balance (Wii Balance Board; SB), and multiple object tracking speed (NeuroTracker; MOT). **RESULTS:** Total KD times were significantly faster following a training session ( $35.86 \pm 8.05$  vs.  $43.34 \pm 8.92$  s;  $P < 0.001$ ). Likewise, RT ( $0.43 \pm 0.04$  vs.  $0.48 \pm 0.04$  s;  $P = 0.003$ ) and VM ( $1.06 \pm 0.22$  vs.  $1.20 \pm 0.25$  s;  $P = 0.011$ ) times improved significantly following training. MOT speed ( $2.15 \pm 0.26$  vs.  $2.03 \pm 0.34$  m·s<sup>-1</sup>;  $P = 0.442$ ) and NC distance ( $5.18 \pm 5.12$  vs.  $6.62 \pm 5.85$  cm;  $P = 0.284$ ) also improved following training, although these changes were not significant. SB was virtually identical from baseline to post-training ( $2.27 \pm 0.95$  vs.  $2.27 \pm 1.30$  cm<sup>2</sup>;  $P = 0.994$ ). **CONCLUSION:** Compared to baseline measures, some assessments of neurologic function revealed significant changes after a single MMA training session. Contrary to what was expected, all significant changes were the result of improved performance from baseline to post-training. Based on these findings, neurologic function of MMA fighters does not appear to be impaired following a single training session. Furthermore, MMA training bouts may be associated with acute improvements in eye movement, reaction time and visuomotor ability.

**2309** Board #228 May 28 2:00 PM - 3:30 PM  
**Smooth Pursuit And Saccadic Eye Movements Following Years Of Contact Collision Sports: A Pilot Study**  
 Nicholas G. Murray, Brian Szekely, Arthur Islas, Cameron Kissick, Philip Pavilonis, Sushma Alphonsa, Madison R. Taylor, Nora Constantino. *University of Nevada, Reno, Reno, NV.*  
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 (No relevant relationships reported)

Repetitive head impacts (RHI) are the result of a blow to the head that does not elicit clinical signs or symptoms of a concussion. Recent evidence suggests that RHI from a single season of collegiate football can lead to a reduction in midbrain white matter integrity. The midbrain carries projecting fibers to the trochlear and oculomotor nerves, which if damaged may impair oculomotor control. **PURPOSE:** The purpose of this study was to evaluate oculomotor function following multiple years of Division I contact sports during a dynamic visual acuity (DVA) task. **METHODS:** Two NCAA Division I football defensive backs with no diagnosed concussion history (a first-year freshman [F1; age=18 years], senior [S1; age=21 years]) and a healthy control (CON; age=23 years), all with lower than 20/20 vision, completed a DVA task at pre-season. For the DVA task (optotype spatial range=1.0 to -0.3), participants were asked to complete 60 randomized trials of smooth pursuit (30°/s) and saccades (150°/s). Participants head were stabilized in a chin rest at a distance of 154cm away from the 26° visual field monitor (165Hz, 2560 x 1440 pixel resolution, 300 cd/m<sup>2</sup> luminance) while wearing a head-mounted binocular video ophthalmography eye tracker (Eyelink SR research, 500 Hz, Ottawa, CN). Using a 2-up-1-down staircase method, participants tracked a Landolt-C ring that moved across the screen (horizontally left to right) where the size of the gap in the C along with the orientation (left, right, up or down) adjusted based on the correct/incorrect responses during both smooth pursuit and saccadic trials. Smooth pursuit eye movement (SPEM) velocity gain and saccadic peak velocity were calculated using ternary eye movement classification from the transformed spherical coordinates via a custom MATLAB code (MATLAB 2019a, Natick, MA, USA).

No statistical analysis were performed given the single-subject design. **RESULTS:** SPEMs gain is lower for S1 (0.88) when compared to F1 (0.82) and CON (0.92). Similarly, during the saccadic trials, S1 had slower average saccadic peak velocity (S1=279.75°/s; F1=392.34°/s; CON=491.96°/s). **CONCLUSIONS:** These results may indicate that engaging in contact collision sport for 2+ years at the Division 1 level may result in less accurate (lower SPEMs gain) and slower saccadic eye movements. Supported by NIH P20GM103650

**2310** Board #229 May 28 2:00 PM - 3:30 PM  
**Submaximal Exercise Does Not Increase Brain-Derived Neurotrophic Factor (BDNF) In People With Spinal Cord Injury**

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(No relevant relationships reported)

Brain-derived neurotrophic factor (BDNF) has been implicated in repair and regeneration of peripheral neurons, and is important for brain health. Acute exercise (EX) increases circulating BDNF in an intensity dependent manner in able-bodied individuals. However, the response of BDNF to EX in people with spinal cord injury (SCI) is poorly understood. **PURPOSE:** to investigate the hypothesis that submaximal EX will increase serum and plasma BDNF in people with SCI. **METHODS:** Nine adults with SCI participated (M age = 39.2 ± 11.0 years; M years post-injury = 16.5 ± 9.2). After completing a maximal exercise test on an electromagnetically braked arm-crank ergometer to determine peak power output (PPO), participants completed two visits in randomized order: 1) submaximal EX (30 minutes maintaining 55-65 rpm @ 60% PPO); and 2) seated control (CTL). Ratings of perceived exertion (RPE) were measured during EX using the 6-20 visual Borg RPE scale. Heart rate (HR) and blood pressure (BP) were measured pre- and post-EX. BDNF was measured via ELISA in both serum and plasma from venous blood sampled at pre-, post-, and 90 min post-EX. For the CTL visit, participants rested quietly for 120 min and blood was sampled at equivalent time points to EX. A 2-factor repeated measures ANOVA was computed to assess BDNF responses by time and condition. Paired t-tests were computed to assess HR and BP responses to EX. Pearson correlations were computed to explore relationships between BDNF and physiological responses to EX and work rate. **RESULTS:** The average EX work rate was 47 ± 17 W and RPE was 13 ± 1. HR increased by 26 ± 33 bpm (+41%; p=0.059), whereas systolic and diastolic BP remained unchanged after EX. Contrary to our hypotheses, EX had no effect on serum (Pre vs. Post-EX = 22447.9 ± 9071.1 pg/mL vs. 26552.8 ± 6563.4 pg/mL;  $F_{(1,12)} = 0.51$ , p=0.53) or plasma (Pre vs. Post-EX = 1802.7 ± 1031.1 vs. 1662.7 ± 1390.0 pg/mL;  $F_{(1,10)} = 0.77$ , p=0.45) BDNF. Exploratory correlational analyses showed no relationships between changes in BDNF and the outlined parameters. **CONCLUSIONS:** Submaximal EX did not increase BDNF in people with SCI. Future studies should systematically investigate BDNF responses to higher EX intensities given the intensity-dependent response in able-bodied people. **FUNDING:** Rick Hansen Foundation through the Blusson Integrated Cures Partnership

**2311** Board #230 May 28 2:00 PM - 3:30 PM  
**Beyond The Runners High: Cannabis And Exercise**  
Whitney Ogle, Lukas Coppen, Claire Copriviza. *Humboldt State University, Arcata, CA.*  
(No relevant relationships reported)

Cannabis use has been gaining wider social acceptance, and with increased legalization cannabis users are talking more openly about how and why they consume cannabis. While there is growing interest in combining cannabis with physical activity, there is a distinct lack of cannabis research in humans, particularly as it relates to physical activity.

**PURPOSE:** To investigate how and why people use cannabis with exercise as well as categorizing the types of exercise users engage in.

**METHODS:** 126 subjects (n = 63 male, 62 female, 1 non-binary) were recruited to complete an anonymous online survey if they reported both participation in regular physical activity and cannabis use. The survey consisted of five sections: cannabis with exercise, general exercise participation, general cannabis use, unanticipated experiences, and demographics.

**RESULTS:** Over 44% of participants reported that they use cannabis every or almost every time before they exercise. Most smoke cannabis (53%) and use Sativa-dominant strains (65%) before exercise. Only 18% of participants used non-psychoactive CBD products during exercise. The highest reports of exercise participation under the influence of cannabis include hiking (61%), yoga (58%), aerobic machines (50%), walking (43%), and weight lifting (43%). The primary reasons for using cannabis before exercise include: helps me focus/concentrate (66%), helps me enjoy exercise (65%), enhances mind-body-spirit connection (64%), keeps me in the zone (61%), and enhances body awareness (52%). The majority (70%) of respondents reported feeling

more satisfied with their workouts under the influence of cannabis compared to when they do not use cannabis prior to exercise and have not suffered any unanticipated experiences (61%).

**CONCLUSIONS:** This is the first study to investigate how and why people use cannabis with exercise. This study provides a starting point for future studies investigating the impact that cannabis consumption has on exercise participation and performance.

**2312** Board #231 May 28 2:00 PM - 3:30 PM  
**Impact Of Exercise Intensity On Cue Reactivity In Heavy Alcohol Users**

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(No relevant relationships reported)

Physical exercise has been shown to reduce craving for alcohol in alcoholics. There is a high prevalence of heavy alcohol use in college-aged adults (18-29 years of age). This can be predictive of an alcohol or other substance use disorder developing later in life. Acute exercise alters cue reactivity to addictive substances but it is unknown if the magnitude of change in cue reactivity is impacted by exercise intensity. **PURPOSE:** The purpose of this investigation is to examine the impact of acute aerobic exercise of varying intensities on cue reactivity to alcohol in heavy alcohol users. **METHODS:** Nine participants (8 females, 1 male) (Age = 21.5 ± 0.5 years, BMI = 23.9 ± 0.1,  $VO_{2Max} = 32.25 ± 1.06$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) completed 3 experimental sessions. Heavy alcohol use was identified using an adapted version of the CAGE questionnaire. During one session subjects rested (REST) for 30 minutes and during the other two sessions subjects exercised for 30 minutes at a moderate (MOD: 53 ± 7% of Peak HR) or vigorous (VIG: 76 ± 2% of Peak HR) exercise intensity. Sessions were randomized for each participant. Prior to and immediately following each session, EEG data were collected using a 64-channel system while subjects were exposed to 210 images (90 alcoholic drinks (ALC), 90 non-alcoholic drinks (NON), 30 control images). Images were presented in a random order and proceeded by a fixation stimulus using a variable time span (0.5 to 1.5 sec). Adaptive mean amplitude for P300 (210-240 ms post stimulus) and mean amplitude for the late positive potential (LPP) (400-600 ms post stimulus) were calculated in parietal-occipital electrodes. **RESULTS:** The P300 response to ALC increased from pre to post in both REST (pre = 2.69 ± 0.72 μV, post = 3.41 ± 0.52 μV; p = 0.002) and VIG (pre = 1.62 ± 0.40 μV; post = 2.95 ± 0.51 μV, p < 0.001) conditions. In comparison, the P300 response to ALC decreased in the MOD (pre = 1.31 ± 0.29 μV; post = 0.66 ± 0.32 μV, p < 0.001) condition. The LPP to ALC was much greater after REST (2.55 ± 0.69 μV) than after MOD (-0.10 ± 0.32 μV; p < 0.001) and VIG (0.73 ± 0.78 μV; p = 0.003). **CONCLUSION:** These findings suggest that the impact of exercise on cue reactivity to images of alcohol in heavy alcohol users is dependent on exercise intensity. Specifically, it appears that moderate intensity exercise has a greater benefit than vigorous exercise.

**2313** Board #232 May 28 2:00 PM - 3:30 PM  
**Age Of First Exposure Influences Cerebrovascular Reactivity In High School Football Athletes**  
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(No relevant relationships reported)

Late-life physiological and clinical impairments are associated with age of first exposure (AFE) to tackle football. There is a dearth of literature describing how AFE may influence physiological outcomes in current high school football athletes. Cerebrovascular reactivity (CVR) measures the cerebral blood flow response to variations in carbon dioxide partial pressures. Understanding how AFE affects cerebrovascular function in high school athletes may offer insight into potential long-term deficits following cumulative head impact exposure. **PURPOSE:** To investigate how the age at which high school football athletes began playing tackle football influences baseline CVR. **METHODS:** High school football athletes [n=29; age=15.8 ± 1.1 yrs; height=175.8 ± 8.1 cm; mass=75.1 ± 12.6 kg] self-reported AFE (median AFE=13 years old, range=5-15). Transcranial Doppler (TCD) ultrasound was used to assess middle cerebral artery velocity (MCAv) prior to beginning the competitive season. Baseline MCAv was collected for 2 minutes. Changes in MCAv were measured in response to 5 breath-holding trials (20s breath-hold/40s rest) and 5 hyperventilation trials (20s hyperventilation/40s rest). We employed separate mixed effects models with quadratic mean structures to assess group differences in MCAv response to breath-holding and hyperventilation tasks. **RESULTS:** The AFE significantly predicted CVR during breath-holding ( $F_{(1,170)} = 5.27$ , p=0.02) and hyperventilation ( $F_{(1,170)} = 4.08$ , p=0.04). One-year increases in AFE were associated with a 0.69% reduction in average CVR response during breath-holding and a 0.58% increase in average CVR during hyperventilation. **CONCLUSIONS:** Though AFE is associated with CVR in high school football players, the underlying mechanisms driving the observed results

are unclear. The effect of cumulative head impact exposure at the high school level is understudied despite long-term neurophysiological deficits reported in retired professional football players. Studying neurophysiological responses in young football players may provide important insights into addressing cerebrovascular function and other late-life physiological health in athletes.

**2314** Board #233 May 28 2:00 PM - 3:30 PM  
**Validation Checks Decrease Sandbagging On Baseline Neurocognitive Tests**

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 (No relevant relationships reported)

**PURPOSE:** To examine whether a second baseline test (Group 2B) in those scoring an invalid first test on CNS Vital Sign (CNSVS) is comparable to those achieving a valid baseline initially (Group 1).

**METHODS:** This is a retrospective cohort of 817 Division I collegiate student-athletes ages 17-26 who completed at least one valid baseline examination. Subjects were asked to complete a pre-participation computerized neurocognitive test (CNSVS) and those with invalid baseline exams were retested. The valid scores for the retest-group (Group 2B) were compared to subjects who earned a valid baseline exam on their first visit (Group 1). Standard scores were included for all CNSVS domains. The mean scores for all outcome variables of Group 1 and Group 2B were compared using ANOVA analyses with significance set at  $p=0.05$ .

**RESULTS:** In the majority (11/13) of cognitive test scores, subjects with an initial invalid baseline performed similarly in their second attempt (Group 2B) compared to subjects who had a valid baseline exam after one attempt (Group 1). The general memory ( $92.17 \pm 15.56$ ) and visual memory ( $93.26 \pm 13.21$ ) scores for Group 2B remained significantly lower than Group 1 ( $99.96 \pm 15.15$ ;  $101.33 \pm 13.97$ ) ( $p=0.015$ ,  $p=0.006$ ), respectively, while motor speed for the re-test group ( $109.91 \pm 12.48$ ) was significantly higher than Group 1 ( $102.90 \pm 12.30$ ) ( $p=0.02$ ). Interestingly, the total test time (seconds) and the testing duration (seconds) were significantly faster ( $p < 0.001$ ;  $p=0.008$ ) during the second testing session (Group 2B =  $1745.74 \pm 205.72$ ;  $1599.09 \pm 196.59$ ) compared to the those who earned valid scores in their initial attempt (Group 1 =  $2042.53 \pm 276.76$ ;  $1693.53 \pm 167.16$ ) respectively.

**CONCLUSIONS:** Subjects initially completing an invalid baseline examination for concussion testing show significantly worse results than their peers who complete valid baseline tests initially, but these poor results do not persist when given a retest. When computerized neurocognitive tests include validity measurements, "sandbagging" of results can be significantly mitigated, improving overall accuracy of post-injury concussion monitoring, thus decreasing the probability of returning an athlete too early following a concussive injury.

**2315** Board #234 May 28 2:00 PM - 3:30 PM  
**NEUROPHYSIOLOGICAL CHANGES AFTER UPPER AND LOWER LIMB GRADED EXERCISE TESTING.**

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 (No relevant relationships reported)

Aerobic exercise, including graded exercise testing (GXT), may cause neurophysiological changes of circuits in the primary motor cortex (M1) related to mechanisms of fatigue and/or plasticity. Investigating M1 inhibitory circuit changes over time in exercising compared to non-exercising muscles after GXT of the upper limbs (UL) and lower limbs (LL) may distinguish between different post-exercise mechanisms. **PURPOSE:** To evaluate M1 inhibitory circuit changes resulting from UL and LL GXT and determine their associations with fitness. **METHODS:** Six healthy subjects ( $30 \pm 6$  yrs) participated. Transcranial Magnetic Stimulation (TMS), Peripheral Nerve Stimulation (PNS), and Electromyography (EMG) were used for neurophysiological testing. Gas analysis was performed to evaluate  $VO_{2max}$  (UL:  $24.2 \pm 4.8$ , LL:  $35.1 \pm 5.9$  mL/kg/min) during GXTs. Surface electrodes were placed over the first dorsal interosseous (FDI) and tibialis anterior (TA) muscles. Measures of M1 and M1-related afferent inhibition included cortical silent period (CSP) and short-latency afferent inhibition (SAI), respectively. SAI inter-stimulus intervals (ISI) between PNS and TMS stimulations were 21-23ms (UL), and 32-35ms (LL). TMS coil orientation (CO) was altered between posterior-anterior (PA) and anterior-posterior (AP) for both measures of CSP and SAI. CSP and SAI were taken 0-45 min (POST1) and 45-90 min (POST2) post-exercise and compared to pre-exercise. Repeated measures ANOVAs were performed to evaluate effects of exercise type, CO, time, and ISI. **RESULTS:** CSP decreased at POST1 and increased at POST2 in FDI ( $97.9 \pm 1.2\%$  vs.  $104.5 \pm 2.5\%$ ,  $p < 0.05$ ) with a trend toward significance in TA ( $99.3 \pm 2.5\%$  vs.  $103.5 \pm 4.9\%$ ,  $p = 0.19$ ). Although SAI was found for the TA at 32ms ( $p < 0.05$ ) and FDI at 21-23ms ( $p < 0.05$ ), the interaction of exercise type, CO, and ISI did not reach significance after Huynh-Feldt correction (FDI:  $p = 0.10$ , TA:  $p = 0.10$ ). Univariate linear regression of  $VO_{2max}$  and SAI revealed a potential relationship reliant on exercise type and CO (UL:  $R^2 = 0.91$ , LL:  $R^2 = 0.68$ ). **CONCLUSIONS:** Changes in

CSP suggest that exercise may cause early disinhibition followed by greater inhibition in M1 while changes in SAI may be influenced by fitness levels. Collectively, the results support UL and LL GXTs cause measurable M1 neurophysiological changes.

**2316** Board #235 May 28 2:00 PM - 3:30 PM  
**Vestibular, Spatial Cognition And Mental Fatigue Status Of Female Soccer Players Before A Competitive Season**

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 (No relevant relationships reported)

**PURPOSE:** To examine visual-vestibular interaction and the relationship to visuospatial cognition, mental fatigue, and concussion history in female soccer players before the start of a competitive season. **METHODS:** Twenty-four NCAA Division 1 women's soccer athletes participated in the study. All players completed medical history including dates and number of prior concussions. Vestibular and visual interaction was assessed using the Dynamic Visual Acuity Test (DVAT) which examines the loss in visual acuity when the head is moving in the yaw plane at 85 deg/sec or more compared to head stationary. Visuospatial cognition was assessed using the Symbol Digit Modalities Test (SDMT) and the Ray-Osterrieth Complex Figure (ROCF) while current fatigue level was assessed using the Mental Fatigue Scale (MFS). Spearman's correlations examined the correlations between DVAT loss and MFS, SDMT, and ROCF. Comparison of MFS, SDMT score, and ROCF score between groups based on number of concussions was completed using t-tests.

**RESULTS:** Of the 24 participants (mean age  $19.3 \pm 1.3$ ), 15 had a prior history of concussion (range 1-7). Mean loss of visual acuity in the pitch plane in logMAR upwards was  $0.14 \pm 0.08$  and downwards was  $0.19 \pm 0.1$ , and in the yaw plane was  $0.15 \pm 0.08$  to the right and  $0.14 \pm 0.1$  to the left (normative values for this age group are  $0.08 \pm 0.17$  logMAR). The SDMT score was  $59.88 \pm 6.7$ , ROCF score was  $29.9 \pm 5.4$ , and MFS score was  $6.9 \pm 5.8$ . Spearman's correlations showed significant relationships between DVAT loss to the right ( $p=0.04$ ) and mental fatigue ( $p=0.04$ ). Comparisons of athletes who had sustained 2 or more concussions compared to those with 0-1 showed significant differences in the MFS ( $p=0.03$ ).

**CONCLUSIONS:** Greater loss of dynamic visual acuity was seen in female soccer players before the start of a competitive season. Gaze stability deficits are correlated with higher mental fatigue and athletes who had 2 or more concussions had more mental fatigue.

**2317** Board #236 May 28 2:00 PM - 3:30 PM  
**Stress Response And Performance Changes Of Law Enforcement Officers' Marksmanship Under Varied Levels Of Stress**

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 (No relevant relationships reported)

**PURPOSE:** To investigate changes in shooting performance of law enforcement officers under varying levels of stress. This study determined how increasing levels of stress from operating a firearm on static targets changed when participants were subjected to simulated life threatening situations.

**METHODS:** Thirteen law enforcement officers completed three trials of handgun shooting trials using a battery-operated laser marking pistol. Trial one included a modified course from the Illinois State Firearms Qualification Course of Fire. Officers completed two separate simulation trials separated by 48 hrs (SIMCON1, SIMCON2). Each officer engaged in dangerous encounters with virtual suspects using a TI Simulator (TI Training, Golden, Colorado) requiring each officer to draw his weapon and fire against an armed assailant. Heart rate, blood pressure, salivary cortisol, and shooting performance data were collected throughout the courses of fire.

**RESULTS:** Compared with the qualification course of fire (99.23% hit rate of intended target), there was a statistically significant reduction  $p < .001$  in percentage of shots hit during both SIMCON1 (hit rate 47.48%) and SIMCON2 (hit rate 50.13%) conflicts. Compared to trial 1 mean heart rate increased 16.46 BPM and 19.7 BPM and systolic blood pressure 18.77 mm Hg and 23.08 mm Hg respectively for SIMCON1 and SIMCON2 trials. Although a significant physiological effect was noted following both SIMCON trials, it did not statistically correlate with poor marksmanship performance.

**CONCLUSIONS:** Future research should collect physiological variables such as heart rate and blood pressure when the officers are on duty. This real-life situation would likely heighten the physiological responses versus that of simulated setting used in this study. It may provide better insight how real-life scenarios may negatively affect marksmanship performance.

**2318** Board #237 May 28 2:00 PM - 3:30 PM  
**Effects Of Treadmill Exercise On DCX And A Beta1-42 In AD Mice**

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 (No relevant relationships reported)

**PURPOSE:** To investigate the effects of different load exercise on the hippocampal neurogenesis markers DCX and Aβ1-42 in adult AD mice.

**METHODS:** The 3-month-old APP/PS1 dual-transgenic AD mice were randomly divided into four groups: Control group(ADC), Low-load exercise group(ADL), Medium-load exercise group(ADM) and High-load exercise group(ADH), Wild-type control group(WTC) was also set, 6 mice in each group. ADC and WTC group mice were fed naturally for 5 months. Intervention with different loads of aerobic exercise for every exercise group. Low load running speed was 12 m/min, medium load running speed was 15 m/min, and high load running speed was 18m/min. 5d/w for 30 min/d for 5 months. Then, the Morris Water Maze (MWM) test was performed to estimate mice' learning and memory abilities, the immunofluorescence technique was used to determine the expression levels of DCX and Aβ1-42 in the hippocampus.

**RESULTS:** (1) In the process of navigation training, all mice' escape latencies gradually shortened. On the second day, the average escape latency of the ADC group was significantly higher than that of the WTC group ( $p < 0.05$ ). Compared with the ADC group and the ADL group, the mice in the ADM group were significantly reduced from the third day, and the mice in the ADH group were significantly reduced from the fourth day ( $p < 0.05$ ). In the MWM navigation experiment, for the time of through the area of the original platform, ADC group was significantly reduced than WTC group ( $p < 0.01$ ), ADM group and ADH group was significantly higher than ADC group and ADL group ( $p < 0.01, p < 0.05$ ). (2) Compared with WTC group, the expression of DCX in ADC group was lower but Aβ1-42 was higher ( $P < 0.05$ ). Compared with ADC group, the expression of DCX in every exercise group was higher but Aβ1-42 was lower ( $P < 0.05, P < 0.01$ ). Compared with ADL group, the expression of DCX in ADM group was higher but Aβ1-42 was lower ( $P < 0.05$ ).

**CONCLUSIONS:** Medium and high load exercise can significantly improve the spatial learning and memory ability of AD mice. Exercise, especially medium load exercise, can enhance the expression of DCX in AD mice and reduce the expression of Aβ1-42 in hippocampal.

**2319** Board #238 May 28 2:00 PM - 3:30 PM  
**Effects Of Acute Aerobic Exercise On Working Memory Of Male Smoking College Students: An Erp Study**

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 (No relevant relationships reported)

**PURPOSE:** Studies have shown a relationship between acute exercise and working memory among smokers. However, how acute aerobic exercise affects working memory of smoking college students is still under-researched. The current study was to explore the impact of different intensities of acute aerobic exercise on the working memory using behavioral and ERP assessment.

**METHODS:** Male smoking college students (n=64) aged 18-22 yrs were randomly selected. After signing the informed consents, they were assigned to a control group with 25-min reading at rest and three cycling exercise groups at light, moderate and high intensity. All participants completed a letter delay- and a space position delay-matching task pre- and post- intervention, both programmed in E-prime software. Reaction time and performance accuracy were measured. ERPs were recorded by NeuroScan EEG system. Amplitude and latency at FZ, FCZ, CZ, and PZ were collected by Curry 7 software. Statistical analyses were conducted with repeated measures ANOVA using SPSS 20.0. An alpha level was set at  $P \leq 0.05$ .

**RESULTS:** Three exercise groups had significantly shorter reaction times ( $p < 0.001$ ) and higher performance accuracy ( $p < 0.001$ ) in both tasks, compared with the control. Moderate exercise exhibited the best scores in both tasks. All exercise groups showed significantly higher accuracy scores in spatial working memory task than those verbal scores. ERP data revealed changes as follow: 1) significant differences were observed in N2 amplitude at FZ ( $p = 0.048$ ) and FCZ ( $p = 0.017$ ) and in P3 amplitude at FZ ( $p = 0.002$ ), FCZ ( $p = 0.000$ ), CZ ( $p = 0.002$ ) and PZ ( $p = 0.008$ ); 2) significant differences were found between different type of stimulus tasks, in N2 latency at FCZ ( $p = 0.045$ ) and PZ ( $p = 0.049$ ) and in P3 latency at FZ ( $p = 0.022$ ), FCZ ( $p = 0.013$ ), and CZ ( $p = 0.014$ ); 3) all exercise groups exhibited shorter P3 latency than the control at FCZ ( $p = 0.040$ ) and CZ ( $p = 0.031$ ) with the moderate and high intensity groups showing the shortest.

**CONCLUSIONS:** Acute aerobic exercise could improve male smoking college students' working memory, attention resource utilization, and cognitive processing speed. Moderate intensity exercise may have the greatest influence on these parameters. Acute aerobic exercise may have beneficial effects on cognition at behavioral and neuroelectric levels.

**2320** Board #239 May 28 2:00 PM - 3:30 PM  
**Prefrontal Theta Rhythm As An Index Of Effortful Activity**

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Cognitive tasks that tap executive functions and uncomfortable strenuous physical tasks require a deployment of mental effort. Several psychophysiological studies propose different indexes of this engagement in mental effort: for instance, pupillary dilation, power density of high frequency in heart rate variability, and pre-ejection period. More recently, it has been suggested that slow waves (4-8 Hz) recorded above prefrontal areas may also be a good candidate to assess effort engagement. **PURPOSE:** To determine whether theta oscillations recorded above prefrontal areas are a good index of mental effort deployed in a handgrip task. **METHODS:** Sixteen young voluntary adult participants performed three consecutive tasks in the same session: (1) a handgrip task in which they have to maintain an isometric contraction at 13% of maximal voluntary contraction (MVC) until exhaustion (H1), (2) a 30-min Stroop task aiming to deplete self-control resources and (3) the same handgrip task as previously (H2). A Biosemi system was used to amplify and record electroencephalographic (EEG) and electrooculographic (EOG) signals throughout the experiment. The sampling frequency of EEG was 2000 Hz and the bandwidth ranged between 0.1 and 40 Hz. **RESULTS:** A MANOVA was carried out with Time on task (TOT; T1-T4), Task (H1, H2), and Electrodes location (Fpz, AFz, Fz, FCz, Cz) as repeated measures factors on theta waves spectral density ( $\mu V^2/Hz$ ) recorded during the handgrip task. Theta wave density significantly increased between T1 and T2 and between T3 and T4, during both handgrip tasks (H1 and H2). There was also a significant interaction between the Electrode location and the Handgrip task. Theta wave density was higher during H1 than H2 and this effect was larger on Fpz than on the other electrodes. Perceived effort, pain and fatigue significantly increased throughout both handgrip tasks. Perceived fatigue was higher after H2 than H1. **CONCLUSION:** As expected, theta wave spectral density increased with time on task and particularly above prefrontal areas. However, it is difficult to determine if this biomarker reflects an increase in mental fatigue throughout the task or an increase in mental effort to compensate for the increase in mental fatigue.

**2321** Board #240 May 28 2:00 PM - 3:30 PM  
**Task-specificity Of Corticospinal Excitability: The Influence Of Contractile Properties**

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Transcranial magnetic stimulation (TMS) is increasingly applied to investigate neurophysiological function during exercise interventions. Although often assessed in testing modalities that are different than the intervention, neurophysiological function may be task-specific. **PURPOSE:** To compare neurophysiological function between an isometric squat (SQT) and knee extension (KE). **METHODS:** Twenty-two young adults (2 women, 20 right-footed, age:  $25 \pm 5$  yrs, BMI:  $25.9 \pm 3.1$ ,  $VO_2$ :  $46.2 \pm 8.8$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) performed isometric SQT (N=7) or KE (N=15), with hip-, knee- and ankle-joints fixed at 90° as part of a larger study, exposing participants to operational stress for a 5-day period. Lower extremity strength and muscle activity (RMS) were recorded during maximum voluntary contractions (MVCs), using a linear force transducer and electromyography (EMG) sensors placed over the vastus lateralis, respectively. Motor-evoked-potential (MEP)-based stimulus response curves (SRC) were derived using TMS and a double cone coil placed over the dominant motor cortex leg hotspot during intermittent isometric contractions at 15% MVC. Forty stimuli were applied for two rounds of SRC, with stimulator output (SO) ranging from 5-100% in 5% increments and random order. Since neurophysiological function did not differ across days, grand averaged responses were compared using multivariate ANOVAs or Mann-Whitney U. **RESULTS:** Greater force and muscle activity were evident for KE compared to SQT (Force:  $1303.9 \pm 407.0$  vs.  $812.8 \pm 189.5$  N,  $p = 0.01$ ;  $EMG_{RMS}$ :  $0.04 \pm 0.003$  vs.  $0.06 \pm 0.01$ ,  $p = 0.03$ ). KE corticospinal excitability was twice as high compared to SQT ( $1.4 \pm 0.7$  vs.  $0.7 \pm 0.4$  mV,  $p = 0.04$ ), but similar when normalized to muscle activity (KE:  $25.3 \pm 13.9$  vs. SQT:  $17.4 \pm 10.7$  mV·EMG<sub>RMS</sub><sup>-1</sup>,  $p = 0.21$ ). No difference was evident in SRC<sub>50</sub> and SRC<sub>SLOPE</sub> ( $54 \pm 9$  vs.  $62 \pm 14\%$ ,  $p = 0.12$  and  $5.0 \pm 1.9$  vs.  $4.2 \pm 1.1$ ,  $p = 0.35$ ). **CONCLUSION:** Contractile and corticospinal excitability appear to be task-specific, discouraging the assessment of neurophysiological function in modalities that are different from the intervention. Contractile function further seems

to influence corticospinal excitability, which may reflect the underlying differences in neuromechanics between the two movements. Supported by the Department of Defense W81XWH-16-PHTBIRP-CR3A.

**2322** Board #241 May 28 2:00 PM - 3:30 PM

### FRONTAL ASYMMETRY: A POTENTIALLY NOVEL BIOMARKER FOR SEDENTARY BEHAVIOR

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(No relevant relationships reported)

Consistent with other human behaviors, sedentary behavior appears to be modulated, at least in part, by emotional and motivational processes. Past research has found that various emotion and motivation interactions show different patterns of asymmetric frontal cortical activity (FCA). It is possible that the decision, motivation, or the intention to engage in sedentary behavior may depend on the FCA. However, FCA has yet to be investigated as a potential neurobiological marker to predict sedentary behavior. **PURPOSE:** To examine the relationship between sedentary behavior and resting frontal asymmetry using electroencephalography (EEG). **METHODS:** Forty-five college students participated in this study in exchange for partial course credit. A modified short version of the International Physical Activity Questionnaire was administered to determine habitual level of physical activity and sedentary time. Standard processing of EEG data was performed using BrainVision Analyzer software. Univariate correlation analyses were used to examine the relationship between frontal asymmetry and sedentary time. **RESULTS:** Average number of minutes spent sitting on a weekday ( $r(22) = -0.45, p = 0.027$ ) and on a weekend day ( $r(22) = -0.55, p = 0.005$ ) correlated with relative left frontal activity. **CONCLUSION:** To our knowledge, our data are the first to find a link between neurobiological markers of approach/avoidance motivation and sedentary activity, suggesting that reduced left frontal activity might be a novel neurophysiological marker for sedentary behavior.

**2323** Board #242 May 28 2:00 PM - 3:30 PM

### Test-retest Reliability Of Cognitive And Neuroimaging Measures In Older Adults

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(No relevant relationships reported)

**PURPOSE:** Exercise is a promising strategy to help maintain brain function during aging. Determining the efficacy of exercise interventions requires reliable clinical outcome measures. In addition to measurement error and biological variability, long-term test-retest values can also be influenced by biasing factors - namely aging and practice effects. The purpose of this study was to determine the 12-week test-retest reliability of cognitive and neuroimaging measures in older adults. **METHODS:** Twenty healthy older adults (14 females, 60-80 years of age) participated in two sessions of cognitive testing and multimodal 3T MRI scanning (Siemens MAGNETOM Prisma). All tests were performed by a single rater separated by a 12-week control period. The NIH Toolbox Cognition Battery (NIHTB-CB) was used to assess fluid and crystallized cognitive function. T-2 FLAIR images were processed for white matter lesion volume (WMLV, ml) using the Lesion Segmentation Toolbox. T-1 MPRAGE images were processed for gray matter volume (GMV, mm<sup>3</sup>) in 3 subcortical regions using FrecSurfer cortical segmentation. Statistical analyses were performed in SPSS (v.25) including mean percent difference, effect size, paired t-test, and two-way mixed intraclass correlation coefficient (ICC) with absolute agreement. **RESULTS:** Results are presented in Table 1. There were no significant t-test values indicating good agreement between the two sessions. As expected, reliability was excellent in crystallized cognition and moderate to good in fluid cognition. Last, all brain segmentations showed good to excellent reliability. **CONCLUSIONS:** The long-term (12-weeks) test-retest reliability of standard cognitive and neuroimaging measures were within an acceptable tolerance for use in future intervention studies. Although fluid cognition has the greatest implications for and neurobiological link to cognitive aging, investigators should consider the greater variability in these measures.

