

G-11 Highlighted Symposium - Make No Bones About It: Bone Loading in Relation to Bone Stress Injuries

Saturday, June 1, 2019, 9:00 AM - 11:00 AM
Room: CC-303

The skeleton adapts and responds to repetitive mechanical loading. The same loading features that induce favorable bone adaptation can also lead to bone stress injuries, including stress fractures. This symposium will discuss the loading and response of bone as it relates to bone stress injuries.

3218 Chair: Stuart J. Warden, FACSM. Indiana University, Indianapolis, IN.

Reported Relationships: **S.J. Warden:** Industry contracted research; GE/ NBA Orthopedics and Sports Medicine Collaboration.

3219 June 1 9:10 AM - 9:40 AM Keynote

Stuart J. Warden, FACSM. Indiana University, Indianapolis, IN.
Reported Relationships: **S.J. Warden:** Industry contracted research; GE/ NBA Orthopedics and Sports Medicine Collaboration.

3220 June 1 9:40 AM - 9:55 AM Changes in Bone Microarchitecture and Estimated Bone Strength Over 12 Months After Tibial Stress Fracture Diagnosis: Implications for Return to Sport

Kristin L. Popp¹, Sara G. Rudolph², Signe Caksa², Amy Yuan², Julie M. Hughes³, Kathryn E. Ackerman, FACSM⁴, Adam S. Tenforde⁵, Chun Xu⁶, Ginu Unnikrishnan⁶, Jaques Reifman⁶, Mary L. Bouxsein⁷. ¹Massachusetts General Hospital, Harvard Medical School, United States Army Research Institute of Environmental Medicine, Boston, Natick, MA. ²Massachusetts General Hospital, Boston, MA. ³United States Army Research Institute of Environmental Medicine, Natick, MA. ⁴Massachusetts General Hospital, Harvard Medical School, Boston Children's Hospital, Boston, MA. ⁵Spaulding Rehabilitation Hospital, Boston, MA. ⁶High Performance Computing Software Applications Institute, Frederick, MD. ⁷Massachusetts General Hospital, Harvard Medical School, Beth Israel Deaconess Medical Center, Boston, MA.

(No relevant relationships reported)

Stress fractures (SF), common injuries among athletes, have been reported in up to 20% of track and field athletes. Typically, after a period of unloading and gradual return to weight-bearing activities, athletes return to unrestricted participation in their given sport 12-14 weeks after SF diagnosis. However, the time course of the recovery of mechanical competence of the bone is not well characterized, and reinjury rates are high. **PURPOSE:** To determine changes in bone microarchitecture and estimated bone strength over 12 months following tibial SF diagnosis. **METHODS:** We enrolled 30 women, ages 18-35, with a tibial SF (grade 2 or higher) for this prospective observational study. Participants completed a baseline visit within 3 weeks of SF diagnosis. At baseline, 6, 12, 24, and 52 weeks following SF diagnosis, we collected high-resolution peripheral quantitative computed tomography (HR-pQCT) scans of the ultradistal tibia (4% of tibia length), background and lifestyle questionnaires, and a physical activity assessment. **RESULTS:** Over the initial 12 weeks, total volumetric bone mineral density (vBMD) declined by 1.2% ($p=0.001$), trabecular vBMD by 1.2% ($p=0.006$), cortical thickness by -1.0% ($p=0.007$), and bone volume/total volume by 1.2% ($p=0.008$). At 24 weeks, mean values for all bone parameters were nearing baseline values, and by 52 weeks, mean values had surpassed baseline values. A similar trend was seen in estimated bone strength, though changes did not reach statistical significance. Of the 30 participants, 7 incurred a subsequent SF during the course of the 12 month-follow up and 2 incurred ≥ 2 subsequent SFs. **CONCLUSION:** Persisting decrements in bone microarchitecture and estimated bone strength suggest bone mechanical integrity does not return to baseline for 3-6 months after tibial SF diagnosis. This, coupled with the high rate of recurrent SFs, suggests more conservative return to sport guidelines may be in order.

The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Army or of the U.S. Department of Defense. This abstract has been approved for public release with unlimited distribution.

3221 June 1 9:55 AM - 10:10 AM

Changes in Tibial Bone Microarchitecture in Response to 8 Weeks of US Army Basic Combat Training in Men and Women: A Preliminary Analysis from a Large Field Study

Julie M. Hughes¹, Katelyn I. Guerriere¹, Kathryn M. Taylor¹, Kristin L. Popp², Ronald W. Matheny, Jr.¹, Stephen A. Foulis¹, Mary L. Bouxsein³. ¹United States Army Research Institute of Environmental Medicine, Natick, MA. ²United States Army Research Institute of Environmental Medicine, Massachusetts General Hospital, Natick, MA. ³Massachusetts General Hospital, Harvard Medical School, Beth Israel Deaconess Medical Center, Boston, MA.

(No relevant relationships reported)

Stress fractures are overuse injuries in bone tissue that are common during Army Basic Combat Training (BCT) when recruits undergo a period of heightened physical activity. The pathophysiology and mechanoadaptive biology that underlie stress fracture development and prevention continue to be characterized. Mechanoadaptation to BCT has been demonstrated in the tibial microarchitecture of female military recruits. Whether male military recruits are able to mount an analogous response to BCT remains to be determined. **PURPOSE:** To analyze preliminary data from a large prospective field study (427 men and women from a larger cohort of ~4000 recruits to be studied) with the goal of characterizing changes in tibial bone microarchitecture in male and female recruits as a result of 8 weeks of BCT. **METHODS:** We collected high-resolution peripheral quantitative computed tomography images of the distal tibia (4% from the distal tibial plateau) before and after BCT and analyzed data on 303 male and 124 female recruits who volunteered and completed BCT. Linear mixed models were used to estimate the mean difference for each outcome from pre- to post-BCT, while controlling for race/ethnicity, age, and body mass index. **RESULTS:** Mean age of male (20.7 ± 3.4 yrs) and female (20.6 ± 3.6 yrs) recruits was similar. At the distal tibia, cortical thickness, trabecular thickness, bone volume/total volume, and total, trabecular, and cortical volumetric bone mineral density (vBMD) increased significantly by 0.50-2.28% (all $p<0.0001$) over the BCT period in women and by 0.32-1.84% (all $p<0.0001$) in men. **CONCLUSIONS:** This preliminary view of data collected to date found that following BCT, both men and women mounted an adaptive response in tibial trabecular bone microarchitecture, indicative of de novo trabecular bone formation. The responses in tibial bone microarchitecture were of greater magnitude in women than in men, which may be due to lower average baseline values in bone microarchitectural properties in women, and therefore potentially greater loading stimuli. Other lifestyle and demographic factors may also influence the adaptive bone response to BCT and will be investigated in the larger sample following study completion.

3222 June 1 10:10 AM - 10:40 AM

Keynote

Irene S. Davis, FACSM. Harvard Medical School, Cambridge, MA.

(No relevant relationships reported)

G-17 Thematic Poster - Athlete Nutrition II

Saturday, June 1, 2019, 9:00 AM - 11:00 AM
Room: CC-101A

3248 Chair: Lynn Cialdella-Kam. Case Western Reserve University, Cleveland Heights, OH.

(No relevant relationships reported)

3249 Board #1 June 1 9:00 AM - 11:00 AM
Effects Of An Online Sports Nutrition Curriculum On Biomarkers Of Iron Status In Youth Athletes

Marni E. Shoemaker, Zachary M. Gillen, Brianna D. McKay, Nicholas A. Bohannon, Alegria I. Mendez, Joel T. Cramer, FACSM. *University of Nebraska-Lincoln, Lincoln, NE.*
 (Sponsor: Dr. Joel T. Cramer, FACSM)

(No relevant relationships reported)

Online nutrition education curricula framed around concepts of sports nutrition may improve accessibility as well as engagement, awareness, and adherence for active high school athletes.

Purpose: Examine the effects of an online sports nutrition curriculum on ferritin, soluble transferrin receptor (sTfR), and hemoglobin (Hb) biomarkers of iron status in high school athletes.

Methods: One hundred twenty-three male (n=56, age: 17 ± 1 y, stature: 76 ± 20 kg, mass: 176 ± 6 cm) and female (n=67, 16 ± 1 y, 67 ± 16 kg, 164 ± 6 cm) high school athletes were tested for ferritin, sTfR, and Hb concentrations before and after participating in seven online sports nutrition modules (~1 module per week) focused on macronutrients, micronutrients, performance plate, energy balance, nutrient timing, and supplements. Pre- and post-education prevalence of poor iron status for each biomarker was calculated, while individual subject's iron status classification was tracked. Mixed factorial ANOVAs (time x sex) compared mean biomarker concentrations.

Results: Prevalence of iron depletion (ferritin cutoffs) increased from 48 to 52% and decreased from 79 to 75%, low iron levels (sTfR cutoffs) decreased from 38 to 30% and increased from 29 to 33%, and anemia (Hb cutoffs) decreased from 20 to 14% and 29 to 23% in males and females, respectively. Subjects classified as iron depleted (n=65) did not change, one subject improved iron levels, while six subjects (6%) improved their classification from anemic (n=25) to non-anemic (n=19) from pre- to post-education. There were no interactions (p>0.05) or main effect for time (p>0.05) for ferritin (pre 28.4 ± 15.1 to post 28.0 ± 14.2), sTfR (19.0 ± 8.2 to 20.1 ± 7.4), or Hb (13.5 ± 2.2 to 13.9 ± 1.8). There was no main effect for sex (p>0.05) for sTfR (m: 19.2 ± 6.4, f: 19.8 ± 6.4), but males exhibited higher (p≤0.05) concentrations of ferritin (m: 32.5 ± 18.2, f: 23.8 ± 18.2) and Hb (m: 14.3 ± 1.7, f: 13.2 ± 1.7).

Conclusions: Females present a greater risk of poor iron status, suggesting a need to focus on dietary iron in young female athletes. Participating in the online sports nutrition curriculum did not improve mean concentrations of ferritin, sTfR, or Hb, but did improve anemia classifications for six subjects (n=3 males, n=3 females).

Acknowledgments: This study was funded by the Nebraska Beef Council.

3250 Board #2 June 1 9:00 AM - 11:00 AM
NCAA Division I Women's Cross Country Consumes Adequate Energy Midseason Following Nutrition Education Seminars

Catherine Saenz¹, Jared A. Mallard¹, Kelsey M. Beckmann¹, Terrance Orange¹, Kevin RM Coyle¹, Kara L. Conway¹, Jeff T. Wight¹, George G.A. Pujalte, FACSM², David R. Hooper¹.
¹Jacksonville University, Jacksonville, FL. ²Mayo Clinic, Jacksonville, FL. (Sponsor: Carena Winters, FACSM)

(No relevant relationships reported)

Elite-level endurance athletes are prone to low energy availability due to the high energy demands of the sport and the propensity to emphasize low body compositions. Low energy availability may lead to nutrient-related deficiencies such as low iron and low vitamin D. Chronic deficiency in these essential nutrients may lead to health issues, including symptoms related to the female athlete triad. Women endurance athletes are at a particular risk for low energy availability mid-season due to the high energy demands. Previous studies indicate that collegiate-level women's cross country runners do not have enough knowledge on how nutrition and energy availability affect health. Little is known on how nutrition education may affect energy intake mid-season and how it may affect circulating markers commonly associated with the female athlete triad. **PURPOSE:** To observe: 1) If collegiate women cross country runners consumed adequate energy mid-season after receiving nutrition education. 2) To observe how mid-season nutrition affected serum Iron and serum Vitamin D values. **METHODS:** Five women from a NCAA Division I cross-country team (age: 20.8±1.5 years, height: 169.6±5.7 cm, weight: 58.3±4.1 kg) received nutrition education starting at pre-season and continuing on throughout the season. Three-day diet records were collected and analyzed by a registered dietician. After an overnight fast, blood samples were collected and measured for total ferritin and circulating Vitamin D by immunoassay. **RESULTS:** Athletes consumed an average (95% CI) of 1980 kcal/d (1740-2220kcal/day). Dietary carbohydrate was 4.2g/kg/d (95% CI: 3.4-5.0g/kg/d), dietary fat was approximately 28% (95% CI: 25-33%), and dietary protein was 1.5g/kg/d (95% CI: 1.3-1.6g/kg/d) of the diet. Serum ferritin was 28.1 ng/mL (95% CI: 14-35ng/mL) and Vitamin D was 46.8ng/mL (95% CI: 39.6-54.6ng/mL). **CONCLUSION:** Despite the demanding training volume mid-season, collegiate women's cross country runners were able to maintain adequate calories and recommended intake for dietary fat and

dietary protein. Circulating markers commonly associated with female athlete triad were also within the recommended ranges for optimal health. A nutrition education program may help bring awareness and knowledge on how adequate energy is vital to health and performance.