12-week test-retest results				
Measure	Mean % Difference ± SD	Effect Size	T-test p-value	ICC (3,1)
NIHTB-CB Fluid Composite Score	0.7 ± 6.4 %	0.06	0.71	0.77
- Attention	1.9 ± 7.2 %	0.21	0.26	0.64
- Working Memory	-1.4 ± 8.2 %	-0.18	0.37	0.69
- Executive Function	1.4 ± 4.5 %	0.17	0.25	0.81
- Processing Speed	-1.3 ± 11.8 %	-0.15	0.49	0.57
- Episodic Memory	3.2 ± 11.7 %	0.19	0.41	0.47
NIHTB-CB Crystallized Composite Score	0.4 ± 3.2 %	0.05	0.59	0.91
- Vocabulary	0.1 ± 3.9 %	0.02	0.88	0.89
- Reading Recognition	0.5 ± 2.5 %	0.07	0.41	0.93
WMLV	-0.1 ± 32.5 %	0.04	0.30	0.98
Caudate Nucleus GMV	4.5 ± 17.4 %	0.07	0.22	0.97
Putamen GMV	1.1 ± 4.8 %	0.07	0.41	0.93
Hippocampus GMV	-1.2 ± 2.5 %	-0.09	0.06	0.98

**2324** Board #243 May 28 2:00 PM - 3:30 PM

### Aerobic Fitness Is Associated With Greater Cortical Thickness In Functional Connectivity Networks

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(No relevant relationships reported)

**Purpose:** This study investigated the associations between cortical morphometry of functional connectivity networks and aerobic fitness (AF) in aging adults. **Methods:** Older adults (60-80 yrs; n=205) completed a graded exercise test to measure AF and a structural MRI. Cortical thickness was calculated and parcellated into 7 functional connectivity networks (Yeo et al., 2011). The associations between AF and thickness were investigated by calculating 5000 bootstrapped samples of a correlation coefficient between AF and either whole brain or network parcellated cortical thickness. Age and sex were used as covariates. Whole-brain exploratory analysis was conducted to examine the spatial extent of network morphometry and AF. First, correlation coefficients for each vertex and AF were calculated and bootstrapped. Next, a shuffled distribution was calculated across 100,000 permutations and the proportion of permutations greater or equal to the number of significant vertices was used to assess significance. **Summary of Results:** Greater AF was associated with greater whole brain cortical thickness ( $r = 0.29, p < .001, 95\% CI [0.17, 0.41]$ ), greater cortical thickness in the visual ( $r = 0.23, p < .001, 95\% CI [0.12, 0.35]$ ), somatomotor ( $r = 0.33, p < .001, 95\% CI [0.22, 0.44]$ ), dorsal attention ( $r = 0.22, p = .002, 95\% CI [0.10, 0.33]$ ), salience ( $r = 0.30, p < .001, 95\% CI [0.18, 0.42]$ ), limbic ( $r = 0.26, p = .001, 95\% CI [0.14, 0.38]$ ), and default mode ( $r = 0.24, p = .002, 95\% CI [0.12, 0.36]$ ) networks. However, no such effect was observed for the frontoparietal control network after correcting for multiple comparisons ( $r = 0.21, p = .010, 95\% CI [0.12, 0.36]$ ). The whole brain exploratory analysis found that both the somatomotor and salience networks showed the largest extents of significant vertices. **Conclusion:** These findings indicate the beneficial associations between aerobic fitness and brain health in an aging population. Cortical thickness was associated with AF across 6 of the 7 major functional connectivity networks investigated. In addition, exploratory analyses revealed that the somatomotor and salience networks had the largest extent of significant vertices. As the world's population is aging, aerobic fitness may provide a lifestyle benefit to brain health. Supported by NIA Grant R37 AG025667.

**2325** Board #244 May 28 2:00 PM - 3:30 PM

### Expression Of Tyrosine Hydroxylase In The Nucleus Accumbens Are Not Altered By Diet Or Fecal Transplantation In Male C57Bl/6j Mice

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(No relevant relationships reported)

Multiple studies have indicated that regulation of physical activity may be largely controlled by central neural factors, such as dopamine (DA) signaling in the nucleus

accumbens (NAc). It was hypothesized that metabolites produced from the gut microbiome influence DA signaling by altering the rate-limiting enzyme tyrosine hydroxylase (TH). **PURPOSE:** To determine whether microbial transplants from high active C57Bl/6J male mice eating a chow diet (CH) altered TH expression in the NAc of C57Bl/6J male mice made low active through intake of a high fat high sugar (HF) diet. **METHODS:** Mice were randomly assigned to one of four groups: a chow diet (CH/CH), a high fat to chow diet plus a microbial transplant (HF/CH+), a high fat diet to chow diet (HF/CH), or a high fat diet plus a microbial transplant (HF/HF+). Changes to group base diets and microbial transplants began at week 14. Transplants were completed once a week using sample donated from the CH/CH group via oral gavage. Mice were sacrificed at the end of 17 weeks, the NAc was dissected on ice, and flash frozen in liquid nitrogen. Immunoblotting was performed using NAc lysate probed with TH antibody. Bands were normalized using  $\beta$ -actin and an analysis of variance was conducted. **RESULTS:** There were no significant differences between group means for CH/CH ( $1.023 \pm 0.59$ ), HF/CH+ ( $0.8810 \pm 0.21$ ), HF/CH ( $0.882 \pm 0.27$ ), or HF/HF+ ( $1.069 \pm 0.32$ ) as determined by a one-way ANOVA, ( $p = 0.51$ ). **CONCLUSION:** TH expression in the NAc was not altered by diet or microbial transplantation from the active CH/CH group. Funding for this study was provided by the Omar Smith Endowment at Texas A&M University.

## D-70 Free Communication/Poster - RPE, Pain and Fatigue

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
Room: CC-Exhibit Hall

2326 Board #245 May 28 2:00 PM - 3:30 PM

### The Relationship Between Patient Expectations And Outcomes Of Injections For Knee Osteoarthritis

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(No relevant relationships reported)

#### The Relationship Between Patient Expectations and Outcomes of Injections for Knee Osteoarthritis

**Purpose:** Patient expectations have been shown to be related to outcomes after surgery. The relationship between expectations and outcomes after less invasive treatments, such as injections for knee osteoarthritis (OA), has not been studied. The objective of this prospective study was to assess the relationship between expectations and outcome of injections for knee OA.

**Methods:** We measured knee injection (intra-articular steroid or hyaluronic acid) expectations using a modified version of the Knee Replacement Expectations Scale (KRES) and Roland-Morris Disability Questionnaire. Patients were re-evaluated at 4 weeks post-injection for pain and disability outcomes. A multiple regression linear analysis was applied to model expectation entry scores; association between change in outcomes and expectation scores were studied through linear regression models, controlling for baseline scores as covariates.

**Results:** Forty-nine ( $n = 49$ ) knee OA patients completed the study with improvement in knee weakness being the highest symptomatic improvement expected (mean score 4.8/5). Patients had the lowest expectations of pain relief and ability to walk (mean 1.3 and 1.1/5). Multivariate linear regression modeling did not show an association between demographic/clinical variables and global expectation scores. Injection treatment did significantly reduce pain (mean pain reduction 2.3,  $p < 0.001$ , and disability ( $p < 0.001$ )). Baseline expectation score had a low but significant association with change in pain and disability (NPRS  $R^2 = 0.1$ ,  $p = 0.056$  and  $R^2 = 0.14$ ,  $p = 0.02$ ).

**Conclusion:** Knee injections improved pain and disability in this cohort of patients, and expectations before treatment had a small but significant association with patient reported outcomes. Studying a larger number of subjects and incorporating physical and psychological outcomes may further advance knowledge in this area.

2327 Board #246 May 28 2:00 PM - 3:30 PM

### Effects Of Mental Fatigue On Maximal Exercise Test Performance In Physically Active And Sedentary Adults

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**PURPOSE:** This study examined the effects of mental fatigue on maximal treadmill walking exercise performance.

**METHODS:** 50 young male ( $n = 25$ ) and female ( $n = 25$ ) adults were recruited to perform a maximal treadmill walking exercise test to volitional exhaustion on two

occasions. Prior to the exercise test, participants performed a cognitive task in a randomized, counterbalanced manner for 30 minutes, with the incongruent Stroop task in the mental fatigue condition, and leisure magazine reading in the control condition. Subjective ratings of perceived mood, fatigue, and motivation to exercise were assessed before and after the cognitive task. Perceptual and physiological responses were collected throughout the exercise test.

**RESULTS:** Significant decrease in perceived mood ( $p < 0.001$ ) and motivation ( $p = 0.001$ ), and significant increase in fatigue ( $p = 0.028$ ) were found in the mental fatigue condition. Participants were found to rate their perceived physical exertion higher during the exercise test in the mental fatigue condition ( $p = 0.042$ ). However, there were no significant differences in physiological responses and test exhaustion time. **CONCLUSIONS:** Mental fatigue increased perceived physical exertion during maximal treadmill walking exercise but did not impair exercise performance in both active and sedentary adults.

2328 Board #247 May 28 2:00 PM - 3:30 PM  
Effects Of Self-selected Or Experimenter-selected Music On Psychological Responses During A Sprint Interval Training Session

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Music is widely used as an ergogenic aid before and during exercise to enhance performance. The ergogenic effects of music seem to be influenced by its choice and exercise intensity. However, little is known concerning its effects during sprint interval training (SIT). **PURPOSE:** The purpose of this study was to analyze the effects of self-selected and experimenter-selected music on perceptual (affective responses, perceived exertion, attentional focus, and enjoyment), and performance (power output) during a SIT protocol compared to a control condition. **METHODS:** 14 active males ( $27.0 \pm 3.9$  years;  $79.0 \pm 9.1$  kg;  $176.4 \pm 5.3$  cm) performed SIT sessions composed by 8 x 15s all-out bouts against a fixed load of 9% of body mass interspersed by 120s of passive recovery under three conditions: self-selected music (playlist of high-tempo subject's favorite music), experimenter-selected music ("Power Workout" playlist from an online streaming music platform) and no-music (control). Affective responses, perceived exertion, and power output were measured throughout the protocols. Enjoyment and attentional focus (effort and recovery) were measured after each exercise session. **RESULTS:** Perceived exertion did not differ between conditions, but a main effect of time was detected ( $F_{2,26} = 1.67$ ;  $p = 0.208$ ;  $\eta_p^2 = 0.114$ ), with lower values in the first bout when compared to all others moments ( $p < 0.001$ ). The affective responses differed between conditions ( $F_{2,26} = 4.02$ ;  $p = 0.030$ ;  $\eta_p^2 = 0.236$ ), but the post-hoc indicated only a tendency ( $p = 0.067$ ) of lower values for the self-selected music ( $1.3 \pm 1.3$  a.u.) compared to experimenter-selected music ( $2.0 \pm 1.2$  a.u.). Attentional focus also differed between conditions ( $F_{2,26} = 6.62$ ;  $p = 0.005$ ;  $\eta_p^2 = 0.337$ ), however, just between self-selected ( $70.2 \pm 30.3$  a.u.) and no-music conditions ( $42.9 \pm 27.1$  a.u.  $p = 0.043$ ). Enjoyment and power output measures did not differ between conditions, however, a main effect of time was observed for peak power ( $F_{2,26} = 0.96$ ;  $p = 0.393$ ;  $\eta_p^2 = 0.069$ ), and mean power ( $F_{2,26} = 1.23$ ;  $p = 0.307$ ;  $\eta_p^2 = 0.087$ ), throughout the bouts ( $p < 0.001$ ). **CONCLUSIONS:** Although there were no significant differences between conditions concerning performance, perceived exertion, and enjoyment, listen to the self-selected music during the SIT session increased the attentional focus.

2329 Board #248 May 28 2:00 PM - 3:30 PM  
Validity Of The Session Rpe For Detecting Accumulated Fatigue

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Studies have shown that the ratio of blood lactate concentration to Rating of Perceived Exertion (HLA/RPE) and session RPE (sRPE) may be considered useful to detect overreaching and accumulated fatigue. However, no study has investigated their relationship. **PURPOSE:** To examine the relationship between HLA/RPE and sRPE during a period of intensified training. **METHODS:** Twelve young adults performed incremental exercise to assess their max power output (MPO). They performed 30 and 60-min interval workouts on a cycle ergometer over a 2-week period. Each session started with a 5-min warm-up at 25% MPO followed by 5-min at 50% MPO, 2-min at 25% MPO, 5-min at 75% MPO, 2-min at 25% MPO, 2-min at 100% MPO, 2-min at 25% MPO and 7-min at 50% MPO, which finished the 30-min session. During the first week, 4 sessions consisting of 30-min on Monday, Tuesday, Wednesday and a 60-min (30-min session back to back) on Thursday, were organized. After 3 days off,

the second week consisted of 3 consecutive 60-min sessions (Monday to Wednesday) with the last day (Thursday) being of 30-min. HLa and RPE were measured at the end of each stage of the interval training, and HLa/RPE computed for each session. sRPE was obtained after the sessions. Non-linear regression analysis was used to assess the relationship between HLa/RPE and sRPE. **RESULTS:** A very large negative relationship ( $r = -0.70$ , Root-mean-squared error = 0.59,  $p < 0.0001$ ) was found (Figure 1). **CONCLUSIONS:** The negative relationship supports the concept that sRPE is a sensitive tool that, in addition to information about relative exercise intensity, might provide further information on accumulated fatigue. Coaches and exercise scientists without access to HLa measurement may gain insight into accumulated fatigue during periods of increased training by using sRPE.

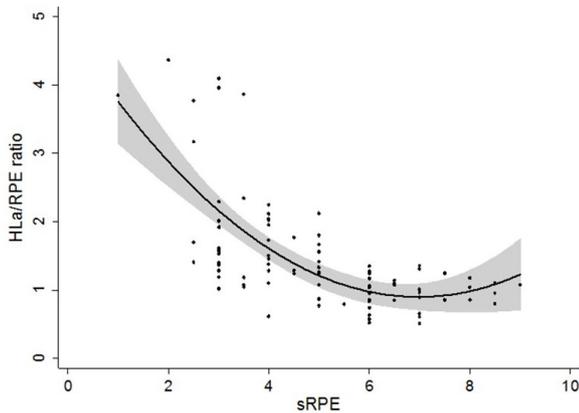


Figure 1. Relationship between HLa/RPE and sRPE

Black dots represent all subjects' training session; black line represents the predicted mean; the grey shade area represents the 95% confidence interval of the predicted mean.

**2330 Board #249 May 28 2:00 PM - 3:30 PM**  
**Association Between Perceived Recovery And Heart Rate In A Submaximal And Maximal Task In Firefighters**

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The job of a firefighter is physically and mentally demanding and requires maximal or near maximal effort. As time on a shift progresses, these tasks may be performed in an under recovered state due to stressors of the work. Prior research in athletes has explored the relationship between subjective measures of stress/recovery and performance on exercise tests. As such, it is possible that a firefighter's subjective assessment of recovery may influence objective measures of performance on an exercise test. **PURPOSE:** To determine the association between perceptions of recovery and heart rate (HR) response in both a submaximal and maximal task in firefighters. **METHODS:** 16 (14 male, 2 female) active-duty firefighters (35.3 ± 8.0 years, 179.1 ± 6.2 cm, 91.1 ± 16.9 kg) volunteered to participate. Participants completed a submaximal Queens College Step Test (SUBMAX) and a maximal treadmill test (MAX) with 24-72 hours separating each test. Prior to testing, participants stated their perceived recovery status (PRS; 0-10 scalar measure) to assess current state of recovery. Upon completion of each test, participants reported a rating of perceived exertion (RPE). HR was recorded at the conclusion of each test ( $HR_{PEAK}$ ) and after 60 seconds of seated recovery ( $HR_{60}$ ). Bivariate Pearson correlations determined the relationship between PRS, RPE,  $HR_{PEAK}$ , and  $HR_{60}$  on both SUBMAX and MAX tests. An alpha of 0.05 determined statistical significance. **RESULTS:** Significant correlations were identified in the SUBMAX test between  $HR_{PEAK}$  (137.5 ± 12.7 bpm) and RPE (10.8 ± 1.8) ( $r = 0.707$ ,  $P = 0.002$ ), and  $HR_{60}$  (95.4 ± 18.8 bpm) and RPE ( $r = 0.619$ ,  $P = 0.011$ ), but neither were related to PRS (6.8 ± 2.4). On the MAX test,  $HR_{PEAK}$  (183.0 ± 9.7 bpm) and  $HR_{60}$  (147.4 ± 13.7 bpm) were not related to either RPE (18.2 ± 1.1) or PRS (6.0 ± 2.1). **CONCLUSION:** These results suggest that among firefighters, PRS may not be a meaningful instrument to understand readiness for performance, regardless of task intensity. In addition, the task specific response for RPE may suggest self-reporting of effort is not an effective method to evaluate intensities greater than a submaximal level. Firefighter-specific measures should be developed to better determine subjective recovery and effort to guide implementation strategies with which to optimize health and performance readiness.

**2331 Board #250 May 28 2:00 PM - 3:30 PM**  
**Reducing Sedentary Time In Fibromyalgia (ReSeT-FM): A Feasibility Study**

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 (No relevant relationships reported)

Fibromyalgia (FM) is characterized by chronic widespread musculoskeletal pain, impaired functional mobility and extreme sedentary behavior (SB). Research suggests that individuals with FM who spend more time in SB experience greater clinical pain and overall impact of FM, irrespective of time spent in moderate to vigorous physical activity (PA). To date, no studies have investigated the potential impact of reducing SB on key clinical outcomes in FM. **PURPOSE:** To evaluate the feasibility of an 8-week behavioral intervention designed to replace SB with light PA in Veterans with FM. **METHODS:** Nine veterans with FM completed an 8-week intervention designed to reduce sedentary time, which included: 1) Education on the risks of being sedentary, 2) Wearing an activity tracker that provided behavioral prompts to move during prolonged sedentary behavior and synched with a phone app to self-monitor activity and stationary time, 3) Weekly 30-minute meetings with a study coach to set and review progress towards goals aimed at reducing time in SB. PA levels (Sedentary, High and Low light PA, High and Low moderate PA) were objectively measured at baseline and during the last week of the intervention with accelerometers worn for 1-week at each assessment. Participants also completed the Fibromyalgia Impact Questionnaire-Revised (FIQR) and Brief Pain Inventory pre and post intervention. **RESULTS:** While the results trended in the right direction, the paired t-tests indicated no significant differences between pre and post sedentary levels ( $p = .23$ ), low light PA ( $p = .32$ ), high light PA ( $p = .12$ ), low moderate PA ( $p = .18$ ) and high moderate PA ( $p = .89$ ). Pain severity ( $p = .022$ ), pain interference ( $p = .002$ ), and total FIQR score ( $p = .035$ ) significantly decreased from pre to posttest. Bivariate correlations indicated that greater increases in high light PA were associated with greater reductions in pain severity ( $r = -.750$ ,  $p = .020$ ) and total FIQR score ( $r = -.803$ ,  $p = .009$ ). **CONCLUSION:** While the intervention did not significantly decrease sedentary time or increase light PA in veterans with FM, these results suggest that increasing light PA in FM patients could potentially have a positive impact on pain outcomes. This study was funded by the School of Health and Human Sciences at IUPUI.

**2332 Board #251 May 28 2:00 PM - 3:30 PM**  
**Impact Of Mental Fatigue In Endurance Sports Performance**

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**PURPOSE:** The aim of the present study is to evaluate the effect on the overall perception of well being (OPWB) in the sports performance, as measured by an incremental treadmill running test, in mentally fatigued volunteers. **METHODS:** 34 volunteers participated in the study, 18 males and 16 females. They were divided into 2 groups and each volunteer performed 2 incremental treadmill running tests (2 minutes stage) in different dates. The tests were interrupted at the request of the volunteer. After the first test, the volunteers were randomly divided into 2 groups of 17 individuals each. One of the groups was driven to a mental fatigue by taken a mathematics test, 30 minutes before the test. The second group (control group), was led to mental fatigue. The mental fatigue group filled a questionnaire immediately after the test, to check the impact of the mathematics test on the OPWB. The OPWB questionnaire presented 5 possible classifications (1 very bad, 2 reasonable, 3 good, 4 very good, 5 excellent). The treadmill running tests were performed 72 hours apart. **RESULTS:** From the group that was driven to fatigue (17 volunteers), 9 were female and 8 males. 44% of the females had no change in the OPWB score, as did 37.5% of the males. Therefore, in this study, males were more susceptible to mental fatigue after performing the mathematics test. By taking an average of the scores, before and after the mathematics test, the overall score went from 3.94 to 3.12 (4.00 to 3.22 for females and 3.88 to 3.00 for males). In other words, a reasonable reduction in OPWB was observed in volunteers undergoing the mathematics test, which indicates that they were fatigued. Another interesting aspect was to evaluate the impact of the worsening in OPWB on the performance of the volunteers. In the group not led to mental fatigue (control group), there was a positive variation of 12% between the first and the second test. However, in the group driven to mental fatigue there was a reduction of 11.82% in their performance (same was measured taken in consideration the duration of the test), being 12.26% for the male volunteers and 11.45% for females. **CONCLUSIONS:** The present study showed that mental fatigue seems to impact sports performance. Therefore, searching for training strategies to support greater mental fatigue seems to be relevant.

**2333** Board #252 May 28 2:00 PM - 3:30 PM  
**Three Weeks Of Mental Strength Training Improves Cycling Performance By Changing Key Physiological Parameters**

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Short-term grit and resilience training, as well as internal self-talk training have increased physical performance. However, little is known about longer mental training. **PURPOSE:** Perform 21 days of mental training to observe how performance and physiological variables change.

**METHODS:** Participants were 33 college-aged (16 mental strength (MS), 17 control (CON)) individuals (20.7 ± 1.2yrs, weight 72.3 ± 9.3kg, height 1.77 ± .09m, VO<sub>2peak</sub> 47.9 ± 9.3mL/kg/min). A VO<sub>2peak</sub> was performed on a cycle ergometer on day one. Subsequent visits consisted of time trials to exhaustion (TTE) performed 10% above ventilatory threshold. MS groups watched one of four 10-minute videos daily for 21 days. VO<sub>2</sub>, ventilation (VE), respiratory rate (RR), tidal volume (TV), heart rate (HR), RPE, and VAS scores (0-100) for pain and fatigue were recorded during pre- and post-time trials. Participants took GRIT-S and CD-Rise psychological surveys before pre- and post-TTE. RM-ANOVA were done to compare group, time, and trial differences as a percentage of total time as well as absolute times (0-3 minutes).

**RESULTS:** TTE significantly increased for MS (8.8 ± 13.2%) and decreased for CON (-6.6 ± 14.6%, p < 0.05). VO<sub>2</sub>, VE, RPE, fatigue, and pain as a percentage of total time were unchanged. HR was significantly higher after 21 days of MS compared to CON at 40, 60, 80, and 100% of TTE (p < 0.05). When compared at absolute times, there were significant decreases in VO<sub>2</sub> at minute 3 (p < 0.05) and VE at minute 2 and 2.5 (p < 0.05). RR was lower following MS (p < 0.05) though there was no difference in TV. There was a trial x group interaction in RPE (F(1,25) = 4.823, p < 0.05) with MS experiencing a decrease in RPE after training.

**CONCLUSION:** MS training for three weeks allowed participants to cycle longer before exhaustion. HR increased as a percentage of TT time post-MS training, perhaps due to increased duration post-TTE leading to measuring HR at later absolute times. By measuring HR later, metabolites would be expected to be higher, thus increasing HR. Decreases in VE and RR may be due to one of the mental strategies that involved instruction to reduce stress and anxiety by taking deeper and slower breaths, which may contribute to a reduced perception of effort. Finally, MS training reduced O<sub>2</sub> consumption, contributing to a decreased RPE and increased TTE duration.

**2334** Board #253 May 28 2:00 PM - 3:30 PM  
**The Effects Of Essential Oils On Perception Of Exertion, Task Pleasantness And Time On Task**

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 (No relevant relationships reported)

Essential oils have become wildly popular in recent years for their therapeutical and health-related benefits. Research that focuses on essential oils and their ergogenic effects may be helpful in increasing adherence to exercise by making the task more pleasant and/or less exertive (Basevitch, 2011; Jaradat et al, 2016). **PURPOSE:** The purpose of this study was to test the effects of essential oils on perception of exertion, exercise task pleasantness and total time on task. **METHODS:** Thirty college students (24 females, 6 males) were recruited to perform a handgrip squeezing task. They were randomly assigned to one of three groups: placebo, bergamot essential oil, or peppermint essential oil (n<sub>Peppermint</sub> = 10, n<sub>Placebo</sub> = 10, n<sub>Bergamot</sub> = 10). Adhesive strips with each essential oil were placed under the noses of all participants. Participants in the placebo group had a strip with no essential oil. After establishing participants' baselines for maximal voluntary contraction, participants squeezed a handgrip dynamometer at 30% of their baseline for as long as they could tolerate. Participants' session RPE, perceived exercise-task pleasantness and total grip time were recorded at session completion. **RESULTS:** Results from ANOVA analysis showed no significant group effect for RPE session (p > .05). Chi square analyses indicated that participants in the placebo group rated the exercise task most pleasant, (n=6, Pleasant). Participants with bergamot essential oil rated the task as mildly pleasant, (n=5, Mildly Pleasant). Participants with peppermint essential oil rated the task as least pleasant (n=6, Neutral) and these differences were significant (p < .05). Due to small size in each group and the skewness of the distribution, group medians were also analyzed as more robust and sensible signs of central tendency. Results indicated that participants with bergamot essential oil squeezed the dynamometer longer durations than others with peppermint essential oil or placebo (M<sub>Bergamot</sub> = 18.07 minutes; M<sub>Placebo</sub> = 15.31 minutes;

and M<sub>Peppermint</sub> = 12.27 minutes). **CONCLUSION:** These findings suggest that bergamot essential oil may help optimize exercise-related affects and increase exercise duration. Studies with larger sample sizes are needed to confirm these findings.

**2335** Board #254 May 28 2:00 PM - 3:30 PM  
**Effects Of Transcranial Direct Current Stimulation During Aerobic Exercise On Cognition, Perceived Exertion And Cycling Performance**

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(No relevant relationships reported)

**PURPOSE:** Interest in harmless but effective and easy-to-use methods such as transcranial direct current stimulation (tDCS) and aerobic exercise (AE) to improve cognitive performance in health and disease is growing. Recent research suggests that a combined application of both methods in a multimodal manner (e.g. tDCS before, during or after AE) could lead to improved cognitive improvement. Also tDCS could be a potential tool to modulate sports performance parameters such as perceived exertion and endurance capacity. Thus, here we investigated the impact of tDCS during moderate AE (cycling) on cognition, perceived exertion and power output. **METHODS:** Data from 101 healthy subjects (average age = 25.31, SD = 2.05, female = 45) were collected in five separate experiments (EXP). Each experiment had a crossover design. EXP-1: anodal tDCS vs. sham during active control (AC); EXP-2: cathodal tDCS vs. sham during AC; EXP-3: AE vs. AC; EXP-4: a. tDCS vs. sham during AE; EXP-5: c. tDCS vs. sham during AE. High-resolution (HD-)tDCS was applied for 25 minutes at 1 mA to the left dorsolateral prefrontal cortex (DLPFC) using a 4x1 ring electrode configuration (stim electrode at F3). For AE, subjects ran at 75% of their maximum heart rate (moderate intensity) for 25 minutes, while rating of perceived exertion (RPE) and power output (watts) were recorded every four minutes. As a measure of cognition, response inhibition was assessed before and after 20 minutes during the ongoing intervention by a flanker task. **RESULTS:** A relevant TIME x CONDITION interaction for cognitive performance was only found in EXP-5. Cathodal tDCS during cycling led to a decrease in accuracy whereas accuracy remained constant for sham tDCS during cycling, F(1,23) = 4.58, p = .043, η<sub>p</sub><sup>2</sup> = .17. A sig. TIME x CONDITION x SEX showed that men were better able to maintain their cycling performance (measured in watts) during the intervention if when receiving anodal tDCS, F(2,32,44.03) = 3.27, p = .041, η<sub>p</sub><sup>2</sup> = .15. No interaction effects could be demonstrated for RPE and heart rate. **CONCLUSIONS:** Contrary to current literature only the multimodal, but not unimodal application of tDCS and AE had an influence on cognitive performance. The application of anodal tDCS during moderate AE led to improved cycling performance in men, a finding requiring further consideration in the future.

**2336** Board #255 May 28 2:00 PM - 3:30 PM  
**Impact Of Operational Stress On Motor Evoked Potentials In Military Personnel**

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Sleep restriction is a prevalent operational stressor that may degrade neurophysiological performance in military personnel. Transcranial magnetic stimulation (TMS) is an established non-invasive brain stimulation technique capable of assessing corticospinal excitability that is not extensively investigated in military populations. **PURPOSE:** To examine the influence of operational stress (i.e., sleep restriction) on corticospinal excitability in military personnel. **METHODS:** Thirty-one male and seven female service members (25.1 ± 4.9yr) performed two series of stimulus response curves (SRCs) at 15% maximum voluntary muscle contraction for five consecutive days (D0-D4) using single-pulse TMS and a figure-of-eight coil. A familiarization day served as D0 with baseline testing on D1. Participants were allowed eight hours to sleep on D0, D1 and D4. On D2 and D3, participants had their sleep restricted for two 2-hour segments. For the SRC, stimulator outputs were randomly administered from 5-100% in 5% increments. Motor evoked potentials of the first dorsal interosseous muscle were quantified as the peak-to-peak electromyography amplitude of the 50ms post TMS stimulus. Corticospinal excitability was assessed by fitting MEP responses to a Boltzmann sigmoidal curve (BSC) via nonlinear regression and determining BSC<sub>MAX</sub> and BSC<sub>V50</sub> (i.e., stimulator output at the mid-point between

BSC<sub>MIN</sub> and BSC<sub>MAX</sub>). Repeated-measures one-way ANOVAs with Tukey post-hoc tests were used to compare BSC properties over time. **RESULTS:** ANOVAs revealed a main effect of time for both BSC<sub>MAX</sub> and BSC<sub>V50</sub> ( $F(3,31, 122.40)=2.71, p=.04$  and  $F(2.96, 109.50)=3.26, p=.02$ , respectively). No significant pairwise comparisons were detected for BSC<sub>V50</sub>. BSC<sub>MAX</sub> revealed to be significantly greater on D3 compared to D0 (5.21 vs 4.56 mV,  $p=.02$ ) and D1 (5.21 vs 4.44 mV,  $p=.02$ ) but similar to D2 and D4 ( $p>.05$ ). **CONCLUSION:** Our findings suggest corticospinal excitability is a sensitive biomarker for subtle alterations during simulated operational stress. Furthermore, BSC<sub>MAX</sub> remained elevated on D4, suggesting one day is inadequate recovery time after operational stress. Supported by the Department of Defense W81XWH-16-PHTBIRP-CR3A.

**2337** Board #256 May 28 2:00 PM - 3:30 PM  
**The Effect Of Moderate-intensity Intermittent Interval Walking On Heart Rate And Enjoyment In Middle-aged Women**

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 (No relevant relationships reported)

**PURPOSE:** The purpose of this study was to investigate heart rate (HR) and exercise enjoyment during and following three walking protocols in middle-aged women. **METHODS:** Ten women (mean  $\pm$  SD = 55  $\pm$  4 years) completed three walking protocols of the same work volume (90 MET-min) in a randomized, counter-balanced order. The protocols consisted of one 30-min bout of low-moderate continuous walking (CW) (3 METs;  $\sim$  4.8 km/h), three 10-min bouts of low-moderate intermittent walking (IW), and three 8-min 40-s bouts of intermittent interval walking (IIW) with cycles of 30 s:120 s of high-moderate (5 METs;  $\sim$  6.4 km/h): low-moderate intensities. HR and exercise enjoyment were assessed during six evenly distributed exercise increments and post-exercise (0-min, 10-min). The Exercise Enjoyment Scale (EES) was utilized to assess enjoyment during and post-exercise, while the Physical Activity Enjoyment Scale (PACES) only assessed post-exercise enjoyment. Repeated measures ANOVA was used to analyze mean HR and enjoyment differences between experimental treatments. **RESULTS:** IIW (112.0  $\pm$  16.0) elicited a significantly higher during exercise HR than IW (105.0  $\pm$  14.0;  $p = 0.01$ ), but HR during CW (107.0  $\pm$  14.0;  $p > 0.05$ ) was not different from the other treatments. Immediately following exercise (0-min), both CW (108.0  $\pm$  14.0;  $p = 0.004$ ) and IIW (109.0  $\pm$  16.0;  $p = 0.03$ ) elicited a significantly higher HR than IW (102.0  $\pm$  14.0). However, 10 min later, CW (82.0  $\pm$  18.0) elicited a significantly higher HR than IW (73.0  $\pm$  12.0); IIW (77.0  $\pm$  13.0;  $p > 0.05$ ) did not differ from the other treatments. Despite during and post-exercise HR differences, exercise enjoyment during (CW: 4.0  $\pm$  0.82; IW: 4.0  $\pm$  0.61; IIW: 4.0  $\pm$  1.2) and following (EES 0-min: CW: 4.0  $\pm$  0.99; IW: 4.0  $\pm$  0.68; IIW: 4.0  $\pm$  1.4) (PACES 0-min: CW: 89.0  $\pm$  10.1; IW: 89.0  $\pm$  11.5; IIW: 88.0  $\pm$  22.4) (EES 10-min: CW: 4.0  $\pm$  1.1; IW: 4.0  $\pm$  0.66; IIW: 4.0  $\pm$  1.2) (PACES 10-min: CW: 89.0  $\pm$  15.0; IW: 88.0  $\pm$  12.6; IIW: 86.0  $\pm$  20.2) exercise were not different amongst treatments (all  $p > 0.05$ ). **CONCLUSION:** Based on the results of the present study, it is possible to conclude that moderate-intensity intermittent interval walking may be a viable exercise prescription suitable for middle-aged women to progress to higher exercise intensities and address the barrier of time.

**2338** Board #257 May 28 2:00 PM - 3:30 PM  
**Perceptions Of Pain Over A 4-week Neuromuscular Electrical Stimulation Treatment In Older Adults**

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 (No relevant relationships reported)

Neuromuscular electrical stimulation (NMES) evokes involuntary muscle contraction and may be a safe and effective treatment option for muscle strengthening. However, little research exists on patient tolerance to NMES in older adults. **PURPOSE:** The aim of this study was to determine changes in stimulation intensity and perceived pain pre-post 4 weeks of NMES training in older adults. **METHODS:** Participants ( $n = 9$ ) were healthy, older adults (69.9  $\pm$  2.4 years). Subjects performed maximal voluntary contractions (MVC) of the quadriceps muscles on an isokinetic dynamometer to determine maximal strength. Participants were seated in the isokinetic dynamometer with the knee at 60° and a 40-min NMES treatment was applied to the quadriceps muscles of each leg 3 times per week for 4 weeks. Stimulation frequency was 60 Hz with repeated cycles of 10s on and 15s off. Stimulation intensity was set to achieve 15% MVC and was increased every 5 minutes if the torque dropped below 15% MVC. Using a standard pain scale, participants were asked to rate perceived pain (0 = no pain, 10 = worst pain possible) during the NMES at 1, 20, and 40 minutes of stimulation on each leg during treatment day 1, 7, and 12. Stimulation intensity was also recorded. Pain scores and stimulation intensity were averaged across right and left leg. Pain score and stimulation intensity were each analyzed with a 3 x 3

repeated measures analysis of variance (DAY x MIN), with significance set at  $p \leq 0.05$ . **RESULTS:** For perceived pain, there was a significant main effect for MIN ( $p = 0.011$ ) and DAY ( $p = 0.004$ ). For MIN, perceived pain significantly increased (MIN 1: 3.2  $\pm$  0.8 vs MIN 20: 4.5  $\pm$  0.7;  $p = 0.009$ ) and then remained stable (MIN 40: 5.2  $\pm$  0.8;  $p = 0.052$ ). For DAY, perceived pain decreased 36.2% (DAY 1: 5.8  $\pm$  0.8 vs DAY 7: 3.7  $\pm$  0.7;  $p = 0.001$ ) and then remained stable (DAY 12: 3.4  $\pm$  0.9;  $p = 0.488$ ). For stimulation intensity, there was a significant main effect for DAY ( $p = 0.001$ ). Stimulation intensity for DAY increased (DAY 1: 13.3  $\pm$  0.9 vs DAY 7: 16.3  $\pm$  1.5 mA;  $p = 0.003$ ) and then decreased (Day 12: 14.8  $\pm$  1.3 mA;  $p = 0.012$ ). **CONCLUSION:** Findings indicate that participants experienced moderate discomfort during the first NMES treatment. However, perceived pain decreased significantly by day 7, demonstrating that NMES may be a feasible muscle strengthening option for older adults.