3251 Board #3 June 1 9:00 AM - 11:00 AM
Nutrition and the Female Athlete: Macronutrient Consumption and Body Composition Changes among Collegiate Volleyball Players.

Yvette L. Figueroa. *Augusta University, Augusta, GA.* (Sponsor: Arlette C. Perry, FACSM)
 Email: yfigueroa@augusta.edu

(No relevant relationships reported)

An athlete's diet and physical training have been reported to have direct positive influences on performance variables including strength and power which are strategic to athletic performance. According to nutritional recommendations, however, female athletes consume far less total calories, carbohydrates, and proteins when compared to male athletes of similar lean body mass (LBM). **PURPOSE:** To determine 1) whether collegiate volleyball players meet nutrition recommendations and 2) whether there are significant changes in macronutrient consumption and body composition after an eight-week, off-season resistance training program. **METHODS:** Eleven collegiate-level competitive female volleyball players were examined for total calorie, carbohydrate, and protein consumption using three-day food logs. A body height/weight scale and hydrodensitometry were used to compute body mass index (BMI), LBM, and percent body fat (BF). **RESULTS:** The volleyball players reported total calorie consumption 15.06% and 10.79% below recommended guidelines before and after training, respectively, while carbohydrate intake was 7.27% and 4.77% below recommended guidelines before and after training, respectively. Protein intake levels met recommended guidelines and did not change throughout the training program. Paired samples t-tests showed increases in LBM, and decreases in BMI and BF following eight weeks of training (p<0.05 for all). **CONCLUSION:** Our study showed that despite positive improvements in body composition, collegiate volleyball players are not meeting current nutritional recommendations for optimal athletic performance. These findings may have important health and performance implications specific to collegiate female athletes.

3252 Board #4 June 1 9:00 AM - 11:00 AM
Examination Of Energy Availability On The Hormonal Profile Of Endurance-trained Male Athletes

Erin M. Moore¹, Toni M. Torres-McGehee², Clemens Drenowatz³, Brittany T. Williams², Thaddeus C. Broderick², David F. Stodden², Justin M. Goins². ¹University of South Florida, Tampa, FL. ²University of South Carolina, Columbia, SC. ³Pädagogische Hochschule Oberösterreich, Linz, Austria.
 Email: emm6@health.usf.edu

(No relevant relationships reported)

Currently, there is inadequate literature existing for male athletes who participate in high-energy expenditure activities with decreased energy needs. Understanding the physiological demands and consequences of decreased energy availability (EA) in male athletes is critical for acute and long-term health and prevention of injuries and illness. **Purpose:** Examine the effect of EA on reproductive (Testosterone [T] and Luteinizing Hormone [LH]) and metabolic hormones (Insulin, Leptin, Cortisol, and Interleukin-6 [IL-6]) in male endurance-trained athletes. **Methods:** A cross-sectional design on 14 endurance trained male athletes (age: 26.4 ± 4.2 yrs.; weight: 70.6 ± 6.4 kg; height: 179.5 ± 4.3 cm, BMI: 21.9 ± 1.8, Body Fat% (BFP): 13.6 ± 3.5%) were recruited from the local community. Participants completed 2 separate training weeks (low [LV] and high [HV] training volumes) and each week included: 7-day dietary logs, 7 day-exercise logs, and 1 blood draw each week to determine concentrations for 6 hormones (reproductive and metabolic). Anthropometric measurements (height, weight, and body composition) were taken prior to data collection. LEA was defined as (≤ 20 kcal/kg FFM·d. **Results:** Participants at risk for LEA (41.2%: n = 7; HV: 50%: n = 4; LV: 33.3%, n = 3) had increased T levels (p = 0.20) and 21.7% (n = 5) (HV: 18.2%, n = 2; LV: 25%, n = 3) presented with low Leptin levels (p = 0.01). A significant difference was found between the 2 training weeks - Leptin (t₍₁₃₎ = 1.61 p < 0.001; HV: 78.6%, n=11; LV: 85.7%, n=12), EA - overall T (χ² (2) = 4.4, p = 0.04), and HV week - T (χ² (2) = 5.8, p = 0.02). A strong negative correlation was found for overall Leptin to BFP: (r₍₂₄₎ = -0.73, p < 0.001) and T-RMR (F(1, 23) = 16.23, p < 0.001). A weak negative correlation for T-EI (F(1,24) = 6.7, p = 0.02) and a strong positive correlation was found for overall T- BFP (F(1, 24) = 51.9, p < 0.001). **Conclusion:** Overall, participants who demonstrated LEA, highlighted a significant negative relationship between LEA and Leptin. Due to Leptin's negative response to EA below 20 kcal/kg FFM·d; male runners should monitor their exercise expenditure and dietary intake to maintain appropriate levels of EA (> 20 kcal/kg FFM·d). Valid and reliable predictive equations for hormones should be examined to become useful tools for clinicians whom do not have access to blood work.

3253 Board #5 June 1 9:00 AM - 11:00 AM
Sources Of Nutrition Information And Knowledge For Ultra-runners

Sara E. Mahoney, FACSM, Thomas R. Wójcicki, Andrew J. Carnes, Nigel Ouslan. *Bellarmine University, Louisville, KY.*
 Email: smahoney@bellarmine.edu
 (No relevant relationships reported)

PURPOSE: Ultra-marathon events (i.e., >42.2-km) continue to grow in popularity; however, little research exists on the typical dietary intake of ultramarathon participants, or the sources of information which influence their habits and beliefs. The objectives of this study were to characterize the acquisition of nutrition information among ultra-endurance athletes, and to determine the relationship between the use of different sources of information and nutritional knowledge (relative to current evidence-based recommendations). **METHODS:** Participants (n=196) were adults who had completed an ultramarathon at least once in the past 2 years. Measures included: a demographic questionnaire; the Sources of Nutrition Information (SONI) questionnaire, which included 7 major sources of nutrition information, as well as their credibility, accessibility, frequency, interest; and the General Nutrition Knowledge Questionnaire - Revised (GNKQ-R). Repeated measures ANOVA was used to analyze differences between items on the SONI scale. Spearman rank correlation was used to test for a relationship between sources of information and GNKQ-R score. **RESULTS:** 18% self-identified as vegan/vegetarian, 6% paleo/ketogenic, 20% traditional American diet, 54% "healthy" and 12% "other". Peer reviewed literature was reported as the most frequently used (mean score=1.64, p<0.001), credible (3.02, p<0.001), and interesting (2.62, p=0.002). Social media was the most accessible (2.81, p<0.001), but the least credible (1.87, p<0.001). A modest, significant correlation (r=0.185, p = 0.015) exists between use of peer-reviewed literature and nutrition knowledge. **CONCLUSIONS:** Ultrarunners report high usage of peer-reviewed literature for nutrition information, which is related with improved nutritional knowledge. Because of its accessibility, social media may be a promising tool to provide nutrition information to this population.

3254 Board #6 June 1 9:00 AM - 11:00 AM
Lack Of Nutrition Knowledge In Division II Athletes Associated With Limited Access To Registered Dietitians

Brian P. Reagan¹, Darby Culp¹, Christa Parkes¹, David Pierce².
¹University of Indianapolis, Indianapolis, IN. ²Indiana University - Purdue University, Indianapolis, Indianapolis, IN.
 (Sponsor: Dr. Riggs Klika, FACSM)
 Email: reaganb@uindy.edu
 (No relevant relationships reported)

Limited nutrition knowledge is prevalent among all types of athletes, which is correlated with negative health consequences. Eating disorder (ED) etiology is the most documented, dire issue facing athletes, especially those in lean-emphasized sports (LES) such as gymnastics and tennis. primary contributor to ED in LES is athletes' lack of nutrition knowledge of carbohydrates (CHO), fats, and weight management (WM). **PURPOSE:** To assess NCAA Division II (DII) athletes' knowledge in distinct domains: (1) CHO, (2) fats, and (3) WM. **METHODS:** The Macronutrient and Energy Metabolism Expertise Survey (MEMES) was created through modification of Reagan's NET Survey. Changes included different domains (e.g. WM questions vs. Etiology) and expanding number of questions (5 to 10). An expert panel confirmed the face and construct validity of the MEMES before it was piloted. Athletes signed informed consent and then voluntarily completed the MEMES via Qualtrics in a designated computer lab on one test date. Email reminders were sent 1 month, 1 week, and 1 day prior to test date. The criterion for "Adequate Knowledge" (AK) was set at 80% for each domain and total score correct. Pearson product moment correlations were calculated between variables (e.g. percent correct, gender, sport). **RESULTS:** Eighty-eight males and eighty females completed the MEMES (35.8% return rate). Males scored significantly higher on CHO (p = 0.017) and athletes (n = 16) who reported having access to a Registered Dietitian (RD) scored significantly higher on the CHO and fat domains (p = 0.00 and 0.042, respectively). The majority (28.6%) reported "experience as an athlete" as their primary source for nutrition knowledge. The least cited source was a RD (8.9%). Also, the athletes lacked knowledge: the mean total score was 14.4 correct out of 40 or 36%, falling below the established AK of 80%. The mean of correct scores were 29.1%, 37.0%, and 41.9% for fats, CHO, and WM, respectively. **CONCLUSION:** The results suggest that athletes are at a high risk of health consequences such as ED. Likewise, they are likely to be misinformed about sound sports nutrition by relying on their self-knowledge rather than a professional advice from a RD. This challenges the notion that experience as an athlete is a source of nutrition knowledge.

3255 Board #7 June 1 9:00 AM - 11:00 AM
Evidence Of A Relationship Between Dietary Fat Intake And Inflammation Among Professional Soccer Players

Diarmuid Daniels¹, Nathan Lewis², Paul Catterson³, John Newell¹, Georgie Bruinvels⁴, Micheal Newell¹, Andrew Simpkin¹, Andrew Barr⁴, Charles R. Pedlar². ¹National University of Ireland Galway, Galway, Ireland. ²St Mary's University, Twickenham, United Kingdom. ³Newcastle United Football Club, Newcastle, United Kingdom. ⁴Orreco, Business Innovation Centre, National University of Ireland, Galway, Ireland.
 (No relevant relationships reported)

Reducing background inflammation in athletes may be a medical and performance objective. Data describing the relationship between erythrocyte membrane fatty acids (EMFA) and low grade inflammation in soccer players are absent from the literature. EMFA reflects dietary fat intake in the weeks preceding the blood test. **PURPOSE:** To investigate the strength and reproducibility of the relationship between EMFA and inflammation in a group of professional soccer players. **METHODS:** We conducted an observational study, collecting venous blood samples measuring high-sensitivity C-reactive protein (CRP) and EMFA in the early season (T1) and late season (T2). A total of 47 blood samples were collected from 29 different athletes, with 25 athletes tested at T1, and 22 athletes at T2. A cut off point of >5mg/L¹ was set to minimise the effect of acute inflammation, and these samples were removed from the analysis. Linear relationships between biomarker variables were examined using Pearson correlation tests. **RESULTS:** At T1, we report significant positive correlations between CRP and the following EMFA variables: Omega6:Omega3 ratio and the Arachidonic Acid: Eicosapentaenoic acid (AA:EPA) ratio (0.566, p< 0.003, and 0.582, p< 0.002 respectively) and significant negative correlations with the Omega 3 index and the anti-inflammatory fatty acid index (AIFAI; -0.495, p< 0.011, and -0.465, p< 0.018 respectively). However, at T2, the relationship between EMFA variables and inflammation had attenuated, with no strong linear correlations observed. The correlation analysis of all the blood samples collected (n=47) showed significant correlations between the Omega-3 Index, the AIFAI and CRP (-0.319, p< 0.028, and -0.299, p< 0.040 respectively). **CONCLUSION:** There is a relationship between inflammation and EMFA variables in professional soccer players and the strength of this relationship appears to depend on the sampling occasion. Future research should explore augmenting EMFA as an anti-inflammatory strategy.