**2339** Board #258 May 28 2:00 PM - 3:30 PM  
**No Sex Differences In Conditioned Pain Modulation Or Exercise-induced Hypoalgesia Following Lower Body Isometric Exercise**

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 (No relevant relationships reported)

Women are more at risk than men for developing chronic pain conditions. Differences in endogenous pain-modulatory function could be a contributing factor. **PURPOSE:** The aim of this study was to compare conditioned pain modulation (CPM) and exercise-induced hypoalgesia (EIH) responses between adult men and women. **METHODS:** In a cross-sectional, non-randomized study with two independent groups of college aged males ( $n = 52$ ) and females ( $n = 45$ ), pressure pain thresholds (PPT) were assessed bilaterally in the vastus lateralis (VL) and brachioradialis (BR) muscles using a pressure algometer prior to and immediately following a conditioning stimulus (placing their foot in an ice bath) and performing isometric knee extension exercise to failure at 25% of maximal strength. **RESULTS:** Men had higher baseline PPTs than females (LBR: 372  $\pm$  217 vs. 303  $\pm$  119; RBR: 396  $\pm$  236 vs. 315  $\pm$  143; NDVL: 552  $\pm$  281 vs. 434  $\pm$  157 DVL: 572  $\pm$  253 vs. 454  $\pm$  147;  $P < 0.01$ ). PPTs increased significantly ( $P < 0.05$ ) following the conditioning stimulus in both males and females (LBR: 387  $\pm$  264 to 453  $\pm$  318 kPa, and 315  $\pm$  126 to 359  $\pm$  145 kPa; RBR: 400  $\pm$  225 to 450  $\pm$  280 kPa; and 325  $\pm$  135 to 372  $\pm$  161 kPa; DVL: 579  $\pm$  289 to 658  $\pm$  349 kPa; and 470  $\pm$  200 to 541  $\pm$  201 kPa; NDVL 542  $\pm$  263 to 623  $\pm$  326 kPa; and 433  $\pm$  174 to 503  $\pm$  185 kPa in the males and females, respectively) indicating a CPM response in all limbs tested. PPTs increased significantly ( $P < 0.05$ ) following isometric knee extension exercise to a similar extent in both males and females in all limbs tested (LBR: 387  $\pm$  177 to 466  $\pm$  245 kPa; and 305  $\pm$  140 to 353  $\pm$  162 kPa; RBR: 409  $\pm$  172 to 462  $\pm$  228 kPa; and 312  $\pm$  147 to 355  $\pm$  173 kPa. DVL: 572  $\pm$  253 to 763  $\pm$  366 kPa; and 454  $\pm$  147 to 611  $\pm$  252 kPa; NDVL: 552  $\pm$  281 to 633  $\pm$  353 kPa and 434  $\pm$  157 to 526  $\pm$  210 kPa) There was no interaction between the group x testing site for either the CPM response ( $P = 0.314$ ) or the EIH response ( $P = 0.242$ ). **CONCLUSIONS:** Men had a higher resting pain threshold than women. However, men and women exhibited similar endogenous pain inhibitory function both locally and systemically following a conditioning stimulus and isometric lower body exercise.

**2340** Board #259 May 28 2:00 PM - 3:30 PM  
**Concurrent Pain Effects On Exercise Tolerance, Neuromuscular Fatigue And Perceptual Responses, Preliminary Data.**

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Exercise-induced fatigue and pain negatively affect exercise tolerance; however, the influence of these sensations on regulation of neuromuscular (NM) and perceptual responses during locomotor exercise has yet to be determined. **PURPOSE:** To investigate the effects of one leg exercise-induced fatigue and pain on the contralateral leg exercise tolerance, NM and perceptual responses. **METHODS:** Nine healthy young men (age: 26 $\pm$ 7 years) performed right leg sustained contraction at 25% of isometric maximal voluntary contraction (25%IMVC) to task failure. In three testing sessions, the 25%IMVC protocol was preceded by one of the three left leg interventions including: i) 6 min rest (CON) ii) cycling to exhaustion at 80% of peak power output (CYCL) and iii) CYCL immediately followed by blood flow occlusion to right leg task failure (OCCL). The experimental sessions were selected randomly. NM function was characterized by assessing IMVC and voluntary activation (VA) using twitch interpolated technique. Right leg pain and rating of perceived exertion (RPE) were also recorded during sustained contraction. **RESULTS:** 25%IMVC to task failure was longer in CON (221  $\pm$  106 s) than CYCL (141  $\pm$  67 s) and OCCL (119  $\pm$  51 s) ( $p < 0.05$ ). Relative to baseline, the drop on IMVC was similar for CON (-40 $\pm$ 10%), CYCL

( $-36 \pm 18\%$ ) and OCCL ( $-32 \pm 17\%$ ) ( $p = 0.09$ ). VA drop was also similar for CON ( $-6 \pm 12\%$ ), CYCL ( $-9 \pm 11\%$ ) and OCCL ( $-15 \pm 18\%$ ) ( $p > 0.05$ ). The potentiated twitch force decline was lower for OCCL ( $-44 \pm 25\%$ ) when compared to CYCL ( $-53 \pm 24\%$ ) and CON ( $-51 \pm 23\%$ ) ( $p < 0.05$ ). During the 25%IMVC, RPE at the onset was lower for CON ( $7 \pm 2$ ) compared to CYCL ( $13 \pm 3$ ) and OCCL ( $14 \pm 3$ ) ( $p < 0.001$ ) but no difference was observed between the three conditions at the task failure ( $18 \pm 2$ ,  $19 \pm 1$  and  $19 \pm 1$ , respectively) ( $p > 0.05$ ). Right leg pain increased from onset to exhaustion for CON ( $2 \pm 2$  and  $9 \pm 1$ ), CYCL ( $2 \pm 2$  and  $9 \pm 1$ ) and OCCL ( $2 \pm 1$  and  $9 \pm 1$ ) ( $p < 0.05$ ). Left leg pain decreased from the onset of the right leg exercise to task failure for CYCL ( $6 \pm 1$  and  $3 \pm 2$ ) ( $p < 0.05$ ) however it stayed high during OCCL ( $9 \pm 1$  and  $9 \pm 1$ ) ( $p < 0.05$ ). **CONCLUSION:** Our preliminary data suggest that one leg exercise-induced fatigue and pain decreased the contralateral leg exercise tolerance, exacerbated perceptual pain and RPE, and blunted peripheral fatigue during subsequent exercise.

**2341** Board #260 May 28 2:00 PM - 3:30 PM  
**Internal Load Metrics In Division III Men's And Women's Soccer: The Significance Of Sleep Quality**

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Wearable technology is the number one fitness trend for 2019. Sleep quality (SQ), sleep duration, mood, stress, soreness, and fatigue have been associated with performance in sports through physiological and psychological mechanisms. Division III (DIII) schools are the biggest participant in NCAA. In terms of number of athletes, soccer is the second most popular sport in NCAA.

**PURPOSE:** To investigate the relationship of SQ with sleep duration, mood, stress, soreness, and fatigue in a DIII men's and women's soccer team.  
**METHODS:** All 56 players agreed to participate ( $M_{age} = 19.42$ ,  $SD = 1.09$ ). Data were collected using readiness surveying based on the Titan 1+ sensor protocol. Subjective information on SQ, sleep duration, mood, stress, soreness, and fatigue was reported by each athlete before every practice and game. All data, but sleep (in hours), were quantified via a 0-10 visual analog scale (e.g., SQ: 0=Excellent, 10=Poor). In total, 200 assessments took place in pre- and in-season. The analysis consisted of Pearson correlations,  $t$  tests, and regression analysis in  $R$ .

**RESULTS:** The correlations of SQ with the other variables were: sleep duration ( $r = -.43$ ), mood ( $r = .70$ ), stress ( $r = .62$ ), soreness ( $r = .53$ ), and fatigue ( $r = .83$ ). There were no statistically differences between male and female athletes on any of the variables included in the analysis. Therefore, the data were analyzed in aggregate. The regressions were estimated to examine the expected increase in these outcomes for a one-point improvement in reported SQ (e.g., a one-point improvement in SQ is associated with an expected 0.98-point improvement in reported fatigue;  $p < .001$ ).  
**CONCLUSIONS:** On average, the findings indicate a strong relationship between SQ and hours of sleep, mood, stress, fatigue, and soreness in this DIII soccer program. Therefore, there is preliminary evidence to support that all stakeholders may need to focus on SQ strategies (including sleep duration) as means to manipulate several internal load variables that affect performance in sports. Future studies should add external metrics (e.g., speed/sprint/impact metrics), investigate differences between practice and game-day data and Divisions, and collect information from larger samples. Possible limitations include convenience sample and self-reported data.

**2342** Board #261 May 28 2:00 PM - 3:30 PM  
**Session RPE During A Constant Load Submaximal Treadmill Exercise**

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Session-RPE (S-RPE) is a measure of perceived exertion experienced for an entire exercise session but estimated post-exercise following a prior defined period of rest (Thekkada, 2006). **PURPOSE:** To study the relationship of S-RPE with differentiated (Leg-RPE, Chest-RPE) and undifferentiated (Overall-RPE) RPE during constant load submaximal treadmill exercise. **METHODS:** A total of 18 participants (Males = 8, and Females = 10;  $21.5$  years  $\pm 2.4$  years) non-athletes healthy physically active (as per ACSM guidelines) participants from Cabrini University volunteered for the study. Each subject completed a 15-minute moderate intensity constant-load treadmill exercise. During exercise, at minute 5, 10, and 15; L-RPE, C-RPE, and O-RPE were estimated using the Adult OMNI-Walk/Run Scale. The average RPE for leg (L-RPEavg), chest(C-RPEavg), and overall body (O-RPEavg) for entire exercise session was also calculated. 5-minute post-exercise S-RPE was obtained for overall body. **RESULTS:** S-RPE was significantly correlated ( $r = 0.41-0.55$ ,  $p < 0.01$ ) with O,L,C- RPEavg and O,L,C- RPE for 5,10, and 15 minute. The highest correlation ( $r = 0.55$ ,  $p < 0.01$ ) was observed between S-RPE and O- RPEavg. **CONCLUSION:** The current study shows that S-RPE was strongly related to average of entire exercise

session O-RPE. Previous literature has shown that a single session-RPE rating may accurately reflect the intensity of an exercise session (Haddad, 2017). Future studies should explore the effect of varied duration, intensity, and mode of exercise on S-RPE.

**2343** Board #262 May 28 2:00 PM - 3:30 PM  
**The Effects Of Mental Imagery Use On Perceived Exertion And Exercise Tolerance**

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Physical inactivity is the main public health concern of the 21st century (Blair, 2009). Perceptions of exertion and physiological stress are important contributors to the problem of physical inactivity (Lind, Welch, & Ekkekakis, 2009). **PURPOSE:** The purpose of this study was to test the effectiveness of two types of mental imagery (associative vs. dissociative) on perceived exertion and physiological stress. **METHODS:** Forty-five college students (22 males, 23 females) were randomly assigned to dissociative imagery, associative imagery, and control (i.e., no imagery) conditions. Participants completed a progressive cycling task to volitional fatigue. Ratings of perceived exertion (RPE), attention focus and heart rate (HR) were monitored at 1minute intervals. Lactate accumulation (LA) was recorded at RPE=12 and at task completion. **RESULTS:** Participants using associative imagery reported the highest RPEs ( $p < .05$ ). These participants also tended to tolerate the task longer as compared to both the dissociative imagery group ( $ES = .04$ ) and the control group ( $ES = .14$ ). Participants in the associative imagery condition focused more on internal cues of exertion ( $p < .01$ ). Participants using either type of imagery seemed to expend increased effort as demonstrated by higher ( $p = .102$ ) means for lactate accumulation during and at the completion of the task. **CONCLUSION:** Using associative imagery might cause individuals to focus on internal cues of exertion thus increasing the subjective perception of effort. However, using associative imagery may help increase exercise tolerance compared to dissociative imagery or no imagery. These findings are consistent with previous research and may have important implications for promoting exercise tolerance.

**2344** Board #263 May 28 2:00 PM - 3:30 PM  
**Exercise-induced Hypoalgesia Differ At Sites Local And Remote To The Exercising Muscle Group**

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 (No relevant relationships reported)

Dysfunction of endogenous pain-inhibitory function such as exercise-induced hypoalgesia (EIH) may predict development of chronic pain conditions. While EIH has been shown to occur in both the exercised muscle group and in remote unexercised muscle group, few studies have compared the magnitude of EIH in an exercised muscle and remote muscle groups in the same individuals following the same exercise bout. **PURPOSE:** The purpose of the study was to examine the EIH response at four different sites following a bout of single legged isometric exercise. **METHODS:** Pressure pain thresholds (PPT) of 102 participants (50 females; 52 males) were assessed bilaterally in the vastus lateralis (VL) and brachioradialis (BR) using a pressure algometer before and after isometric knee extension at 25% of maximal voluntary contraction held until task failure using their dominant leg. The percent difference between post and pre measures was defined the EIH response. **RESULTS:** PPT's increased in the left BR ( $18.1\% \pm 24.7$ ;  $p < 0.001$ ,  $d = 0.275$ ), right BR ( $14.4\% \pm 26.1$ ;  $p < 0.001$ ,  $d = 0.233$ ), non-dominant VL ( $17.4\% \pm 24.0$ ;  $p < 0.001$ ,  $d = 0.318$ ) and the dominant VL ( $34.5\% \pm 28.3$ ;  $p < 0.001$ ,  $d = 0.643$ ). There were no differences between the left and right BR and the non-dominant VL with regards to the EIH response ( $p > 0.05$ ), however the exercised leg demonstrated a greater EIH response compared to the remote, unexercised limbs ( $p < 0.001$ ). **CONCLUSION:** EIH occurred in all sites. However the EIH response in the exercised leg was significantly more robust than the remote, unexercised sites. This findings suggests the magnitude of EIH is determined by both local and systemic factors and this should be taken into consideration when comparing EIH among studies.

**2345** Board #264 May 28 2:00 PM - 3:30 PM  
**Relationship Between Enhanced Cognitive Function And Autonomic Nervous Activity After A Subjectively Selected Intensity Exercise**  
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**PURPOSE:** The purpose of this study was to identify a practical method for engaging in exercise that could improve cognitive function. We tested whether cognitive function improves after exercise at subjectively selected intensity by using ratings of perceived exertion (RPE). In addition, we examined the relationship between the improvement in cognitive function and cardiac autonomic nervous system.

**METHODS:** Twelve participants performed cognitive tasks in a running or resting condition with a randomized crossover design. In the running condition, the participants ran on a treadmill for 10 min at the running speed correspond to the RPE10-12 for each participant. Cognitive tasks including the Spatial Delayed Response task and Go/No-Go task were performed before and after running or resting. Cardiac autonomic nervous activity was obtained by calculating from heart rate variability during cognitive tasks.

**RESULTS:** In the running condition, the RPE was  $11.1 \pm 0.8$  immediately after running. Running at the RPE10-12 significantly improved reaction time in the Go trials ( $688 \pm 191$  [Pre] vs  $568 \pm 159$  ms [Post],  $P < 0.05$ ). In the resting condition, cognitive performance was unchanged throughout the experiment ( $628.5 \pm 163.1$  ms [Pre] vs  $666.9 \pm 139.7$  ms [Post],  $P > 0.05$ ). Parasympathetic nervous activity remained lower after running at RPE10-12 ( $586 \pm 424$  ms<sup>2</sup> [Pre] vs  $373 \pm 322$  ms<sup>2</sup>), but sympathetic nervous activity was not changed. Moreover, the  $\Delta$  reaction time (Post-Pre) tended to be positively correlated with  $\Delta$  parasympathetic nervous activity ( $r = 0.514$ ,  $P = 0.088$ ). In contrast,  $\Delta$  reaction time was not associated with  $\Delta$  sympathetic nervous activity ( $r = 0.177$ ,  $P = 0.581$ ).

**CONCLUSIONS:** The present study demonstrated that subjectively selected intensity of exercise can improve cognitive function. The improvement in cognitive function after exercise may be associated with cardiac autonomic nervous activity.

**2346** Board #265 May 28 2:00 PM - 3:30 PM  
**Heart Rate And Rating Of Perceived Exertion During High-intensity Interval Training: Implications For Prescribing Intensity**  
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High-intensity interval training (HIIT) is a popular and effective time-efficient alternative to moderate-intensity continuous training for improving cardiorespiratory fitness in a wide range of populations. However, there is limited research investigating the most effective and practical way to prescribe training intensities for HIIT.

**PURPOSE:** To determine heart rate (HR) and rating of perceived exertion (RPE) responses across a single bout of HIIT. Additionally, the relationship between HR and RPE were examined. **METHODS:** Young adults ( $n=16$ ; age  $21.8 \pm 1.4$  years; 10 females) visited the lab on two separate occasions. At the first visit, participants completed an incremental exercise test on a cycle ergometer to determine peak power output (PPO). Participants completed the HIIT session during their second lab visit. The HIIT protocol involved ten, 1-minute bouts of cycling at 80% PPO interspersed with 1-minute of active rest cycling at 20% PPO. HR and RPE were measured at the end of the first, fifth and tenth work interval. RPE was measured using the CR10 Borg scale. One-way repeated measures ANOVAs were used to determine HR and RPE responses across the HIIT session. Pearson correlations were utilized to assess relationships between HR and RPE. **RESULTS:** HR and RPE both significantly increased from the first (HR  $157 \pm 16$  bpm; RPE  $5.0 \pm 1.8$ ) to the fifth interval (HR  $174 \pm 14$  bpm; RPE  $6.8 \pm 1.7$ ;  $p < 0.05$  for both). However, there were no significant differences in HR or RPE between the fifth and tenth interval ( $180 \pm 12$  bpm; RPE  $7.7 \pm 1.9$   $p > 0.05$  for both). There were no significant relationships between HR and RPE for any of the time points ( $r = -0.01$  to  $-0.34$ ,  $p = 0.19$  to  $0.89$ ) or the average of the session ( $r = 0.37$ ,  $p = 0.16$ ). **CONCLUSIONS:** HR and RPE both increased initially during the HIIT session with no further increase after mid-point. There were no significant relationships between HR and RPE. These findings suggest that RPE, using the CR10 Borg scale, may not replicate HR for determining intensity during HIIT. Future research may be beneficial to determine a practical method for prescribing exercise intensity during HIIT. Further, it would be beneficial to examine the use of RPE and HR as methods of prescribing intensity in long-term, real-world intervention studies.

**2347** Board #266 May 28 2:00 PM - 3:30 PM  
**Perception Of Moderate Intensity Physical Activity By Onset Of Obesity: A Randomized Crossover Trial**  
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Moderate intensity physical activity is typically recommended for inactive adults with overweight or obesity. However, it is unknown whether there is a difference in the perception of moderate intensity by onset of obesity (childhood versus adulthood). **PURPOSE:** To determine if there was a difference in selection of moderate intensity between inactive adults with juvenile-onset (JO) and adult-onset (AO) overweight or obesity. **METHODS:** Participants ( $N=38$ ; JO=18 and AO=20) completed an initial study visit where height, weight, fitness (time to 85% of age predicted HR<sub>max</sub>), and weight history (modified Cincinnati Weight History Questionnaire) were assessed. After stratification by age of obesity onset, participants were randomly assigned the order to complete 20-minute moderate intensity exercise sessions on the treadmill and cycle ergometer (separate visits). A standardized script was used to instruct participants to exercise at a moderate intensity. Participants were given an opportunity to change the speed of the treadmill or cycle ergometer power output every 5 minutes of the session. VO<sub>2</sub>, METs, and HR were measured continually during exercise sessions. Multiple linear regression was used to determine whether exercise intensity (average MET value and % age-predicted HR<sub>max</sub>) differed significantly between onset groups while controlling for age and gender. **RESULTS:** On the treadmill, JO and AO participants selected an average intensity of (mean  $\pm$  sd)  $3.5 \pm 0.9$  vs.  $3.7 \pm 0.9$  METs which equated to  $64.0 \pm 7.7$  and  $64.9 \pm 7.5$  % of their age-predicted HR<sub>max</sub>, respectively. On the cycle ergometer, JO and AO participants selected an average intensity of  $3.3 \pm 0.9$  vs.  $3.3 \pm 1.0$  METs. This represented  $65.2 \pm 8.8$  and  $60.7 \pm 7.2$  % of their age-predicted HR<sub>max</sub>, respectively. After adjusting for age and gender, AO participants expended on average 0.13 more METs on the ergometer (0.03 METs on the treadmill) than JO participants ( $p=0.50$ ,  $0.90$ , respectively). For HRmax, findings were similar ( $\beta=0.34$ ,  $-0.01$ ;  $p=0.08$ ,  $0.95$ ) for the ergometer and treadmill, respectively. **CONCLUSION:** Perception of moderate intensity did not differ by onset of obesity. However, inactive individuals with obesity selected an intensity at the low end of moderate intensity for both treadmill and cycle exercise resulting in lower overall energy expenditure.

**2348** Board #267 May 28 2:00 PM - 3:30 PM  
**Conditioned Pain Modulation And Blood Pressure Responses To Cold Pressor Test Among Resistance Exercisers**  
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Conditioned pain modulation (CPM) examines central pain inhibitory processing by assessing changes of sensitivity to the first pain stimulus after exposure to the second pain stimulus compared to baseline, and serves as risk factor of chronic pain. Aerobically-trained individuals typically show greater CPM compared to controls, but little is known regarding CPM among resistance exercisers (REs) who habitually engage in resistance exercise/strength training. REs often show elevated resting blood pressure (BP), which is associated with greater BP responses to cold pressor test (CPT) of immersing a hand into a cold water bath. Given past research showing the positive association between CPM and BP responses to CPT as the second pain stimulus, REs may exhibit greater CPM, along with augmented BP responses to CPT. **Purpose:** To compare CPM and BP responses to CPT between REs and controls. **METHODS:** REs were primarily recruited from weight lifting and power lifting teams ( $n = 15$ ). Controls were healthy, normally active individuals (NAs) ( $n = 15$ ). The participants completed the CPM test to evaluate changes in pain ratings (0-100) to electrical stimuli delivered to the ankle after CPT for a maximum of 2 minutes compared to baseline. The magnitude of CPM was calculated as change scores: post-CPT pain ratings - baseline pain ratings, with smaller pain ratings indicating greater pain inhibition. BP was assessed at baseline and every minute during CPT. CPM and BP data were analyzed using a mixed model ANOVA. The relationship between CPM and BP was tested using a correlational analysis. **Results:** Each group consisted of young, 9 men and 6 women (REs:  $23 \pm 5$  yrs vs. NAs:  $22 \pm 2$  yrs,  $p > 0.05$ ). REs reported spending  $9.1 \pm 4.5$  hours/week for resistance exercise. REs and NAs exhibited comparable CPM (Change scores. REs:  $-12 \pm 12$  vs. NAs:  $-14 \pm 12$ ,  $p > 0.05$ ), but REs showed greater systolic BP responses to CPT compared to NAs (Mean SBP. REs:  $129 \pm 11$  mmHg vs. NAs:  $119 \pm 14$  mmHg,  $p < 0.05$ ). No significant association was found between systolic BP and CPM in REs (Resting:  $r = 0.2$ ,  $p > 0.05$  & Reactivity:  $r = -0.2$ ,  $p > 0.05$ ), but resting

systolic BP was positively associated with CPM in NAs (Resting:  $r = 0.5$ ,  $p < 0.05$  & Reactivity:  $r = -0.1$ ,  $p > 0.05$ ). **Conclusion:** The role of BP in CPM is likely complex, and the potential role of exercise in central pain processing needs to be studied.

**2349** Board #268 May 28 2:00 PM - 3:30 PM  
**Psychological Flexibility And Catastrophizing Predict Pain Interference In Veterans With Chronic Pain: Physical Therapy Considerations**

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The opioid crisis has made imperative the need for effective biopsychosocial interventions for chronic pain. The Empower Veterans Program (EVP) at the Atlanta VA is an interdisciplinary 10-week outpatient program involving group psychoeducation, psychotherapy, and physical therapy for Veterans with chronic pain. The aim is to improve patients' self-management of pain through increasing coping skills and functioning. Increasing psychological flexibility, the ability to persist or change behavior in pursuit of goals and values, and decreasing pain catastrophizing are two processes that may contribute to the impact of pain, and therefore may influence the efficacy of physical therapy.

**PURPOSE:** To determine whether psychological flexibility and pain catastrophizing predict pain interference in Veterans with chronic pain.

**METHODS:** Baseline measures were assessed in a sample (N=373) of Veterans enrolling in EVP. Stepwise linear regression was used to predict self-reported pain interference (Multidimensional Pain Inventory- Interference/MPI). Model predictors included general and pain-specific measures of psychological flexibility (General = Acceptance and Action Questionnaire/AAQ-II; Specific = Chronic Pain Acceptance Questionnaire/CPAQ), pain catastrophizing (Pain Catastrophizing Scale/PCS), and average pain intensity (Numeric Rating Scale/NRS). Demographic (age, gender and race) and physical performance (Timed Up and Go) were included in the model as covariates.

**RESULTS:** Sample characteristics were age ( $55.5 \pm 0.4$ ), gender (69.2% male), and race (15.9% white/ 79.1% black). The overall adjusted R<sup>2</sup> of the model was 0.48 ( $p = 0.008$ ). Psychological flexibility (CPAQ  $\beta = -.26$ ; AAQ  $\beta = .23$ ), pain catastrophizing (PCS  $\beta = .15$ ), and pain intensity (NRS  $\beta = .24$ ) were significant predictors of pain interference.

**CONCLUSIONS:** Psychological flexibility and pain catastrophizing are two important psychological processes that contribute to pain interference. Rehabilitation strategies should consider the impact and response to treatment related to these constructs, especially aligning exercise and physical activity with values and behavior change principles.

**2350** Board #269 May 28 2:00 PM - 3:30 PM  
**The Influence Of Sex And Cuff Width On Discomfort To Blood Flow Restriction In The Lower Body**

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 (No relevant relationships reported)

Wide cuffs cause arterial occlusion at lower pressures but may produce greater discomfort immediately following blood flow restricted exercise compared to more narrow cuffs in the upper body. Whether this is true in the lower body or if this differs by sex is currently unknown. **PURPOSE:** To determine the impact of cuff width, sex, and pressure on perceived discomfort in the lower body. **METHODS:** Experiment 1 (n=99) compared discomfort at rest between a 5 and 12 cm cuff. Experiment 2 (n=96) compared discomfort between a 5 and 12 cm cuff after four sets of knee extension exercise. For Experiments 1 and 2, the cuffs were inflated to 40% of the arterial occlusion pressure for each cuff. Experiment 3 (n=95) used the same exercise protocol as Experiment 2 to compare the discomfort between a 12 cm cuff inflated to pressure meant for a narrow cuff and a 12 cm cuff inflated to the appropriate pressure. Discomfort was rated following the 4<sup>th</sup> set (0: no discomfort, 100: maximal discomfort). Following the exercise bout in Experiments 2 and 3, participants were asked to choose which condition they would prefer to use regularly. A Bayesian repeated measures analysis with a between subject factor of sex was used to assess differences in discomfort. A contingency table was used to determine if cuff preference differed by sex. Bayes Factors (BF<sub>10</sub>) were used to quantify evidence. **RESULTS:** In Experiment 1, the narrow cuff had higher discomfort than the wide cuff [16 vs 12 AU, BF<sub>10</sub>=31]. In Experiment 2, men reported greater discomfort [58 vs 48 AU, BF<sub>10</sub>=4.9], however, there were no differences in discomfort (52 vs. 53 AU) between

cuffs [median difference (95% credible interval) of -0.5 (-3, 1.8) AU, BF<sub>10</sub>=0.17]. Narrow cuffs were preferred by most participants. Experiment 3 found cuffs inflated to pressure intended for narrow cuffs had greater ratings of discomfort [73 vs 52 AU, BF<sub>10</sub>=1.2e+19] and participants preferred to use it less. Of note, the pressure for the 5 cm cuff had to be estimated for the majority of participants. **CONCLUSIONS:** The inability to directly assess arterial occlusion on the majority of the sample limits the conclusions that can be made. There was no strong evidence that discomfort differed between cuff widths though there was some indication that participants preferred the narrow cuff and the cuff inflated to the appropriate relative pressure.

**2351** Board #270 May 28 2:00 PM - 3:30 PM  
**The Perceptual Responses Of Multiple Sclerosis Patients To Traditional Versus Blood Flow Restriction Resistance Exercise**

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 (Sponsor: Michael G. Bembem, FACSM)  
 (No relevant relationships reported)

**PURPOSE:** To investigate the perceptual responses (ratings of perceived exertion [RPE] and discomfort [RD]) of multiple sclerosis patients (MS) to low-load resistance exercise (RE) with blood flow restriction (BFR) and to traditional high-load RE without BFR. **METHODS:** Thirteen individuals (males = 3, females = 10) with a confirmed diagnosis of relapsing-remitting MS were randomly assigned to the following RE conditions: 1) low-load RE with BFR (LL-BFR) and 2) high-load RE without BFR (HI). Participants performed 4 sets (30-15-15-15 reps) of bilateral leg press (LP) and knee extension (KE), at 20% of their one-maximum repetition (1-RM), and with 50% of BFR for the LL-BFR exercise trial. For the HI exercise condition, participants completed 4 sets (10-10-10-10 reps) of the same exercises at 70% of 1RM. There was a 3-minute rest period between sets and 5 minutes between exercises. RPE was assessed after each set using the OMNI-RES scale, with scores ranging from 0 to 10. The RD were assessed immediately before and after each set using a visual numeric pain scale, with scores ranging from 0 to 10. Data were analyzed using the Friedman's and the Wilcoxon non-parametric tests with Bonferroni correction, and with  $p$  set at 0.05. Data are winsorized means  $\pm$  SD. **RESULTS:** Greater RPE values were observed for the HI exercise condition compared to LL-BFR following the first set of LP ( $6.83 \pm 1.17$  vs  $4.84 \pm 2.05$ ,  $p < 0.05$ ), but not after sets 2 ( $6.83 \pm 1.48$  vs  $4.2 \pm 2.14$ ), 3 ( $7.62 \pm 1.63$  vs  $4.82 \pm 2.09$ ), and 4 ( $7.94 \pm 1.44$  vs  $4.98 \pm 1.87$ ). During KE, HI elicited significantly ( $p < 0.05$ ) higher RPE after sets 2 ( $8.07 \pm 1.06$  vs  $6.47 \pm 1.52$ ), 3 ( $8.86 \pm 1.02$  vs  $6.84 \pm 1.26$ ), and 4 ( $9.02 \pm 1.17$  vs  $6.84 \pm 1.26$ , but not set 1 ( $8.24 \pm 0.66$  vs  $6.54 \pm 1.74$ ). For the RD, LL-BFR induced significantly ( $p < 0.05$ ) greater RD than HI only after the first set of both LP ( $2.26 \pm 1.46$  vs  $0.80 \pm 0.54$ ) and KE ( $4.69 \pm 1.80$  vs  $2.52 \pm 1.65$ ). For the RD measured immediately before each set, LL-BFR was significantly greater ( $p < 0.05$ ) than HI only before sets 3 ( $3.13 \pm 1.41$  vs  $0.52 \pm 0.68$ ) and 4 ( $3.14 \pm 1.92$  vs  $1.10 \pm 1.09$ ) of LP, and before sets 2 ( $3.75 \pm 1.93$  vs  $0.94 \pm 1.10$ ) and 3 ( $3.15 \pm 1.41$  vs  $1.15 \pm 0.96$ ) of KE. **CONCLUSION:** LL-BFR results in similar RPE and RD compared to HI. However, the RD perceived immediately before a subsequent set remained partially elevated following some of the sets of LL-BFR.

**D-71** Free Communication/Poster - Clinical Exercise Testing

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
 Room: CC-Exhibit Hall

**2352** Board #271 May 28 3:00 PM - 4:30 PM  
**Re-occurrence Of Oscillatory Ventilation During Cardiopulmonary Exercise Testing Post Left Ventricular Assist Device Implantation**

Miranda Contursi, MS, John Boehmer, MD. Hershey Medical Center, Hershey, PA.  
 (No relevant relationships reported)

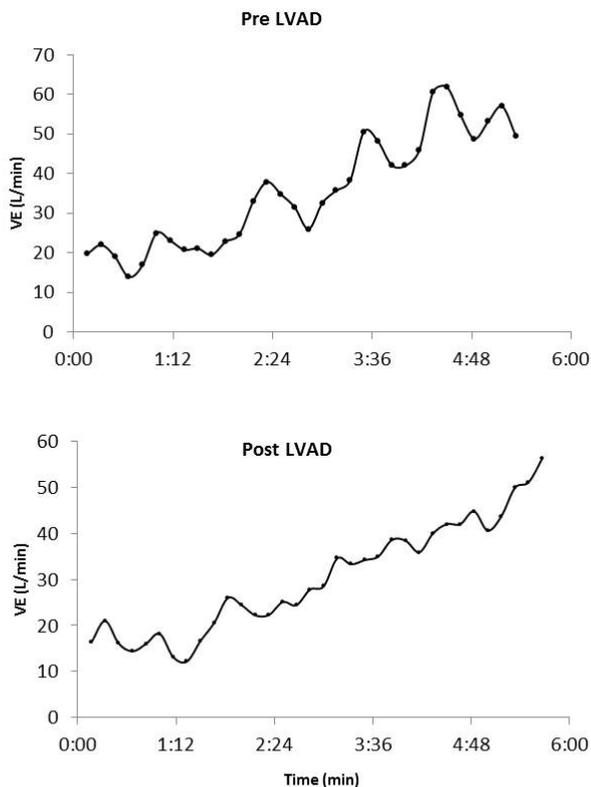
Oscillatory ventilation, characterized by cyclic fluctuations in minute ventilations, is recognized as a significant prognostic indicator of adverse outcomes in heart failure patients. Assessing for exercise induced oscillatory ventilation (EOV) during cardiopulmonary exercise tests (CPET) is a valuable non-invasive parameter in evaluating HF. Various reversibility studies using pharmacological, valvular surgery, cardiac transplantation, exercise training, and nocturnal adaptive servo-ventilation have been associated with an attenuation of EOV, but no studies have assessed if the incidence of EOV is reduced post LVAD implantation during routine CPET.

**PURPOSE:** To quantify the reoccurrence of EOv during CPET in HF patients that previously demonstrated EOv during a CPET prior to their LVAD implantation surgery.

**METHODS:** A retrospective analysis of HF patients that received LVAD implantation surgery from 1988-2018 was conducted. CPET data was collected and evaluated for EOv from patients that had testing done within one year both pre and post LVAD. EOv was defined as oscillatory ventilations that persist for at least 60% of the exercise test and amplitude of 15% or more of the average resting value.

**RESULTS:** Among 325 participants with LVAD's, 32 underwent CPET testing within one year both pre and post-surgery. Basic demographics are as follows: 81% male, age = 57 ± 8.8, and BMI = 32 ± 7. Forty four percent (n=14) of the participants demonstrated EOv during their pre LVAD CPET and 12% (n=4) demonstrated EOv on their post LVAD. This represents a 71% decrease in the occurrence of EOv which is significant at p<.05. No participant newly developed EOv post LVAD.

**CONCLUSION:** Among HF people with EOv during a CPET, LVAD implantation is associated with an attenuation of EOv. Future study is warranted to determine if EOv post LVAD correlates with early hospital re-admission or cardiovascular mortality.



**Figure.** Ventilation from a representative patient before and after LVAD implantation surgery displaying reduction of amplitude and cycle length of EOv

**METHODS:** A total of 117 female participants (age: 38.7 ± 7.6 years) underwent muscle mass (dual-energy x-ray absorptiometry), muscle strength (*knee extensors* isokinetic *peak torque at 60 °/s*), and physical function (sit-to-stand, timed up-and-go, and six-minute walk tests) evaluation. *Spearman's rank correlation coefficient* was used to identify associations. Mann-Whitney U test was used to compare the physical function of participants in the lowest and highest quartiles of muscle mass and strength.

**RESULTS:** The table below presents the association between muscle mass, muscle strength and physical function. Of the studied muscle-related phenotypes, only muscle strength was significantly related to physical function. Compared to the highest quartile of muscle strength, participants in the lowest quartile exhibited significantly worse performance in the timed-up and go test (6.3 ± 0.9 s vs. 5.8 ± 0.9 s; p= 0.048), but did not reach statistical significance the sit-to-stand (14.6 ± 2.9 vs. 16.3 ± 4.0; p= 0.124) and six-minute walk (569.6 ± 54.9 m vs. 599.8 ± 82.1 m; p= 0.178) tests.

**CONCLUSION:** Muscle strength, but not muscle mass, is associated with physical function in long-term gastric by-pass women; which support a growing body of evidence demonstrating that strength has a better prognostic value compared to muscle mass to predict worsening disability.

Keywords: Gastric bypass, Muscle strength, physical functional performance.

The association between muscle mass, muscle strength and physical function in long-term gastric by-pass women.		
	Muscle mass	Muscle strength
Sit-to-stand test	-0.112	0.245*
Timed up-and-go test	0.120	-0.216*
Six-minute walk test	0.096	0.198*
* Denotes significant correlation (p<0.005).		