3256 Board #8 June 1 9:00 AM - 11:00 AM
Sex Differences in Nutrition Knowledge of Division I College Athletes

Alyssa J. Guadagni, Emily N. Werner, James M. Pivarnik, FACSM. *Michigan State University, EAST LANSING, MI.*
 (Sponsor: JAMES M. PIVARNIK, FACSM)
 Email: guadagn2@msu.edu
 (No relevant relationships reported)

Appropriate nutrition is imperative for participation in, and recovery from, exercise. However, many college athletes do not have a sufficient nutrition knowledge base to help them stay healthy during their physically taxing sports. **PURPOSE:** To assess the nutrition knowledge base of NCAA Division I college athletes using a validated nutrition knowledge survey. **METHODS:** Varsity athletes at a Division I university were recruited via word-of-mouth. A validated nutrition knowledge survey (Callella et al., 2017) that contained both general- and sport nutrition-specific sections, was administered at different settings convenient to the athletes (e.g., team meetings or training table). Participants were asked not to share answers or use any outside resources (e.g., internet). Scores were summed as +1 for a correct answer or +0 for no answer, an incorrect answer, a double-answer, or the "I don't know" option. The maximum possible score was 97. Knowledge was categorized as low (<33rd percentile), medium (33rd to 66th percentile), and high (> 66th percentile). Frequencies of knowledge categories were tallied, and an independent t-test was run to determine sex differences. Alpha level was set at p<0.05. **RESULTS:** Athletes (n=128; n=70 female, n=58 male) from eight different sports completed the nutrition knowledge survey. Frequencies of each knowledge category were 42 (n=11 female, 31 male) with low knowledge, 24 (n= 7 female, 17 male) with medium knowledge, and 62 (n=52 female, 10 male) with high knowledge. Average scores for females were 64.5±15.9, 43.1±11.0, and 21.4±5.9 for the total survey, general nutrition, and sport nutrition sections, respectively. On average, males scored significantly lower, with scores of 43.6±15.1, 27.6±10.1, and 16.0±6.7 for the total survey, general nutrition, and sport nutrition sections, respectively (p<0.001). **CONCLUSION:** Based on survey results, the majority of NCAA Division I athletes assessed fell into the high nutrition knowledge category, with most in the category being female. Future research should expand on this to assess knowledge of specific nutrition concepts.

G-18 Thematic Poster - Behavioral Aspects of Exercise

Saturday, June 1, 2019, 9:00 AM - 11:00 AM
Room: CC-102A

3257 Chair: Erica M. Taylor, FACSM. *Columbus State University, Columbus, GA.*

(No relevant relationships reported)

3258 Board #1 June 1 9:00 AM - 11:00 AM

The Physical and Mental Rehabilitation Effect of Healthy-mind Exercise intervention on Individuals of Illicit Drug Dependent

Dong Zhu¹, Mei Jiang¹, Ding Xu². ¹Shanghai University of Sport, Shanghai, China. ²Shanghai Drug Administration, Shanghai, China.

Email: zhudong@hotmail.com

(No relevant relationships reported)

PURPOSE: Healthy-mind exercise is an exercise of a low-medium intensity and benefit to both physically and mentally. The exercise is composed of Tai Chi, Healthy Qi Gong and Yoga. The hypothesis of this experiment was that the healthy-mind exercise intervention is superior to the conventional physical rehabilitation methods in Shanghai compulsory detoxification and rehabilitation centers on the effect of fitness and quality of life.

METHODS: A total of 100 male individuals of illicit drug dependent who met the inclusion criteria were recruited and randomly assigned to two groups. In the experimental group (n=50), subjects practiced three times of healthy-mind exercise in the morning, noon and evening for 20 minutes for each exercise session. The total time of the exercise was 60 minutes, 5 times a week. The control group was treated with the conventional rehabilitation method (n=50). The contents of the exercises in control group included recreational gymnastics, gesture exercise, the times of daily practice, duration of each session, total duration of a day and the repetitions per week were the same as those of the experimental group. Outcomes of fitness, quality of life for drug addiction questionnaire (QOL-DA) were measured at the baseline, 3 month and 6 month. Data analysis was applied with SPSS 19.0. A two-way repeated measures analysis of variance (ANOVA) was applied to test whether the treatments were different after 6 months.

RESULTS: At baseline, no statistically significant differences were observed between two groups in terms of demographic outcomes, fitness and the scores of QOL-DA. After 6 months of exercise intervention, there were significant differences found in systolic ($F_{(2,166)}=11.77$), diastolic ($F_{(2,166)}=8.96$), heart rate ($F_{(2,166)}=7.82$), vital capacity ($F_{(2,166)}=3.08$), flexibility ($F_{(2,166)}=13.85$), aerobic endurance ($F_{(2,166)}=15.05$). The results of QOL-DA showed that there were significant differences between experimental group and control group in physical function ($F_{(2,170)}=10.32$), psychological function ($F_{(2,170)}=9.71$), symptom function ($F_{(2,170)}=6.42$), social function ($F_{(2,170)}=14.91$) and total score ($F_{(2,170)}=15.95$). **CONCLUSIONS:** This study proved that the healthy-mind exercise was suitable for substance dependent individuals.

3259 Board #2 June 1 9:00 AM - 11:00 AM

Confirmation of Self-Reported Ambulatory Exercise Bouts During Ecological Momentary Assessment

Lindsay P. Toth, Lucas F. Sheridan, Kelley Strohacker, FACSM. *The University of Tennessee, Knoxville, TN.*

(No relevant relationships reported)

Ecological momentary assessment (EMA) is a method of self-report (SR) that can be used to examine how fluctuations in physical activity (PA) behavior are related to affective, contextual, and cognitive antecedents. Concurrent objective PA monitoring is recommended with EMA to supplement retrospective questions about PA. The objective PA data could be useful for confirming that SR bouts of ambulatory exercise occurred as described (timeframe, duration, intensity). To date, such a confirmation process has not been described in the literature. **PURPOSE:** Assess the use of accelerometry to confirm EMA of ambulatory exercise. **METHODS:** Participants (N=29, age 24±6y) completed four mobile surveys/d for 14-d (82% response rate) denoting exercise type and duration over the preceding 4-h. Throughout the 14-d period, participants wore an ActiGraph GT3X+ (AG) on the hip (14.0±3.5h/d). To confirm EMA reported exercise bouts, survey meta-data (date, time-stamp) and bout durations were used to guide visual inspection (VI) of AG data within the corresponding 4-h time blocks by two independent reviewers (inter-observer agreement=84% and after deliberations=100%). The Crouter 2-Regression Model (C2RM) was applied to AG counts to determine a min-to-min coefficient of variation (CV). SR bouts were confirmed when the C2RM CV ranged between 1% and 10%

continuously and step counts were above 5 steps per 10s epoch for the approximate SR duration. Descriptive statistics and frequency analyses were conducted. **RESULTS:** 93 of 128 bouts were confirmed, and the average SR bout duration (29±20min) was slightly greater than VI bouts (25±20min). Ten bouts were unable to be confirmed due to AG non-wear. In the 25 remaining unconfirmed cases, no continuous bouts matching the SR durations were observed. **CONCLUSIONS:** Processing AG data using C2RM allowed intuitive and reliable VI for confirmation of continuous ambulatory exercise bouts reported via standard EMA survey items. Feasibility of applying this process may be limited by large sample sizes.

3260 Board #3 June 1 9:00 AM - 11:00 AM

Feasibility Of A Novel Video Game-based EMG Biofeedback System In Patients With Knee Osteoarthritis

Eileen Krepkovich¹, Colby Magnum², Susan Saliba², Matthew Lichter¹, Aaron Olowin¹, Neal Richardson¹, Joseph Hart, FACSM². ¹Barron Associates, Inc., Charlottesville, VA.

²University of Virginia, Charlottesville, VA. (Sponsor: Joseph Hart, FACSM)

(No relevant relationships reported)

PURPOSE: Rehabilitation through quadriceps strengthening is a well-established treatment for patients with osteoarthritis (OA) of the knee. Electromyography (EMG) biofeedback units provide an interactive mechanism to increase motivation during exercise, but conventional systems are expensive, and their simplistic interface may not be engaging to the user. The purpose of this study was to compare technology acceptance and knee extension torque production using EMG biofeedback presented to patients from within a video game interface.

METHODS: A novel virtual world game system ("KneeBRIGHT") was developed that integrated electromyography (EMG) biofeedback and guided patients through quadriceps strengthening routines. Feasibility testing was completed with 19 patients with a prior diagnosis of knee joint osteoarthritis (51.9±7.5yrs, 88.7±19.8kg, 170.5±7.4cm). Participants conducted 2 testing sessions on separate days. During the first session, participants performed 3 sets of lower body exercises with emphasis on maximal muscle activation, endurance, and motor control/precision. These exercises were conducted with a commercially available EMG biofeedback unit (Pathway MR-20, Promethius Group, Dover, NH). During the second session, participants used the KneeBRIGHT game that was designed to match the exercise sets in the first session. For all sessions, knee extension torque was recorded during the isometric muscle activation exercises using a dynamometer, and patient engagement was assessed using the technology acceptance model (TAM) questionnaire. Peak torque and TAM scores obtained during the KneeBRIGHT and traditional biofeedback sessions were compared using paired t-tests.

RESULTS: Knee extension torque generated during KneeBRIGHT game exercise sessions was increased by an average of 25% compared to the torque generated during conventional EMG biofeedback sessions (2.14 Nm/kg vs. 1.77 Nm/kg, p=0.02). There was no significant difference in TAM scores between the sessions (3.42±0.4 vs 3.2±0.5, p=0.25).

CONCLUSIONS: Patients exercising with the KneeBRIGHT game produced greater knee torque than patients exercising with the conventional system, and demonstrated positive levels of engagement.

3261 Board #4 June 1 9:00 AM - 11:00 AM

Exploring Qualitative Determinants of Regular Group Indoor Cycling Participation in a Diverse Sample of Adults

Alvin L. Morton¹, Lyndsey M. Hornbuckle¹, Miguel Aranda¹, Derrick T. Yates¹, Courtney L. Anderson². ¹University of Tennessee, Knoxville, Knoxville, TN. ²Georgia State University, Atlanta, GA.

Email: amorto16@vols.utk.edu

(No relevant relationships reported)

While U.S. adults generally do not acquire adequate amounts of physical activity, non-Hispanic Blacks (NHB) obtain less physical activity than non-Hispanic Whites (NHW). Identifying reasons why NHB regularly participate in a given exercise modality may help tailor future recommendations in this population. Group indoor cycling (GIC) classes have gained popularity and are offered widely in fitness facilities. **PURPOSE:** To qualitatively investigate the motivation for regular GIC class participation in a racially diverse sample.

METHODS: Women and men attending GIC classes at a rhythm-based cycling studio ≥ 1 day/week for the preceding three consecutive months were recruited. Participants completed a questionnaire that included two open-ended questions: 1) "Why do you continue to regularly choose GIC classes for exercise?" and 2) "How does the environment at this cycling studio motivate you to continue to choose GIC for exercise?" Three investigators independently analyzed data using established procedures for thematic analysis. Data from the two questions were reported in

aggregate. **RESULTS:** Seventeen adults (88% female; 71% NHB; 29% NHW; mean±SD age: 32.1±7.4 yrs.; body mass index: 26.2±3.6 kg/m²) completed the study. Five main themes emerged as reasons for regular GIC class participation in NHB and NHW, respectively: music selections (83 and 80%), studio atmosphere (67 and 40%), social support (67 and 80%), physical health (58 and 100%), and enjoyment/fun (42 and 60%). **CONCLUSIONS:** The music (majority hip-hop and rap) in this studio may have played an integral role in attracting NHB to participate in GIC classes at this studio on a regular basis. NHW participants indicated physical health as a key motivator for class attendance. More research is needed to gain a deeper understanding of cultural relevance as it relates to motivational factors for exercise, which could inform future strategies for promoting regular exercise in various populations.

3262 Board #5 June 1 9:00 AM - 11:00 AM
Creativity In Children With Different Level Of Cardiorespiratory Fitness And Fat Mass: A Cross-Sectional Study

Gleydiane A. Fernandes¹, Kell Grandjean da Costa¹, Kaline Brito¹, Karina da Silva Oliveira², Tatiana de Cássia Nakano², Eduardo Bodnariuc Fontes¹. ¹UFRN, Natal, Brazil. ²PUC-Campinas, Campinas, Brazil.
 Email: ciane_al@hotmail.com
 (No relevant relationships reported)

Low cardiorespiratory fitness and accumulated fat mass have been widely associated with impaired cognitive performance in children, however, their influence on creativity remains unclear. The creativity is a component of cognition and is defined as the process of identifying the difficulty, formulating hypotheses about the deficiencies and solving the problems. Actually, the creativity has become an element key to cognition because contribute to personal and professional success of the subject. **PURPOSE:** Here, we compare creativity in children with different levels of cardiorespiratory fitness (CF) and fat mass (FM), as well as their relationship. **METHODS:** In this cross-sectional study, 73 children with age ranging from 10.1 to 11.5 participated while attending two testing sessions. On the first testing session, all children had general anthropometric assessments and completed a graded shuttle run test to estimate cardiorespiratory fitness (VO₂ max). On the second session, they perform the Children's Figural Creativity Test, scholar performance test and have the fat mass (FM) measured by the Dual-energy X-ray Absorptiometry. Children were divided in two groups (Lower x Higher) separated by the median value of CF and FM. Creativity was compared between groups by a paired t test and unpaired Mann-Whitney (P<0.005). Pearson or Spearman correlations were used to compare the associations between the variables. **RESULTS:** The results demonstrate no significant differences on creativity between VO₂ max (p=0.75) and FM (p=0.56) levels. In addition, no correlation was identified between creativity with CF (r=-.031; p=.828) and FM (r=-.174; p=.218). **CONCLUSIONS:** In conclusion, creativity is similar in children with different VO₂ and FM level and there is not relationship between these variables. However, are necessary more studies with a robust creativity measurement technique, based in neurobiological markers (NIRS, fMRI).

3263 Board #6 June 1 9:00 AM - 11:00 AM
The Relationships between Cell Phone Use and Sedentary Behavior in Samples of Japanese and American College Students

Jacob E. Barkley¹, Andrew Lepp¹, Takahiro Sato¹, Koji Yamatsu², Ellen L. Glickman, FACSM¹. ¹Kent State University, Kent, OH. ²Saga University, Saga, Japan. (Sponsor: Ellen Glickman, FACSM)
 Email: jrbarkle1@kent.edu
 (No relevant relationships reported)

Previous work from our research group has indicated a significant, positive relationship between cellular telephone (cell phone) use and sitting or sedentary behavior in college students. However, this work has been limited to only a single, large, public university in the Midwestern United States. Therefore, it remains unknown if this relationship would be present in groups of college students from different geographic regions and/or cultural backgrounds.

PURPOSE: To compare the relationship between daily cell phone use and sedentary behavior in samples of college students from Japan and the United States. **METHODS:** A sample of college students (N = 808, 20.2 ± 1.8 years old) from either a university in Japan (n = 534, 19.8 ± 1.1 years old) or the United States (n = 274, 21.71 ± 2.4 years old) completed validated surveys assessing age, daily cell phone use (min) and daily total sedentary behavior (min). Surveys were administered in English for American students and Japanese for students from Japan. **RESULTS:** Independent samples t-tests revealed that Japanese students reported greater daily sitting (420 ± 264 min/day) and less daily cell phone use (215 ± 125 min/day) than American students (360 ± 198 min/day sitting, 274 ± 150 min/day cell phone use). Because of these differences, Pearson's correlation analyses assessing the relationship between cell phone use and sedentary behavior were performed

for Japanese and American students separately. There were significant, positive relationships between cell phone use and sedentary behavior in both Japanese (r = 0.132, p = 0.002) and American (r = 0.166, p = 0.006) college students. **CONCLUSION:** While there were differences in sedentary behavior and cell phone use in Japanese versus American college students, the relationships between these variables was positive and significant regardless of group. This finding supports previous data indicating that elevated cell phone use is predictive of greater daily sitting in college students. Furthermore, present results indicate that this relationship extends beyond American college students.

3264 Board #7 June 1 9:00 AM - 11:00 AM
Investigating the Impact of Acute Exercise and Brain Stimulation on Cognitive Control in Healthy Adults

Erika K. Hussey¹, Eduardo B. Fontes², Nathan Ward², Daniel R. Westfall³, Shih-Chun Kao⁴, Arthur F. Kramer³, Charles H. Hillman³. ¹US Army, NSRDEC, Natick, MA. ²Tufts University, Medford, MA. ³Northeastern University, Boston, MA. ⁴Purdue University, West Lafayette, IN.
 (No relevant relationships reported)

The field of cognitive enhancement has grown in popularity in recent years. Exercise and transcranial direct current stimulation (tDCS) are two approaches for which there is some evidence of transiently improved cognitive control. Yet, no research has systematically compared both approaches, so the degree to which these techniques influence similar mechanisms of improvement remains unknown. **PURPOSE:** We parametrically compared the acute effects of aerobic exercise and tDCS over left prefrontal regions on cognitive control. **METHOD:** 96 young healthy individuals (22.4 ± 4.1 years old) completed two testing sessions. The first session included baseline measurements of cognitive control on a flanker inhibition task and an n-back working memory task, followed by a maximal graded exercise test. During the second session, participants were randomly assigned to either 20 minutes of running on a treadmill at moderate intensity (60-70% of maximal heart rate) or 20 minutes of seated rest. After a 10-minute interval, participants were randomly assigned to receive 30 minutes of active tDCS (2mA anode over left prefrontal cortex; cathode over right bicep) or sham stimulation as they completed the flanker and n-back tasks. We compared baseline-corrected cognitive control performance as a function of Exercise (running vs. seated rest) and Stimulation (active vs. sham tDCS) using linear mixed effects models. **RESULTS:** Models revealed a main effect of Condition on n-back sensitivity (nonparametric signal detection A': t=2.45, p=0.014), but no significant effects of Stimulation, and no interaction of Exercise and Stimulation. Specifically, the individuals who exercised were better able to discriminate n-back targets from nontargets compared to the seated group. We did not observe any effects of Exercise or Stimulation on flanker performance (accuracy and response times on incongruent or congruent trials). **CONCLUSION:** Whereas noninvasive brain stimulation produced no effects on cognitive control, acute aerobic exercise significantly improved working memory performance. This suggests that the neuroenhancement mechanisms impacted by short bouts of exercise and tDCS may be distinct. Further, this pattern hints that aerobic exercise may have broader effects on cognitive control than non-invasive brain stimulation.

3265 Board #8 June 1 9:00 AM - 11:00 AM
The Individual and Combined Effect of Hypoxia and Music on Physical Performance

Kate O'Keefe, Jacob Dean, Dr. Simon Hodder, Dr. Alex Lloyd. Loughborough University, Loughborough, United Kingdom.
 (Sponsor: Prof. George Havenith, FACSM)
 Email: k.e.okeefe@lboro.ac.uk
 (No relevant relationships reported)

Humans ascending to high altitude are susceptible to debilitating psychological alterations which include severe mood changes, cognitive fatigue, and neuropsychological impairments. The combination of environmental stressors that occur at altitude can further inhibit both physical and cognitive performance. **PURPOSE:** Music has ergogenic effects on physical performance through enhancing psychological factors such as mood, emotion and cognition. This study aimed to explore the impact of music as a tool for mitigating the performance decrements observed at altitude. **METHODS:** Following ethical approval from Loughborough University, 13 healthy males (mean ± SD; 23.9 ± 4.01 years) completed one familiarisation session and four counterbalanced experimental trials; 1) normoxia (0.209 FiO₂) and no music; 2) normoxia (0.209 FiO₂) with music; 3) normobaric hypoxia (0.13 FiO₂) and no music; 4) normobaric hypoxia (0.13 FiO₂) with music. All conditions were completed at 21°C with 50% relative humidity. Music was self-selected by each participant prior to the familiarisation session. The songs were assessed for their motivational qualities using the Brunel Music Scale Inventory (BMRI-2). Each experimental trial included a 15-min self-paced time trial on an arm bike, followed by a 60-s isometric maximal voluntary contraction (MVC) of the biceps brachii. Supramaximal nerve stimulation was used to quantify central and peripheral

fatigue with voluntary activation (VA%) calculated using the twitch interpolation method. Subjective measures included motivation (MS) and mood using the Brunel Mood Scale (BRUMS). **RESULTS:** Average power output (W) was reduced with a main effect of hypoxia ($p = 0.02$) and significantly increased with a main effect of music ($p = 0.001$). When combined the interaction was additive ($p = 0.87$). Average MVC force (N) was reduced in hypoxia ($p = 0.03$) but VA% of the biceps brachii was increased with music ($p = 0.02$). MS and BRUMS remained unchanged across all conditions ($p > 0.06$). Music reduced subjective scores of mental effort, breathing discomfort, and arm discomfort in hypoxia ($p < 0.001$). **CONCLUSION:** Music increased self-paced and maximal physical exertion through enhancing neural drive and diminishing detrimental mental processes, enhancing performance at both sea level and high altitude.

G-19 Thematic Poster - Endocrine Responses to Exercise and Occupational Stressors

Saturday, June 1, 2019, 9:00 AM - 11:00 AM
Room: CC-101B

3266 Chair: Jay Heaney, *Naval Health Research Center, San Diego, CA.*

(No relevant relationships reported)

3267 Board #1 June 1 9:00 AM - 11:00 AM Coupling of Adrenal and Gonadal Hormones: Potential Relationship to Occupational Demand

Matthew R. Schoenherr, Lisa M. Hernandez, Marcus K. Taylor, Ph.D., FACSM. *Naval Health Research center, San Diego, CA.*
(Sponsor: Marcus Taylor, PhD, FACSM)
Email: matthew.r.schoenherr.ctr@mail.mil

(No relevant relationships reported)

The positive coupling hypothesis describes the hypothalamic-pituitary-adrenal and -gonadal systems as parallel, cooperative processes that represent joint calibration to meet internal, and/or environmental, demands. We recently tested this hypothesis in Naval Special Warfare (NSW) personnel and found positive coupling between the adrenal hormones, cortisol (CORT) and dehydroepiandrosterone (DHEA), and the gonadal hormone, testosterone (TESTO).

PURPOSE: To test the positive coupling hypothesis in Explosive Ordnance Disposal (EOD) personnel; a specialized military population whose mission is to ensure that hazardous explosives are rendered safe for unit preservation and security. **METHODS:** Active duty U.S. Navy EOD operators ($N = 64$; mean \pm SD age: 34 ± 6.0 years) self-collected saliva samples in a non-deployed, free-living setting on 2 consecutive weekdays at wake, wake + 30 min, wake + 60 min, 1600, and 2100 (10 samples total). Exclusion criteria included use of any anabolic supplements within the last 3 months. Coupling hypotheses (associations between CORT, DHEA, and TESTO summary parameters) were tested with Pearson product-moment correlation analyses. Established summary parameters were determined for each hormone: highest morning value, area under the curve (with respect to ground [morning values]), and averages of morning and evening values, respectively. **RESULTS:** DHEA was positively coupled with TESTO (r range: .28-.61, $p < .05$) and also with CORT (r range: .50-.57, $p < .05$) throughout the day. Positive coupling between CORT and TESTO was only observed in the evening ($r = .32$, $p = .014$). **CONCLUSION:** This study partially replicated our prior report in NSW personnel, which demonstrated that DHEA positively coupled with TESTO as well as CORT. The evening association of TESTO and CORT is also consistent with our previous findings and likely indicative of homeostatic processes. Unlike the previous study, however; the morning values of TESTO and CORT were not coupled in the present study. This inconsistency could potentially be explained by a warfighter's specific operational demands. For example, positive coupling may be adaptive for duties that include direct engagement with the enemy. In contrast, uncoupling may be more conducive to ensuring unit safety and security.