**2354 Board #273 May 28 3:00 PM - 4:30 PM**  
**Clinical Application Of Duke Activity Status Index To Select An Appropriate Cardiovascular Stress Test Protocol**

Mary Ann Reynolds, Rachel Myers, Josh West, Katey Sweat, Virginia McGhee, Hem Bhardwaj, W. Greg Hundley, Ross Arena, FACSM, Justin Canada. *Virginia Commonwealth University, Richmond, VA.* (Sponsor: Ross Arena, FACSM)  
*(No relevant relationships reported)*

Patients referred for cardiovascular stress testing with limited functional capacity due to age, deconditioning, or clinical comorbidities may be unable to achieve an adequate exercise stress level to render a diagnostic cardiovascular stress test. The Bruce treadmill protocol is the current clinical standard, but may be inappropriate for some patients due to large changes in speed/grade between stages. The Duke Activity Status Index (DASI), a validated 12-item questionnaire that utilizes self-reported physical work capacity to estimate metabolic equivalents (METs), may help clinicians select the most appropriate stress test protocol. **PURPOSE:** To determine if DASI estimated MET levels can predict the achievement of an adequate diagnostic exercise stress test using the Bruce treadmill protocol. **METHODS:** DASI questionnaires were administered to patients prior to stress testing. DASI estimated METs were calculated from the total score. Measured METs were determined from peak treadmill speed and grade. Criteria for determining a suboptimal exercise stress was defined as inability to complete stage 1 of a Bruce protocol. **RESULTS:** A total of 400 patients completed the DASI questionnaire. Mean DASI estimated METs and measured METs were 8.1 ± 1.7 and 8.4 ± 2.8, respectively. Logistic regression analysis showed DASI estimated and measured METs predicted a suboptimal test result (P<0.001). Receiver operator characteristic curve (Figure 1) demonstrated a DASI estimated MET level ≤ 7.4 was the optimal threshold to predict a suboptimal test result, AUC=0.883, SE=0.037 (0.811-0.956), sensitivity= 94%, specificity= 73%, P<0.0001. **CONCLUSIONS:** Findings suggest the Duke Activity Status Index may be an effective way to stratify stress type in the clinical setting. Further study is needed to assess if more conservative exercise protocols with smaller incremental changes in workload would increase the likelihood of achieving a diagnostic cardiovascular stress result.

**2353 Board #272 May 28 3:00 PM - 4:30 PM**  
**Muscle Strength, But Not Mass, Is Associated With Physical Function In Long-term Gastric By-pass Women**

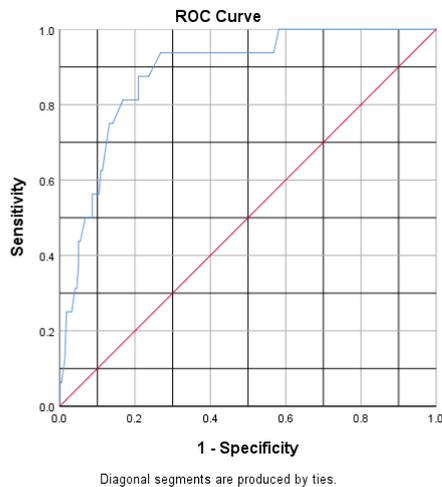
HIGOR RAMOS FERREIRA, SILVIA G. NERI, GUSTAVO N. GOMES, KÊNIA M. De Carvalho, ELIANE S. DUTRA, RICARDO M. LIMA. *Universidade de Brasília-UnB, Brasília, Brazil.*  
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*(No relevant relationships reported)*

**Muscle strength, but not mass, is associated with physical function in long-term gastric by-pass women**

Muscle-related phenotypes have been linked to physical function in the general population; however, this relationship has yet to be examined in long-term gastric by-pass women.

**PURPOSE:** To examine the association between muscle mass, muscle strength and physical function in women who have been doing gastric by-pass for over 2 years.

THURSDAY, MAY 28, 2020



2355 Board #274 May 28 3:00 PM - 4:30 PM

**Does Low Volume, High-intensity Interval Training Impact Right Ventricular Size And Function?**

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(No relevant relationships reported)

**PURPOSE**

The minimum volume of exercise training required for the right ventricular (RV) adaptation's changes to occur is unknown. We aimed to determine possible effects on RV size and function with extremely low volume, high-intensity exercise training (HIT) in previously untrained subjects.

**METHODS**

Healthy, young subjects not performing regular training were recruited for six weeks of supervised HIT, three times per week. Each of the 18 sessions consisted of three 30 seconds all-out sprints on a bicycle ergometer (breaking force 7.5% of the subject's body weight), separated by two minutes of low intensity cycling. A maximal cardiopulmonary exercise test (CPX) and an echocardiogram (echo) at rest were performed before and the week after the last session. Right atrial volume (RAV), RV inflow-tract diameter (RVId) and end diastolic area (RVEDA) were measured. RV systolic function was determined as fraction area change (FAC), tricuspid annular plane systolic excursion (TAPSE) and global longitudinal strain based on 2D speckle tracking in 6 segments of free wall and septum (RVGs).

**RESULTS**

Maximal oxygen uptake (VO<sub>2</sub> max) was determined in 27 subjects and increased from 3.0±0.8 L/min to 3.4±0.8 L/min post training, mean +14%, p<0.001. Pre- and post HIT echo data were available in 28 subjects (27±5 yrs, 16 male, BMI 24±2 kg/m<sup>2</sup> (18-28). RVEDA was larger post training (19.6±4.1 vs 18.3±3.6 cm<sup>2</sup>, p=0.003) while RVId showed no difference (3.7±0.4 vs 3.7±0.5cm, p=0.9). FAC, TAPSE and RVGs remained unchanged after the training period (51.3±7 vs 52.9 ±6%, p=0.2; 2.4±0.3 vs 2.8±1.8 cm, p=0.3; -23.1±3.6 vs -22.9 ±3.6%, p=0.6). RAV showed a tendency to larger values post training but not statistically significant (46.0±15.7 vs 49.6±17.3 mL, p=0.07). There was a significant correlation between VO<sub>2</sub>max, RVEDA and RAV at baseline and post training (r<sup>2</sup>=0.32, p=0.003 resp. r<sup>2</sup>=0.21; p=0.01 and r<sup>2</sup>=0.20, p=0.04 resp. r<sup>2</sup>=0.45, p=0.0001). **CONCLUSION**

Larger RV chamber size was present after less than 5 min high-intensity exercise training per week for six weeks. This was not proportional to changes in VO<sub>2</sub> max. The systolic RV function remained unchanged.

2356 Board #275 May 28 3:00 PM - 4:30 PM  
**Abstract Withdrawn**

2357 Board #276 May 28 3:00 PM - 4:30 PM  
**Peak Responses To Graded Exercise Protocols In Young Children**

Tori L. Vogelaar, Lilly A. Bradley, Kathryn R. Lanphere, Mark Vranicar, Jody L. Clasey, FACSM. *University of Kentucky, Lexington, KY.* (Sponsor: Jody L. Clasey, FACSM)  
(No relevant relationships reported)

The Bruce protocol (Bruce) is a progressive treadmill test with an aggressive initial grade that was developed for use in adults, and is often used to assess cardiac patients. Due to the steep grade, young children may terminate the Bruce prematurely. The University of Kentucky Pediatric Exercise Physiology Lab has developed a protocol (PEP Lab) with lower grades which we hypothesized would be better tolerated and potentially elicit greater peak VO<sub>2</sub> and cardiovascular responses. **PURPOSE:** To compare peak oxygen uptake (pVO<sub>2</sub>; ml·kg<sup>-1</sup>·min<sup>-1</sup>), heart rate (pHR; bpm), systolic blood pressure (pSBP; mmHg), and respiratory exchange ratio (pRER) responses to the Bruce versus the PEP Lab in 43 (22 boys) young (7-11 yr old) children of varying adiposities. We also evaluated each subject's perception of difficulty between the two protocols.

**METHODS:** Subjects completed the Bruce and the PEP Lab protocols in a random order 1 week apart. pVO<sub>2</sub> and pHR were determined with an integrated metabolic system, and pSBP was determined by manual auscultation. Verbal encouragement was provided during both testing sessions and test completion based on volitional fatigue. Results are expressed as mean ± SE and significance p < 0.05.

**RESULTS:** The Bruce versus PEP Lab pVO<sub>2</sub> (43.6 ± 1.5 vs 43.9 ± 1.5) and pHR (186.6 ± 2.0 vs 188.2 ± 2.2) did not significantly differ. However, pSBP during the Bruce was significantly lower (136.4 ± 1.4 vs 141.3 ± 1.1) and the Bruce pRER was significantly higher (1.065 ± 0.018 vs 1.013 ± 0.014) than the PEP Lab. Bruce and PEP Lab protocol pVO<sub>2</sub>, pHR, pSBP, pRER were significantly correlated (r = 0.61, 0.47, 0.53 and 0.42, respectively). The majority (88%) of the children perceived the Bruce to be more difficult.

**CONCLUSIONS:** A less steep protocol can elicit similar cardiopulmonary results as the Bruce. Protocols that are perceived as less difficult may help guarantee that children do not terminate their exercise tests prematurely to reaching their true pVO<sub>2</sub>. Supported by the University of Kentucky Pediatric Exercise Physiology Lab Endowment; NIH National Center for Advancing Translational Sciences through grant number UL1TR001998. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

2358 Board #277 May 28 3:00 PM - 4:30 PM  
**Ventilatory Constraint Analysis During Maximal Exercise Testing In Elite Youth Athletes**

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(No relevant relationships reported)

**PURPOSE:** Assessment of ventilatory constraint has become essential in the assessment of exercise performance. However, minimal data exists regarding a systematic evaluation of these constraints in an elite athletic population. The study was performed to provide new normative data and preliminary analysis of how these variables correlate.

**METHODS:** Twenty four individuals were analyzed as part of a human performance evaluation. 16 individuals competed in Div 1 soccer (16F, age 18-22 yrs) and 8 in AAA hockey (8M, age 13-14 yrs). A graded maximal exercise test was performed (Bike: Lode Excalibur) with breath by breath gas analysis (Med Graphics). Expiratory flow limitation (EFL%), VE/MVV, ventilatory reserve capacity (VRC%), shift in EELV (IC/VC%), shift in EILV (VT/IC%), and inspiratory reserve (IR) were recorded. Spearman coefficients were determined between ventilatory constraint and exercise variables. Unpaired Student t tests were performed for comparison within constraint variables. Values are expressed as mean±SD with significance set at p<0.05.

**RESULTS:** All constraint variables were obtained except IR (incomplete data). EFL% (37.8±26.5), VRC% (90.2±1.7), IC/VC% (65.1±8.9), VE/MVV% (100.4±8.5) and VT/IC% (83.5±7.7) did not vary by sport. EFL% correlated to VRC% (r=0.57, p<0.05) and weakly correlated to IC/VC% (r=0.35, p=0.09) but not VE/MVV% or VT/IC%. No relationship existed between the remaining variables. VO<sub>2</sub> (ml/kg lean body mass) was higher for VE/MVV >100% than <100% (64.2±6.1 vs 59.9±3.4, p<0.05). Peak work capacity (PWC)/LBM, % of predicted, was similarly affected (142.5±10.5 vs 153.6 ± 10.2, p<0.05). For IC/VC%, higher PWC (297.7±47.3 vs 265.8±22.3 Watts, p<0.05)

and  $\text{VO}_2$  ( $3.32 \pm 0.51$  vs  $2.98 \pm 0.29$  liters,  $p < 0.05$ ) were seen in the low IC/VC group (<65%) compared to the high group (>65%). EFL% and VT/IC% did not correlate with PWC or  $\text{VO}_2$ .

**CONCLUSIONS:** Ventilatory constraint analysis yielded normative data. EFL was associated with ventilatory reserve. However, unlike previous data in cystic fibrosis, VE/MVV was not correlated to ventilatory constraint. While a shift in EELV (IC/VC%) may be considered abnormal in underlying respiratory diseases, the ratio in this study was associated with increased exercise performance reflecting different underlying compensatory breathing mechanics.

**2359 Board #278 May 28 3:00 PM - 4:30 PM**  
**The Index Of Physical Performance In Muscle Damage Biomarker In Youth Athletes**

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 (No relevant relationships reported)

**PURPOSE:** To investigate the index of the physical performance among different levels of serum creatine kinase in youth athletes.

**METHODS:** 53 youth male athletes ages of 12 to 18 years were divided into three groups, low-level group (LL,  $n=17$ ), middle-level group (ML,  $n=20$ ), and high-level group (HL,  $n=16$ ) by CK level of serum (reasonable CK range: 82-1,083 U/L for male athletes). Fasting blood samples of CK and myoglobin were collected in the morning. The physical performance test included gripping, low back muscle strength, curl up, standing broad jump, lower limb flexibility, 30m sprint, vertical jump, whole-body reaction time, agility, and yo-yo test for aerobic endurance. One-way ANOVA and Pearson's correlation were used to determine the difference between physical performance and biomarkers.

**RESULTS:** In biomarkers, the value of CK had positive correlation between low back muscle strength ( $r=0.278$ ,  $p < 0.05$ ) and reaction time ( $r=0.412$ ,  $p < 0.01$ ). There was a negative correlation between CK and aerobic endurance ( $r=-0.288$ ,  $p < 0.05$ ). The myoglobin of LL (19.76 ng/ml) was significantly lower than ML and HL (25.18 ng/ml; 28.96 ng/ml) ( $p < 0.05$ ). The aerobic endurance of LL was significantly higher (26.6%) than HL ( $p < 0.05$ ). In the reaction time, LL and ML (267.12ms; 284.95ms) were significantly faster than HL (367.27ms) ( $p < 0.05$ ). There were no significant differences in other physical performance.

**CONCLUSIONS:** This study suggested that the performance of whole-body reaction time and yo-yo test perhaps to be reminded for muscle damage or fatigue in the reasonable CK range. In addition, future research can regularly implement both physical indexes to track muscle fatigue.

**2360 Board #279 May 28 3:00 PM - 4:30 PM**  
**Chronotropic Intolerance In Patients With Chronic Lyme Disease Identified By Serial Cardiopulmonary Exercise Testing**

Saejel G. Mohan<sup>1</sup>, Courtney D. Jensen<sup>2</sup>, Staci Stevens<sup>3</sup>, Jared Stevens<sup>3</sup>, Todd Davenport<sup>2</sup>, J. Mark VanNess<sup>2</sup>. <sup>1</sup>University of California at Berkeley, Berkeley, CA. <sup>2</sup>University of the Pacific, Stockton, CA. <sup>3</sup>Workwell Foundation, Ripon, CA.  
 (No relevant relationships reported)

In the U.S., annual incidence of Lyme disease is approximately 300,000. In an estimated 5-30% of cases, post-treatment Lyme disease syndrome (PTLDS) develops; symptoms include post-exertional malaise characteristic of myalgic encephalomyelitis. The contribution of autonomic regulation has not been elucidated. **PURPOSE:** To evaluate cardiovascular responses to serial cardiopulmonary testing in patients with PTLDS. **METHODS:** 14 patients with PTLDS and 8 sedentary controls underwent 2 maximal exercise tests separated by 24 hours. Heart rate (HR) was measured continuously via electrocardiogram. Expired air was collected for determination of anaerobic threshold (AT) using V-slope methodology and maximal exertion was defined as a respiratory exchange ratio  $> 1.09$ . Independent-samples t-tests compared baseline characteristics of PTLDS patients and controls. Linear regression determined the effect of PTLDS diagnosis on HR at AT and peak holding workload constant. **RESULTS:** Patients were  $44.0 \pm 10.1$  years old, weighed  $69.8 \pm 16.2$  kg, and achieved a peak  $\text{VO}_2$  of  $23.8 \pm 6.2$  mL/kg/min during test 1. HR was  $116.2 \pm 21.8$  bpm at AT and  $162.6 \pm 25.1$  at peak. PTLDS and controls did not differ in peak  $\text{VO}_2$  during test 1 ( $p=0.161$ ), test 2 ( $p=0.134$ ), or the difference between test 1 and test 2 ( $p=0.498$ ). HR at AT was comparable in test 1 ( $p=0.127$ ) but different in test 2 ( $p < 0.001$ ). HR at peak was different in test 1 ( $p=0.001$ ) and test 2 ( $p < 0.001$ ). During test 1, holding workload constant, PTLDS patients had lower peak HR by 19.5 bpm ( $p=0.033$ ; 95% CI: -37.3 to -1.8). During test 2, holding workload constant, PTLDS predicted a lower HR by 26.8 bpm at AT ( $p=0.004$ ; 95% CI: -43.9 to -9.8) and 24.3 bpm at peak ( $p=0.007$ ; 95% CI: -40.9 to -7.7). **CONCLUSIONS:** Patients with PTLDS demonstrated abnormal cardiovascular responses to exercise. Despite accomplishing the same  $\text{VO}_2$  and holding workload constant, the HR response was diminished in the post-exertional state, potentially indicating dysautonomia in PTLDS.

**2361 Board #280 May 28 3:00 PM - 4:30 PM**  
**Normalizing Cardiorespiratory Fitness To Fat-free Mass Improves Mortality Risk Prediction In Overweight Adults From The Ball St Cohort**

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 (No relevant relationships reported)

**PURPOSE:** Cardiorespiratory fitness (CRF) is a significant predictor of mortality outcomes in various populations, including overweight and obese adults. However, CRF is commonly expressed normalized to total body weight ( $\text{VO}_{2\text{peakTBW}}$ ) which may weaken the relationship in obese adults as fat-free mass (FFM) is directly related to CRF, and increased body fat is associated with lower CRF in adults. Therefore, this study aimed to assess the relationship between CRF normalized for FFM ( $\text{VO}_{2\text{peakFFM}}$ ) and all-cause mortality, as well as compare the predictive ability of  $\text{VO}_{2\text{peakFFM}}$  and  $\text{VO}_{2\text{peakTBW}}$  in a cohort of self-referred overweight and obese adults.

**METHODS:** Participants included 1,021 overweight and obese adults (520 men, 501 women; BMI:  $30.8 \pm 5.3$ ) who completed a cardiopulmonary exercise test (CPX) and body composition assessment between 1970-2016 to determine CRF. Participants were included if their BMI  $> 25$  kg·m<sup>-2</sup> and/or waist circumference was  $> 88$  cm in women and  $> 102$  cm in men. FFM was estimated using the skinfold method to estimate FFM. Participants were followed for  $17.8 \pm 10.8$  years after their CPX and body composition assessments for mortality outcomes. Cox-proportional hazard models were performed to determine the relationship of  $\text{VO}_{2\text{peakFFM}}$  with mortality outcomes. A Wald Chi-square test of equality was performed to compare the predictive ability of CRF expressed as  $\text{VO}_{2\text{peakTBW}}$  and  $\text{VO}_{2\text{peakFFM}}$ .

**RESULTS:** Overall,  $\text{VO}_{2\text{peakFFM}}$  was inversely related to all-cause mortality, with an 11.8% lower risk per 1 mL·kgFFM<sup>-1</sup>·min<sup>-1</sup> improvement, respectively ( $p < 0.01$ ).  $\text{VO}_{2\text{peakFFM}}$  was shown to be a significantly stronger predictor of all-cause mortality than  $\text{VO}_{2\text{peakTBW}}$  (parameter estimates: -0.44 vs. -0.18,  $p < 0.05$  respectively).

**CONCLUSIONS:** Body composition is an important factor when considering the relationship between CRF and mortality risk. Clinicians should consider normalizing CRF to FFM when feasible, especially in individuals with excess body fat as it will strengthen the predictive power of the measure.

**2362 Board #281 May 28 3:00 PM - 4:30 PM**  
**Hemodynamic Performance In Patients With A Bicuspid Aortic Valve During Treadmill Ramp Exercise Testing**

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 (No relevant relationships reported)

**PURPOSE:** To evaluate the effect of a bicuspid aortic valve on the hemodynamic response to a treadmill ramp protocol in pediatric patients. **METHODS:** We evaluated 18 patients with a bicuspid aortic valve (BAV) and 18 normal subjects (C), age and size matched, using a Ramp Treadmill protocol. Neither group was treated with a Beta Blocker. Resting aortic valve peak gradient (PG) and shortening fraction (SF) were evaluated by echocardiography for the BAV group. Systolic blood pressure (SBP), cardiac output and stroke volume (SV) were obtained at rest and maximal exercise. Maximal oxygen pulse (MO2P), percent predicted oxygen pulse (%PO2P) and respiratory exchange ratio (RER) were obtained at maximal exercise. **RESULTS:** There were no significant differences between the BAV and C groups in age ( $14.6 \pm 2.1$  vs  $15.8 \pm 3.1$  (yr)), height ( $1.63 \pm 0.1$  vs  $1.66 \pm 0.12$  (m)) or weight ( $55.7 \pm 15.1$  vs  $57.6 \pm 13.2$  (kg)). The BAV group had a resting PG of  $16.5 \pm 8$  mmHg and a SF of  $39.5 \pm 4.9$  %. The SBP in the BAV group was significantly decreased at rest ( $113 \pm 9$  vs  $120 \pm 10$  mmHg)  $p < 0.05$  and exercise ( $160 \pm 14$  vs  $174 \pm 19$  (mmHg)  $p < 0.02$ ) compared to the C group. BAV group had a significantly decreased SV ( $56 \pm 13$  vs  $64 \pm 21$  (ml/beat)  $p < 0.04$ ) compared to C at rest. The decreased MO2P in the BAV group approached significance ( $6.6 \pm 1.7$  vs  $7.6 \pm 1.6$  ml/beat  $P=0.06$ ) compared to C. In BAV, %PO2P was significantly decrease ( $94 \pm 24$  vs  $113 \pm 18$  (%))  $p < 0.01$ . Max RER was not significantly different in BAV and C groups ( $1.19 \pm 0.08$  vs  $1.19 \pm 0.06$ ). MO2P significantly correlated to cardiac output ( $r=0.67$   $p < 0.05$ ). Significance was set at  $p < 0.05$ . **CONCLUSION:** BAV and C groups reached the same intensity of exercise as reflected by the RER. The BAV group had decreased systolic blood pressure and O2Pulse response to exercise. These data suggest that in the face of a mild aortic valve gradient and normal shortening fraction, these BAV patients had a diminished hemodynamic response to exercise.

2363 Board #282 May 28 3:00 PM - 4:30 PM  
**Abstract Withdrawn**

2364 Board #283 May 28 3:00 PM - 4:30 PM  
**Predictors Of Achieving An Adequate Heart Rate Response During Cardiovascular Exercise Stress Testing**

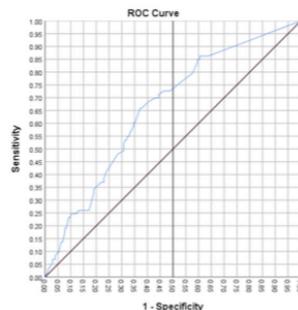
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 (No relevant relationships reported)

Cardiovascular exercise stress testing is a noninvasive, diagnostic tool to assess for myocardial ischemia. Achievement of  $\geq 85\%$  of age-predicted maximal heart rate (APMHR) is commonly used as criteria to define an adequate stress test. **PURPOSE:** The purpose of this study was to determine if patient characteristics could predict ability to achieve an adequate heart rate response during exercise stress testing. **METHODS:** Baseline characteristics including age, race, gender, height, weight, body mass index (BMI), referring provider type, Duke Activity Status Index (DASI) score and stress type (pharmacologic versus exercise) were collected on all patients who completed cardiovascular stress testing. All exercise tests were performed using a standard Bruce treadmill protocol. Criteria for determining an adequate exercise stress test was  $\geq 85\%$  of age-predicted maximal heart rate. **RESULTS:** Out of 608 cardiovascular stress tests, 354 performed exercise stress. Patient characteristics of those who underwent exercise stress was as follows: female= 175 (49%), Caucasian=173 (47%), African American=146 (45%), mean age was  $57 \pm 13$  years, mean BMI= $31.4 \pm 8.1$  kg/m<sup>2</sup>, mean DASI estimated METS=  $8.1 \pm 1.7$  and mean METS achieved=  $8.4 \pm 2.8$ . Fifty-eight (19%) patients did not achieve  $\geq 85\%$  APMHR. Exercise time, DASI estimated METS and METS achieved were significant predictors of achieving  $\geq 85\%$  APMHR (all P's <0.02). Age, race, gender, height, weight, BMI, provider type were not significant (all P's >0.11). **CONCLUSIONS:** In conclusion, exercise duration during graded exercise testing predicted achievement of adequate stress response during cardiovascular stress testing. Strategies to select an appropriate exercise test protocol allowing longer exercise duration may improve the ability to reach target heart rate during cardiovascular stress testing.

**Prediction of Suboptimal Effort (<85%PMHR) by DASI est.METS**

AUC = 0.659 (0.589-0.730) P<0.0001

Optimal Threshold for Suboptimal Effort = 8.0 DASI est.METS  
 Sensitivity=65%, Specificity=65%



2365 Board #284 May 28 3:00 PM - 4:30 PM  
**Effect Of Combined Exercise On Lung Function, Blood Vitamin D, Calcium And Bone Metabolism Hormones In Elderly Women**

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 (No relevant relationships reported)

**PURPOSE:** This study was to investigate the effects of a combined exercise training regimen on lung function, blood vitamin D, calcium and bone metabolism hormones (calcitonin, osteocalcin) in elderly women. **METHODS:** Thirty healthy elderly female volunteers, were randomly assigned to combined exercise group (n=13) trained for 12-week or to a "non-exercise" control group (n=17). The combined exercise program was conducted for 60 minutes per session three times a week at the following intensities: Aerobic exercise intensity was 40-50%HRR (RPE 12-13) for 1-4 weeks, 50-60% HRR (RPE 13-14) for 5-8 weeks, and 60-70%HRR (RPE 14-15) for 9-12 weeks. Resistance exercise intensity was set at 3-4 in OMNI-RES for 1-4 weeks, 5-6 in OMNI-RES for 5-8 weeks, 7-8 in OMNI-RES for 9-12 weeks.

**RESULTS:** FEV1 showed interaction effects group  $\times$  time, FVC and FEV1 were significantly increased in the exercise group. Vitamin D and calcium showed interaction effects between group  $\times$  time, vitamin D was significantly increased in the both group, and calcium was decreased in the control group. Calcitonin and osteocalcin of bone metabolism showed interaction effects group  $\times$  time, osteocalcin was significantly decreased in control group. **CONCLUSIONS:** Our findings indicate that combined exercise were effective in improving the lung function and bone metabolism hormones in elderly women due to decreased physical activities.

2366 Board #285 May 28 3:00 PM - 4:30 PM  
**Pilot Study On Effect Of Ipsilateral Long Kinetic Chains On Shoulder Elevation Strength**

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 (No relevant relationships reported)

There is growing evidence to suggest that kinetic chains extend far beyond the core muscles, following myofascial meridians that interestingly appear to overlap with classically-known acupuncture channels. Strengthening programs during the rehabilitation of musculoskeletal injuries utilize kinetic chain exercises; however, how lower extremity strength potentially directly affects upper extremity strength has not been quantified. **PURPOSE:** To examine quantitatively the effect on shoulder elevation strength (SES) in the sagittal plane on ipsilateral lower extremity tibialis anterior muscle activation. **METHODS:** Twenty young healthy adult volunteers (half women, half men), ages 20-60 years, having no shoulder pain were recruited. Participants had baseline SES evaluated with a hand-held dynamometer applied just proximal to the radial styloid with the arm held in 90-degree elevation in the sagittal plane. The participants underwent the following interventions: SES and ipsilateral anterior tibialis muscle activation (IATMA) while standing, SES and IATMA while seated with legs dangling, and SES with ipsilateral gastrocnemius activation while seated with legs dangling. **RESULTS:** In females, IATMA, in standing and seated position, reduced SES by a mean percentage of 12.57 and 14.88, respectively, from baseline. SES with gastrocnemius activation (reciprocal relaxation of anterior tibialis) reduced SES by a mean percentage of 3.93 from baseline. In males, IATMA, in standing and seated position, reduced SES by a mean percentage of 5.58 and 10.84, respectively, from baseline. SES with gastrocnemius activation (reciprocal relaxation of anterior tibialis) reduced SES by a mean percentage of 3.3 from baseline. **CONCLUSIONS:** IATMA directly reduces SES; it also produces a greater decrement in SES compared to ipsilateral gastrocnemius activation. This kinetic chain effect appears coincident with known myofascial meridians.

2367 Board #286 May 28 3:00 PM - 4:30 PM  
**Cardiovascular Response During Exercise In Patients With Hypertension And Patients With Hypertension With Diabetes**

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 (No relevant relationships reported)

**Purpose:** Heart rate product (RPP) can be used to predict cardiovascular diseases (CVD) and can be regarded as an index for continuous monitoring of ejection fraction and myocardial oxygen consumption. Exercise can improve patients' cardiovascular function and reduce the risk of having CVD. The purpose of this study was to investigate changes in heart rate (HR) and blood pressure (BP) of patients who suffer from hypertension or hypertension with diabetes mellitus during exercise and at post-exercise recovery period.

**Methods:** This study recruited 85 diagnosed hypertension subjects and diagnosed hypertension with diabetes mellitus subjects (40-69 years of age), who were divided into hypertension group (HTN, n = 66) and hypertension with diabetes mellitus group (HDM, n = 19). The modified Bruce protocol was adopted in this study, in which patients pedaled the cycle ergometer, starting from the level of 25W, for 3min per stage and then increasing the levels gradually. HR, BP, RPE and oxygen saturation (SPO<sub>2</sub>) were measured at rest, during exercise and at recovery and RPP and pulse pressure difference (SBP minus DBP) were calculated.

**Results:** (1) The HTN group had a significantly lower resting HR than the HDM group (P<0.05, 76.12 $\pm$ 10.73 vs 86.50 $\pm$ 16.80 bpm, respectively). Resting RPP is significantly lower in HTN group than in HDM group (P<0.05, 88.30 $\pm$ 26.57 vs 106.50 $\pm$ 40.44 times $\cdot$ mmHg/100, respectively) (2) RPP at 50W is significantly lower in the HTN group, compared with the HDM group. (P<0.05, 160.86 $\pm$ 41.10 vs 186.68 $\pm$ 29.86 times $\cdot$ mmHg/100, respectively) (3) SBP at 100W (P<0.05, 186.62 $\pm$ 17.10 vs 206.25 $\pm$ 17.58 mmHg, respectively) and pulse pressure difference at 100W (P<0.05, 97.00  $\pm$  18.87 vs 127.25  $\pm$  25.38 mmHg, respectively) were significantly lower in HTN group. (4) The HTN

group had a significantly lower pulse pressure at the time of 5-minute post-exercise recovery than the HDM group ( $P < 0.05$ ,  $54.29 \pm 15.54$  vs  $72.59 \pm 28.71$  mmHg, respectively). (5) SBP at the time of 15-minute post-exercise recovery in HTN group were significantly higher than in the HDM group ( $P < 0.05$ ,  $121.81 \pm 13.70$  vs  $111.78 \pm 8.94$  mmHg, respectively).

**Conclusions:** The responses of heart rate and blood pressure of patients with hypertension was superior to those with hypertension with diabetes both in exercise and at post-exercise recovery period.

**2368** Board #287 May 28 3:00 PM - 4:30 PM

### Effect Of Graded Exercise On Ror And Blood Oxidative-stress In Trained And Untrained Subjects

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(No relevant relationships reported)

Submaximal graded exercise testing is a commonly used method to assess cardiovascular stress. Reserve of repolarization of the heart (RoR) is an ECG-based, non-invasive method to monitor the heart's stress response, and assesses cardiac cells ability to reestablish their membrane potential. RoR has been shown to be a useful indicator of cardiovascular disease risk in cardiac patients. This study examined RoR difference between trained (T) and untrained (U) individuals and correlate this outcome with blood stress markers. **PURPOSE:** To determine if RoR and blood stress markers in response to a graded exercise in T and U cohorts differ. **METHODS:** Thirty-nine (male and female) subjects ( $23.6 \pm 5.6$  yrs) were recruited. Subjects arrived after overnight fast between 7-9 am and rested for 20 minutes. Subjects completed a fitness questionnaire to determine training status (T or U). ECGs (12 lead) were monitored before, during and after exercise to obtain RoR. A graded walking test (GXT) on a treadmill until 85% of estimated maximum heart rate was performed. Blood obtained at rest and immediately after exercise were analyzed using HPLC for glutathione (oxidized [GSSG], reduced [GSH], total [TGSH]). Repeated measures ANOVAs were utilized to analyze the results using SPSS v24 with significance set at  $\alpha = 0.05$ . **RESULTS:** There were significantly lower resting HRs ( $p = .023$ ) and higher workloads achieved during testing ( $p = .002$ ) between T vs U groups. Resting RoR (independent of group) was significantly reduced from  $75 \pm 5\%$  pre-test to  $26 \pm 10\%$  RoR at the end of exercise ( $p < .001$ ). Final stage RoR was significantly lower for T compared to U group (T:  $20 \pm 9.4\%$ ; U:  $31 \pm 9.4\%$ ,  $p = .041$ ), but T group performed significantly greater stages ( $p = 0.002$ ). The GXT induced a reduction in blood GSH (Pre  $366 \pm 161$   $\mu$ M, Post  $273 \pm 180$   $\mu$ M,  $p < .001$ ) and an increase of GSSG (Pre  $135 \pm 62$   $\mu$ M, Post  $157 \pm 83$   $\mu$ M,  $p = .038$ ) with no difference between groups. GSSG/TGSH decreased after GXT ( $p = 0.028$ ) independent of group. **CONCLUSIONS:** These data suggest that a GXT induces a different stress response in T and U individuals. The oxidative stress at end GXT was similar but needed more workloads to get to this same internal stress level in the T group. Further studies are needed to ascertain stress responses with RoR and relative workloads.

**2369** Board #288 May 28 3:00 PM - 4:30 PM  
**Determining An Appropriate Cardiopulmonary Exercise Testing Protocol For Individuals With Neuromuscular Disease**

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(No relevant relationships reported)

**PURPOSE:** To review published standards and recommendations for people with neuromuscular disease and establish a graded ramp-up protocol to assess exercise tolerance for individuals who have moderate to severe muscle weakness. **METHODS:** A review of literature for muscular dystrophy or neuromuscular disease and exercise testing was performed to assess different methodologies in Cardiopulmonary Exercise Testing (CPET) using cycle ergometry CPET. A progressive ramp-up protocol was developed and administered with patients who attend Stanford's multidisciplinary clinic to determine feasibility and test termination criteria that may limit the ability to achieve maximum oxygen consumption. **RESULTS:** Literature search resulted in 43 research studies. The study breakdown included Myopathies and McArdle disease =20; Pompe=5; FSHD; SMA, Metabolic Myopathies=3; DMD/BMD=2, Myotonic Dystrophy=2; CMT=1; IBM=1. Studies greatly ranged in mode of testing. Most study participants were ambulatory. Most protocols used a graded 1-2 minute progressive ramping protocol up to the point of exhaustion indicated by a Visual Analog Scale and heart rate. Early termination resulted from participants voluntarily stopping due to muscle weakness.

We developed a progressive ramp up protocol with 1-minute increment increase in workload at 5-watt intervals to avoid early termination from large increases in workload. We tested 3 individuals with neuromuscular disease and 2 controls. Only 2 participants (1 with NMD and 1 control) were able to reach an RER of 1.1 of

maximal oxygen uptake (VO<sub>2</sub>max). Reasons for early termination were consistent with the published literature including heart rate, voluntary stop and muscle weakness. **CONCLUSIONS:** With promising treatments on the horizon for neuromuscular diseases, physical therapists are asked to determine appropriate exercise prescriptions for individuals with a range of functional abilities and muscle weakness. Currently, CPET protocol methodology varies for weaker individuals. Our results will contribute to developing a proposed submaximal clinical exercise tolerance test protocol to establish safe exercise prescriptions and determine treatment intervention benefits for patients with neuromuscular disease.