3268 Board #2 June 1 9:00 AM - 11:00 AM Testosterone Status Following Short-term, Severe Negative Energy Balance Predicts Fat-free Mass Loss in U.S. Marines

Claire E. Berryman, John J. Sepowitz, Holly L. McClung, Stefan M. Pasiakos, FACSM. *US Army Research Institute of Environmental Medicine, Natick, MA.* (Sponsor: Stefan M. Pasiakos, FACSM)

(No relevant relationships reported)

Male US military personnel exposed to periods of severe negative energy balance often experience marked reductions in circulating total testosterone, and it is not uncommon for concentrations to fall below normal levels (< 300 ng/dL). However, testosterone fluctuations following severe negative energy balance are variable, and little is known about the metabolic and physiological differences between males who experience low testosterone (LT) and those who maintain normal testosterone (NT). **PURPOSE:** To determine metabolic and physiological differences between males with LT versus those with NT following 8 d of strenuous military training. **METHODS:** Male US Marines ($n = 68$) were dichotomized based on testosterone concentration ($< \text{or} \geq 300$ ng/dL) following 8 d of severe negative energy balance incurred during military training. Body composition (DEXA) and whole-body protein turnover (^{15}N alanine) were measured and blood and urine samples collected before (PRE) and after (POST) training. Linear mixed models were used to assess the effects of testosterone status, time, and their interaction on outcomes. **RESULTS:** Testosterone concentrations decreased PRE (505 ± 135 ng/dL) to POST (284 ± 115 ng/dL, $P < 0.01$). When volunteers were dichotomized by POST testosterone status (NT, $n = 24$; 407 ± 97 vs. LT, $n = 44$; 217 ± 52 ng/dL, $P < 0.01$), PRE BMI, total fat mass, and testosterone were greater in NT compared to LT ($P < 0.05$). LT lost more fat-free mass (FFM, -3.4 ± 1.3 kg) and less fat mass (-2.4 ± 1.2 kg) compared to NT (-2.4 ± 2.0 and -3.2 ± 1.6 kg, respectively; P -interaction < 0.03). Insulin ($+5.55 \pm 9.35$ $\mu\text{U/mL}$) and norepinephrine ($+0.23 \pm 0.29$ ng/mL) increased from PRE to POST in LT, whereas no changes occurred in NT ($+1.03 \pm 3.75$ $\mu\text{U/mL}$ and $+0.04 \pm 0.30$ ng/mL, respectively), resulting in significant differences between groups (P -interaction < 0.02). Independent of time, LT had greater whole-body protein synthesis, breakdown, and flux (P -status < 0.01), but not net balance (P -status = 0.2), compared to NT. **CONCLUSION:** Military personnel susceptible to operational stress-induced LT may be predisposed to greater FFM loss during periods of negative energy balance incurred during short-term, strenuous military training. Supported by US Army Medical Research and Materiel Command; authors' views not official US Army or DoD policy.

3269 Board #3 June 1 9:00 AM - 11:00 AM Salivary Stress Biomarkers During the Lake Placid Ironman® Ultraendurance Event

Aidan P. Fiol, Deanna M. Dempsey, Douglas J. Casa, FACSM, Jun Hashiwaki, Rebecca L. Stearns, Robert A. Huggins, Amy L. McKenzie, Colleen X. Munoz, Elaine C. Lee. *University of Connecticut, Storrs, CT.*
Email: aidan.fiol@uconn.edu

(No relevant relationships reported)

Biomarkers such as salivary IgA (sIgA) have been established as valid, reliable, and non-invasive stress markers. sIgA concentrations have been reported to decrease following periods of high physiological stress, such as that experienced during ultraendurance events. Heat shock protein 70 (HSP70), a molecular chaperone, has been assessed primarily as a plasma/serum stress biomarker. The role of HSP70 in saliva, how it responds to extremely stressful exercise events and its correlation to changes in sIgA remain unclear. **PURPOSE:** To test the hypothesis that salivary HSP70 can be used as a salivary stress biomarker correlated to sIgA during an ultraendurance event. **METHODS:** Thirty-three subjects competing in the Lake Placid Ironman triathlon participated (all data, mean \pm SD: 38 ± 8 yrs, 178.4 ± 8.9 cm, 76.3 ± 10.4 kg, $10.8 \pm 3.8\%$ body fat, finish time 708 ± 90 min). Environmental symptoms questionnaires (ESQ) were administered before (PRE) and 1 hour after the race (POST). Hydration status was assessed via urine specific gravity (USG). Saliva samples were collected PRE, POST, and 1 day post-race (AMPOST) and analyzed for IgA (Salimetrics) and HSP70 (Enzo Life Sciences) by ELISA according to manufacturer instructions. Significant differences among time points were analyzed by repeated measures ANOVA and LSD post hoc tests. **RESULTS:** Subjects experienced significant stress with completion of the race (708 ± 90 min finish time, ESQ 1hPOST (20 ± 8) vs. PRE (5 ± 3 , $p < 0.05$), POST RPE (18 ± 2)). sIgA was decreased POST (41.71 ± 20.46 $\mu\text{g}\cdot\text{ml}^{-1}$) vs. PRE (48.88 ± 17.20 $\mu\text{g}\cdot\text{ml}^{-1}$, $p = 0.05$) and vs. AMPOST (37.76 ± 27.02 $\mu\text{g}\cdot\text{ml}^{-1}$, $p = 0.006$). Salivary HSP70 was increased POST (3.91 ± 3.29 ng $\cdot\text{ml}^{-1}$) vs. PRE (1.68 ± 1.93 ng $\cdot\text{ml}^{-1}$, $p = 0.0002$). **CONCLUSIONS:** Salivary HSP70 was detectable using a commercially available ultrasensitive HSP70 ELISA. Extracellular HSP70 in the oral cavity may be a non-invasive marker of stress during an ultraendurance event and is correlated with more common salivary stress marker sIgA.

- 3270** Board #4 June 1 9:00 AM - 11:00 AM
Daily Cortisol Patterns in Specialized Military Men: Replication and Refinement in a Novel Population
 Genie Leah A. Padilla¹, Lisa M. Hernández¹, Marcus K. Taylor, FACSM². ¹Leidos, San Diego, CA. ²Naval Health Research Center, San Diego, CA.
 (No relevant relationships reported)

Amassing evidence suggests that post awakening cortisol patterns are useful indicators of health status. Our lab established summary parameters of cortisol and reported excellent stability across 2 days of repeated sampling in 58 U.S. Navy SEALs. To confirm the generalizability of our original findings, there is a need to replicate procedures in another military population with unique operational demands. **PURPOSE:** To establish the summary parameters of daily cortisol patterns, the stability of repeated sampling, and the impact of salivary sampling compliance in U.S. Navy Explosive Ordnance Disposal (EOD) operators. **METHODS:** Seventy active duty, male EOD operators (mean \pm SD age = 34.9 \pm 6.5 y) self-collected saliva samples in a nondeployed, free-living setting. Samples were collected on 2 consecutive weekdays at Wake, Wake + 30 min, Wake + 60 min, 1600, and 2100. Three measures of magnitude and three measures of pattern were computed. The stability of each parameter was evaluated via correlational analyses and Cronbach's alpha (α). Compliance was evaluated via actigraphy using two alternate compliance criteria. **RESULTS:** Average salivary cortisol concentrations increased at Wake + 30 min (mean \pm SE reactivity = 48.9 \pm 6.8%), followed by a swift recovery at Wake + 60 min. Approximately 17.4% (n = 12) were classified as negative-reactors (i.e., <0% change from Wake to Wake + 30 min). The three measures of magnitude demonstrated good stability across 2 days (r value range: 0.37-0.45, ps < 0.01; α range: 0.54-0.62). Fifty-five percent of the sample was classified as compliant (defined as <15 min deviation from target sampling times) across both days; this decreased to 31% when compliance was refined to <5 min deviation. However, controlling for compliance did not convincingly influence any of the summary parameter estimations or their stability. **CONCLUSIONS:** These findings demonstrate a thorough replication and refinement of our prior report, implying that these results are generalizable across diverse military populations. The noninvasive salivary sampling protocol used in this study yields stable estimations of daily cortisol patterns in specialized military men. This sampling protocol is recommended for use as an operational health surveillance instrument for chronically stressed military members.

- 3271** Board #5 June 1 9:00 AM - 11:00 AM
Cortisol Responses During a Long Duration Incremental Exercise Protocol in the Heat while Wearing Personal Protective Equipment
 Thomas Service¹, Cory Coehoorn¹, Lynne Stuart-Hill¹, Olave Krigolson¹, Patrick Neary². ¹University of Victoria, Victoria, BC, Canada. ²University of Regina, Regina, SK, Canada.
 (No relevant relationships reported)

Individuals in occupations that wear personal protective equipment (PPE) are exposed to acute heat stress on a regular basis. There is no research evaluating the effects of rapid and uncompensable core temperature (T_c) acquisition, as which occurs when one is wearing PPE, on rate and magnitude of salivary cortisol appearance. **PURPOSE:** To determine the effects of rapid and uncompensable (T_c) acquisition on the rate and magnitude of salivary cortisol appearance. **METHODS:** Fourteen male subjects (33.6 \pm 12.1 years) performed an incremental treadmill test to a termination point in a control session (CON) and an experimental session (PPE). Salivary samples were collected using an oral swab stimulated method. Saliva samples were processed and analyzed for salivary cortisol concentration using a highly sensitive enzyme immunoassay. Heart rate (HR), thermal comfort scale (TCS) and thermal sensation (TS) were also recorded at each 0.5°C increase in core temperature (T_c). **RESULTS:** There were significant differences in time to termination (TTT) (CON = 77.3 \pm 12.6 min; PPE = 50.3 \pm 6.9 min), pre-exercise HR (CON = 76.8 \pm 4.8 bpm; PPE = 86.5 \pm 5.1 bpm), post-exercise HR (CON = 161.1 \pm 11.9 bpm; PPE = 179.6 \pm 6.8 bpm), end-exercise T_c (CON = 38.57 \pm 0.3°C; PPE = 39.01 \pm 0.3°C), TCS (CON = 3.57 \pm 0.6; PPE = 4.63 \pm 0.3), and TS (CON = 7.57 \pm 0.5; PPE = 8.67 \pm 0.3). There was also a 0.04°C/min increase in T_c during PPE and a 0.02°C/min increase in T_c during CON. Significant cortisol results showed a difference in the rate of cortisol appearance (CON = 0.002 μ g dL⁻¹ min⁻¹; PPE = 0.018 μ g dL⁻¹ min⁻¹). There was a significant difference in mean cortisol values between start of exercise and the end of exercise (p \leq 0.01). There was also a significant difference (p \leq 0.05) between magnitude of salivary cortisol values at termination when comparing CON and PPE. **CONCLUSION:** Rapid and uncompensable T_c acquisition results in an elevated acute cortisol response. This will have implications for individuals who are employed in fields that are exposed to acute heat stress chronically. The acute effects of increased cortisol concentration are a decreased anabolic response, decreased cognitive performance, and decreased mood states. The chronic effects are many, but are mostly related to atherosclerosis development and subsequent cardiovascular disease.

- G-20** Thematic Poster - Exercise and Physical Activity in Cancer Survivors

Saturday, June 1, 2019, 9:00 AM - 11:00 AM
 Room: CC-102B

- 3272** **Chair:** Kerri M. Winters, FACSM. Oregon Health & Science University, Portland, OR.
 (No relevant relationships reported)

- 3273** Board #1 June 1 9:00 AM - 11:00 AM
Objectively-Measured Physical Activity in Breast Cancer Patients Undergoing Chemotherapy

Whitney A. Welch¹, Kara Gavin¹, Juned Siddique¹, Jason Fanning², Payton Solk¹, Cesar A. Santa Maria³, William Gradishar¹, Seema Khan¹, Swati Khulkarni¹, Siobhan Phillips¹. ¹Northwestern University Feinberg School of Medicine, Chicago, IL. ²Wake Forest School of Medicine, Winston-Salem, NC. ³Johns Hopkins Sidney Kimmel Comprehensive Cancer Center, Baltimore, MD. (Sponsor: Ann Swartz, FACSM)
 Email: whitney.welch@northwestern.edu
 (No relevant relationships reported)

PURPOSE: To determine the effect of demographic, health, and treatment factors on moderate to vigorous physical activity (MVPA) in breast cancer patients undergoing chemotherapy. **METHODS:** Breast cancer patients (N=66, M_{age} = 48.3 \pm 10.0 years) undergoing chemotherapy (CT) wore an accelerometer for 24-hours (worn on the hip during the day and wrist while sleeping) for ten consecutive days (3 days pre-, day of, and 6 days post-CT dose) during three treatment phases (beginning, middle and end of chemotherapy). Mixed models were used to assess the effect of demographic, health, and treatment factors on MVPA. We assessed the effect of time point (burst), treatment status (i.e. pre-CT dose v. day of/post-CT dose), burst x treatment status interaction, age, body mass index, education, total number of comorbidities, disease stage, cumulative treatment cycle number, self-reported pre-diagnosis minutes/day of MVPA, weekend v. weekdays, and self-reported health status on daily minutes of MVPA. **RESULTS:** On average, breast cancer patients engaged in 20.8 minutes/day (95%CI:17.4,24.1) of MVPA across all bursts. Results indicate a significant decrease of 5.0 minutes/day of MVPA(95%CI:-6.5,-3.5) as time point increases, a 4.2 minute/day decrease in MVPA(95%CI:-5.8,-3.2) on day of CT dose or post-CT days compared to pre-CT dose days, a 0.9 minute/day increase in MVPA (95%CI: 0.5,1.3) as treatment cycle number increases, and a 2.2 minute/day increase in MVPA (95%CI:1.1,3.2) on weekends. **CONCLUSIONS:** Results from the current analysis suggest treatment-related factors, such as treatment day, post-treatment days, and time undergoing chemotherapy, had the greatest effect on MVPA in breast cancer patients, significantly decreasing minutes per day spent in MVPA over time. These results show the importance of tailoring future physical activity interventions to specific treatment factors in order to reduce the decline in MVPA during chemotherapy.