**D-72** Free Communication/Poster - Obesity/Weight-loss

Thursday, May 28, 2020, 2:00 PM - 4:30 PM

Room: CC-Exhibit Hall

**2370** Board #289 May 28 3:00 PM - 4:30 PM

### ACUTE RESPONSE OF BLOOD LIPID PROFILES TO DIFFERENT INTENSITIES OF EXERCISE IN OBESE MEN

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(No relevant relationships reported)

**PURPOSE:** This study was conducted in order to examine the blood lipid profile changes following lower or higher-intensity exercise in obese men. The changes in blood lipid profiles include TC, TG, LDL-C, HDL-C following moderate or high intensity exercise in obese males. **METHODS:** In a randomized, cross-over design, fifteen obese (BMI > 30 kg/m<sup>2</sup>) sedentary (less than 2 days per week of physical activity) male volunteers, the ages between 18 and 30 participated in the study. The participants performed a single bout of cycling exercise (average energy expenditure ~300 kcal) at two different intensities in random order [moderate-intensity: 50% of maximal heart rate and high-intensity: 80% of maximal heart rate]. Overnight fasting blood samples were collected at baseline, immediate post-exercise (IPE), 1-hr PE, and 24-hr PE for each intensity of exercise to determine blood lipids and lipoproteins (TC, TG, LDL-C, and HDL-C). A 2(intensity) X 4 (time) ANOVA with repeated measures was used to examine the mean differences in intensity and time on blood lipids and lipoproteins. The Bonferroni pairwise comparisons were conducted as post hoc to locate the significant mean differences. A  $p$ -value < .05 was set for the statistical significance. **RESULTS:** TG, LDL-C or HDL-C did not change, while TC ( $209.31 \pm 28.89$  mmol/L) at 24-hrPE decreased ( $p = .041$ ) from IPE ( $217.80 \pm 32.55$  mmol/L) following higher-intensity exercise. However, the main effects of time ( $p = .272$ ) or intensity ( $p = .735$ ) demonstrated no statistically significant differences in TC. **CONCLUSIONS:** The acute higher-intensity exercise can lower TC. However, acute different intensities of exercise may not alter significantly blood lipid profiles in obese men due to the short volume and duration. Therefore, future research should determine if different intensities of chronic exercise alter blood lipid profiles in obese men.

**2371** Board #290 May 28 3:00 PM - 4:30 PM

### Sleep Quality Is Associated With Habitual Physical Activity In Overweight, Older Adults

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(Sponsor: Kyle Timmerman, FACSM)

(No relevant relationships reported)

Poor sleep quality has been associated with negative health outcomes. This relationship has mostly been documented in middle-age and young adults with less focus on older adults. Therefore, the **PURPOSE** of this cross-sectional study was to examine relationships between sleep duration/quality with body composition, physical activity, blood lipids, and indicators of blood glucose control. **METHODS:** In 34 overweight (BMI  $\geq 27$  kg/m<sup>2</sup>) older adults ( $\geq 58$  years) enrolled in a longitudinal weight-loss and exercise training study, baseline measures of body composition [skeletal muscle mass (SMM), visceral fat area (VFA) and fat mass (FM)]; cardiorespiratory fitness (VO<sub>2</sub>max, indirect calorimetry); moderate-to-vigorous physical activity (MVPA, 7-day accelerometry); blood lipids/glucose/HbA1c (point-of-care analyzer); and sleep quality and duration (Pittsburgh Sleep Quality Index .PSQI) were assessed. PSQI scores can range from 0-21 with higher values representing lower sleep quality. Pre-intervention relationships among these variables were analyzed utilizing partial correlations, controlling for age and sex. Significance was set at  $\alpha < 0.05$ . **RESULTS:** Mean values were age:  $64.3 \pm 4.5$  years; BMI:  $35.3 \pm 5.0$  kg/m<sup>2</sup>; VFA:  $217.8 \pm 41.5$  cm<sup>2</sup>; sleep duration:  $6.8 \pm 1.2$  hours; PSQI score:  $10.6 \pm 1.3$ ; VO<sub>2</sub>max:  $15.6 \pm 3.8$  ml/kg/min; MVPA:

45.6±22.8 min/day; HbA1c:5.5±0.5%. Sleep score was correlated with MVPA (-0.41,  $p < 0.05$ ), but not BMI, VFA, FM, or VO2max. **CONCLUSION:** These preliminary data suggest that higher levels of MVPA were associated with better sleep quality in older adults. However, unlike previous studies, we found no relationship between indices of body composition and sleep quality. This study was supported by a grant from the National Institute on Aging (R15 AG055923-01)

**2372 Board #291 May 28 3:00 PM - 4:30 PM**  
**The Need For Exercise Recommendations For Children And Adolescents Post-Bariatric Surgery: A Systematic Review**

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 (No relevant relationships reported)

Bariatric surgery is an effective treatment option for children and adolescents with severe obesity. Yet, pediatric post-bariatric surgery (PBS) exercise recommendations are elusive. **PURPOSE:** To perform a systematic review assembling professional pediatric PBS exercise recommendations. **METHODS:** To gather PBS exercise recommendations, databases were searched from inception to 2/22/19 with terms related to exercise, pediatric obesity, bariatric surgery, and weight status. This search located no records so another PubMed search was performed to identify randomized controlled trials (RCTs), published in peer-reviewed English language journals, examining the effects of exercise on body mass index (BMI) and percent body fat (%BF) among participants 2-19yr with obesity from inception to 3/20/19. The standardized mean difference effect sizes ( $d_e$ ) were calculated following random-effects models for BMI and %BF and then back-converted to the original unit for clinical interpretation. We assessed inconsistencies in  $d_e$  with the  $I^2$  statistic transformed from the  $Q$  statistic. **RESULTS:** The second search identified 556 reports with 9 qualifying RCTs. Of these, 7 were combined resistance and aerobic and 4 aerobic interventions only. All participants ( $n=342$ , 53.8% girls, 13±2yr) had obesity. The moderate-to-vigorous intensity exercise interventions lasted 13.5±4.0 wk, 3.5±0.8 d/wk for 56.8±6.4 min/session. Exercise interventions ( $k=11$ ) elicited moderate BMI reductions ( $d_e=-0.40$ , 95%CI: -0.73, -0.06;  $-1.03\text{kg}\cdot\text{m}^{-2}$ ) vs non-exercise control, with moderate-to-high heterogeneity ( $I^2=61.3\%$ , 95%CI: 25.3, 80.0). Exercise interventions ( $k=7$ ) also elicited moderate %BF reductions ( $d_e=-0.61$ , 95%CI: -0.90, -0.31;  $-4.63\%$ ) vs non-exercise control, with low heterogeneity ( $I^2=20.5\%$ , 95%CI: 0.0, 64.0). **CONCLUSIONS:** We found limited but favorable evidence of the effects of moderate-to-vigorous exercise training on BMI and %BF among children and adolescents with obesity but were unable to locate any professional pediatric PBS exercise recommendations. Due to the increasing number of pediatric bariatric surgeries performed, there is an urgent need for professional guidance on exercise in this clinical population. Supported by the University of Connecticut Center on Excellence in Teaching and Learning

**2373 Board #292 May 28 3:00 PM - 4:30 PM**  
**The Role Of Exercise In Preventing Weight Regain In Adults Post-weight Loss Surgery**

Katherine M. Manuel<sup>1</sup>, William B. Pierce<sup>2</sup>, Yin Wu<sup>3</sup>, Jill Livingston<sup>4</sup>, Linda S. Pescatello, FACSM<sup>3</sup>. <sup>1</sup>Howard University, Washington, DC. <sup>2</sup>University of Tennessee at Chattanooga, Chattanooga, TN. <sup>3</sup>University of Connecticut, Storrs, CT. <sup>4</sup>Wesleyan University of Connecticut, Middletown, CT. (Sponsor: Dr. Linda S. Pescatello, FACSM)  
 (No relevant relationships reported)

The steady increase in the prevalence of obesity is reflected in the rising rate of weight loss surgeries, and repeat surgery for weight regain that occurs 1-2 yr post-weight loss surgery (PWLS). **PURPOSE:** We performed a systematic review of randomized control trials (RCTs) to determine if exercise was associated with attenuation of weight regain in adults PWLS. **METHODS:** We searched 5 databases with terms related to exercise, weight, weight regain, and weight loss surgery, and found no systematic reviews of exercise interventions ≥1yr PWLS among adults ≥18 yr, nor did we locate professional exercise guidelines for this population. We then performed a search in PubMed for randomized controlled trials (RCTs) involving exercise interventions in adults ≥18 yr PWLS. Other inclusion criteria were RCTs in peer-reviewed journals published in English, that included the frequency, intensity, type and time of the exercise intervention, and a control group receiving usual care consisting of diet and exercise advice. The standardized mean difference effect sizes ( $d_e$ ) were calculated following random-effects models for body weight lost, and back-converted to the

original unit for clinical interpretation. We assessed inconsistencies in  $d_e$  with the  $I^2$  statistic transformed from the  $Q$  statistic. **RESULTS:** The second search yielded 442 reports, with only 3 RCTs qualifying. Participants ( $n=132$ ) were mostly white women 46.8±3.9yr, and 13.1±6.7mo PWLS. Interventions were supervised; lasted 40-60min/session, 2-5d/wk for 12-26wk; and involved moderate-to-vigorous intensity, combined aerobic and resistance training, while 1 added flexibility exercises. Compared to usual care, exercise interventions elicited moderate reductions in body weight ≥1yr PWLS ( $d_e=-0.46$ , 95%CI: -1.12, 0.21;  $-4.1\text{kg}$ ) that did not reach significance ( $p=0.069$ ) with high levels of heterogeneity ( $I^2=62.9\%$ , 95%CI: 0.0, 89.4). **CONCLUSIONS:** In a very limited literature, exercise interventions elicited clinically important reductions in weight of ~4kg representing ~4% of baseline weight ≥1yr PWLS. There is an urgent need for professional exercise guidelines and RCTs examining the effects of exercise on weight regain PWLS with larger, more diverse samples. Supported by the University of Connecticut Center on Excellence in Teaching and Learning

**2374 Board #293 May 28 3:00 PM - 4:30 PM**  
**Resistance Training, Regardless Of Protein Supplementation, Improves Muscular Phenotypes In Women Long-term After Bariatric Surgery**

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**PURPOSE:** This double-blind placebo-controlled study investigated the effects of resistance training (RT), with and without protein supplementation (PRO), on body composition, muscle strength and physical function in long term Roux-en-Y bypass (RYGB) female patients. **METHODS:** A total of 45 women (age 40.4 ± 8.5 yrs, BMI 29.0 ± 4.7 kg/m<sup>2</sup>) with 4.1 ± 1.4 yrs after RYGB surgery were divided into four groups: Control + Placebo (CON+PL;  $n = 11$ ), Control + PRO (CON+PRO;  $n = 10$ ), RT+PL ( $n = 12$ ), and RT+PRO ( $n = 12$ ). Patients were evaluated before and after the 12-weeks study protocol for body composition (Tetrapolar Bioelectrical Impedance), knee extensors isokinetic strength and physical function (timed up and go [TUG], 30-seconds sit to stand, and 6-minutes walking). PRO and PL were administered in a double-blind fashion and respectively consisted of daily 0.5 g of whey protein powder per kg of ideal body weight and an isocaloric placebo powder, both throughout the study period. Training protocol comprised 3 sets of 8-12 reps for 8 exercises targeting all major muscle groups and with progressive loads. ANOVA was used to assess time by group interactions. **RESULTS:** No significant between-groups differences were observed for any variable at baseline (all  $P > .05$ ). Significant improvements were observed in the exercised groups, but not in the nonexercised groups, for skeletal muscle mass (RT+PL 0.6 ± 0.3,  $P = .02$ ; RT+PRO 0.8 ± 0.2,  $P < .01$ ; CON+PL -0.1 ± 0.3,  $P = .68$ ; and CON+PRO 0.3 ± 0.3 kgs,  $P = .31$ ), isokinetic peak torque (RT+PL 12.9 ± 3.1,  $P < .01$ ; RT+PRO 8.7 ± 2.6,  $P < .01$ ; CON+PL -4.4 ± 2.9,  $P = .15$ ; and CON+PRO -3.1 ± 2.9 Nm,  $P = .30$ ), TUG (RT+PL -1.1 ± 0.2,  $P < .01$ ; RT+PRO -0.7 ± 0.2,  $P < .01$ ; CON+PL -0.2 ± 0.2,  $P = .38$ ; and CON+PRO -0.3 ± 0.2 seconds,  $P = .23$ ), six-minutes walking (RT+PL 48.4 ± 20.6,  $P = .02$ ; RT+PRO 37.4 ± 17.8,  $P = .04$ ; CON+PL -0.9 ± 21.9,  $P = .97$ ; and 4.4 ± 19.5 meters,  $P = .82$ ) and seat to stand test (RT+PL 3.2±0.7,  $P < .01$ ; RT+PRO 1.7±0.6,  $P < .01$ ; CON+PL 1.1±0.7,  $P = .13$ ; and CON+PRO 0.7 ± 0.6 repetitions,  $P = .25$ ). No differences for the improvements were observed between exercised groups (all  $P > .05$ ). Also, no significant alteration occurred for percent body fat in any group (all  $P > .05$ ). **CONCLUSIONS:** A 12-weeks RT program, regardless of PRO, improves muscle mass, knee extensors isokinetic strength and physical function in long term RYGB female patients.

THURSDAY, MAY 28, 2020

- 2375** Board #294 May 28 3:00 PM - 4:30 PM  
**A 5-month High-intensity Interval Neuromuscular Training Program Improves Cardiometabolic Health In Obese Women.**  
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Obesity epidemic is a complex and multifactorial chronic condition affecting one in three adults globally while it is associated with high metabolic risk factors enhancing chronic illness. On the other hand, high-intensity interval training (HIIT), group training, body weight training, and functional fitness training have been recently reported as some of the top worldwide trends in the health and fitness industry. **PURPOSE:** This randomized controlled trial investigated the effects of a 5-month high-intensity interval-type neuromuscular training program (DoIT) with adjunct portable modalities on cardiometabolic health in previously inactive obese women. **METHODS:** Forty-nine premenopausal Caucasian obese female volunteers (n = 49; 36.4 ± 4.4 years; 29.1 ± 2.9 kg/m<sup>2</sup>; 46.8 ± 5.0% body fat; 0.87 waist-to-hip ratio) were randomly assigned to control group (C, n = 21) or to training group (TR, n = 28). The exercise protocol was a supervised, low-volume, progressive, and time-efficient (<30 min) training program incorporating HIIT and functional fitness into a real-world gym setting. Neuromotor exercises (10-12 integrated movements) with alternate portable modalities at prescribed work-to-rest intervals (20-40 sec) in a circuit fashion (2-3 rounds) were implemented on nonconsecutive days for 5 months. Blood samples were drawn to determine cardiometabolic risk factors at pre- and post-training. **RESULTS:** After 20 weeks, TR demonstrated changes in waist circumference (-6.6%, p < 0.05; TR vs. C: -6.3%, p < 0.05), total cholesterol/high-density lipoprotein ratio (-14.1%, p < 0.05; TR vs. C: -17%, p < 0.05), mean arterial blood pressure (-4.1%, p < 0.05; TR vs. C: -4.6%, p < 0.05), and metabolic syndrome severity z score (-327%, p < 0.05; TR vs. C: -283%, p < 0.05). No change in homeostasis model assessment of insulin resistance (HOMA-IR) was observed from pre- to post-intervention in both groups, whereas HOMA-IR did not differ between groups at any time-point. **CONCLUSIONS:** These findings suggest that high-intensity interval neuromuscular training may improve cardiometabolic health in previously inactive obese women following a 20-week intervention. This study provides critical evidence for implementation of this nontraditional hybrid-type exercise regimen from adults with obesity into a real-world gym setting.

- 2376** Board #295 May 28 3:00 PM - 4:30 PM  
**Exercise Suppresses The Ubiquitin-proteasome System In The Skeletal Muscle Of Obese Women Following Bariatric Surgery**  
 Saulo Gil<sup>1</sup>, Bruno Gualano<sup>1</sup>, Wagner S. Dantas<sup>1</sup>, Igor H. Murai<sup>1</sup>, Sujoy Ghosh<sup>2</sup>, Samuel K. Shinjo<sup>1</sup>, Carlos Merege-Filho<sup>1</sup>, Walcy R. Teodoro<sup>1</sup>, Rosa Maria Pereira<sup>1</sup>, Fabiana B. Benatti<sup>1</sup>, Ana L. de Sá-Pinto<sup>1</sup>, Fernanda Lima<sup>1</sup>, Roberto de Cleval<sup>1</sup>, Marco A. Santo<sup>1</sup>, John P. Kirwan<sup>2</sup>, Hamilton Roschel<sup>1</sup>. <sup>1</sup>University of São Paulo, São Paulo, Brazil. <sup>2</sup>Pennington Biomedical Research Center, Baton Rouge, LA. (Sponsor: Craig Sale, FACSM)  
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 (No relevant relationships reported)

Muscle wasting observed in obese women undergoing bariatric surgery is likely related to altered abnormal intramyocellular signaling. Exercise may reestablish the anabolic capacity in this condition. **PURPOSE:** We examined the effects of exercise training on the main pathways related to skeletal muscle plasticity in obese women undergoing bariatric surgery. **METHODS:** Women with severe obesity were randomly allocated to either bariatric surgery (RYGB) or bariatric surgery followed by exercise (RYGB+ET). A 6-month, three-times-a-week, supervised, combined aerobic and resistance training program started 3 months after surgery for RYGB+ET, while RYGB followed standard of care. We assessed the transcriptome (RNA-seq) from skeletal muscle samples obtained by muscle biopsies (n = 6 per group) at baseline (PRE) and 9 months after surgery (POST9). We tested whether a set of genes defined *a priori* were differentially expressed utilizing the Gene Set Enrichment Analysis. Significance was assumed at a fold change > 1.5, P-value < 0.05, and FDR (false discovery rate) < 0.1. To validate the RNA-seq findings, we performed real time-polymerase chain reaction assays (n = 15 per group) for targeted genes. **RESULTS:** Pathway-level analysis showed that exercise significantly suppressed ubiquitin mediated proteolysis pathway (normalized enrichment scores [NES]: 1.7, P=0.01, FDR=0.09). *Atrogin-1* gene expression was suppressed in the exercised group at POST9 in comparison to PRE, and POST3,

and also when compared with the non-exercised group at POST9 (estimated mean difference [RYGB vs. RYGB+ET at POST9]: -1.97, CI95%=-3.0 to -0.8, P=0.01). *MuRF-1* gene expression decreased after surgery and kept reduced after the intervention for both groups (main time effect: P<0.01 for both). **CONCLUSIONS:** Our data suggest that a 6-month, exercise training program suppresses the ubiquitin-proteasome system via the downregulation of *Atrogin-1* in obese woman undergoing bariatric surgery. This may elucidate a molecular mechanism that partially explains muscle wasting following bariatric surgery and the exercise-induced hypertrophic effect in this condition. Clinicaltrials.gov: NCT02441361

- 2377** Board #296 May 28 3:00 PM - 4:30 PM  
**Estimation Of Visceral Adipose Tissue: A Device Comparison**  
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 (No relevant relationships reported)

Many body composition devices now provide an estimate of visceral adipose tissue (VAT), a significant risk factor for cardiometabolic disease. **PURPOSE:** To evaluate the relationship between estimates of VAT from bioelectrical impedance (BIA), ultrasound (US), and dual-energy x-ray absorptiometry (DXA). **METHODS:** VAT was estimated in 124 adults (66% Female; Mean ± SD: Age: 25.4±8.9 yrs; BMI: 25.4±5.5 kg·m<sup>-2</sup>; %BF: 29.7±10.5%). VAT area (cm<sup>2</sup>) was estimated from a BIA system specific algorithm. VAT thickness (cm) was estimated using US, quantified as the distance between the linea alba and aorta. VAT volume (cm<sup>3</sup>) was estimated from the DXA predefined android region. Linear regression was used to evaluate the relationship between estimates and to identify factors that may contribute to estimate differences in the entire group and by sex. **RESULTS:** In the full group, VAT estimates from all three methods were significantly correlated [BIA-DXA (R=0.768; R<sup>2</sup>=0.589); BIA-US (R=0.545; R<sup>2</sup>=0.297); DXA-US (R=0.785; R<sup>2</sup>=0.616) (p<0.001)]. In men, stronger relationships were observed with DXA [BIA-DXA (R=0.852; R<sup>2</sup>=0.727); BIA-US (R=0.774; R<sup>2</sup>=0.600); DXA-US (R=0.878; R<sup>2</sup>=0.772) (p<0.001)]; in women, weaker relationships were observed with US [BIA-DXA (R=0.890; R<sup>2</sup>=0.793); BIA-US (R=0.567; R<sup>2</sup>=0.321); DXA-US (R=0.690; R<sup>2</sup>=0.477) (p<0.001)]. In men, total body water (TBW) explained 31.9% and 12.0% of the variance in the difference between BIA-DXA and BIA-US, respectively; %BF explained 13.1% of the variance in the difference between DXA-US (all p<0.05). In women, %BF explained 28.9%, 34.0%, and 15.6% of the variance in the difference between BIA-DXA, BIA-US, and DXA-US, respectively (all p<0.001). **CONCLUSIONS:** BIA and US are cost-effective alternatives to DXA. BIA may provide a more comparable estimate to DXA, while greater variability may occur when comparing with US, especially in women. Differences between estimates may be influenced by TBW and %BF.

- 2378** Board #297 May 28 3:00 PM - 4:30 PM  
**Inter-individual Variation In Cardiometabolic Outcomes Following 6-months Of Endurance Training In Overweight And Obese Youth.**  
 Travis Hrubeniuk<sup>1</sup>, Jacqueline Hay<sup>2</sup>, Andrea MacIntosh<sup>3</sup>, Brandy Wicklow<sup>3</sup>, Kristy Wittmeier<sup>3</sup>, Jonathan M. McGavock<sup>3</sup>, Martin Sénéchal<sup>1</sup>. <sup>1</sup>University of New Brunswick, Fredericton, NB, Canada. <sup>2</sup>University of Manitoba, Winnipeg, MB, Canada. <sup>3</sup>Children Hospital Research Institute of Manitoba, Winnipeg, MB, Canada.  
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Inter-individual variation in response to exercise training (ET) is broad and can lead to individuals, termed 'non-responders', who do not experience the anticipated improvements. The inter-individual variation in cardiometabolic response to ET among overweight and obese youth and prevalence of non-responders is poorly understood. **Purpose:** To investigate inter-individual variation following 6-months of high-intensity or moderate-intensity ET, and estimate the proportion of overweight and obese youth expected to respond. **Methods:** One hundred and six overweight and obese youth were randomized to high-intensity ET (70–85% of heart rate reserve), moderate-intensity ET (40–55% heart rate reserve), or a control group for 6 months. Cardiometabolic response to ET was assessed by insulin sensitivity (IVGTT), hepatic triglyceride content (<sup>1</sup>H-MRS), visceral adipose tissue (MRI), and cardiorespiratory fitness. Participants with ≥70% adherence were included in this secondary analysis. Inter-individual variation within each study arm was determined using the standard deviation of individual responses (SD<sub>IR</sub>), calculated as: SD<sub>IR</sub> = √(SD<sub>Intervention</sub><sup>2</sup> - SD<sub>Control</sub><sup>2</sup>). The proportion of responders (defined as a change surpassing the smallest worthwhile difference) to each program was estimated using the variance (SD<sub>IR</sub>) around the mean treatment effect. **Results:** Inter-individual variation resulting from high-intensity ET was observed in visceral adipose tissue (SD<sub>IR</sub> = 5.92) and cardiorespiratory fitness (SD<sub>IR</sub> = 1.33), with

51.2% and 79.1% of overweight and obese youth estimated to respond. Inter-individual variation resulting from moderate-intensity ET was observed in hepatic triglyceride content ( $SD_{tr} = 9.64$ ) and cardiorespiratory fitness ( $SD_{tr} = 2.15$ ), with 34.3% and 71.8% of overweight and obese youth estimated to respond. Inter-individual variability was not detected among changes in insulin sensitivity following either program. **Conclusion:** These data support the concept of inter-individual variation in cardiometabolic health outcomes following high- and moderate-intensity ET in overweight and obese youth. High-intensity ET was estimated to produce a higher proportion of cardiorespiratory fitness responders compared to moderate-intensity ET.

**2379** Board #298 May 28 3:00 PM - 4:30 PM

**Effects Of High-Intensity Interval Training On Cardiometabolic Risk Factors And Motivation To Exercise In Women With Abdominal Obesity**

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(No relevant relationships reported)

There has been recent interest in high-intensity interval training (HIIT) as an alternative to moderate-intensity continuous training (MICT) to reduce body composition, adiposity and cardiometabolic risk factors in obese patients. Despite the promising evidence supporting HIIT in this population, there is limited research targeting women with abdominal obesity. **PURPOSE:** The objective of this study was to compare the effects of MICT and energy-matched HIIT on cardiometabolic risk factors in women characterized by abdominal obesity. **METHODS:** Twenty abdominally obese women (age range, 28-56 years) were submitted to 12 weeks of intervention and were randomly allocated into 2 groups: MICT (n=10) and HIIT (n=10). The MICT group performed a 38 to 62-minute continuous exercise at 70 % of the maximal heart rate. The HIIT group training performed 3 to 6 sets of 4-minute bouts at a running velocity corresponding to 90 % maximal heart rate, interspersed by a 4-min active recovery period at 50 % maximal heart rate. Anthropometric parameters, maximal oxygen uptake ( $VO_{2max}$ ) and cardiometabolic risk variables were measured at the beginning and after 12 weeks. Self-determined motivation toward physical activity was also evaluated with a validated questionnaire. **RESULTS:** MICT intervention led to significant improvements in  $VO_{2max}$  (29.9 to 32.7 ml  $O_2 \cdot kg^{-1} \cdot min^{-1}$ ,  $p=0.005$ ), with no change in HIIT group. However, at the beginning of the study,  $VO_{2max}$  was significantly lower in the MICT group when compared to the HIIT group ( $p=0.04$ ). During the intervention, no significant difference was found in cardiometabolic risk factors in the MICT group. However, HIIT resulted in statistically significant reduction in triglycerides levels (1.91 to 1.58 mmol/l,  $p=0.046$ ) even though waist circumference was significantly increased (98.0 to 100.7 cm,  $p=0.038$ ) after the 12-week intervention program. In addition, the HIIT group increased self-determined motivation toward physical activity in a greater magnitude when compared with the MICT group ( $p=0.016$ ). **CONCLUSION:** HIIT appears to provide greater benefits to MICT for improving triglyceride levels. In addition, as HIIT is associated with a greater improvement in self-determined motivation toward physical activity, HIIT could be associated with promising long-term adherence to exercise.

**D-73 Free Communication/Poster - Sports Medicine Fellow Research Abstracts**

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
Room: CC-Exhibit Hall

**2380** Board #299 May. 28 3:00 PM - 4:30 PM

**Intensive Behavioral Therapy For Obesity Utilizing Cardiopulmonary Exercise Testing: The Bridge Project Pilot Study.**

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(No relevant relationships reported)

**PURPOSE:** To gather preliminary pilot data on dietary and exercise prescription utilizing Cardiopulmonary Exercise Testing (CPET) incorporated into Medicare and Medicaid Services-based Intensive Behavioral Therapy for Obesity (IBT-O) in a primary care setting. **METHODS:** A prospective cohort of 30 subjects completed a World Health Organization Quality of Life (WHOQOL) questionnaire, and performed a cardiopulmonary exercise test (CPET) on a treadmill using a modified Balke protocol at baseline as well as following 6 and 12 months of exercise conditioning. With a cardiovascular exercise prescription developed from CPET data delivered to the subjects' Smartphone through an interactive app. Subjects were also provided with a resistance training prescription and YMCA membership. Consistent with CMS criteria,

subjects participated in weekly physician directed IBT-O appointments throughout the first month, and then bi weekly for the next 5 months. If subjects lost 6.6 lbs (3 kg) in the initial 26 weeks (6 months) they qualified to continued physician once a month for an additional 6 months. **RESULTS:** With the 30 subjects initially enrolled, there were 9 enrollment failures. There was an overall follow up rate of 76% of the 21 successfully enrolled, with 19 completing all 6 months. At the 6 months, 14 subjects lost 6.6lbs required by CMS to continue for an additional 6 months, and 11 completing all of the 12 months. Data reported in table using mean  $\pm$  standard deviations for all continuous variables. All analyses were two-tailed and were performed at a significance level of 0.05.

**CONCLUSIONS:** In addition to improvements in QOL and clinically meaningful weight loss >5% at 12 months, there was also an increase CRF. Improvements in CRF has been reported in the literature with annual cost savings per MET/year of \$5,193 and \$3,603 for individuals with and without diabetes, respectively. Also, increases of 1-2 METs are associated with 10%-30% lower adverse cardiovascular event rates.

	N	Mean	Q1	Median	Q3	P value
Weight Loss (lbs)	11	24.73	17	21	34	<0.000*
% weight Loss	11	10.9%	8.0%	10.6%	11.6%	0.0003*
BMI decrease	11	4.02	3.02	3.92	5.33	<0.0001*
$VO_{2peak}$	11	4.19	1.4	4.0	5.6	0.0013*
MET peak	11	1.21	0.4	1.2	1.6	0.0015*
WHOQOL QOL Score	11	0.73	0	0	2	0.0236*
WHOQOL Health Satisfaction Score	11	1.73	1	2	3	0.0032*
WHOQOL Physical Health Score	11	15.28	0	6	31	0.0105*
WHOQOL Psychological Score	11	16.09	6	00	32	0.0076*
WHOQOL Social Relationships Score	11	7.09	0	6	12	0.0796
WHOQOL Environment Score	11	13.55	0	12	19	0.044*

**2381** Board #300 May. 28 3:00 PM - 4:30 PM

**Do Different Wet Bulb Globe Temperature Reading Cutoffs Change Outdoor Heat Injury Frequency And Severity?**

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(Sponsor: Dr. Franklin Sease, FACSM)  
(No relevant relationships reported)

**PURPOSE:** To evaluate differences in injury frequency and severity between two different heat participation policies in South Carolina high school and collegiate athletics.

**METHODS:** Retrospective cohort study of Division II collegiate & high school athletes looking at injury frequency & severity between 2 different heat participation policies. Fifty middle & high schools as well as 2 Division II colleges with a total of 16,832 athletes were investigated over 3 years. Inclusion criteria were reported heat illnesses between July 1 & November 30<sup>th</sup> for 12 outdoor sports resulting in 86 injuries that were analyzed. Chi square analysis was used to compare injury frequency & severity between no outdoor workouts with a wet bulb globe temperature (WBGT) > 90 (policy 1) versus WBGT > 92 (policy 2).

**RESULTS:** For policy 1 there was a mean of 31 heat illnesses/year with an average of 16 days for illness resolution. For policy 2 there was a mean of 24 heat illnesses/year but the average of 41 days for illness resolution was significantly higher ( $p=0.02$ ). Grading heat illness severity was based on guidelines developed by Rauh et. al. Mild to moderate injury was defined as 0-21 days for return to activity while severe injury >21 days for return to activity. With policy 1, 4.8% of heat illnesses met severe criteria while 20.8% of heat illnesses in policy 2 were severe showing an odds ratio of heat illness with policy 2 is 5.2 times higher than policy 1 (OR 5.2, 95% CI 1.1-23.7). Conversely the percentage of mild to moderate illness was statistically lower with policy 2 compared to policy 1 ( $p=0.022$ ) suggesting that policy 2 resulted in more severe heat illness. Policy 1 was in place for several years with no record of EMS transport for heat illnesses however within the first season of policy 2, there was 3 athletes transported. The average age at time of injury was 16 years old & not statistically different between policies. There was an average of 45 minutes of practice per week lost with the WBGT cutoff of 90 compared to cutoff of 92.

**CONCLUSIONS:** Although the total number of heat illnesses did not change between policies, there was a statistically significant increase in severity of illness & time for return to sport with raising the WBGT participation cutoff from 90 to 92. Our data suggests that a cutoff of 90 reduces the frequency of severe heat illness in athletes.

**2382** Board #301 May. 28 3:00 PM - 4:30 PM  
**Differences In Baseline Concussion Symptom Reporting Across Age And Gender**  
 Joshua Pacious, Franklin Sease, FACSM, Vicki Nelson. *Prisma Health- Center for Family Medicine, GREENVILLE, SC.*  
*(No relevant relationships reported)*

**Purpose:**

Previous studies have identified significant differences across age and gender in post-concussion symptoms reporting, with female and high school aged athletes reporting both a higher number of symptoms and a greater symptom severity. This study evaluates differences in baseline symptom reporting across age group and gender.

**Methods and Study Design:**

Between 2007-2019, concussive symptoms were reported by middle school (MS), high school (HS) and collegiate athletes (CA) utilizing the post-concussion symptom scale at baseline. Excluded athletes included those with invalid testing, age > 24y or < 10y, learning disabilities, ADHD, autism, or a prior history of concussion. ANOVA was performed assessing the total number of symptoms and the total symptom severity score as reported by age group, and gender. Results: (1000)25,694 athletes (60% male and 40% female) were included: 4.6% MS (n=1,179), 89.7% HS (n=23,047) and 5.7% CA (n=1,468). Among the different age groups, there were no significant differences in number of symptoms (p=0.21) or symptom severity score (p=0.48). However, there were significant differences noted between male and female athletes. Males reported fewer symptoms than females (1.75 ± 3.0 vs 2.50 ± 3.6, p<1x10<sup>-70</sup>). Males also reported a lower baseline symptom severity (3.34 ± 6.7 vs 4.96 ± 8.7, p<1x10<sup>-62</sup>). This difference between genders held true across age levels with significant differences in the number of baseline symptoms reported (MS p<0.001, HS p<1x10<sup>-60</sup>, CA p<0.001) and symptom severity score (MS p<0.001, HS p<1x10<sup>-51</sup>, CA p<0.01).

**Conclusion:** This study identifies symptom differences between genders at baseline. These baseline differences may contribute to the post-concussive discrepancies seen previously. In contrast, baseline differences are not present between age groups possibly suggesting a pathophysiologic underpinning to the post-concussive discrepancies of higher total symptoms and higher severity noted in high school athletes.

**Significance of Findings:** Significant differences in concussive symptom reporting by age level, despite comparable baselines shown here, may reflect pathophysiologic, rather than reporting discrepancies, necessitating specific evaluation and management strategies across age levels.

**2383** Board #302 May. 28 3:00 PM - 4:30 PM  
**Assessing Knowledge And Confidence In Musculoskeletal Medicine Among Primary Care Specialties**  
 Jessica Mofidi, Cindy Ong, Michael Fong, Marissa Vasquez. *Kaiser Permanente Los Angeles Medical Center, Los Angeles, CA.* (Sponsor: Aaron Rubin MD, FACSM)  
*(No relevant relationships reported)*

Prior studies suggest primary care clinicians lack knowledge and confidence in how to diagnose and treat musculoskeletal (MSK) disorders. One showed 64% of academic primary care attendings scored <70% on an MSK knowledge exam, while another noted that primary care residents scored an average of 56% on an MSK competency exam. Few studies examine differences among Family Medicine, Internal Medicine, and Pediatrics in knowledge and confidence in diagnosing and treating MSK conditions. **Purpose:** To determine if a significant difference exists between primary care specialties for both residents and non-fellowship trained attendings in knowledge and confidence in diagnosing MSK conditions. To assess whether a focused lecture series can increase resident knowledge and confidence in diagnosing MSK disorders. **Methods:** An anonymous shoulder, hip, knee, and ankle survey was emailed to Pediatric, Internal Medicine, and Family Medicine residents and attendings at a local teaching hospital. Sports Medicine Fellows lectured Internal Medicine and Pediatrics residents, focusing on exam and common conditions for each joint. Family Medicine was excluded from the lectures, as MSK education is a part of their ACGME requirement. Pre and post lecture surveys with 5 knowledge questions and two 5-point Likert scale confidence measures were administered to Pediatric and Internal Medicine residents. Two-tailed t-tests were used with a p value set at <0.05. **Results:** Pediatric residents showed a significant increase in shoulder knowledge scores (60% vs 72.8%, p=0.04), shoulder confidence scores (2.2 vs. 3.11; 2.13 vs. 2.94; p<0.001), and confidence in doing an appropriate knee exam post lecture (2.6 vs. 3.4, p=0.03). There was no significant difference between Family Medicine, Internal Medicine, or Pediatrics regarding general MSK knowledge and confidence. There was no significant difference for Internal Medicine between pre and post lecture scores for all joints. There was no significant difference for pre and post lecture scores on the hip and ankle for Pediatrics. **Conclusion:** Dedicated lectures related to the MSK exam and common MSK conditions can increase the knowledge and confidence among primary care residents, but further studies with a greater number of subjects are needed.

**2384** Board #303 May. 28 3:00 PM - 4:30 PM  
**Documentation Of Obesity On The Problem List And Referral Rates Among Obese Children And Adults**  
 Heidi Walls, Christina Holt, Amy Haskins, William Dexter, FACSM. *Maine Medical Center, Portland, ME.*  
*(No relevant relationships reported)*

Obesity is a serious public health concern that is overwhelming primary care providers. Studies have shown that simply documenting obesity on the problem list promotes action about obesity. **PURPOSE:** To determine the rate of obesity documentation on the problem list and referrals to obesity medicine specialists and dietitians among obese adult and pediatric patients at 14 primary care offices in a regional health network in Southern Maine. **METHODS:** All patients with BMI > 30 (adults) or BMI > 95<sup>th</sup> percentile for age (pediatrics) between 5 - 100 years old, who were seen at one of 14 primary care clinics in Maine between July 1, 2017 and June 30, 2019 were included for retrospective review. Variables requested included age, BMI, inclusion of obesity on the problem list, various comorbidities, and any referrals to dietitian or obesity medicine specialists. The percentage rate of inclusion of obesity on the problem list and rate of referrals were calculated for both pediatric and adult patients.

**RESULTS:** We obtained records for 20,461 patients, 2,780 under 18 and 17,681 over 18. Obese children had obesity on the problem list in 31.2% of cases, and received any referral 12.5%. Obese adults had obesity on the problem list 54.2% of the time, and a referral in 8.4% of cases. For both children and adults, more referrals were made for patients with obesity on the problem list compared to those without this problem listed (in children: 20.2% vs 9.0%; for adults: 12.12% vs 3.9%, p values < 0.0001). Similarly, a statistically significant higher proportion of referrals were made for those with higher BMI (in children: 26.6% vs 8.6% for those with a BMI ≥ 99 percentile; adults: 19.88% vs 5.75% for those with a BMI ≥ 40, p values < 0.0001), and for those with a greater number of comorbidities on the problem list (referrals in 20.2% vs 10.7% for children with ≥ 1 comorbidity vs 1 or fewer, and in 22.68% vs 5.13% of adults with ≥ 3 comorbidities compared to 0 comorbidities, p values < 0.0001).

**CONCLUSIONS:** The inclusion rate of obesity on the problem list for obese children and adults was found to be low overall, but inclusion was associated with higher proportion of referrals to obesity medicine specialists and dietitians. There was also more likely to be a referral among patients with higher BMI and multiple comorbidities.

**2385** Board #304 May. 28 3:00 PM - 4:30 PM  
**Improving The Diagnosis Of Menstrual Dysfunction Through Quality Improvement**  
 Kayla E. Daniel, Amy Valasek. *Nationwide Children's Hospital, Columbus, OH.* (Sponsor: Anastasia Fischer, FACSM)  
 Email: Kayla.Daniel@nationwidechildrens.org  
*(No relevant relationships reported)*

**PURPOSE:** Prevalence of menstrual dysfunction in female high school athletes ranges from 19-54%. Menstrual dysfunction can be screened and treated. Consequences of menstrual dysfunction include decreased bone mass, increased risk of stress fractures, increased rate of musculoskeletal injuries with prolonged recovery time, endothelial dysfunction, and effects on future fertility. Early recognition and intervention are crucial to prevent long term consequences. The purpose of this Quality Improvement (QI) project is to optimize the institution's Epic Best Practice Advisory (BPA) screening tool and synthesize new patient questionnaire responses to diagnose menstrual dysfunction in female athletes greater than 12 years of age presenting to a pediatric sports medicine clinic.

**METHODS:** Using QI methodology, we evaluated the clinic work flow, Epic BPA tool, and actions by the physician following appropriate firing of the menstrual dysfunction BPA. Menstrual dysfunction was defined in our BPA as criteria for Amenorrhea, Oligomenorrhea, or Irregular Menstruation Unspecified which was further specified as menstrual cycles effected by training in sport. Staff education, patient education, and BPA provider alert fatigue were identified as appropriate areas for intervention. Staff were educated to ensure appropriate intake and implementation of survey data, a menstrual dysfunction handout was created and provided to newly diagnosed patients, and the BPA alert was changed to promote identification and diagnosis of menstrual dysfunction. We implemented interventions using progressive monthly Plan-Do-Study-Act (PDSA) cycles to encourage change and optimize our screening process.

**RESULTS:** The rate of appropriate diagnosis of menstrual dysfunction in female athletes greater than 12 years of age seen at a pediatric sports medicine clinic increased from a baseline of 1.5% to 27% over a 3-month period.

**CONCLUSIONS:** Through QI methodology we are optimizing our menstrual dysfunction screening tool and subsequently increasing the rate of appropriate diagnosis of menstrual dysfunction among our female athletes. Identifying the appropriate diagnosis improves patient education and provides the framework for applicable interventions, further work-up, and follow-up.

**2386** Board #305 May. 28 3:00 PM - 4:30 PM  
**Injury Trends In Special Olympics Athletes From The 2018 USA Games**

Bram Newman<sup>1</sup>, Jessie Fudge, FACSM<sup>2</sup>, Amy Haskins<sup>1</sup>, Christina Holt<sup>1</sup>, William Dexter, FACSM<sup>1</sup>. <sup>1</sup>Maine Medical Center, Portland, ME. <sup>2</sup>Everett Medical Center, Everett, WA. (No relevant relationships reported)

**Purpose:** We analyzed injury data from the Seattle Special Olympics USA Games 2018. Our findings and analysis may inform ways by which medical coverage at future similar events can be reinforced, prepared, and improved.

**Methods:** Deidentified injury data, collected by the RaceSafe app, was categorized by injury type: Musculoskeletal (MSK), Non-musculoskeletal (Non-MSK) and Minor Injury (including ice, bandaging, and massage). Individual event data was analyzed by percent of athletes injured and by injuries per 1000 athlete exposures. For each team sport, injury data was analyzed by injuries per game.

**Results:** The individual events with the highest percent of athletes injured were gymnastics (38.5%, 95% CI 22.4-62.0), tennis (31.5, 95% CI 21.5-44.7) and stand-up paddleboard (28.6%, 95% CI 11.6-59.4). The individual event with the lowest percent of athletes injured was golf (12.9%, 7.9-19.9). Among the gymnastics and tennis injuries, 53.3% and 58.6% were MSK, respectively. For stand-up paddleboard there were no MSK injuries with the majority being non-MSK (66.7%). Per 1000 athlete exposures, gymnastics had the highest rate of MSK injuries at 25.6 (95% CI 11.9-48.7), while stand-up paddleboard had the highest rate of both non-MSK injuries at 95.2 (95% CI 30.3-23.0) and minor injuries at 47.6 (95% CI 8.0-157.3). The team sports with the highest rate of injuries per game were softball at 1.9 (95% CI 1.6-2.4), followed by soccer at 1.7 (95% CI 1.4-2.0), and flag football at 1.6 (95% CI 1.3-1.9).

**Conclusion:** The Special Olympics 2018 USA Games required a well-staffed and organized medical team to meet the injury needs of its athletes. Based on our analysis, future events should provide a team with many medical personnel divided amongst the competition venues. A unique feature of the Special Olympics is the high rates of non-MSK injuries requiring medical attention, and appropriate measures should be taken to address these conditions.

**2387** Board #306 May. 28 3:00 PM - 4:30 PM  
**The Use Of Micro-doppler Radar For Motion Analysis In NCAA Athletes**

Joseph Andrie<sup>1</sup>, Cayce Onks<sup>1</sup>, Donald Hall<sup>2</sup>, Tyler Ridder<sup>2</sup>, Zacharie Idriss<sup>2</sup>, Ram Narayanan<sup>2</sup>. <sup>1</sup>Penn State Health, Hershey, PA. <sup>2</sup>Penn State University, University Park, PA. (No relevant relationships reported)

**Purpose:** The current musculoskeletal portion of the pre-participation physical exam lacks evidence for the detection of biomechanical subtleties that predispose an athlete to injury. Previous pilot data has shown that micro-Doppler radar has the potential to provide objective data on limb and torso variations at a granular level using a handheld, portable and cost effective device. The purpose of this study was to determine if micro-Doppler radar signals can predictably and accurately detect subtle differences in human movement patterns.

**Methods:** This is a cross sectional study using micro-Doppler radar technology to detect known differences in biomechanics among Division III athletes. Each participant performed 3 sets of 3 squat jumps in front of the micro-Doppler radar antenna. Each set of squat jumps was performed barefoot, with shoes and with a 2cm heel lift at both 0 degrees and turned 90 degrees to the antenna. The micro-Doppler responses were processed using short-time Fourier transform, principal component analysis and linear discriminant analysis to highlight differences among the data sets and to minimize background noise from the radar. Further computer learning classification using support vector machine, k-nearest neighbor and discriminant analysis classifier were used to determine the micro-Doppler radar accuracy for predicting movement patterns.

**Results:** Thirty seven NCAA Division 3 Football athletes aged 18-22 were recruited and consented to perform the protocol. All micro-Doppler radar responses were recorded and processed successfully. The overall accuracy of the computer-derived models to predict which participants were wearing shoes, a heel lift or barefoot was 83%-100% for all groups regardless of whether the athlete was facing or turned to the right of the radar. **Conclusions:** This study was able to demonstrate that micro-Doppler radar technology has excellent predictability and can accurately detect subtle differences in movement. Future studies will aim to further validate data sets using comparison studies to biomechanical video analysis techniques. Ultimately the goal will be to use the micro-Doppler radar to define movement patterns that may predispose athletes to injury allowing us to determine a high risk group to direct injury prevention resources.

**2388** Board #307 May. 28 2:00 PM - 3:30 PM  
**Comparison Of Ultrasonography To Mri In The Diagnosis Of Lower Extremity Bone Stress Injuries.**

Kevin Mullins<sup>1</sup>, Lauren Bosshardt<sup>1</sup>, Sara Raiser<sup>2</sup>, Richard Lawley<sup>3</sup>, Yaeko Fukushima<sup>1</sup>, Isaac Syrop<sup>4</sup>, Jeremiah Ray<sup>5</sup>, Andrea Finlay<sup>6</sup>. <sup>1</sup>Stanford University, Redwood City, CA. <sup>2</sup>Emory University, Johns Creek, GA. <sup>3</sup>Cornerstone Orthopaedics, Superior, CO. <sup>4</sup>Columbia University, Tarrytown, NY. <sup>5</sup>University of California, Davis, Davis, CA. <sup>6</sup>Stanford University, Stanford, CA. (Sponsor: Michael Frederickson, MD, FACSM) Email: kevinmullinsmd@gmail.com (No relevant relationships reported)

**BACKGROUND:** Bone-stress injuries (BSIs) are relatively common in college-level athletes and can result in substantial disability leading to prolonged leave from sport when diagnosed in more advanced stages. Early detection and intervention of BSIs in this population is critical given the demanding NCAA schedules and expectations for timely returns to full activity. Currently, the gold standard for detecting early-stage BSIs is magnetic resonance imaging (MRI), however with recent global advancements in ultrasound technology, there are new opportunities for early diagnosis of BSIs in the sports medicine clinic and training-room settings.

**Purpose:** To examine the sensitivity and specificity of ultrasound imaging (USI) in the diagnosis of BSIs, utilizing MRI as the gold standard.

**Study Design:** Cohort Study (diagnosis)

**Methods:** Thirty-nine elite primarily NCAA division 1 athletes (mean age, 21.64 years; standard deviation [SD], 7.24; range 18-62) underwent USI and MRI for clinical suspicion of a BSI in the lower extremity. 32 females and 7 males enrolled, with running as the most common sport (44%). An 8-point assessment system was utilized on USI for detecting BSI, and the Frederickson Criteria was used to classify MRI findings. Sensitivity, specificity, positive and negative predictive values (PPV and NPV) of USI compared to MRI were calculated.

**Results:** Using MRI, there were 31 (79%) athletes with a positive and 8 participants with a negative BSI diagnosis. The most common bone injuries were metatarsal (51%) and tibia (33%). Average days to onset was 31.87 (SD = 34.20). Compared to MRI, USI demonstrated 0.77 sensitivity (95% confidence interval [CI], 0.59-0.90) and 0.75 specificity (95% CI, 0.35-0.97) in detecting BSI, with a PPV of 0.92 (95% CI, 0.75-0.99) and NPV of 0.46 (95% CI, 0.19-0.75). Subcutaneous edema was the most sensitive (0.81, 95% CI=0.63-0.93) USI finding but the least specific (0.25, 95% CI=0.03-0.65), while calcified bone callus was the most specific (0.88, 95% CI=0.47-1.00) but least sensitive (0.26, 95% CI=0.12-0.45).

**Conclusion:** USI is a reliable screening tool for sports medicine providers to combine with their clinical evaluation in the diagnosis of bone stress injuries. Further research is ongoing to determine the role of USI in follow-up care and return-to-play protocols.

**2389** Board #308 May. 28 3:00 PM - 4:30 PM  
**Does Poor Recovery Predict Injury In The Division 1 Female Collegiate Lacrosse Athlete?**

Jeffrey Wisinski, Paul Herickhoff, Brandon Hall, Peter Seidenberg, FACSM. Penn State University, University Park, PA. (Sponsor: Peter Seidenberg, FACSM) Email: jwisinski@pennstatehealth.psu.edu (No relevant relationships reported)

**BACKGROUND:** Overtraining continues to be a serious issue across youth athletes at all levels. As an athlete transitions to the collegiate level, their training volume typically increases significantly. With more female athletes participating in Collegiate Lacrosse, there needs to be an ongoing awareness of athletes at increased risk for overuse and acute injuries. Examining injury incidence patterns and attempting to objectively find risk factors for the development of these injuries can provide helpful feedback to coaches, athletic trainers, and team physicians when determining athlete participation recommendations.

**Purpose:** Retrospectively analyze data related to the recovery of 31 Division 1 Collegiate Female Lacrosse athletes obtained over an entire regular season, and then determine if athletes who suffered injuries had lower recovery scores in comparison to athletes who did not suffer injuries.

**Methods:** The data related to the recovery of the Collegiate Female Lacrosse athletes was obtained using a questionnaire developed through the Restwise division of Recovery Science and Technology. An overall Recovery score was calculated based on the athlete's heart rate, weight, pulse oximetry, and their responses to questions about quality and amount of sleep, energy level, presence of illness, and mood state. Athletes submitted their respective responses using the online Restwise application prior to each practice and game. Injury reports were then analyzed to determine specific dates of injuries. A logistic regression analysis was performed to determine if there was a statistically significant association between overall recovery scores as well as the specific components of overall recovery scores, and future injury.

**RESULTS:** 21 total injuries took place throughout the regular season. Overall recovery scores were not shown to be associated with future injury ( $p = 0.518$ ). Previous injury ( $p = 0.118$ ), illness ( $p = 0.48$ ), mood ( $p = 0.588$ ), amount of sleep ( $p = 0.648$ ), sleep quality ( $p = 0.686$ ), and energy state ( $p = 0.211$ ) were also not shown to have a statistically significant relationship with future injury.

**CONCLUSION:** Restwise Recovery Data was not shown to have a statistically significant association with future injury in the Division 1 Female Lacrosse Athlete.

**2390** Board #309 May. 28 3:00 PM - 4:30 PM

### The Effect Of Social Media Use On Sleep Quality Among College Athletes

Rhonda Watkins, Dai Sugimoto, Danielle Hunt, Jeesie Oldham, Andrea Stracciolini, FACSM. *Boston Children's Hospital, Boston, MA.*

(No relevant relationships reported)

**BACKGROUND:** Social media use among young adults has increased significantly in recent years. Existing literature suggests that increased social media use is linked to poor sleep quality, but this is unexplored in college athletes, who pose a unique risk for poor sleep given academic, social, and sport demands. **PURPOSE:** 1) To examine the effect of social media use on sleep quality among college athletes. 2) To compare the effect of social media use on sleep quality by sex. **METHODS:** Study participants included local NCAA Division III college athletes. Across sectional study design was employed. Data was collected using social media use and PROMIS sleep disturbance questionnaires. Main outcome measures were social media volume measured in hours of social media use per day over 7 days and collected using iPhone screentime function. Sleep quality was determined using the PROMIS T-score. Statistical analysis utilized Pearson's correlation (little:  $r < .25$ , weak:  $r = .25-.50$ , moderate:  $r = .50-.75$ , strong:  $r > .75$ ), t-test ( $p < .05$ ), and effect size (small: Cohen's  $d = .20$ , medium: Cohen's  $d = .50$ , large: Cohen's  $d > .80$ ). **RESULTS:** 87 athletes (age:  $19.5 \pm 1.2$  years, 40 males, 47 females) completed the survey. Mean social media use was  $4.6 \pm 3.4$  hours/day. Female athletes spent more time on social media compared to male athletes ( $5.0 \pm 3.2$  and  $4.1 \pm 3.5$  hours/day respectively,  $p = .018$ , Cohen's  $d = .27$ ). No correlation was found between increased social media time and reduced sleep quality ( $r = .20$ ,  $P = .068$ ). Similarly, analysis by sex revealed no correlation in sleep quality (females  $r = .22$ ,  $p = .131$ , males  $r = .18$ ,  $P = .276$ ). College athletes who spent more time on social media than the mean of 4.6 hrs/day demonstrated worse sleep quality ( $51.0 \pm 8.1$  vs.  $47.8 \pm 7.6$ ,  $p = .130$ , Cohen's  $d = .41$ ). When stratified by sex this finding held true for female athletes but not for male athletes ( $53.2 \pm 8.5$  vs.  $49.1 \pm 8.3$ ,  $P = .186$ , Cohen's  $d = .49$ , and  $46.3 \pm 6.6$  vs.  $47.6 \pm 6.5$ ,  $P = .505$ , Cohen's  $d = .20$ , respectively). **CONCLUSION:** Female college athletes use social media more than male college athletes. Social media use appears to have a negative impact on sleep quality among female college athletes, although more research is needed to explore this. These findings may have implications for developing social media use guidelines for college athletes to improve their sleep quality.

**2391** Board #310 May. 28 3:00 PM - 4:30 PM

### Psychotropic Medication Use And Concussion History Among Adolescent Athletes

Mary Daley<sup>1</sup>, Jessie Oldham<sup>1</sup>, Corey Lanois<sup>1</sup>, David R. Howell<sup>2</sup>, Rebekah Mannix<sup>1</sup>, Diane Sartanowicz<sup>1</sup>, William P. Meehan<sup>1</sup>.  
<sup>1</sup>Boston Children's Hospital, Boston, MA. <sup>2</sup>Children's Hospital Colorado, Aurora, CO.

(No relevant relationships reported)

An estimated 5-8% of children and adolescents in the United States take prescription psychotropic medications, including antidepressants, stimulants, anxiolytics, antipsychotics, and mood stabilizers. Psychotropics are occasionally used for patients with concussion to treat both cognitive and psychological symptoms, but little is known about the association between psychotropic medication use and concussion history. **PURPOSE:** To examine the relationship between psychotropic medication use with concussion history and concussion symptom burden among adolescent athletes tested at baseline.

**METHODS:** Data was collected prospectively by the Massachusetts Concussion Management Coalition that contains demographics, medications, and concussion symptom scores from junior high and high school athletes in Massachusetts. Independent samples t-tests were used to investigate differences in concussion history and in symptom scores between those who were and were not on psychotropic medications at the time of baseline testing.

**RESULTS:** Data was collected from a total of 18,833 adolescent athletes (mean age  $14.8 \pm 1.7$  yrs; 39.6% female). Individuals who were on psychotropics had significantly greater average number of prior lifetime concussions ( $0.63 \pm 0.99$  vs  $0.34 \pm 0.72$  concussions;  $p < 0.001$ , Cohen's  $d = 0.34$ ), and significantly higher symptom scores at baseline ( $8.67 \pm 11.63$  vs  $4.81 \pm 8.25$ ;  $p < 0.001$ , Cohen's  $d = 0.38$ ). Those with a history of depression or anxiety had a significant but smaller increase in number

of prior concussions compared with healthy controls ( $0.55 \pm 0.91$  vs  $0.34 \pm 0.72$  concussions;  $p < 0.001$ , Cohen's  $d = 0.26$ ), and a greater difference in symptom scores ( $12.4 \pm 14.05$  vs  $4.54 \pm 7.8$ ;  $p < 0.001$ , Cohen's  $d = 0.69$ ).

**CONCLUSIONS:** Adolescent athletes taking psychotropic medications reported a significantly greater number of prior lifetime concussions and higher concussion symptom scores at baseline. Similar trends were seen in those with a history of depression or anxiety, suggesting that these diagnoses alone may be correlated with concussion history and symptom burden regardless of medication use. Future research is warranted to further examine how psychotropic medication use alone may influence these variables, as well as how psychotropics may affect post-concussion symptoms and recovery.

**2392** Board #311 May. 28 3:00 PM - 4:30 PM

### Accuracy Of The Limb-lead Electrocardiogram In Identifying Conditions Associated With Sudden Cardiac Death

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(No relevant relationships reported)

The best screening strategy to prevent sudden cardiac death (SCD) in athletes remains unknown. Using the electrocardiogram (ECG) as a part of a pre-participation examination remains controversial due to the cost and rate of false positives. Screening athletes can be both time intensive and costly. Our previous study demonstrated that using a limb-lead ECG is faster than using a 12-lead ECG. However, the utility and accuracy of limb-leads alone in identifying cardiac abnormalities associated with SCD have never been studied. **PURPOSE:** To assess agreement and diagnostic accuracy in the interpretation of limb lead v. 12-lead ECG in identifying cardiac abnormalities associated with SCD.

**METHODS:** This study compared the interpretation accuracy of 4 physicians evaluating publicly available ECGs of the most common cardiac conditions associated with SCD in athletes. 4 Medical Sports Medicine fellows participated in the study and each interpreted a total of 100 ECGs: 50 normal ECGs (25 limb lead and 25 12-lead) and 50 abnormal ECGs (25 limb lead and 25 12-lead). The agreement between limb lead and 12-lead ECGs was assessed by Cohen's kappa coefficient and the accuracy of identifying an abnormal ECG was compared across limb lead and 12-lead ECGs using a chi-squared test. Inter-rater and intra-rater reliability were assessed by estimating the Fleiss's kappa coefficient. **RESULTS:** Preliminary data of 150 interpreted ECGs showed an accuracy of 77.8% and 82.1% in identifying abnormal from normal ECGs using 12-lead v. limb-lead, respectively ( $p = 0.513$ ). Based on the readings of the physicians in this study, the sensitivity of limb-lead was 97.2% and 12-lead was 89.5%. The specificity of limb-lead was 69.1% and 12-lead was 64.7%. **CONCLUSIONS:** There was no significant difference in the accuracy of physicians' interpretations of limb lead ECGs compare to standard 12-lead ECGs in identifying cardiac conditions associated with SCD.

**2393** Board #312 May. 28 3:00 PM - 4:30 PM

### Is Dynamic Ultrasound Of Femoroacetabular Translation Increased In Female Dancers With Acetabular Dysplasia?

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(No relevant relationships reported)

**BACKGROUND:** Hip pain is common in dancers. A contributing factor to hip pathology in dancers may be the high prevalence of acetabular dysplasia. Dynamic ultrasound (US) of femoroacetabular translation has been shown as a reliable measure of femoroacetabular motion and may serve to assist in the evaluation of hip microinstability. Evidence regarding associations between acetabular dysplasia and femoroacetabular translation is unknown.

**PURPOSE:** To investigate associations between acetabular dysplasia and dynamic US femoroacetabular translation in female dancers with hip pain.

**METHODS:** Prospective cross-sectional study design. Dynamic US of femoroacetabular translation was performed in three positions: neutral (N), neutral with contralateral hip flexion (NF), and the apprehension position with contralateral hip flexion (EER flexed). Dysplasia was defined using radiographic measures:  $LCEA < 25$  or  $ACEA < 20$ . Multivariable linear regression analysis was used to assess variation in femoroacetabular translation between dancers and non-dancers with and without dysplasia controlling for covariates. Independent variables included age, Beighton score, hypermobility (Beighton score  $\geq 5$ ), BMI, and femoral version angles.  $P$ -values  $< 0.05$  were considered significant.

**RESULTS:** The study included 64 female dancers and 92 non-dancer athletes. Dancers were younger ( $p=0.001$ ), had a higher Beighton score ( $p=0.006$ ), and were more likely to be hypermobile ( $p=0.005$ ) compared to non-dancer athletes. Dynamic US femoroacetabular translation was not different in dancers with and without dysplasia ( $N, p=0.55$ ; NF,  $p=0.78$ ; EER flexed,  $p=0.93$ ). Dancers showed greater dynamic US femoroacetabular translation when compared to non-dancer athletes in both the NF position ( $5.0\pm 2.57$  mm,  $4.2\pm 2.50$  mm;  $p=0.04$ ) and EER flexed position ( $6.0\pm 2.53$  mm,  $5.2\pm 2.41$  mm, respectively;  $p=0.04$ ).

**CONCLUSION:** Acetabular dysplasia was not associated with increased dynamic US femoroacetabular translation in this cohort. Dancers showed increased US femoroacetabular translation compared to non-dancer athletes. This finding is likely related to increased ligamentous laxity and stretched ligaments inherent to dance training. Future research is warranted to collect data in asymptomatic dancers with and without acetabular dysplasia.

**2394 Board #313 May. 28 3:00 PM - 4:30 PM**  
**Identification Of Functional Popliteal Artery Entrapment Syndrome In Athletes Who Have Failed Compartment Release**

Daniel B. Sisk<sup>1</sup>, Richard Lawley<sup>2</sup>, Michael Fredericson, FACSM<sup>1</sup>. <sup>1</sup>Stanford University, Redwood City, CA. <sup>2</sup>Cornerstone Orthopedics, Denver, CO. (Sponsor: Michael Fredericson, FACSM)

(No relevant relationships reported)

ACSM FPAES abstract

**TLevel of evidence:** IV **Objective:** To evaluate the work up and outcomes of athletes with exertional leg pain, specifically the co-existence of functional popliteal artery entrapment syndrome (FPAES) and chronic exertional compartment syndrome (CECS), in athletes who were unable to return to sport or have significant symptomatic improvement after lower leg compartment fasciotomy. **Design:** Retrospective case series **Setting:** Outpatient musculoskeletal sports clinic, outpatient vascular surgery clinic **Participants:** 36 patients aged 15-67 (average age 26.9) diagnosed with functional popliteal artery entrapment syndrome using CT-angiogram with provocative maneuvers or MRI-angiogram with provocative maneuvers. In our cohort, a moderate number of athletes (11/36 athletes, 19/59 affected limbs) were referred for evaluation by vascular surgery after already having undergone lower leg fasciotomies for chronic exertional compartment syndrome. **Interventions:** Partial debulking of anterolateral quadrant of the medial head of the gastrocnemius muscle with or without fasciotomy **Main Outcome Measures:** Return to sport/previous activities **Results:** Mean follow up was  $52.3 \pm 22.2$  months. 78% (28/36) of the patients were able to fully return to their previous athletic competitive levels. All patients were able to resume their athletic sport at a recreational level. The patients participated in a myriad of sports and athletic activities: 14 runners, 9 soccer players, 3 unspecified, 2 lacrosse, 2 basketball, 1 triathlete, 1 jumper, 1 diver, 1 water polo, 1 rugby, 1 skier. At 6-month follow-up, there were 13% of affected limbs that had recurrent symptoms, at 12 months, only 5% had recurrent symptoms and at three years, no patients had symptoms present. **Conclusions:** Many of these patients were unable to return to participate in high levels at their respective sport even after initial fasciotomy for CECS, suggesting that FPAES was unidentified, overlooked, or possibly developed after fasciotomy. FPAES can be a co-existing diagnosis that warrants screening during the evaluation of CECS. Provocative CT-A and MRI-A protocols can help guide the diagnosis as well as location of muscle debulking to alleviate the functional entrapment that occurs in these athletes with exercise. It is important to consider and screen for this diagnosis to allow for proper treatment and return to sport.

**D-74 Free Communication/Poster - Sports Medicine Fellow Clinical Cases**

Thursday, May 28, 2020, 2:00 PM - 4:30 PM  
 Room: CC-Exhibit Hall

**2395 Board #314 May. 28 3:00 PM - 4:30 PM**  
**19 Y/o Male Marine Experiencing Exercise-induced Laryngeal Obstruction (eilo) During Military Training.**

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(No relevant relationships reported)

**HISTORY:** 19 year old male with a long history of shortness of breath on exertion. States that since childhood he has had inspiratory wheezing and tightness in chest with exertion, but he was told he would outgrow it. More recently, he has noted that it has worsened with maximal exertion during military training. He states that he is

unable to run all out once around the track without experiencing inspiratory difficulty with gasping. It takes about 10 minutes for him to recover. If he resumes exercise it will recur. Asthma inhalers have not helped. Episodes are associated with pain and dysphagia. **PHYSICAL EXAMINATION:** Laryngeal examination shows that there is reduced abduction of the vocal folds, with a maximum glottic space of about 6 mm. During high ventilatory output tasks there is evidence of paradoxical movement of the vocal folds, most prominently on inspiration, resulting in shortness of breath, and loud stridor on inspiration. **Cardiac:** RRR, without murmur **Lungs:** Clear to Auscultation bilaterally "at rest", Loud inspiratory stridor during "high ventilation". **MSK:** Significant muscle tension dyspnea, an inefficient breathing pattern with an upper torso / clavicular breathing, and hyperfunction of strap muscles.

**DIFFERENTIAL DIAGNOSIS:-** Hypertrophic Obstructive Cardiomyopathy (HOCM)- Asthma- Exercise-Induced Bronchoconstriction (EIB)- Exercise-Induced Laryngeal Obstruction (EILO)- Exercise-Induced Anaphylaxis (EIA) **TEST AND RESULTS:** Cardiopulmonary Exercise Test (CPET): negative. Spirometry with methacholine challenge: negative. Laryngeal function Study: videoendoscopy with stroboscopy revealed reduced abduction of the vocal folds. During high ventilatory provocative challenge, there was evidence of paradoxical movement of the vocal folds, most prominently on inspiration, resulting in shortness of breath, and loud stridor on inspiration. **FINAL/WORKING DIAGNOSIS: Exercise-Induced Laryngeal Obstruction (EILO)** Patient has developed poor breathing patterns with reduced bilateral vocal fold abduction. **TREATMENT AND OUTCOMES:** Breathing Retraining Therapy (4-6 sessions). Patient report significant improvement in symptoms after 2nd session, and complete resolution of symptoms following the 5th session. Remaining symptom free for 4 months.

**2396 Board #315 May. 28 3:00 PM - 4:30 PM**  
**The Two-Year Long Pubalgia**

George Liras. UT Health, Houston, TX. (Sponsor: Mark Chassay, FACSM)

(No relevant relationships reported)

**HISTORY:** 20-year-old male collegiate basketball player with prior history of athletic pubalgia s/p repair 2 years ago. The patient was seen in our clinic for evaluation of LLQ abdominal pain that has been present for the past 2 years. During that time, he has had 2 MRIs of the Pelvis w/o contrast showing bone marrow edema and erosive changes in the pubic symphysis and the left superior pubic ramus area and was prescribed physical therapy as well as medication management. The patient also received an ultrasound guided corticosteroid injection in the area for left lower quadrant pain 8 months prior to his visit in our clinic. During the visit the patient reported a fever with a Tmax of 102F the night before, as well as fatigue, cold sweats, chills and groin pain. Of note two days prior, the patient was seen in the ER for a right sided abdominal laceration from a fall of a broken mug. A CT scan of the abdomen and pelvis showed signs of worsening of the previously seen erosive periostitis. He was also found to have an elevated WBC count with left shift.

**PHYSICAL EXAM:** BP: 125/ 73, T: 98.7 F, HR: 100bpm Constitutional: NAD, AOx 3 Eyes: eyelids normal, conjunctiva and sclera normal, PERRLA, EOMI. Pulmonary: the respiratory rate was normal, the lungs were clear to auscultation bilaterally. Cardiovascular: the heart and rate and rhythm were normal, normal S1, normal S2, no murmurs, rubs or gallops were present. Abdomen: abdominal laceration sutures clean, dry and intact.

**DIFFERENTIAL DIAGNOSIS:** 1.Osteomyelitis 2.Bone tumor 3.Abdominal Hernia **STUDIES/ LABS:-** ESR: 101 [H]-CRP: 174 [H]-ALP: 139 [H]-ALT: 81 [H]-AST: 74 [H]-WBC: 10.5 [WNL]-Hg: 12.5 [L]-Hct: 36.1 [L]-Blood smear: Neutrophilia, Normochromic normocytic anemia-ANCA screen: Negative MRI of Pelvis w/o contrast: - Post-surgical changes from repair of left-sided sports hernia - Complex irregular cyst at the repair site - Development of new erosion along the inferior aspect of the pubic symphysis with moderate marrow edema within the pubic bodies and edema of the surrounding soft tissues.

**FINAL DIAGNOSIS:** Osteomyelitis of pubic bone **TREATMENT AND OUTCOMES:-** Trans-abdominal drainage of pelvic abscess -IV antibiotics (Cefazolin) and transitioned to 6 weeks of PO Keflex under the supervision of Infectious Disease specialist-Patient has recovered well-Will follow up with surgery at the 3 months post-op mark for repeat MRI.

**2397 Board #316 May. 28 3:00 PM - 4:30 PM**  
**Abdominal Pain In A Collegiate Quarterback**

Allen R. Harris. Crozer Keystone Healthplex Sports Medicine Institute, Springfield, PA. (Sponsor: Thomas Kaminski, FACSM)

Email: allen.harris@crozer.org  
 (No relevant relationships reported)

ACSM case Core Injury - Football Allen R. Harris, DO, Crozer Keystone Healthplex Sports Medicine Institute, Suburban Philadelphia, PA (Sponsor: Thomas Kaminski, University of Delaware, ATC, PhD, FACSM) **HISTORY:** A 21-year-old collegiate quarterback sustained a right flank/hip injury during the first quarter of a football game. He scrambled and was tripped from behind falling forward onto the heel of an offensive lineman. He experienced instant pain over his right flank and hip.

He required assistance off the field and complained of pain with breathing. He was immediately escorted to the sports medicine office on-site for examination. **PHYSICAL EXAMINATION:** On examination there was bruising over the lower right abdomen and anterior hip along with tenderness to palpation over the right lower quadrant. No rebound tenderness or guarding. There was marked tenderness over the right ASIS and iliac crest. There was tenderness over the rectus abdominus and right hip flexor. No tenderness over the right upper quadrant. He had decreased strength and range of motion with hip flexion. He did not have dysuria or hematuria. Under ultrasound guidance, the superior aspect of the right iliac crest was injected with 6cc of lidocaine/Sensorcaine in a ratio of 1:2. The patient experienced a 50% reduction in pain and did not return to the game. **DIFFERENTIAL DIAGNOSIS:** 1. Iliac crest contusion (hip pointer) 2. Core muscle injury/avulsion 3. Abdominal contusion **TESTS AND RESULTS:** ultrasound: No free fluid, hematoma or evidence of avulsion or bony disruption. X-ray right hip: No acute fracture. MRI pelvis without contrast: 1. Full-thickness detached tears of the right transversus abdominis and internal oblique muscles at their attachment to the right iliac crest. 2. Grade 1-2 strain of the overlying external oblique muscle. Grade 1 strain of the lateral portion of the right iliacus muscle. **FINAL/WORKING DIAGNOSIS:** Core muscle injury/avulsion **TREATMENT AND OUTCOMES:** 1. Aspiration of hematoma, rest and NSAIDs. 2. Surgical repair of the obliques and rectus abdominis muscles 10 days after initial injury 3. 6-week progressive physical therapy/rehabilitation plan 4. Progressed back to full activity without setback 8 weeks following injury.

**2398** Board #317 May. 28 3:00 PM - 4:30 PM  
**An Unusual Case Of Back Pain**  
 James McKee. *University of Massachusetts, Worcester, MA.*  
*(No relevant relationships reported)*

**HISTORY:** A 13-year-old male with a past medical history of Hermansky-Pudlak syndrome was playing soccer and was struck from behind. He presented to the ED complaining of left lateral rib pain with waxing and waning intensity for seven days. The pain was described as a deep ache combined with sharp stabbing pain with deep inspiration without radiation, exacerbated by bending, twisting, and coughing. OTC NSAIDs provided mild relief. He simultaneously also complained of low back pain of unknown lengthy duration. The back pain was a stiffness in the morning that routinely takes until noon to dissipate. ROS otherwise negative. **PHYSICAL EXAMINATION:** Neck: No midline cervical spine tenderness, step-offs, or deformity. Full ROM. Pulmonary/Chest: Effort normal, breath sounds normal. No stridor, wheezes, or rales. Lungs clear bilaterally. Patient reports stabbing pain inferior to left scapula with deep inspiration and lateral bending. No respiratory distress. Musculoskeletal: Normal ROM. No midline spinal tenderness. No tenderness over left posterior ribs. No palpable deformity. Sharp pain just inferior to scapula with inspiration, worse with movement. Straight leg raise negative bilaterally. Steady gait **DIFFERENTIAL DIAGNOSIS:** 1) Rib Contusion 2) Ankylosing Spondylitis 3) Neurogenic **TEST AND RESULTS:** XR Ribs Left: Normal CXR: Normal XR LS: Normal Vitamin D: 27 CRP: 0.4 ESR: 5 RF: <10 HLA-B27: Negative MRI Thoracic and Lumbar Spine: 1) Bone marrow edema in L5 spinous process with small amount of posterior midline subligamentous fluid collection that is likely inflammatory. 2) Congenital narrowing of the bony spinal canal. 3) Syrinx at T5 through T9, up to 2mm at T7. **FINAL/WORKING DIAGNOSIS:** Syringomyelia, spinal stenosis **TREATMENT AND OUTCOMES:** The patient underwent a period of activity modification and PT and clinically improved. Laboratory workup was negative. Lidocaine patches were ineffective. His lower back pain remains unchanged although he states he has received benefits from foam rolling. He decided against playing lacrosse for the spring season. No neurological deficits have manifested. No pulmonary issues have manifested. We continue to recommend that he participated in activities as tolerated with no restrictions.