- 3274** Board #2 June 1 9:00 AM - 11:00 AM
Overcoming Fitness, Symptom, and Behavior Barriers After A Physical Activity Intervention With Fitness Graded Motion Exergames (PAfitME) Among Head And Neck Cancer Patients

Hsiao-Lan Wang¹, Harleah Buck¹, Tapan Padhya¹, Kristine Donovan², Laura Szalacha¹, Ellen Smith³, Srinivas Katkoo¹, Barbara Smith, FACSM¹. ¹University of South Florida, Tampa, FL. ²Moffitt Cancer Center, Tampa, FL. ³University of Michigan, Ann Arbor, MI. (Sponsor: Barbara Smith, Member# 126904, FACSM)
 Email: hwang5@health.usf.edu
 Reported Relationships: H. Wang: Receipt of Intellectual Property Rights/Patent Holder; Exergame Grading Scheme (Copyright: TXu1-996-913).

Purpose: Routinely engaging physical activity (PA) leads to better health outcomes in cancer survivors. Over 50% of head and neck cancer (HNC) survivors rarely engage in any type of PA because of the barriers of impaired fitness, severe symptoms, and poor self-efficacy (SE). A personalized telehealth Physical Activity intervention with fitness graded Motion Exergames (PAfitME) was designed to overcome these barriers. In our pilot study, we found the HNC patients fully adhered with the personalized exergame prescription in the 6-week PAfitME intervention. The purpose of this study was to examine changes in barriers: fitness (gait speed), symptoms, and SE among HNC patients participating in the PAfitME intervention.

Methods: A pre/post-test design was used to test the 6-week PAFitME intervention. Personalized exergame prescriptions were developed and progressed based on the social cognitive theory and exercise principal of adaptation. Fitness was measured by preferred gait speed (m/s). Symptom data were collected via the MD Anderson Symptom Inventory, Brief Pain Inventory, Pittsburgh Sleep Quality Index, General Anxiety Disorder scale, and Center for Epidemiologic Studies Depression Scale. SE was measured by the PA Self-Efficacy scale (0-100%). Descriptive statistics and paired t tests were applied.

Results: A total of 10 HNC participants were recruited. Two participants dropped out due to recurrence. The mean age was 58.2 years old (n=8). Seven (88%) were male. Three (38%) had oral cancer and 5 (63%) had laryngeal cancer. Three (38%) had a feeding tube and 2 (25%) had a tracheostomy. Four (50%) had stage III/IV cancer. Mean gait speed improvement was clinically significant (0.11m/s). There were positive improvements in 17 of 20 symptoms with significant decreases in pain (t=2.34, p=0.05), in fatigue (t=3.64, p=0.008) and in difficulty with voice/speech (t=2.35, p=0.05). Seven participants (88%) had 100% SE to do their personalized exergame prescription in the post test.

Conclusions: This study shows HNC participants overcame their PA barriers after the PAFitME intervention. It also supports the need for a larger randomized clinical trial for efficacy testing. The positive impact from PAFitME will shift PA interventions from a standardized protocol to a personalized, behavioral telehealth approach.

3275 Board #3 June 1 9:00 AM - 11:00 AM

Muscle Function And Cancer Related Fatigue In Prostate Cancer Survivors Receiving Different Treatment Regimens

Sandro Nobre Chaves¹, Filipe Dinato de Lima¹, Martim Bottaro¹, Claudio L. Battaglini, FACSM², Ricardo Jacó de Oliveira¹.
¹University of Brasilia, Brasilia, Brazil. ²University of North Carolina at Chapel Hill, Chapel Hill, NC. (Sponsor: Claudio L Battaglini, FACSM)
Email: sandronobrec@gmail.com
(No relevant relationships reported)

Prostate cancer is the most commonly neoplastic disease that affects men in the world. Androgen deprivation therapy (ADT) is the treatment regimen most used in advanced disease stages. Whereas the occurrence of late side effects induced by ADT seems well described, the long-term consequences of ADT in muscle function and fatigue have not been well documented.

PURPOSE: The purpose of this study was to assess fatigue, muscle strength, muscle thickness, and muscle quality in prostate cancer survivors undergoing to ADT.

METHODS: Ten prostate cancer patients on ADT (ADT group) (74.40 ± 5.76 years, 77.44 ± 14.75 kg and 1.63 ± 0.07 m), 8 patients not undergoing ADT (N-ADT) (69.75 ± 5.92 years, 82.25 ± 9.20 kg and 1.70 ± 0.07 m) and 18 healthy control subjects (CON) (72.17 ± 6.54 years, 77.94 ± 9.47 kg and 1.69 ± 0.07 m) participated in this study. Perceived fatigue was assessed through 20-item Multidimensional Fatigue Inventory. Muscle thickness and quality (e.g., echo intensity) were assessed through B-mode ultrasound. Muscle strength and work capacity were assessed using an isokinetic dynamometer. One-way ANOVAs with Bonferroni post-hoc were used for comparisons between groups adjustment.

RESULTS: Muscle thickness was lower in ADT than CON (21.32 ± 3.20 vs. 26.49 ± 5.10 respectively, p = 0.021). Peak torque was lower in ADT than CON (109.78 ± 30.36 vs. 154.67 ± 33.92 respectively, p = 0.005). Work capacity was lower in ADT than CON (1964.40 ± 571.71 vs. 2923.67 ± 604.39 respectively, p < 0.001). ADT showed greater echo intensity than CON (116.82 ± 15.98 vs. 101.23 ± 8.33 respectively, p = 0.005) and N-ADT (102.73 ± 11.72, p = 0.046). There were no differences between N-ADT and CON on muscle thickness, peak torque, work capacity, and echo intensity (p > 0.05). General fatigue was greater on both ADT (11.10 ± 3.41 vs. 7.83 ± 2.60, p = 0.030) and N-ADT (11.13 ± 3.48 vs. 7.83 ± 2.60, p = 0.047) compared to CON. Physical fatigue was greater on ADT than CON (13.20 ± 4.02 vs. 8.72 ± 2.87, p = 0.006).

CONCLUSIONS: Therefore, it appears that the nature of ADT treatment has a deeply negative effect on muscle function and fatigue when compared to patients not-undergoing ADT. Therefore, further research is needed to confirm these preliminary findings, in order to attenuate the decline of muscle function and fatigue in men undergoing ADT treatment.

3276 Board #4 June 1 9:00 AM - 11:00 AM

Inflammation Mediates The Effects Of Exercise On Fatigue In Patients With Breast Cancer Undergoing Chemotherapy

Anouk E. Hiensch¹, Sara Mijwel², Yvonne Wengström², Anne M. May¹, Helene Rundqvist². ¹University Medical Center Utrecht, Julius Center for Health Sciences and Primary Care, Utrecht, Netherlands. ²Karolinska Institutet, Stockholm, Sweden.
Email: a.e.hiensch-2@umcutrecht.nl
(No relevant relationships reported)

PURPOSE: The randomized controlled OptiTrain trial showed beneficial effects on fatigue after a 16-week exercise program in patients with breast cancer undergoing adjuvant chemotherapy. Hypothesized underlying mechanisms include the involvement of inflammatory pathways. Here, we investigated the effects of exercise on inflammation markers and whether the positive effects on fatigue were mediated by changes in inflammation.

METHODS: 240 women scheduled for chemotherapy were randomized to 16-weeks of resistance and high-intensity interval training (RT-HIIT), moderate-intensity aerobic and high-intensity interval training (AT-HIIT) or usual care (UC). In the current mechanistic analyses, we included participants with >60% attendance and a random selection of controls (RT-HIIT = 30, AT-HIIT = 27, UC = 29). Ninety-two blood markers (e.g. IL-6, TNF α , soluble CD8A) were quantified at baseline and post-intervention. The Piper Fatigue Scale was used to assess general and physical fatigue. Mediation analyses were conducted to explore whether changes in inflammation markers mediated the effect of exercise on general and physical fatigue. ANCOVA, adjusted for menopausal status, chemotherapy treatment (taxanes/no taxanes) and baseline values of the inflammation marker and fatigue, was used to identify between-group differences in the outcome.

RESULTS: In general, chemotherapy led to an increase in inflammation. The increase in IL-6 (pleiotropic cytokine) and CD8A (T-cell surface glycoprotein) was, however, less pronounced following RT-HIIT compared to UC (-0.45 (95% CI -0.85; -0.05), p=0.03 and -0.28 (95% CI -0.57; 0.004), p=0.05, respectively). The changes in IL-6 and CD8A significantly mediated the effects of exercise on both general and physical fatigue by 32.0% and 27.7%, and by 31.2% and 26.4%, respectively. No significant between-group differences in inflammation markers at 16 weeks (post-intervention) were found between AT-HIIT and UC.

CONCLUSIONS: This study is the first showing that supervised RT-HIIT partially counteracted the increase in inflammation during chemotherapy, i.e. IL-6 and soluble CD8A, which resulted in lower fatigue levels post-intervention. Exercise might be put forward as an effective treatment to reduce chemotherapy-induced inflammation and subsequent fatigue.

3277 Board #5 June 1 9:00 AM - 11:00 AM

Differences by Activity Level in Barriers and Benefits of Exercise in Breast Cancer Survivors

Gwendolyn A. Thomas, Margaret F. Bedillion. Syracuse University, Syracuse, NY.
(No relevant relationships reported)

Physical activity is a critical component of treatment for breast cancer survivors that prevents additional cancer recurrence, comorbid chronic disease and body composition changes. However, recommended physical activity guidelines are rarely met.

PURPOSE: This study examined how barriers and benefits of exercise differ between breast cancer survivors who are not engaging in any moderate or vigorous physical activity, those doing physical activity but not meeting physical activity guidelines, and those meeting recommended physical activity guidelines. **METHODS:** 392 breast cancer survivors were recruited through the Susan Love/Army of Women, a national non-profit breast cancer organization, and completed the Exercise Barriers and Benefits Survey, the International Physical Activity Questionnaire and questions on resistance exercise activities. **RESULTS:** Multivariate ANOVAs examined whether exercise groups differed in types of exercise benefits and barriers they reported. 267 of the women (69.6%) did not meet recommended guidelines (150 minutes/week of aerobic activity and twice per week resistance exercise). The greatest perceived benefits were for physical performance and the lowest were for social interaction. There were significant differences between groups on benefits (F= 18.981; df = 2, 16; p=.000; η^2 =.090). Exercise benefits were not significantly different between the some exercise and exercise guidelines groups. The greatest perceived barriers were for physical exertion and the lowest were for the exercise milieu. There were significant differences between groups on barriers (F= 54.807; df = 2, p=.000; η^2 =.222). The some exercise group had significantly higher barriers than the exercise guidelines group (p=.047).

CONCLUSIONS: Despite recommendations, the majority of breast cancer survivors do not meet physical activity guidelines. Understanding which barriers and benefits are relevant to different groups of exercisers is an important avenue to prescribing exercise in an at risk population. Personalized approaches may promote exercise initiation in those not currently exercising; while targeting different barriers may help those already exercising to meet recommended physical activity guidelines.