**2399** Board #318 May. 28 3:00 PM - 4:30 PM  
**Acute Hip Pain In A Female Adolescent Runner**  
 Catherine Lott. *Detroit Medical Center, Detroit, MI.*  
 Email: clott16@gmail.com  
*(No relevant relationships reported)*

**HISTORY:** 13-year-old female presents for evaluation of left hip pain. Initial injury occurred one day prior to presentation during cross-country practice. She states she was approximately three quarters of a mile into a run on the track when she felt/heard a pop and immediately endorsed pain along the anterior left hip. She described it as sharp in quality with immediate discomfort with ambulation. She was not able to complete the remainder of practice and given the severity and intensity of pain she was taken to the emergency department for further evaluation. While there, plain films were obtained and read as negative for acute fracture. She was given Motrin, placed on crutches and instructed on close follow-up. Since this time, she points to her ASIS and iliac crest as the source of pain with exacerbations during resisted/active hip flexion, internal rotation and weightbearing type maneuvers. She denies any lower extremity radicular symptoms, paresthesias, temperature variations or nocturnal awakenings. Denies any fevers, chills, sweats or loss of bowel/bladder function. She does report some mild hip discomfort over the preceding couple of weeks however

this was transient and self-limiting. She currently runs cross-country and participates in a travel softball team 3 days a week. **PHYSICAL EXAMINATION:** Examination of the left hip revealed no lesion/abrasion or overt deformity; normal alignment, no erythema, swelling or ecchymosis. On palpation she had point tenderness over ASIS and Iliac crest, more so at the ASIS, no crepitus or tenderness at greater trochanter or anterior groin; slight pain over the hip flexor. Patient had full ROM of the left hip but noted pain with both internal rotation and flexion. Patient had mildly decreased strength with resisted hip flexion (4/5), but strength was otherwise normal in the left lower extremity. For provocative testing she had a negative Log Roll, negative FABER; neg FADIR; negative SLR; negative Slump test; positive Trendelenburg; neg Adductor squeeze test. She had normal neurovascular exam of the left lower extremity. The contralateral leg was normal to inspection, palpation, ROM and strength and stability testing. **DIFFERENTIAL DIAGNOSIS:** 1. Sartorius Strain/Rupture 2. Iliac Crest Apophysitis 3. Iliac Crest Apophyseal Avulsion Fracture 4. Psoas Strain 5. Stress Fracture/Reaction

**TEST AND RESULTS:** Imaging: L hip/pelvis x-rays showed avulsion of the superior aspect of the lateral left innominate bone with the cortical fragment laterally offset. **FINAL/WORKING DIAGNOSIS:** L Iliac Crest Apophyseal Avulsion Fracture **TREATMENT AND OUTCOMES:**

After consultation with surgical colleagues it was decided to proceed with conservative management including ice/heat/NSAID therapy and non-weightbearing with crutch assistance. Patient followed up 2 weeks after the initial clinic visit with improving symptoms. She no longer required crutch assistance for ambulation. Patient was symptom free at 4-week follow up with further radiographic evidence of healing. At this time she was placed in a formal physical therapy program. Completed gradual return to play and was fully participating in running and softball at 8 weeks post injury.



**2400** Board #319 May. 28 3:00 PM - 4:30 PM  
**Let's Talk About Stress**  
 Lauren Victoria Greene, Sadiq Haque, Brandon Kakos. *Detroit Medical Center, Detroit, MI.*  
*(No relevant relationships reported)*

**HISTORY:** A 32 year old Female nurse presented to the sports medicine clinic with complaint of left hip pain after she was lifting a patient and twisted her left hip internally. She felt sudden sharp pain over the lateral and anterior hip that radiated into the groin. Pain was made worse with movement and improved with rest and she rated the pain as 7 out of 10 after the injury. Her symptoms continued with little improvement over a few weeks resulting in an antalgic gait favoring the left side. She rates her pain as 6 out of 10 on VAS at presentation. She tried ibuprofen with little relief, has had no imaging or treatment. She runs 3 miles 3 to 5 times per week prior to the injury. She had a history of irregular menses for many years. **PHYSICAL EXAMINATION:** Examination in the clinic revealed a slim female with no swelling or bruising over the left hip. She had tenderness to palpation over the anterior groin and greater trochanter on the left side. She had limited internal rotation of the hip and preserved external rotation. Her strength was preserved and she was neurovascularly intact. She had positive log roll, FADIR and negative FABER. She had an antalgic gait favoring the left side. **DIFFERENTIAL DIAGNOSIS:** 1. Labral Tear 2. Femoroacetabular impingement (FAI) 3. Stress fracture of the femoral neck 4. Hip flexor strain 5. Female athlete triad **TEST AND RESULTS:** Left hip x-rays: 1. Preserved joint space with mild pincer deformity suggesting FAI. No fractures or dislocations noted. MRI Arthrogram of Left Hip: 1. Significant marrow edema and contusion involving a large portion of the femoral neck with a non-displaced stress fracture involving the medial left femoral neck. 2. No labral tear noted. Left Hip Xray 1 week post operatively 1. Three compression screws in the femoral head and neck with adequate alignment and no signs of migration or loosening of the screws. **FINAL/WORKING DIAGNOSIS:** Left femoral neck non-displaced stress fracture with

workup for female athlete triad  
**TREATMENT AND OUTCOMES:** 1. Patient made non weight bearing with crutches. 2. Patient was given options of surgical or conservative management of her compression-sided fracture and chose to pursue surgical route given the fracture extended approx. 50% across the femoral neck and her level of activity prior to the fracture. 3. Closed reduction with percutaneous pinning of the left hip. 4. Using a walker for immobilization she was made 25% weight bearing. 5. 1 week post operatively her pain was improving and she was compliant with weight bearing status. 6. 2 weeks post operatively she continues to improve, she is advanced to 50% weight bearing status using walker and starting physical therapy. She remains off of work as a nurse. 7. Plan to return to work three to four months post operatively.

**2401** Board #320 May. 28 3:00 PM - 4:30 PM

**Kindness For Weakness**

Nicole Nash<sup>1</sup>, James Daniels<sup>1</sup>, Erica Miller - Spears<sup>1</sup>, Rob Carmichael<sup>2</sup>. <sup>1</sup>*Southern Illinois University-Quincy, IL, Quincy, IL.* <sup>2</sup>*Culver Stockton College, Canton, MO.*

*(No relevant relationships reported)*

**HISTORY:** 21 year old African American male junior running back on the football team presenting with right shoulder and neck pain after tackling an opponent during a game. He had associated numbness and tingling extending down to the right hand. He is right hand dominant. He was seen on the field by the athletic trainers and a burner stinger was initially suspected. He was then re-evaluated on the sideline, and kept out of play due to persistence of symptoms. He denied any symptoms on the left side or in the lower extremities. He does report a history of two burner/stingers in high school. He is otherwise previously healthy with no regular medications. He later came to the training room for further evaluation.

**PHYSICAL EXAMINATION:** Patient had good range of motion in the neck. Spurling test was negative. Hoffman test was positive. He had global muscle weakness in the right upper extremity. Right shoulder had no swelling or bruising. He had some tenderness over the right bicep tendon. Shoulder range of motion was intact. Sulcus sign and rotator cuff testing were both negative.

**DIFFERENTIAL DIAGNOSIS:** Burner/Stinger - Brachial Plexus Injury, Cervical Disc Herniation, Spinal Cord Syrinx, Spear Tackler's Spine, Cervical Stenosis  
**TEST AND RESULTS:** X-ray of the cervical spine showed no evidence of acute fracture or subluxation. MRI of the cervical spine without contrast showed a small disc protrusion at C5-C6 and a small area of focal dilation of the central canal at C6-C7 concerning for a syrinx.

**FINAL/WORKING DIAGNOSIS:** Spinal cord syrinx

**TREATMENT AND OUTCOMES:** The findings of disc herniation were presumed old, with an acute development of spinal cord syrinx. Patient was referred to an orthopedic spine surgeon who recommended no surgery for the disc and referral to neurology. Neurology started him on baclofen 5 mg twice a day and gabapentin 300 mg twice a day. He has not been cleared to return to play to avoid any further neck trauma. We will continue to monitor his symptoms. He will let us know if he develops any worsening of symptoms. He has a follow up appointment with neurology in 2 months.

**2402** Board #321 May. 28 3:00 PM - 4:30 PM

**Foot injury- Track & Field**

Odrick R. Rosas-Virella<sup>1</sup>, Manuel H. Garcia-Cartagena<sup>2</sup>, William F. Micheo-Martinez, FACSM<sup>1</sup>. <sup>1</sup>*University of Puerto Rico-School of Medicine, San Juan, PR.* <sup>2</sup>*Ponce Health Sciences University, Ponce, PR.*

*(No relevant relationships reported)*

**HISTORY:** A 15 y/o female with no medical history, who participates in long jump, triple jump and 200-meter sprints arrived at our clinic (December 2019) with right foot pain partially treated with a pneumatic boot on October 2019. Patient states pain in her right foot, mainly in the first metatarsophalangeal (MTP) joint. Denies burning, irritation, acute trauma, past hospitalizations, surgery or toxic habit, but stated oligomenorrhea for months. Upon further questioning, patient reports having a previous sesamoid fracture of the left foot on May 2017.

**PHYSICAL EXAMINATION:**

Inspection: Mild edema in the first digit of the right foot  
 Palpation: Point tenderness in plantar aspect of the distal part of the first MTP joint bilateral

Range of Motion: Full passive and active in lower extremities

Strength: MMT 5/5 in lower extremities

Single leg hop test positive for pain

**DIFFERENTIAL DIAGNOSIS:** 1- First MTP joint sprain

2- Stress fracture of sesamoids

3- Sesamoiditis

4- Flexor hallucis brevis tendinopathy

5- Osteonecrosis of hallux sesamoids

**TEST AND RESULTS:** Lab results: CBC, CMP, uric acid level, U/A, TSH level, A1C, OGTT, RA factor; anti-CCP; C3 and C4 levels; IgA, IgG, and IgM levels;

FT3 and FT4 levels; and Prolactin are all within normal reference ranges. Total testosterone: 119 ng/dL (normal= 5-75 ng/dL), T3 uptake: 35.77% (normal= 20.00%-34.00%), LDH level: 121U/L (normal= 125-243 U/L), and CRP: 1.6 mg/dL (normal= 0.0-1.2 mg/dL).

**MRI:** Fractured medial hallux sesamoid with bone marrow edema and a small first MTP joint effusion in the left foot, and a small, fragmented and sclerotic medial hallux sesamoid with lateral sesamoiditis (stress fracture) in the right foot.

**Left Foot X-Ray:** anteroposterior, oblique, and lateral views: Left foot sesamoid fracture had healed.

**Pelvic sonogram:** Prominent right ovary (3.6x2.7x3.5cm), and normal left-sided ovary with an unilocular cyst measuring 2.2x1.5x2.3cm.

**FINAL/WORKING DIAGNOSIS:**

Right hallux sesamoid subacute stress fractures.

Left medial hallux sesamoid healed fracture

Suspected female athlete triad.

**TREATMENT AND OUTCOMES**

1. Physical therapy, home exercises and relative rest from running and jumping.

2. Calcium and Vitamin D supplementation

3. F/U DEXA scan to assess female athlete triad

4. Gradual return to Sports activity

**2403** Board #322 May. 28 3:00 PM - 4:30 PM

**Progressive Rash In A High School Basketball Athlete**

Bram Newman, Adriana Isacke. *Maine Medical Center, Portland, ME.* (Sponsor: Heather Gillespie, FACSM)

*(No relevant relationships reported)*

**History:** A 16 year old female high school basketball player presented to the athletic training room with a rash on the bilateral lower extremities. It was first noticed 1 week prior to presentation and had progressed from the feet and ankles proximally to the upper thighs. She stated that she initially had right ankle pain but at presentation felt her left knee was particularly swollen and painful. She denied any significant itching related to the rash but felt her legs were swollen and heavy. She denied any specific joint trauma and had been participating in her usual physical activities. She endorsed that she was currently recovering from an upper respiratory viral illness that occurred prior to the appearance of the rash. She had tried taking oral diphenhydramine for the rash which did not help.

**Physical Examination:** She was in no acute distress. Nasal congestion and cough were noted. The legs were diffusely swollen from the ankles to the proximal third of the thighs bilaterally with scattered, non-blanching and non-tender purpuric lesions. There was non-specific tenderness to palpation about the left knee without warmth. It was difficult to assess for a knee effusion as there was significant soft tissue swelling. Knee flexion range of motion was 0 to 150 degrees, pain-free and flexion and extension strength was 5/5. Ligamentous structures of the knees were intact. Sensation to light touch of the bilateral lower extremities was intact. She reported pain in the left knee with gait but was not observed as having a limp. Balance was intact.

**Differential Diagnosis:** 1)Septic arthritis2)Transient synovitis3)Lyme disease4) IgA Vasculitis (formerly known as Henoch-Schnlein Purpura)5)Coagulopathy6) Dermatologic hypersensitivity

**Tests and Results:** The patient was sent to the emergency department for further evaluation. Blood pressure was 116/69, pulse was 90, respiration rate was 19 breaths per minute with 100% oxygen saturation, and temperature was 97.5°F. A complete blood count showed normal platelets and no leukocytosis, while a basic metabolic panel showed normal renal function. A urinalysis showed trace blood and left lower extremity vascular ultrasound was negative for DVT. Musculoskeletal ultrasound did not show any intra-articular effusion in the left knee.

**Final/Working Diagnosis:** IgA Vasculitis (formerly known as Henoch-Schnlein Purpura) with polyarticular involvement.

**Treatment and Outcomes:** Our patient was managed conservatively with symptom management as needed. Although there was concern for septic arthropathy, she remained afebrile with no clinical signs of sepsis. The rash and arthralgias resolved within 4 weeks.

**2404** Board #323 May. 28 3:00 PM - 4:30 PM

**A RARE CASE OF WRIST PAIN IN AN ADOLESCENT TENNIS PLAYER**

Marc Phillip Gruner, Jacob Sellon, Edward Laskowski. *Mayo Clinic, Rochester, MN.*

Email: grunerm@gmail.com

*Reported Relationships: M.P. Gruner: OOwnership/interest/stock; own stocks.*

**CLINICAL CASE -16 year old tennis athlete with dorsal wrist pain**

**HISTORY:** A 16 year old female left-handed high school tennis athlete presented with a several month history of left dorsal wrist pain. She had an episode of whole arm pain, which resolved spontaneously, prior to the wrist pain, but she continued to

experience dorsal wrist pain. She described diffuse pain about the dorsal aspect of the wrist radiating into the left hand. She denied mechanical symptoms, swelling, discoloration, or paresthesias. She also denied neck pain.

**PHYSICAL EXAMINATION:** Skin was grossly negative for erythema, breakdown, or concerning lesions in the left wrist/hand region. Neurologic exam: 5/5 strength in all forearm and hand muscles without atrophy, sensation was intact to light touch C5-T1, and tinel test was negative over the superficial radial nerve. Musculoskeletal wrist exam: no swelling or deformity. No focal tenderness or mass. Full active and passive range of motion of the wrist. There was no pain or laxity with distal radial ulnar joint shucking. There was no snuffbox tenderness and Watson's test was negative.

**DIFFERENTIAL DIAGNOSIS:** 1. Ganglion cyst of the wrist joint. 2. Sprain of the dorsal scaphoid-lunate ligament. 3. Symptomatic extensor digitorum brevis manus. 4. Dorsal Impaction syndrome. 5. Extensor tendinopathy.

**TEST AND RESULTS:** Ultrasound examination revealed an extensor digitorum brevis manus accessory muscle traversing from the deep side of the 4th dorsal extensor compartment, extending across the dorsal hand, and terminating into a tendon slip that merged with the dorsal extensor hood of the 3rd digit. The muscle was notably larger on the left side than the right. She had no evidence of tenosynovitis or other abnormalities in the dorsal wrist.

MRI of the wrist revealed a tiny ganglion cyst along the volar margin of the radioscaphoid articulation and a normal variant extensor digitorum manus brevis muscle.

**FINAL/WORKING DIAGNOSIS:** Symptomatic extensor digitorum brevis manus. **TREATMENT AND OUTCOMES:** 1. Immobilization. 2. Diclofenac Gel. 3. Ultrasound guided Botox injection of the extensor digitorum manus brevis muscle.

We discussed different management options and she elected to proceed with an ultrasound guided botox injection since she had minimal relief from immobilization.

**2405 Board #324 May. 28 3:00 PM - 4:30 PM**

### Adverse To Converse

Jeevan Abraham<sup>1</sup>, Raman Singh<sup>2</sup>. <sup>1</sup>AMITA Resurrection Medical Center, Chicago, IL. <sup>2</sup>Advocate Health, Aurora, IL. (Sponsor: Poonam Thaker, FACSM)

(No relevant relationships reported)

Toe Pain--- Cross-Country

**HISTORY:** A 12-year-old female cross country runner presented to the pediatric sports medicine clinic with 3 months of right second toe pain. Initially, the pain started after stubbing her toe. She developed a constant dull ache that was present at rest and worsened with prolonged walking and during cross country. She noted that her symptoms gradually worsened with time, and she was having no improvement with rest, icing and anti-inflammatories.

**PHYSICAL EXAMINATION:** Overlying skin with no rashes or lesions. Tenderness along the plantar surface of her right second metatarsophalangeal (MTP) joint. ROM was limited in both passive and active flexion and extension of the affected joint. Sensation was intact, and strength with flexion and extension of the toe was normal, however there was significant pain with testing. MT squeeze test was negative. Varus and valgus stress to MTP joint elicited no laxity, and "drawer test" of MTP joint showed mild instability.

**DIFFERENTIAL DIAGNOSIS:**

1. Sprain of plantar plate
2. Metatarsal fracture/stress fracture
3. Osteochondrosis of the metatarsal head
4. Metatarsalgia
5. Lisfranc injury
6. Intermetatarsal neuroma

**TEST RESULTS:**

X-ray R foot:

--- Flattening of the second metatarsal head.

MRI R foot without contrast:

--- Flattening/collapse of the 2<sup>nd</sup> metatarsal head/distal epiphysis with prominent marrow edema of the 2<sup>nd</sup> metatarsal head and neck. Mild MTP joint space narrowing.

**FINAL/WORKING DIAGNOSIS:**

Osteochondrosis of the metatarsal head (Freiberg Disease) - Stage 4

**TREATMENT AND OUTCOMES:**

1. Placed in short leg walking boot with protected weight-bearing, ice 1-2 times daily, Foot/Ankle Surgery consultation with discussion of conservative care vs surgical (chondral drilling and/or chondroplasty). Patient opted for conservative care.
2. At 4-week follow-up, patient's pain significantly reduced. Continued walking boot additional 4 weeks with transition into stiff-soled shoe.
3. At 8-weeks post treatment, follow-up MRI showed no progression of disease. Clinically with almost complete resolution of pain.
4. By 10 weeks, transitioned into a custom foot orthotic with added support to float 2<sup>nd</sup> MTP joint. Restrictions included low impact sports only with plan for repeat MRI at 6 months.

**2406 Board #325 May. 28 3:00 PM - 4:30 PM**

### Bilateral Shoulder Pain - Baseball

Frances Adkins Comer, Anastasia Fischer, FACSM. *Nationwide Children's Hospital, Dublin, OH.* (Sponsor: Anastasia Fischer, FACSM)

Email: frances.comer@nationwidechildrens.org

(No relevant relationships reported)

**HISTORY:** A 14-year-old right handed baseball player presents with two and a half years of insidious-onset bilateral shoulder pain. The pain is generalized in both shoulders, but worse anteriorly and in the right shoulder. He has continued to play year-round at an elite level, but he had to stop pitching due to pain. His shoulders "catch" and pain is exacerbated with rapid movements. **PHYSICAL EXAM:**

Examination in clinic demonstrated tenderness of the anterior and posterior humeral head on the right and anterior humeral head on the left. Range of motion is limited in extension, internal rotation, and external rotation, and is full in flexion and abduction. Strength is full in all ranges of motion with pain in abduction, internal and external rotation. Hawkins, O'Brien's, and Crank tests are positive for pain. He is distally neurovascularly intact. **DIFFERENTIAL DIAGNOSIS:** 1. Labral tear. 2. Proximal Humeral Epiphysiolysis. 3. Synovial Osteochondromatosis. 4. Dysplasia Epiphysialis Hemimelica. **TEST AND RESULTS:** Bilateral shoulder radiograph: Abnormal rounded ossific densities anterior to the right humeral head and metaphysis. Similar pattern of ossification anterior to the left humeral head, which is less well-defined than that seen in the right shoulder. Bilateral shoulder MR without contrast: Bilateral symmetric irregularly-shaped osteochondral fragments within the anterior glenohumeral joint spaces with evidence of erosions of the humeral head. Bilateral shoulder CT without contrast: Bony irregularity along the medial, proximal aspect of both humeri with clustered ossicles adjacent to the bony irregularity. No evidence of free intra-articular bodies. **FINAL/WORKING DIAGNOSIS:** Bilateral Synovial Osteochondromatosis of the Shoulders. **TREATMENT AND OUTCOMES:** 1. Referred for a surgical consult, where non-operative treatment was recommended. 2. Started in physical therapy (PT). 3. Continued full participation in sports despite pain. 4. 10-15% improvement after 3 months of PT. 5. Currently travelling for the winter baseball season and continuing PT at a distant site.

**2407 Board #326 May. 28 3:00 PM - 4:30 PM**

### An Unexpected Cause For Hip Pain

Adam Stefaniak. *Resurrection Medical Center, Chicago, IL.*

(Sponsor: Poonam Thaker, FACSM)

Email: awstefaniak@gmail.com

(No relevant relationships reported)

Clinical Case Abstract

Right hip pain-Runner

Adam Stefaniak, DO Resurrection Sports Medicine Fellowship, Chicago, IL. (Sponsor: Poonam Thaker, MD, FACSM)

**HISTORY:** The patient is a 17 year old male who presented with his mother for right hip pain that started 4 months prior to evaluation. There was no known injury when the pain started. The pain was located anteriorly and in the groin. He described the pain as sharp with radiation down his femur. He also started limping recently because of worsening pain. The pain worsened with running, walking, and standing for long periods of time. He felt like his hip sometimes would get "stuck", but denied any snapping, popping or clicking. Pain improved with ibuprofen. He ran track during spring, but he denied participating in any sports or increase in activity prior to the pain starting. Denied back or knee pain. No previous injuries to that hip. Denied fevers, chills, night sweats, weight loss.

**PHYSICAL EXAMINATION:** Antalgic gait. Right Hip- No swelling or bruising. No pain over iliac crest, ASIS, AIIS, PSIS, greater trochanter, IT band. Hip flexion 120, external rotation 45, internal rotation 35. 4/5 hip flexion strength. 5/5 hip extension, knee extension, knee flexion, dorsiflexion, plantar flexion. Positive groin pain with FABER testing. Negative FADIR. Negative log roll. Pain with resisted straight leg test. Pain with jump testing. Negative Ober's test.

**DIFFERENTIAL DIAGNOSIS:** 1. Hip labral tear. 2. Stress fracture. 3. Snapping hip syndrome. 4. FAIS. 5. Muscle strain. 6. Osteitis pubis. 7. Athletic pubalgia

**TESTS AND RESULTS:**

Right Hip and Pelvis Xray: nMild osseous expansion with sclerotic and lucent areas involving the left pubic bone. Right Hip and Pelvis MRI without contrast: nMultiple aggressive appearing osseous lesions throughout the pelvis, proximal femurs, and lower lumbar spine, compatible with metastatic disease. CT biopsy performed of the right ischial bone lesion. CD20+ Diffuse B-cell Lymphoma

**FINAL/WORKING DIAGNOSIS:** Diffuse B-cell Lymphoma

**TREATMENT AND OUTCOMES:** 1. Referral to pediatric hematology/oncology. 2. 10 cycles of intrathecal R-COPADM chemotherapy (ANHL1131 protocol). 3. Activity as tolerated

2408 Board #327 May. 28 3:00 PM - 4:30 PM

**Acute Blindness In An Athlete**

Sarah Abdellatif, Kevin Lisman, Rehal Bhojani. *UT Health in Houston, Houston, TX.* (Sponsor: Mark Chassay, FACSM)  
(No relevant relationships reported)

**TITLE:** Acute Blindness in an Athlete  
**PRESENTER:** Sarah Abdellatif, DO  
**HISTORY:** A 24 yo weightlifter with a past medical history of mitral valve prolapse and Raynaud’s syndrome experienced sudden right eye blindness about one month ago after training at the gym. She finished her session at the gym that day with no issues. Once patient returned home, she decided to sit down and read for a bit when she suddenly lost vision of her right eye. She had no precipitating symptoms. Patient took an aspirin and her vision returned in about thirty minutes. She states that the image was slightly pixelated when it returned. Patient had never had anything like this happen before and had not happened again after that episode.  
**PHYSICAL EXAMINATION:** Height- 66 inches Weight- 112 pounds Blood Pressure- 132/76 HEENT- Extraocular movements intact. Pupils equal and reactive to light. Neck- JVP normal, carotid pulses are full and equal bilaterally without bruits  
**Cardiac-** Regular rhythm and rate, S1 normal, S2 normal, so S3 or S4, no murmurs, no gallops, no rubs detected  
**Peripheral Pulses-** Femoral, popliteal, dorsalis pedis, and posterior tibial pulses are full and equal bilaterally with no bruits auscultated.  
**Neuro-** Cranial nerves 2-12 intact.  
**DIFFERENTIAL DIAGNOSIS:** 1. Patent Foramen Ovale 2. Central Retinal Artery Occlusion 3. Carotid Stenosis 4. Hemiplegic Migraine 5. Multiple Sclerosis  
**TEST AND RESULTS:** Complete 2D Echocardiogram-- The left ventricular systolic function is normal with an estimated EF 60-64%. Patent foramen ovale is seen with left to right shunting.- Qp:Qs ratio is 0.72.- There are no hemodynamically significant valvular abnormalities or insufficiencies noted on this study.  
**FINAL/WORKING DIAGNOSIS:** Large bidirectional shunting via patent foramen ovale with possible aborted central retinal artery occlusion stroke  
**TREATMENT AND OUTCOMES:** 1. Start aspirin and Plavix daily. 2. TEE and a cardiac CTA to include origin of great vessels and carotid arteries. 3. Check a seven day cardiac monitor. 4. Schedule for PFO closure once results return. Risks and benefits discussed, given patient’s level of activity. 5. Refer to stroke neurologist for multidisciplinary evaluation.

2409 Board #328 May. 28 3:00 PM - 4:30 PM

**Mesenchymal Stem Cell Use For ACL Repair: A Case Report**

Navid Javan<sup>1</sup>, Andrew Blecher<sup>2</sup>. <sup>1</sup>Dignity Health Northridge, Northridge, CA. <sup>2</sup>Southern California Orthopedic Institute, Van Nuys, CA.  
(No relevant relationships reported)

**HISTORY:** The subject of this case is a 41-year-old stuntman who was referred for non-surgical consultation for left knee pain and inability to return to work after being hit by a car 2 years prior. He had been treating his knee with rest and a hinged knee brace which had partially improved his pain. He did not report any instability but had not yet “tested” his knee. He had no injuries to this knee prior to that incident. He takes no medications and had no prior surgeries.

**PHYSICAL EXAMINATION:** He had no effusion, deformity or focal tenderness. He had full AROM and strength was 5/5. He had 1+ laxity on Lachman maneuver and anterior drawer testing. McMurray, varus stress, and valgus stress were all negative.

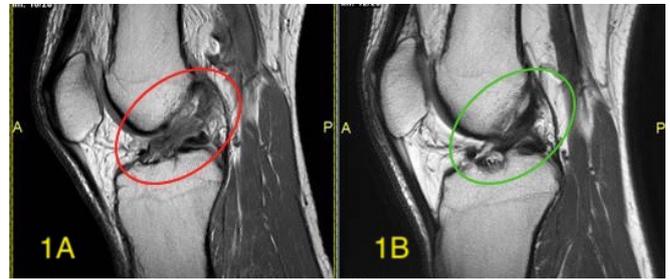
**DIFFERENTIAL DIAGNOSIS:** 1) ACL Sprain 2) ACL Rupture

**TEST AND RESULTS:**

KT1000 testing was performed and showed a 4 mm difference at the 15 lb. level and a 5 mm difference with quadriceps active displacement. MRI of the left knee demonstrated a grade 2 ACL sprain with only a few fibers left intact. MRI also demonstrated an impaction contusional injury of the medial tibial plateau and a small medial meniscal tear. (Figure 1a)

**FINAL/WORKING DIAGNOSIS:** Grade 2 ACL Sprain of the Left Knee

**TREATMENT AND OUTCOMES:** He first verified that he had not taken any NSAIDs within the previous 2 weeks and wouldn’t take any for the next 12 weeks. He received a centrifuged PRP intra-articular knee injection. The patient returned 2 days later for a mesenchymal stem cell (MSC) injection. Bone marrow aspirate was collected from the posterior iliac crest bilaterally and then processed, centrifuged and separated using the Regenxx technique which resulted in MSC, platelet lysate (PL), and a superconcentrated platelet solution (SCP). The PL and SCP was injected intra-articularly. The MSC were injected into the course of the ACL remnant under fluoroscopy. The patient was placed in a knee immobilizer and then received an intra-articular injection of SCP and PL 5 days later. He was evaluated twice over the next two weeks, being advanced to an ACL brace and PT. His ACL brace became pm 8 weeks later. At 6 months he had 90% improvement of his pain with discomfort during backwards running and deceleration but had no instability. He was cleared to return to his occupation as a stuntman. At 9 months he had an intact ACL on MRI (Figure 1B) and complete resolution of his pain.



2410 Board #329 May. 28 3:00 PM - 4:30 PM

**Case Of A Pathologic Phalanx Fracture**

Adam Thompson. *Crozer Keystone Health System, Springfield, PA.* (Sponsor: Thomas Kaminski, FACSM)  
(No relevant relationships reported)

**Phalanx Fracture**

Adam M. Thompson, Crozer Keystone Health System, Springfield, PA. (Sponsor: Thomas Kaminski, ATC, PhD, David Webner, MD, Kevin DuPrey, DO)

**HISTORY:** A 24 year old right hand dominant male presented to urgent care with a hand injury sustained while moving a refrigerator. He was attempting to lift the refrigerator when he dropped it and it landed on his left hand. It landed on his middle and ring fingers. He developed pain and swelling primarily in the middle finger but with some in the ring finger as well.

**PHYSICAL EXAM:** Vital signs were within normal limits. Examination of the patient’s left hand demonstrated swelling and ecchymosis over the middle phalanx of the middle and ring fingers along with tenderness to palpation. There was equal range of motion in pronation, supination, wrist extension and wrist flexion bilaterally. There was decreased active flexion and full extension in those fingers as well - MP 0/85, PIP 0/75, DIP 0/35. Skin was warm and dry. Capillary refill was brisk.

**DDX:** 1. DIP/PIP ligament sprain 2. Phalanx fracture 3. Flexor tendon injury

**TESTS AND RESULTS:** X-ray demonstrated an angulated middle finger middle phalanx fracture with an underlying circumscribed lucent lesion with cortical thinning and some suggestion of internal matrix with somewhat limited evaluation secondary to fracture favored to represent a unicameral bone cyst or enchondroma.

**FINAL/WORKING DIAGNOSIS:** Left long finger middle phalanx cyst, consistent with bone cyst/enchondroma with pathologic fracture.

**TREATMENT/OUTCOMES:** The patient was referred to hand surgery for evaluation due to the fracture extending through the bone cyst. He underwent ORIF for pathologic fracture 7 days post injury. He was placed in a splint post-operatively. At initial follow-up he demonstrated good wound healing and significant improvement in pain. He was placed in a custom splint which he wore for six weeks. At this time he started in hand therapy to work on return to full function.

2411 Board #330 May. 28 3:00 PM - 4:30 PM

**A Writer’s Block**

Cindy Ong. *Kaiser Permanente, Los Angeles, CA.* (Sponsor: Aaron Rubin, FACSM)

Email: cindyong510@gmail.com

(No relevant relationships reported)

**HISTORY:** A 32-year-old male writer had right shoulder pain for four weeks without inciting injury and possibly slept awkwardly on his couch. The pain radiated with numbness/tingling along his right arm, forearm, and right thumb. His pain feels like “a bad sunburn.” His severe pain led to two prior emergency department visits and was provided a sling, Norco and lidocaine patch with minimal relief. He tried NSAIDs, acupuncture, cupping and physical therapy with mild relief. He finished a prednisone burst with improvement, however, with residual shoulder pain with overhead activities. He had also been recovering from a recent viral syndrome before his pain started.

**PHYSICAL EXAMINATION:** Neck: no tenderness over C-spine and paracervical muscles, normal ROM, strength decreased in right C5 4+/5, negative Spurling’s. Right Shoulder: mild forward slumping, tenderness over bicipital groove. ROM normal except internal rotation (IR) at L1 (left IR T6), pain at end arc flexion and abduction, Neer’s/Hawkin’s test positive. Scapula rotation asymmetric, mild dyskinesia, right scapula mildly more protracted than left. Sensation decreased on ulnar/radial C6 and C8 distribution. Radial pulse symmetric. **DIFFERENTIAL DIAGNOSIS:** 1. Neuralgia amyotrophy/brachial neuropathy/brachial neuritis (Parsonage-Turner syndrome) 2. Dorsal scapular nerve entrapment 3. Rotator cuff syndrome 4. Quadrilateral space syndrome 5. Cervical spinal stenosis. **TEST AND RESULTS:** Cervical Spine Radiographs:— Normal. MRI Cervical Spine No Contrast:— Degenerative changes, mild-moderate right neural foraminal narrowing at C3-C4 without spinal canal stenosis. Small central disc protrusion without stenosis at C6-C7. MRI Right Shoulder

No Contrast:— Mild supraspinatus and infraspinatus tendinosis, no tear. Edema

within teres minor without atrophy, possible denervation changes versus muscle strain. **FINAL/WORKING DIAGNOSIS:** Neuralgic amyotrophy. **TREATMENT AND OUTCOMES:** The patient had follow ups with sports medicine and orthopedics with gradual improvement with conservative therapy, including NSAIDs, steroids, rest and physical therapy. He tolerated more of his physical therapy exercises with nerve gliding, increasing range of motion and strengthening.