Supported by Robert E. Leet and Clara Guthrie Patterson Trust (PI: Thomas)

3278 Board #6 June 1 9:00 AM - 11:00 AM**Effects Of Exercise On QoL And Fatigue of Inactive Breast Cancer Survivors, A TwiCs study**

Anne M. May¹, Roxanne Gal¹, Carla H. van Gils¹, Rolf HH Groenwold², Desirée HJG van den Bongard¹, Petra HM Peeters¹, Helena M. Verkooijen¹, Evelyn M. Monnikhof¹. ¹University Medical Center Utrecht, Utrecht, Netherlands. ²Leiden University Medical Center, Leiden, Netherlands.
Email: a.m.may@umcutrecht.nl
(No relevant relationships reported)

PURPOSE: Meta-analyses have shown beneficial effects of exercise on quality of life (QoL) and fatigue in breast cancer survivors. Methodological considerations, however, are drop out after randomization to control caused by disappointment and contamination (controls adopting the behavior of the intervention group), since blinding in exercise trials is not possible. TwiCs (Trials within Cohorts) is an alternative for conventional randomized clinical trials and might overcome these disadvantages. We studied the 6-month effectiveness of a 12-week exercise program on the QoL and fatigue in inactive breast cancer survivors using the innovative TwiCs design.

METHODS: The UMBRELLA Fit study is nested within the UMBRELLA cohort, including patients at the radiotherapy department of the UMC Utrecht. Patients were asked consent for prospective collection of medical data and patient reported outcomes, and to be randomized to future intervention studies. For UMBRELLA Fit, we randomized 260 eligible inactive (<150 min/wk moderate to vigorous leisure time and sports activities) breast cancer survivors, 12-18 months after cohort inclusion. Survivors randomized to the intervention group (n=130) were offered a twice weekly supervised moderate to high intensity aerobic and resistance exercise program. Survivors were also asked to be active for 30 min/day supported by an activity tracker. The control group (n=130) was not informed and received usual care (UC). To evaluate effects on QoL and fatigue by intention to treat ANCOVA regular cohort measurements (EORTC QLQ 30, MFI-20) were used.

RESULTS: Included breast cancer survivors aged 58±10 years and 52% (68/130) accepted the intervention. TwiCs accrual was efficient and no contamination was observed (median change in physical activity from baseline in controls was 0). At baseline, QoL was comparable to Dutch reference values and no significant between-group changes were observed. Physical fatigue was significantly lower following the exercise intervention (effect size 0.2, p<0.05) compared to UC.

CONCLUSIONS: Physical exercise has beneficial effects on physical fatigue of inactive breast cancer survivors. Future instrumental variable analysis will show influence of non-acceptance on the intervention effect. The TwiCs design seems feasible for pragmatic trials.

3279 Board #7 June 1 9:00 AM - 11:00 AM**Community-based Soccer Improves Hip BMD, Mental Health, And Reduces Hospital Admissions In Prostate Cancer Patients**

Eik D. Bjerre¹, Klaus Brasso¹, Julie Midtgaard². ¹Rigshospitalet, Copenhagen, Denmark. ²University of Copenhagen, Copenhagen, Denmark.
Email: eb@ucsf.dk
(No relevant relationships reported)

Physical exercise has been shown to improve quality of life, fitness, and physical function for men with prostate; however, research on effects of real-life interventions is warranted. **PURPOSE:** To evaluate the effects of one year of community-based soccer training on bone mineral density (BMD), body composition, mental health, and hospital admissions. **METHODS:** Design, Setting and Participants: In a pragmatic, multicentre, parallel randomised controlled trial, 214 men with prostate cancer were randomly assigned to either soccer delivered in local football clubs (FG, n=109) or usual care including referral to community-level rehabilitation (UG, n=105). **Intervention:** One hour of soccer twice weekly over one year or usual care. All participants received standardised advice in relation to physical activity guidelines. **Outcome Measurements and Analysis:** BMD, lean body mass, and fat mass were assessed with dual-energy X-ray absorptiometry. Mental health was assessed by Short Form-12 Mental Component Summary. Per-protocol population was defined as soccer participation ≥50% of training sessions over one year. **RESULTS:** Total hip BMD improved for both intention-to-treat (ITT) 0.007 g/cm² (95% CI 0.004 to 0.013, p = 0.037) and per-protocol population 0.007 g/cm² (95% CI 0.000 to 0.015, p = 0.046). The per-protocol population scored 2.9 points higher (95% CI 0.0 to 5.7, p = 0.048) on mental health, and reduced fat mass by 0.9 kg (95% CI -1.7 to -0.1, p = 0.029). No changes were observed in lean body mass. Hospital admissions were reduced in the ITT population with 20 in FG and 33 in UG (p = 0.016). In the per-protocol population odds ratio for hospital admission was 0.34 (p = 0.042) for FG compared to UG.

CONCLUSIONS: Community-based soccer improved hip BMD, and men who played regularly for one year improved mental health, lost fat mass and had fewer hospital admissions.

3280 Board #8 June 1 9:00 AM - 11:00 AM**Exercising Together® for Couples during Radiation Therapy for Prostate Cancer: A Pilot Feasibility Study**

Mary E. Medysky, Jessica C. Siteмба, Kimi Daniel, Arthur Hung, Kerri M. Winters-Stone, FACSM. *Oregon Health & Science University, Portland, OR.* (Sponsor: Kerri Winters-Stone, FACSM)

(No relevant relationships reported)

We developed Exercising Together®, a partnered strength training program, as an exercise-based approach to improve patient, spouse and relationship health for couples coping with cancer. Exercising Together® may be most effective during cancer treatment, when couples experience the most stress, but the program has only been tested in couples post-treatment. **PURPOSE:** To determine the feasibility and acceptability of Exercising Together® during a course of radiation therapy for prostate cancer and the preliminary efficacy of the program on physical function, symptoms and dyadic coping in both the patient and spouse. **METHODS:** Couples were recruited from a radiation oncology clinic to participate in group classes of Exercising Together® 3x/week throughout his treatment. Classes consisted of moderate-intensity strength training performed by the couple who worked as training partners. The Physical Performance Battery (timed walk, stance and chair stand) and 400m walk time, and anxiety (SCL-90 ANX), depressive symptoms (CES-D), intimacy (Physical Intimacy Scale) and dyadic coping (active engagement and protective buffering) were assessed at baseline and at the end of radiation, with self-report measures assessed again 8 weeks after training stopped. Independent Wilcoxon-signed rank tests were used to assess change in each patients and spouses. **RESULTS:** 10 couples were enrolled within 3-months. Retention was 100% and average adherence to prescribed classes was 78%. No adverse events occurred. Patients showed significant increases in 4m walk speed (p=0.017), reductions in anxiety (p=0.027) and more active engagement based on the dyadic coping scale (p=0.039) at the end of training. Spouses had improvements in PPB scores (p=0.023) and chair stand time (p=0.024) post-training. At 8-week follow-up no further changes occurred in men, but spouses had significant reductions in depressive symptoms (p=0.016) and nearly significant reductions in anxiety (p=0.066). **CONCLUSION:** Exercising Together® is feasible, acceptable and improved physical, mental and relationship health over a course of radiation therapy. Comparisons to a control group may further identify benefits; however, based on these data a larger, multi-site trial of Exercising Together® in the radiation oncology setting is warranted.

G-21 Thematic Poster - Muscle Damage and Injury

Saturday, June 1, 2019, 9:00 AM - 11:00 AM
Room: CC-104B

3281 **Chair:** Panagiotis Koutakis. *Florida State University, Tallahassee, FL.*

(No relevant relationships reported)

3282 Board #1 June 1 9:00 AM - 11:00 AM**The Role of T Cells in Muscle Damage Protective Adaptation**

Michael R. Deyhle¹, Meghan Carlisle², Chad Hancock², Robert Hyldahl². ¹University of Florida, Gainesville, FL. ²Brigham Young University, Provo, UT.
Email: mrd.deyhle@gmail.com

(No relevant relationships reported)

Skeletal muscle rapidly adapts to contraction-induced damage such that it is subsequently resistant to damage. This phenomenon is called the repeated bout effect (RBE). Interestingly, following damaging contractions on one muscle group the contralateral analogous muscle group also acquires resistance to damage. This is known as the contralateral RBE (cRBE). The mechanisms that underlie the acquisition of the repeated bout effect are not yet fully understood, yet some studies have shown that muscle immune cell accumulation and inflammation after the initial muscle damage is necessary for the RBE to be realized. T-cells are capable of generating immunological memory, an attribute that is central to their role in adaptive immunity. Additionally, a growing body of literature highlights an important role of T-cells in muscle healing following injury. Therefore, we hypothesized that T-cells could

contribute to the RBE in a way reminiscent to their role in adaptive immunity. In this study, *in vivo* lengthening contractions (LC) were used to model the RBE and the cRBE. Flow cytometry was used to characterize intramuscular T-cells following single and repeated bouts of LC. Herein, we also test the hypothesis that T-cells contribute to the RBE by immunological memory. Rats that did two bouts of LC separated by 2 weeks sustained less damage after the second bout. Rats that did a repeated bout of LC on the opposite limb were not protected from damage. CD4+, CD8+ and regulatory T-cells increased in muscle muscles that sustained damage. In rats that were protected from damage a minimal increase in T-cells was observed. Adoptive transfer of T-cells from rats that had previously done muscle-damaging LC did not confer damage protection to recipient rats. In conclusion, the RBE, but not the cRBE was observed in rats, and T-cells infiltrate muscle damaged by LC, but they do not appear to contribute to the RBE in the same way that they drive adaptive immunity.

3283 Board #2 June 1 9:00 AM - 11:00 AM
Low-Dose Rapamycin Facilitates Recovery from Exercise-Induced Muscle Injury

Christopher L. Rawdon, Christopher P. Ingalls. *Georgia State University, Atlanta, GA.*

Email: crawdon1@student.gsu.edu

(No relevant relationships reported)

Rapamycin has been shown to have a dose-dependent effect on multiple signaling proteins in skeletal muscle cells that influence protein synthesis and calcium handling. However, it has yet to be determined if a low-dose of rapamycin impacts skeletal muscle during recovery from an exercise-induced injury. **PURPOSE:** To determine if low-dose rapamycin affects the rate of isometric strength recovery, muscle ubiquitination levels and markers of autophagy compared to saline control 14 days after exercise induced injury. **METHODS:** Mice were injected with either saline (SAL; 0.9%) or low-dose rapamycin (RAP; 10 µg/kg body weight) every other day for 2 weeks before and after a single bout of 150 eccentric contractions of the left anterior crural muscles. The recovery of strength of the anterior crural muscles was measured *in vivo* immediately, 7 days, and 14 days after injury induction. The magnitude of expression of beclin-1, ubiquitin, and ubiquitinated protein in injured and contralateral control TA muscles (i.e., primary anterior crural muscle) were analyzed via Western blot at 14 days after injury. **RESULTS:** Isometric twitch torque values did not differ between groups at any time point. No group differences in peak isometric tetanic torque were observed pre-injury, post-injury or 7 days following injury. However at 14 days, RAP mice recovered to pre-injury peak isometric torque values (Pre= 2.30 ± .07 Nmm; 14d= 2.25 ± 0.08 Nmm) while SAL group was significantly lower than pre-injury. At 14 days, RAP mice generated 15.4% higher maximal torque than SAL group (p = 0.04). Beclin-1 and free ubiquitin expression in TA muscles were significantly increased in both SAL (1.4-fold and 2.3-fold, respectively) and RAP (2.2-fold and 8.0-fold, respectively) mice at 14 days after injury compared to the uninjured muscle. The increase in the free ubiquitin in the injured muscle was 3.3-fold greater in the RAP treatment compared to SAL (p = 0.001). There were no significant changes in the ubiquitination of proteins among the groups at 14 days post-injury. **CONCLUSION:** Chronic low-dose rapamycin treatment in mice enhances recovery of skeletal muscle from eccentric contraction-induced injury at the 14th day and accentuates the upregulation of free ubiquitin.

3284 Board #3 June 1 9:00 AM - 11:00 AM
Time Course of Change in Critical Torque following Exercise-Induced Muscle Damage

Robert E. Hight, Darshit S. Patel, Jessica A. Peterson, Cameron Lohman, Jason A. Campbell, Michael G. Bembien, FACSM, Christopher D. Black, FACSM. *University of Oklahoma, Norman, OK.* (Sponsor: Christopher D. Black, FACSM)

Email: robbyhight@gmail.com

(No relevant relationships reported)

Exercise-induced muscle damage (EIMD) is a result of high-force eccentric contractions and can lead to significant alterations in the structure and function of skeletal muscles. Critical torque (CT) and the impulse above critical torque (IACT) have both been reported to decrease following EIMD.