**2411a Board #331 May. 28 3:00 PM - 4:30 PM Hand Injury**

Marcin Jungiewicz, Kaleigh Suhs. *Advocate-Aurora Lutheran General Hospital, Park Ridge, IL.* (Sponsor: Mark Hutchinson, FACSM)  
 Email: moi1791@gmail.com  
 (No relevant relationships reported)

**HISTORY:** A 15 year old H.S. football quarterback sustained a right thumb injury while throwing a pass. His hand hit a defender's chest during follow through, jamming his thumb. He noted swelling and bruising over thenar eminence and his 2<sup>nd</sup> MCP joint. This resulted in limited ROM of the right thumb especially of abduction and opposition. **PHYSICAL EXAMINATION:** Examination of the right hand showed edema along the 1<sup>st</sup> MCP joint, thenar eminence with ecchymosis in 1<sup>st</sup> webspace extending into 2<sup>nd</sup> MCP joint. Skin was intact. Thumb was well vascularized. No tenderness over 2<sup>nd</sup> metacarpal or 2<sup>nd</sup> MCP joint. Thumb opposition and 1<sup>st</sup> MCP flexion and extension less than 20° were limited by edema and pain, IP ROM was within functional limits. Tenderness over ulnar aspect of 1<sup>st</sup> MCP joint. Pain and tenderness present during MCP extension with mild laxity with UCL stressing. Laxity at the CMC joint with some dorsal subluxation, reducible. Tenderness proximal to trapezium. Contralateral side thumb revealed also some laxity at the CMC. **DIFFERENTIAL DIAGNOSIS:** 1. Fracture of the right 1<sup>st</sup> Metacarpal bone 2. Fracture of the right thumb proximal phalanx 3. Fracture of the wrist bones 4. Right 1<sup>st</sup> MCP joint UCL sprain **TEST AND RESULTS:** X-rays of the right hand 3V: No bony or soft tissue abnormalities. MRI right hand ordered to rule out occult fracture(s), ligament tears: 1. Nondisplaced fracture of the trapezium. Diffuse bone marrow contusion in the 1st metacarpal with small avulsion fragment of the radial metacarpal at RCL attachment 2. Bone contusion of the distal dorsal capitate 3. Moderate grade sprain of UCL and RCL at the thumb MCP joint with partial tearing of proximal RCL at the avulsion fragment. 4. Diffuse low grade muscle strain with superimposed partial musculotendinous tear of flexor pollicis brevis muscle. **TREATMENT AND OUTCOMES:** 1. Wrist and thumb immobilization in Custom thumb spica splint to enable graduated ROM as tolerated and Occupational Therapy 2. Restriction from all contact sports for 6 weeks 3. Consultation with Hand Orthopedist to evaluate for surgical necessity determined patient to be appropriate for conservative treatment. Patient seen in Sports Medicine Clinic 39 days after initial injury. Returned to sports after 6 weeks of immobilization with thumb/wrist taped. Patient denied pain with activity.

**2411b Board #332 May. 28 3:00 PM - 4:30 PM Chronic Shoulder Pain Secondary To Trampoline Injury**

Johnel Mayberry<sup>1</sup>, Terry Nicola, FACSM<sup>1</sup>, Kevin Machino<sup>2</sup>. <sup>1</sup>University of Illinois at Chicago, Chicago, IL. <sup>2</sup>Rush University, Chicago, IL. (Sponsor: Terry Nicola, FACSM)  
 Email: jaymayberry15@gmail.com  
 (No relevant relationships reported)

**HISTORY:** 14 year old female with right shoulder pain and arm paresthesias after trampolining injury 17 months prior to visit. Her right arm was yanked down and she heard a pop. Pain initially improved but recurred during basketball tryouts 6 months later. At presentation she noted right shoulder "spasm" pain rated 2/10 at rest and worsened to 5/10 with repetitive activities. Most bothersome symptoms were aching, tingling sensation on the medial aspect of her right arm radiating into the 3<sup>rd</sup>-5<sup>th</sup> digits with hand weakness. **PHYSICAL EXAMINATION:** Right first rib was elevated with tenderness. The right middle scalene was notable for spasm with tenderness. Right scapula winging noted. Positive right lift-off test. Weakness in the right abductor pollicis brevis, 3/5 on motor testing. No sensory or other strength deficits. Radiating symptoms reproduced with right shoulder mobility. Negative Neers, Hawkins' and speed's. Positive Roo's maneuver on the right at 15 seconds. Negative Adson's test bilaterally, Negative Tinel's test at the right elbow and wrist. Negative Spurling's and Lhermitte's. **DIFFERENTIAL DIAGNOSIS:** #1-Neurogenic thoracic outlet syndrome #2-Brachial plexopathy #3-Vascular thoracic outlet syndrome **TEST AND RESULTS:** MRI Right brachial plexus - No mass or focal abnormality along right brachial plexus. Diminutive appearance of right internal jugular vein of uncertain clinical significance. MRI of cervical spine - No evidence of neural compromise. Electrodiagnostic exam - There was a 25% decrease in the right median motor amplitude compared to the left. No side to side difference in ulnar nerve studies. The

scapular stabilizers were not evaluated. Vascular Doppler Evaluation - Dampened plethysmography waveforms in the right arm in the Adson maneuver when compared to the left. **FINAL/WORKING DIAGNOSIS:** Arterial thoracic outlet syndrome **TREATMENT AND OUTCOMES:** Dry-needling of the right anterior and middle scalene muscles were performed. Physical therapy was prescribed with focus on stretching the scalenes and pectoralis muscles. She is no longer having symptoms at rest and her strength is significantly improved. She continues to have right 3<sup>rd</sup>-5<sup>th</sup> digit paresthesias with prolonged activities despite focused physical therapy and is undergoing surgical evaluation.

**D-75 Clinical Poster/Reception - Clinicians' Reception with Poster Presentations**

Thursday, May 28, 2020, 6:00 PM - 7:00 PM  
 Room: Hotel-Nob Hill

**2412 Board #1 May 28 6:00 PM - 7:00 PM Influence Of Injury Severity And Recovery Environment On Physical Activity And Function Following Lower-limb Amputation**

Peter Laddow (Sponsor: James Betts, FACSM)<sup>1</sup>, Thomas E. Nightingale<sup>2</sup>, M. Polly McGuigan<sup>3</sup>. <sup>1</sup>UK Ministry of Defence, Loughborough, United Kingdom. <sup>2</sup>University of British Columbia, Vancouver, BC, Canada. <sup>3</sup>University of Bath, Bath, United Kingdom.  
 (No relevant relationships reported)

Restoration of physical function and physical activity (PA) is considered a vital therapeutic component in the short-term rehabilitation and long-term recovery of individuals with traumatic lower-limb amputation(s) (LLA). Unfortunately, evidence suggests an increased prevalence of physical inactivity and reduced functional status in this population. **PURPOSE:** To determine the impact of free-living environment (rehabilitation vs. home) on PA and function in UK military personnel following traumatic LLA, compared to active non-injured controls (CON). **METHODS:** Sixteen LLA (8 unilateral (UNI), 30±5yrs; 8 bilateral (BI), 29±3yrs), nearing the end of their clinical rehabilitation care pathway, attended one 4-week residential rehabilitation admission and one 6-week recovery block at home. Thirteen physically active, age-matched males (28±5yrs) represented CON. Estimated daily ambulatory PA energy expenditure (PAEE) was estimated from an accelerometer (Actigraph GT3X+), worn on the hip of the shortest residual limb in each environment, using validated population specific prediction algorithms. Six minute walk distance (6MWD) was recorded at baseline and 10 weeks (general population 6MWD norms is >459m). **RESULTS:** Whilst at home, mean PA counts.day<sup>-1</sup> reduced by 17% (p=0.018) and 42% (p=0.001) in the UNI and BI group, respectively. UNI group demonstrated a similar capacity for PAEE to CON, both of which were greater (P<0.05) than BI (Table 1). No significant changes in 6MWD were demonstrated within groups (P>0.05), however, significant differences (P<0.05) were demonstrated between all groups at baseline (UNI, 574±66m; BI, 337±85m, CON, 705±32m). **CONCLUSION:** UNI group demonstrate a similar capacity for PA and function to active non-injured CON. To support and manage the long-term health and well-being of more severely injured BI LLA, future research should investigate strategies that promote regular engagement in PAEE, particularly when they return home.

Estimated daily physical activity in all groups. Data presented as mean±SD and Δ mean							
	Unilateral Amputation (n=8)	Bilateral Amputation (n=8)	Control (n=13)				
	Rehabilitation	Home	ΔChange	Rehabilitation	Home	ΔChange	Work
Days (>14 hours)	5 ± 1	5 ± 1	0	6 ± 1	6 ± 1	0	5 ± 1
Wear Time (minutes)	918 ± 41	916 ± 55	-2	918 ± 45	904 ± 42	-14	934 ± 40
PA Counts.day <sup>-1</sup>	645084 ± 86078	534248 ± 90125	-110836	492569 ± 72750	283357 ± 91406	-209212	707632 ± 197909
PAEE (kcal.day <sup>-1</sup> )	839 ± 88	733 ± 87	-106	410 ± 68	217 ± 85	-194	948 ± 155

THURSDAY, MAY 28, 2020

2413 Board #2 May 28 6:00 PM - 7:00 PM

**Does Immobilization Period Affects The Functional Outcomes After Bankart Repair?**Irem Duzgun, Taha I. Yildiz, Gazi Huri, Dilara Kara, Ceyda Sevinc, Egemen Turhan, Serdar Demirci, Leyla Eraslan, Elif Turgut, Ozgur A. Atay. *Institution of Health Sciences, Ankara, Turkey.**(No relevant relationships reported)*

There is no consensus about the absolute immobilization time period and whether the rehabilitation should start in the first or in the third week after Bankart Repair.

**PURPOSE:** The aim of this study was to compare the clinical outcomes of 1 and 3 weeks of absolute immobilization time after the surgery and evaluate their effects on recurrent instability. **METHOD:** Forty-two patients with arthroscopic Bankart surgery were included to the study. Patients were randomly allocated into two groups. One week of absolute immobilization was performed to the patients in group-1 (n=21, age:24.7±7.1, BMI: 25.3±3 kg/cm<sup>2</sup>) and 3 weeks of absolute immobilization was performed to the patients in group-2 (n=21, age: 22.1±6.7 years, BMI: 24.8±2.8 kg/cm<sup>2</sup>). All of the patients come to the clinic once in a week and performed supervised exercise program and the rehabilitation program was progressed. They were also prescribed home exercise program. Shoulder ROM, pain level and shoulder function were assessed, according their groups at the first or third weeks, 4, 8 and 12 weeks of post-operative period. The pain level during resting, activity and at night was assessed with VAS. Shoulder ROM was assessed with standard goniometer and shoulder function was assessed using ASES questionnaire. At the average of 30. weeks after the surgery, it was questioned whether there was a re-dislocation. The demographics of the patients on both groups were analyzed with student t test. Two-way repeated measures ANOVA was used for the statistical analyses. **RESULTS:** There were no significant the "Group\*time" interactions for pain at rest and activity and flexion, abduction, external rotation, internal rotation angles (p>0.05). The main effect of time was significant at rest and activity pain and all ROM measurements (p<0.05). There was a significant "Group\*Time" interaction for pain at night (p<0.05). Pain at night was higher in the group-1 at post-operative 1 and 4. weeks compared to group-2. There were no statistically significant differences between the two groups in shoulder function at post-operative 12 weeks (p>0.05) and 30 weeks (p>0.05). One patient had re-dislocation in the group-2. **CONCLUSION:** One or three weeks of absolute post-operative immobilization period does not differ in terms of functional outcomes on patients with Bankart repair.

2414 Board #3 May 28 6:00 PM - 7:00 PM

**The Effect Of Injuries And Pain On Athletic Identity Across NCAA Divisions**Bryanna Veroneau (Sponsor: Stephen Bailey, FACSM)<sup>1</sup>, Bailey Tadlock<sup>1</sup>, Shefali Christopher<sup>1</sup>, Srikant Vallabhajosula<sup>1</sup>, Amy Knab<sup>2</sup>, Chris Harnish<sup>3</sup>, Garrett Bullock<sup>4</sup>. *Elon University, Elon, NC. <sup>2</sup>Queens University of Charlotte, Charlotte, NC. <sup>3</sup>Mary Baldwin College, Staunton, VA. <sup>4</sup>University of Oxford, Oxford, United Kingdom.**(No relevant relationships reported)*

There is a high prevalence of pain and injury in collegiate athletes, which can affect playing time and performance. Previous studies have observed that surgery and concussions can affect athletic identity. Currently, there is a paucity of research investigating how current pain and injury affect athletic identity.

**Purpose:** To determine how current collegiate athlete pain and injury affect athletic identity and how these relationships differ across NCAA divisions. **Methods:** NCAA division 1 (D1), 2 (D2), and 3 (D3) athletes were administered a questionnaire through an encrypted database. The Athletic Identity Questionnaire (AIM) and Oslo Sports Trauma Research Center Overuse Injury Questionnaire (OSTRC) were used within the survey. AIM estimates self-perceived athletic identity while OSTRC measures level of participation, training volume, performance, and pain. Athletes were further classified by OSTRC scores into overuse and substantial overuse injuries. Multivariable and logistic regressions assessed the relationship between Aim, OSTRC scores, and overuse injury. Models were adjusted for age, gender, NCAA division, history of orthopedic surgery, and history of major injury, with unadjusted and adjusted coefficients and Odds Ratios (OR) with 95% confidence intervals (95% CI). **Results:** 252 athletes (age of 19.4 years (1.2); female: 181, male: 70; D1: 101, D2: 74, D3: 77) participated. Mean AIM scores were D1: 37.98 (7.61), D2: 37.03 (37.03), and D3: 38.86 (6.98). The OSTRC median score was 0 (IQR: 0-22). 127 (50%) athletes had an overuse injury while 47 (19%) had a substantial overuse injury. Adjusted total OSTRC score was -0.67 (95% CI: -2.4, 1.1; p=0.474). Adjusted OR for OSTRC overuse injury was 1.00 (95% CI: 0.97, 1.04; p=0.589) and substantial overuse injury was 0.95 (95% CI: 0.91, 0.99; p=0.036). Similar results were observed between gender and division subgroups. **Conclusion:** After adjusting for confounding variables, it was determined that substantial overuse injuries negatively affected athletic identity, regardless of gender or NCAA division. Sports medicine professionals need to consider the

possibility of lost athletic identity when an athlete sustains an injury. Measures should be taken to ensure that athletes continue to have meaningful contribution to sport following pain or injury.

2415 Board #4 May 28 6:00 PM - 7:00 PM

**Masters Athlete Screening Study: Four-Year Cardiovascular Disease and Event Incidence**Barb N. Morrison<sup>1</sup>, Darren E. R. Warburton<sup>2</sup>, Jack Taunton, FACSM<sup>2</sup>. *<sup>1</sup>SportsCardiologyBC, Vancouver, BC, Canada. <sup>2</sup>University of British Columbia, Vancouver, BC, Canada.**(No relevant relationships reported)*

**Background:** Masters athletes (≥35 yrs) are not immune to elevated cardiovascular risk and cardiac events. In the first year of Masters Athlete Screening Study, 798 masters athletes were screened; 91 (11.4%) of the cohort were found to have cardiovascular disease (CVD). Coronary artery disease (CAD) was the most common diagnosis (7.9%).

**Purpose:** To evaluate the incidence of CVD and adverse cardiovascular events over four years of the screening study.

**Methods:** Masters athletes (≥35yrs) from a variety of sports without previous history of CAD underwent yearly cardiovascular screening for four years. The screen consisted of anthropometrics, resting blood pressure, resting electrocardiogram, modified American Heart Association 14-element recommendations, cardiovascular event questionnaire, physical examination (year one), and Framingham Risk Score. Participants with an abnormal screen according to the European Association of Cardiovascular Prevention and Canadian Cardiology Society Guidelines underwent further evaluations.

**Results:** During the following three years of study an additional 45 cases of CVD were detected, with an incidence rate of 1.9/100 (64.7±7.3yr; 79%M), 3.0/100 (65.1±7.3yr; 62%M), and 1.5/100 (65.0±5.8yr; 80%M), for years two, three, and four, respectively. Twelve participants had a new CVD diagnoses or progression of a diagnoses. The most common diagnoses over the three years was CAD (n=15; 33.3%) and atrial arrhythmias (n=14; 31.1%). An additional 9 participants were diagnosed CVD outside of the study (atrial fibrillation n=2; moderate CAD n=2; mild CAD n=4; genotype positive hypertrophic cardiomyopathy n=1). Five out of 798 (0.6%) participants had a myocardial infarction. A single CV death occurred. Three of the individuals who had a cardiac event demonstrated a negative exercise treadmill test (ETT) (mean time 15±2.9 min) and three had a positive ETT (mean time 12±1.2 min); two of which initiated cholesterol-lowering medication after confirmation of CAD via CCTA, and one declined medication after a negative MIBI.

**Conclusion:** Yearly cardiovascular screening of masters athletes identified ~2 new diagnoses per 100 athletes per year (primarily CAD and atrial fibrillation). Despite yearly cardiovascular screening and high fitness, myocardial infarctions still occur.

2416 Board #5 May 28 6:00 PM - 7:00 PM

**Sex Differences In Patient Reported Outcomes 6 Months Following Acl Reconstruction**Emily Kidwell, Cale Jacobs, Mary Lloyd Ireland, FACSM, Darren Johnson, Brian Noehren, FACSM. *University of Kentucky, Lexington, KY.**(No relevant relationships reported)*

Evidence indicating the important role psychological factors contribute to patient reported outcome (PROs) post anterior cruciate ligament reconstruction (ACLR) has been growing over the last decade. However, it is unclear whether sex-specific differences in psychological profile exist in ACLR recovery. Determining the potential psychological differences between sexes has important implications on the development of targeted intervention strategies post ACLR. **PURPOSE:** To determine whether sex differences in PROs exist at six months following ACLR.

**METHODS:** Forty-one subjects (23 F, BMI 24.0 ± 3.5, Age 19.2 ± 5.9, Tegner 8.8 ± 1.2) six months post ACLR completed PRO questionnaires. Subjects were administered the ACL-Return to Sport after Injury Scale (ACL-RSI), the Knee Self-Efficacy Scale (K-SES), and the Psychological Readiness to Return to Sport Scale (I-PRRS). Independent samples t-tests were used to compare PRO responses between males and females.

**RESULTS:** No significant differences were observed between male and female demographic information (p > 0.05). Significant differences were observed between male and female responses. Males reported higher scores on the ACL-RSI (M: 7.63 ± 1.43, F: 5.46 ± 2.17; p = 0.004, Cohen's d = 1.21), K-SES8 (M: 8.88 ± 0.85, F: 7.53 ± 2.11; p = 0.001, Cohen's d = 0.88), and I-PRRS (M: 51.58 ± 6.22, F: 36.17 ± 13.37; p < 0.001, Cohen's d = 1.54) when compared to females.

**CONCLUSIONS:** These results show that, six months following ACLR, males have significantly higher knee-function self-efficacy, as assessed by K-SES. I-PRRS and ACL-RSI responses show that males are more psychologically ready to resume sports participation. These results show a discrepancy between male and female psychological response following ACLR, which should be a consideration for re-injury risk. While most patients are cleared to return to activity six to nine months

post ACLR, there is a lack of consideration for patient's psychological readiness at the time, for both sexes. If females are returning to sports before being psychologically ready, they are likely to be hesitant and less confident in game situations, contributing to injury risk. Future work is needed to determine if psychologically-focused rehabilitation programs are needed to potentially reverse the reported sex differences.

**2417 Board #6 May 28 6:00 PM - 7:00 PM**  
**Diarrhea (Infectious Disease)-Swimming And Diving**

Jordan P. Hilgefert, Christina Murphy, Amy Miller, Keri Denay, FACSM. *University of Michigan, Ann Arbor, MI.*

(No relevant relationships reported)

**History:** 19-year-old men's collegiate swimming athlete with PMH of anxiety & major depressive disorder presented with 3-days of nausea, vomiting & diarrhea. He reported several teammates with similar symptoms. He returned for reassessment 1 week following initial evaluation endorsing 2 days of symptom improvement followed by return of several episodes of emesis, diarrhea & fatigue.

**Physical Examination:**

General: Well-developed, Well-nourished, NAD

HEENT:

-Head: NC, AT

-Eyes: conjunctiva clear, EOMI, PERLL, no discharge

-Ears: hearing normal on gross assessment, TMs normal

-Nose: nares clear, no deformity

-Throat: MMM, no erythema or exudate

NECK: normal ROM, no lymphadenopathy

PULM/CHEST: CTAB, no wheezes, rales or rhonchi

CV: RRR, no MRG. CR < 2 sec

ABD: BS+, soft, non-tender, non-distended, no organomegaly

SKIN: no visualized rashes or skin lesions, skin is warm and dry

PSYCH: appropriate mood and affect

**Differential Diagnosis:**

- 1) Viral gastroenteritis
- 2) Bacterial gastroenteritis
- 3) Parasitic infection
- 4) Irritable bowel syndrome
- 5) Anxiety

**Tests and Results:** Initial CBC, BMP and TSH were remarkable only for mild thrombocytosis (447 K/mm<sup>3</sup>) and hypoglycemia (63 mg/dL). After incomplete resolution of symptoms, GI PCR panel was obtained and found to be positive for cryptosporidium.

**Final Diagnosis:** Cryptosporidiosis

**Treatment and Outcomes:**

- 1) He was treated with Nitazoxanide 500 mg PO BID x 3 days and held out of the pool for 2 weeks.
- 2) Athletes with exposure to university pools presenting with diarrhea were tested for cryptosporidium via PCR. 6 were positive and all were held out of the pool for 2 weeks.
- 3) The public health department and environmental health experts were consulted to assist with management.
- 4) Administrators from every university and local swimming clubs who shared a common pool with our athletes were notified of potential exposure to cryptosporidium. One head-to-head swimming meet was cancelled in an effort to limit potential exposure.
- 5) University pools were shut down and treated twice with a high-concentration chlorine.
- 6) Water samples were collected serially before and after treatment cycles to ensure eradication prior to re-opening the pools.

**2418 Board #7 May 28 6:00 PM - 7:00 PM**  
**Rare Case Of Avascular Necrosis In A Dodgeball Player**

Steven Liu<sup>1</sup>, Alpha Anders<sup>2</sup>, Kenneth Vitale, FACSM<sup>2</sup>. <sup>1</sup>*Eastern Virginia Medical School, Norfolk, VA.* <sup>2</sup>*UCSD School of Medicine, San Diego, CA.*

(No relevant relationships reported)

**History:**

A 27-year-old male presented with left anteromedial hip/groin pain for 2 weeks. He competes in a dodgeball league and plays occasional racquetball as well. After a dodgeball game, he noted onset of hip and groin pain, which became progressively severe, and went to a local Emergency Department. He had x-rays and were told they were normal, however he had significant pain even with weightbearing at this point. No past history of hip dysplasia, dislocation, hip surgery.

**Physical Examination:**

Hip flexion was 110°, internal rotation 20°, external rotation 60°, abduction 45°; significant pain with flexion, adduction, and internal rotation, and positive FABER. He was able to ambulate without assistance.

**Differential Diagnosis:**

- Labral tear
- Femoroacetabular impingement
- Femoral neck stress fracture
- Loose body
- Chondral defect
- Athletic pubalgia

**Tests and results:**

X-rays were obtained and suggested minimal left femoral head collapse, and did suggest mild right femoral head sclerosis; an MRI showed large areas of grade 2 avascular necrosis bilaterally. The left had a joint effusion, edema in addition to necrotic fatty signal in the femoral head compatible with early collapse.

**Final/Working Diagnosis:**

Bilateral hip avascular necrosis with early left collapse.

**Treatment/Outcome:**

- Internal Medicine and Rheumatology referral for serological work up.
- Referred to Orthopedic Surgeon; recommended toe-touch weightbearing, counseled on risk of progression. Alendronate was considered as with precollapse Ficat stages 0-II.
- At 8 months, left hip pain was progressing, and noted onset of right hip pain. X-rays showed visible left AVN on the entire weightbearing surface with collapse and flattening of the superior articular surface; right hip now showed subtle sclerosis.
- His only pertinent history included a brief course of oral corticosteroids when he got his wisdom teeth removed, which he did not initially disclose. This case reports an unusual etiology of an avascular necrosis after taking a short-term dose of corticosteroids. Case raises awareness to counsel health providers about collaborating to provide patients with optimal care and avoid potential serious side effects.

**2419 Board #8 May 28 6:00 PM - 7:00 PM**

**Bilateral Hip Pain - Soccer Player**

Samantha Lucrezia (Sponsor: Dilipkumar R. Patel, FACSM), Danielle Hirsch, Patrick Mularoni. *Johns Hopkins All Children's Hospital, St. Petersburg, FL.*

(No relevant relationships reported)

**History:** A 16-year-old Asian male presented with 2 weeks of worsening groin pain. Pain began after a difficult soccer practice, without a specific inciting injury. Patient was evaluated by team's athletic trainer and was referred to orthopedic surgery where x-rays were negative. One week later, patient presented to local pediatric emergency center with intermittent fevers, worsening pain and inability to ambulate. He denied any recent travel outside the US or new exposures.

**Physical Exam:** afebrile in no acute distress with tenderness to palpation over paraspinal muscles, costovertebral processes L3-L4 and quadriceps musculature. Patient walked with antalgic gait and found to have 2/5 strength hip flexion bilaterally with 5/5 strength in all other muscle groups. Cardiac, pulmonary and abdominal exam were unremarkable. There was no lymphadenopathy present on exam.

**Differential Diagnosis:**

1. Ankylosing Spondylitis
2. Iliopsoas Abscess
3. Epidural abscess
4. Osteomyelitis
5. Malignancy

**Test and Results:**

- ESR: elevated at 94 mm/hr, CRP: elevated at 4.57 mg/dL
- CBC: mild normocytic anemia without leukocytosis or thrombocytopenia
- CK, CMP, Uric Acid, LDH within normal limits
- Blood culture: negative
- Rheumatologic studies: ANA, adolase, ANCA were negative
- Testicular US: negative

-MRI of lumbar spine and pelvis: signal enhancement within the bones of pubis symphysis with significant surrounding soft tissue edema

-Bone biopsy: focally degenerated bone, mixed chronic inflammation, fibrosis with reactive changes. No microorganisms present on special stains

- Bone aerobic/anaerobic cultures: negative
- Quantiferon gold: POSITIVE, mycobacterium sputum PCR: POSITIVE
- Chest x-ray: negative

**Final/Working Diagnosis:**

Tuberculosis osteomyelitis of the pelvis

**Treatment and Outcomes:**

1. Treatment with ethambutol, isoniazid, pyrazinamide, and rifampin daily until cleared by infectious disease
2. Close follow up with Infectious disease clinic with monitoring labs every 2 weeks
3. Indomethacin PRN for pain
4. Range of motion and strengthening exercises for bilateral hip flexors with physical therapy
5. Regular follow up with local department of health

2420 Board #9 May 28 6:00 PM - 7:00 PM

**Head Injury - Soccer**

Mark Sederberg (Sponsor: Stanley Herring, FACSM), Melinda Loveless. *University of Washington, Seattle, WA.*  
(No relevant relationships reported)

**HISTORY:**

A 16 year-old male presented to an outpatient sports medicine clinic one month after a head-to-head collision during a soccer match with concern for concussion. There was no loss of consciousness, and he continued to play the rest of the game with a mild headache. He felt normal and asymptomatic that evening and was able to complete homework. The following morning he felt tired, but was able to perform adequately at school. Over the coming weeks, he noticed progressive worsening of his cognitive symptoms and tiredness. His athletic trainer became concerned for a concussion and held him from practice. One week prior to presentation he noted midline lower lip numbness, teeth pain while chewing, hearing his pulse in his left ear, and poor sleep due to sweatiness. He also felt progressive lethargy and difficulty concentrating and missed the last three days of school due to these symptoms. His medical history was significant only for a recently diagnosed inguinal hernia.

**PHYSICAL EXAMINATION:**

Mild cognitive deficits in attention and memory, impaired balance on BESS, normal motor strength. Cranial nerve exam showed ptosis of the left eye, mild left facial nerve palsy, decreased hearing in the left ear, and altered sensation to light touch over the middle lower lip. There was no focal tenderness or deformity of the skull or scalp.

**DIFFERENTIAL DIAGNOSIS:**

Mild traumatic brain injury

Intracranial hemorrhage

Cerebral mass

Bell's palsy

**TESTS AND RESULTS:**

MRI Brain with and without contrast: Asymmetric enhancement of the left 7<sup>th</sup> cranial nerve, asymmetric nodular enhancement along the left 5<sup>th</sup> nerve with enhancement of muscles of mastication, diffuse bilateral pachymeningeal enhancement.

Complete Blood Count: WBC 19k, platelets 80, hematocrit 30.4

CT Chest, Abdomen, Pelvis: Large abdominal soft-tissue mass herniating through the inguinal canal, most consistent with a lymphoma

CSF Cytology: Enlarged B-cells most consistent with Burkitt lymphoma.

**FINAL DIAGNOSIS:**

Stage IV Burkitt lymphoma, with primary lesion in abdomen, and perimeningeal spread, causing cranial nerve V and VII palsies.

**TREATMENT AND OUTCOMES:**

1. Admitted for prompt initiation of chemotherapy.
2. Cranial nerve symptoms resolved with chemotherapy and steroids.
3. After multiple rounds of chemotherapy, there is no evidence of residual lymphoma.

2421 Board #10 May 28 6:00 PM - 7:00 PM

**Do Different Wet Bulb Globe Temperature Reading Cutoffs Change Outdoor Heat Injury Frequency And Severity?**

Christina S. Gutta (Sponsor: Dr. Franklin Sease, FACSM)<sup>1</sup>, Ellen E. Shanley<sup>2</sup>, Vicki R. Nelson<sup>1</sup>. <sup>1</sup>*Prisma Health, Greenville, SC.*  
<sup>2</sup>*ATI Physical Therapy, Greenville, SC.*  
(No relevant relationships reported)

**PURPOSE:** To evaluate differences in injury frequency and severity between two different heat participation policies in South Carolina high school and collegiate athletics.

**METHODS:** Retrospective cohort study of Division II collegiate & high school athletes looking at injury frequency & severity between 2 different heat participation policies. Fifty middle & high schools as well as 2 Division II colleges with a total of 16,832 athletes were investigated over 3 years. Inclusion criteria were reported heat illnesses between July 1 & November 30<sup>th</sup> for 12 outdoor sports resulting in 86 injuries that were analyzed. Chi square analysis was used to compare injury frequency & severity between no outdoor workouts with a wet bulb globe temperature (WBGT) > 90 (policy 1) versus WBGT > 92 (policy 2).

**RESULTS:** For policy 1 there was a mean of 31 heat illnesses/year with an average of 16 days for illness resolution. For policy 2 there was a mean of 24 heat illnesses/year but the average of 41 days for illness resolution was significantly higher (p=0.02). Grading heat illness severity was based on guidelines developed by Rauh et al. Mild to moderate injury was defined as 0-21 days for return to activity while severe injury >21 days for return to activity. With policy 1, 4.8% of heat illnesses met severe criteria while 20.8% of heat illnesses in policy 2 were severe showing an odds ratio of heat illness with policy 2 is 5.2 times higher than policy 1 (OR 5.2, 95% CI 1.1-23.7). Conversely the percentage of mild to moderate illness was statistically lower with policy 2 compared to policy 1 (p=0.022) suggesting that policy 2 resulted in more severe heat illness. Policy 1 was in place for several years with no record of EMS transport for heat illnesses however within the first season of policy 2, there

was 3 athletes transported. The average age at time of injury was 16 years old & not statistically different between policies. There was an average of 45 minutes of practice per week lost with the WBGT cutoff of 90 compared to cutoff of 92.

**CONCLUSIONS:** Although the total number of heat illnesses did not change between policies, there was a statistically significant increase in severity of illness & time for return to sport with raising the WBGT participation cutoff from 90 to 92. Our data suggests that a cutoff of 90 reduces the frequency of severe heat illness in athletes.

2422 Board #11 May 28 6:00 PM - 7:00 PM

**International Clinical Scholar Award - Results From The Fifa Sudden Death In Football Registry (FIFA-SDR) — Sport-specific Data Of 5 Years**

Florian Egger<sup>1</sup>, Jürgen Scharhag, FACSM<sup>2</sup>, Andreas Kästner<sup>3</sup>, Jiri Dvorak<sup>4</sup>, Philipp Bohm<sup>5</sup>, Tim Meyer, FACSM<sup>1</sup>. <sup>1</sup>*Saarland University, Saarbrücken, Germany.* <sup>2</sup>*University of Vienna, Vienna, Austria.* <sup>3</sup>*University Heart Center Freiburg, Bad Krozingen, Germany.* <sup>4</sup>*Schulthess Clinic, Zurich, Switzerland.* <sup>5</sup>*University Heart Center of Zurich, Zurich, Switzerland.*  
(No relevant relationships reported)

**PURPOSE:** Large population-based studies about sudden cardiac deaths (SCD) and survived sudden cardiac arrests (SCA) in athletes from the USA and Europe indicate regional differences in the underlying causes. A different ethnic and genetic mix between these regions may lead to such a heterogeneous distribution. It is of great relevance to investigate these regional patterns to possibly optimize existing screening and prevention procedures and reduce fatalities. This registry aims to investigate SCD and SCA in football (soccer) players worldwide, both at professional and recreational level.

**METHODS:** From 2014 to 2018 cases of SCDs and SCAs were mainly recorded by media monitoring (Meltwater®), a confidential web-based data platform and data synchronization with existing national SCD registries (n=16). Inclusion criteria were met when SCD or SCA occurred during football-specific activity or up to one hour afterwards. Death during other activities was excluded.

**RESULTS:** A total of 632 players (mean age 34 ± 16 years, 96% males) was reported from 70 countries; 150 players (24%) survived. Elite players represented a small portion (6%). A diagnosis by autopsy or definite medical reports could be established in 219 cases (35%). The leading causes over the age of 35 years were coronary artery disease (CAD, 74%) and ≤35 years sudden unexplained death (22%), cardiomyopathy (CM, 17%) and CAD (11%). Hypertrophic CM and coronary artery anomalies showed the highest fraction in North America with 15% and 36%, respectively. Myocarditis was most frequently reported from Europe (7%). CAD ≤ 35 years prevailed in Africa (38%) and CM (42%) in South America. Commotio cordis occurred infrequently (3%). In North America and Australia survival rates were the highest (53% and 47%, respectively). Early use of an automated external defibrillator was associated with a higher survival rate (86%) compared to manual cardiopulmonary resuscitation (35%).

**CONCLUSIONS:** Differences between countries in the underlying cardiac diseases for SCA and SCD have to be taken into account to possibly improve and modify primary and secondary prevention measures in football players. The percentage of autopsied cases is difficult to increase because this reflects the law in most countries. Therefore, an expansion of national SCD registries is urgently needed.

2423 Board #12 May 28 6:00 PM - 7:00 PM

**Lisa S. Krivickas Clinician/Scholar Travel Award: The Diagnostic And Prognostic Utility Of Dual-task Tandem Gait For Pediatric Concussion**

Katie A. Van Deventer, Corrine N. Seehusen, Gregory A. Walker, Julie C. Wilson. *Children's Hospital Colorado, Aurora, CO.*  
(No relevant relationships reported)

**Background:** Tandem gait performance is part of the Sports Concussion Assessment Tool (SCAT), but its diagnostic and prognostic value has not been fully assessed in pediatric concussion. **Purpose:** To determine the diagnostic and prognostic value of single-task and dual-task tandem gait by comparing performance of subjects with concussion relative to controls, as well as subjects who developed Persistent Post Concussion Symptoms (PPCS) and those who did not (No PPCS). **Methods:** Subjects seen within 21 days of concussion and uninjured controls completed a single/dual-task tandem gait test battery and modified Balance Error Scoring System (mBESS) test. During the tandem gait test, subjects walked in a heel-toe manner along a 3m strip of fabric down and back as fast as possible. During dual-task trials, they completed a concurrent cognitive task. Outcomes included tandem gait time to completion, cognitive accuracy, and mBESS errors. Subjects with concussion were followed until symptom resolution and sub-grouped into those who developed PPCS (>28 d time to symptom resolution) vs. No PPCS. **Results:** We evaluated 29 subjects with concussion who developed PPCS (mean age=15±2 years; 62% female; tested 12±6 days post-injury), 58 subjects with concussion who did not develop PPCS (mean age=14±3 years; 36% female; tested 8±5 days post-injury), and 58 controls (mean age= 16±1 years; 42% female). Subjects with concussion performed significantly worse than

healthy controls on single-task tandem gait ( $24.4 \pm 12.6$  vs.  $14.9 \pm 3.6$  s;  $p < 0.001$ ; area under curve [AUC]=0.85), dual-task tandem gait ( $33.3 \pm 14.9$  vs.  $20.6 \pm 7.1$  s;  $p < 0.001$ ; AUC=0.84), dual-task cognitive accuracy ( $82.1 \pm 12.5$  vs.  $89.1 \pm 18.9$  %;  $p = 0.01$ ; AUC=0.61), and mBESS ( $6.5 \pm 4.9$  vs.  $3.8 \pm 3.4$  errors;  $p = 0.001$ ; AUC=0.68). The PPCS sub-group performed dual-task tandem gait significantly slower than the No PPCS group ( $38.8 \pm 17.7$  vs.  $30.6 \pm 12.7$  s;  $p = 0.016$ ; odds ratio=1.04), but PPCS and No PPCS groups were not significantly different on other measures. **Conclusions:** Pediatric patients with concussion have impaired performance on balance and gait measures compared to healthy controls. Dual-task tandem gait test specifically showed diagnostic value for pediatric concussion and prognostic value in differentiating subjects who developed PPCS compared to those who did not.