PURPOSE: The purposes of this study were to 1) observe the time course of change in CT and IACT up to 7-days following EIMD, and 2) to assess the extent to which central and peripheral fatigue contribute to changes in CT and IACT following EIMD. **METHODS:** Participants (males = 6, females = 4) completed 2 familiarizations and 5 experimental visits. Fatigue patterns were assessed, and CT and IACT were derived at the 1st experimental visit. The 2nd experimental visit included an EIMD protocol consisting of 100 back squats. The 3rd, 4th, and 5th experimental visits were identical to the 1st. CT and IACT were acquired through voluntary and stimulated conditions. **RESULTS:** The participant's ratings of muscle soreness were significantly elevated up to 4-days following EIMD (p<0.05). Dominant leg MVIC was reduced up to 2-days (p<0.05) while non-dominant leg MVIC was reduced up to 4-days (p<0.05) following EIMD. Mean CT was decreased up to 4-days following EIMD in the voluntary

condition (p<0.05) while decreases lasted up to 2-days in the stimulated condition (p<0.05). IACT was not significantly different following EIMD in either conditions (p>0.05). Voluntary activation was not significantly different following EIMD (p>0.05) and these results are the same for twitch torque (p>0.05). EMG RMS and twitch torque both showed a significant reduction during the voluntary CT test (p<0.05). There were no changes in low-frequency fatigue after the voluntary and stimulated conditions (p>0.05) or following EIMD (p>0.05).

CONCLUSIONS: Even though CT was lower following EIMD, IACT was not. Additionally, our results show no contribution of central or peripheral fatigue on torque production following EIMD. These findings suggest the loss in torque production following EIMD to be a factor of EIMD's effect on muscular function and not the central and peripheral mechanisms of fatigue.

3285 Board #4 June 1 9:00 AM - 11:00 AM
Short Wave Elastography Changes in the Biceps Brachii in Response to a Muscle Damage Protocol

Jeffrey Brent Feland, Garrett Jones, Cameron Smallwood, Jon Blotter, A. Wayne Johnson. *Brigham Young University, Provo, UT.* (Sponsor: J. Ty Hopkins, FACSM)

Email: Brent_Feland@byu.edu

(No relevant relationships reported)

PURPOSE: Standard ultrasound (US) imaging can help determine structural alterations within muscle and tendon; however, it offers limited information about the intrinsic mechanical properties of muscle. Because muscle is compressible, but transversely isotropic, the most accurate measure is the shear modulus, and SWE correlates well with Young's modulus. Shear wave changes should be useful for determination of muscle lesions or intrinsic changes. To date only a couple studies have observed SWE changes in an arm undergoing DOMS with varying results. Thus, the purpose of this study was to track the changes in biceps SWE changes in kilopascals (kPa), from baseline to 1 week post muscle damage protocol.

METHODS: Standard ultrasound (US) imaging can help determine structural alterations within muscle and tendon; however, it is limited in its ability to convey information about the intrinsic mechanical properties of muscle. Because muscle is compressible, and SWE correlates well with Young's modulus. Shear wave changes should be useful for determination of muscle lesions or intrinsic changes. To date only a couple studies have observed SWE changes using velocity as the variable of interest in muscle undergoing DOMS with varying results. Thus, the purpose of this study was to track the changes in bicep SWE changes (kPa), from baseline to 1 week post muscle damage protocol.

RESULTS: All data were analyzed using a RMANOVA with post-hoc comparisons to determine significance between data points. VAS and SWE were significantly increased for the DOM group at 24 and 48 hours post exercise (P<.0001) with no significant difference between 24 and 48 hours for SWE (p=0.825), while VAS scores increased significantly from 24-48 hours post (p=0.031). There was with no significant difference between baseline VAS (p=0.196) or SWE (p=0.087) at 1 week.

CONCLUSIONS: SWE values increased significantly from baseline to 24 hrs and stayed elevated at 48 hours, which is contrary to data from a published study showing a decrease after 24 hours in the brachialis. This could be due to muscle position. SWE measures of the bicep in an extended position appears to follow VAS and muscle damage progression better than SWE measurements reported from DOMS in a resting position.

3286 Board #5 June 1 9:00 AM - 11:00 AM
Vastus Lateralis Muscle Quality Deteriorates More So Than Muscle Size During Knee Joint Immobilization

Michael Sahebi, Rob J. MacLennan, Nathan Becker, Ethan Davis, David Ogilvie, John McDorman, Ernest Vargas, Matt S. Stock. *University of Central Florida, Orlando, FL.*

Email: sahebi12@knights.ucf.edu

(No relevant relationships reported)

Disuse of a muscle group, such as what occurs during bedrest, limb immobilization, and spaceflight, results in atrophy. Investigators have yet to examine the extent to which short-term disuse alters the composition of muscle tissue, which can be quantified via measures of echogenicity. **PURPOSE:** The purpose of this study was to examine the effects of two weeks of knee joint immobilization on vastus lateralis echo intensity and cross-sectional area. **METHODS:** Twelve healthy females (mean ± SD age = 21 ± 2 years) with a body mass index ≤ 30 kg/m² voluntarily underwent two weeks of left knee joint immobilization via ambulating on crutches and use of a brace. The brace was worn at all times except during sleep, and compliance was confirmed via accelerometers secured around both ankles. Before (PRE) and after the two-week period (POST), B-mode ultrasonography was used to obtain panoramic images of the left (immobilized) and right (control) vastus lateralis in the transverse plane. Images were taken from 50% of femur length. The same investigator performed all imaging. Images were analyzed at the end of the study with ImageJ software to quantify vastus

lateralis echo intensity and cross-sectional area. Two-way (time \times limb) analyses of variance, effect size statistics, and linear regression were used to interpret the data. **RESULTS:** Echo intensity showed a significant time \times limb interaction ($F = 8.27, p = .015, \eta^2 = .429$). Follow-up analyses showed a large increase in echo intensity (i.e., decreased muscle quality) for only the immobilized limb ($p = .016$, Cohen's $d = 0.817$). Declines in muscle cross-sectional area for the immobilized limb were less consistent, as no time \times limb interaction was observed ($F = 2.90, p = .116, \eta^2 = .209$). There was, however, a significant association between the change in echo intensity and the change in cross-sectional area ($r^2 = .383, p = .032$). **CONCLUSION:** In healthy female participants, two weeks of knee joint immobilization resulted in considerable changes in vastus lateralis muscle quality, whereas the atrophic response was less dramatic.

3287 Board #6 June 1 9:00 AM - 11:00 AM
The Effects of Betalain Supplementation on Indices of Muscle Damage

Steven Vitti¹, Samuel Headley, FACSM², Susan Sotir², Elizabeth O'Neill¹. ¹University of Illinois Springfield, Springfield, IL. ²Springfield College, Springfield, MA. (Sponsor: Samuel Headley, FACSM)
 Email: svitt2@uis.edu
 (No relevant relationships reported)

Purpose: Immediately following eccentric exercise, a pro-inflammatory and pro-oxidative state ensues to initiate the remodeling phase and subsequent repair of damaged tissue. A continued pro-inflammatory and pro-oxidative state can lead to secondary muscle damage thereby prolonging the repair and regenerative process. Betalains are bioactive pigments that are reported to have anti-inflammatory and antioxidant properties. We therefore examined the effects of a betalain-rich concentrate (BRC) on indices of muscle damage following eccentric exercise in an effort to assess muscle recovery following supplementation. **Methods:** In this counterbalanced repeated measures design, a total of 11 recreationally active males consumed 50 mg of BRC, containing 12.5 mg of betalains, 3 times per day for 3 days (initial testing day, 24 and 48 hr post-exercise), or nothing at all (control). The exercise protocol consisted of 30 maximal eccentric contractions of the elbow flexors. Each condition was separated by 2 weeks and the contralateral arm was used for the second testing session. Maximal voluntary isometric contraction (MVIC), arm circumference (AC), muscle soreness (MS), and range of motion (ROM) were measured pre, post, 24, 48, and 72 hr following the eccentric exercise. Creatine kinase (CK) was measured pre, 24, 48, and 72 hr following the eccentric exercise. **Results:** No significant differences or interactions were observed for any of the variables ($p > .05$). There was, however, a p -value approaching significance with a corresponding large effect size for the main effect of MVIC ($p = .07, \eta_p^2 = 0.28$). **Conclusion:** Betalain supplementation did not enhance skeletal muscle recovery following eccentric damage. However, we feel the large effect size may provide practical significance. Therefore, future studies should expand upon ours to include larger samples of recreationally active individuals using a more intense damage protocol.

3288 Board #7 June 1 9:00 AM - 11:00 AM
Pilot Data Suggest Negative Change In Bone Mineral Content Is Related To Self-report Musculoskeletal Injury In Infantry Marines

Karen R. Kelly, Brenda Niederberger, Dale Bergquist-Turori, Andrew Jensen, Jake Bernards, Jason Jameson. *Naval Health Research Center, San Diego, CA*
 Email: karen.r.kelly8.civ@mail.mil
 (No relevant relationships reported)

Background: Prevalence of musculoskeletal injury (MSKI) is greatest in young Marines due to the high volume of vigorous exercise, especially in early training. Fitness and body composition are known to be related to injury risk; however, understanding changes in such factors over a training cycle and the risk of injury are not well understood.

Purpose: The purpose of this study was to measure changes in body composition and bone density over the 40-day infantry training and its relation to MSKI. **Methods:** Active duty, male, infantry students ($n = 50$) enrolled in the infantry training battalion located at School of Infantry-West (SOI-W) aboard Camp Pendleton were recruited to participate in this study. Pre- and post-SOI-W training (Day 1 and Day 40), Marines completed a whole body dual-energy x-ray absorptiometry (DXA); as well as, sleep, nutrition, and fitness questionnaires. Three months following graduation from SOI-W, a follow-up survey was sent regarding prevalence and type of MSKI. **Results:** Of the original Marines in the study ($n = 50$), six Marines (12%) reported sustaining an MSKI within three months of completing SOI-W. Those that were injured showed decreased bone mineral content (BMC) in both the dominant and non-dominant leg as compared to the group average whom had an increase in BMC (injured vs. non-injured right leg: $\Delta -5.5\%$ vs. $\Delta +3.3\%$; injured vs. non-injured left leg: $\Delta -3.8\%$ vs. $\Delta +1.2\%$). Additionally, of the injured Marines, 50% reported "poor" sleep quality on the Pittsburgh Sleep Quality Index and 67% reported "excessive sleepiness"

on the Epworth daytime sleepiness scale at the follow-up time point. No differences in fitness levels or dairy consumption (milk, cheese, yogurt, ice cream) were present between injured and non-injured Marines at any time point.

Conclusion: These pilot data suggest that MSKI may be related to negative changes in BMC; as well as sleep quality and daytime sleepiness. Further work is needed to determine the relationship between MSKI and BMC and sleep to elucidate mechanisms or impact on injury risk.

G-34 Free Communication/Poster - Body Composition

Saturday, June 1, 2019, 7:30 AM - 11:00 AM
 Room: CC-Hall WA2

3313 Board #1 June 1 8:00 AM - 9:30 AM
Accuracy of Body Fat Estimation Using Circumferences and Air Displacement Plethysmograph on Male Navy Sailors

Katherine M. Wilson, Rebecca S. Weller, Andrew J. Ordille, Douglas M. Jones, Melissa D. Laird, Jay H. Heaney. *Naval Health Research Center, San Diego, CA*
 (No relevant relationships reported)

The Department of Defense maintains fitness and body composition standards for active duty service members to maintain safety and performance as well as promote health and disease prevention. Since height/weight tables do not reflect body fat percentage (BF%), the Navy needed a technique that was quick, portable, cost effective, and scalable to a large, diverse population. An equation to calculate BF% using circumference measurements was developed in 1984, using underwater weighing as the gold standard, and has remained in use by the Navy since its implementation. **PURPOSE:** To assess the accuracy of BF% estimation on male U.S. Navy sailors obtained using circumference (Circ) and air displacement plethysmograph (ADP) techniques compared with BF% estimates using dual-energy X-ray absorptiometry (DXA) as the gold standard. **METHODS:** Same-day DXA, Circ, and ADP measurements were recorded for 45 male subjects (age: 33 ± 7 yr, height: 177.9 ± 7.8 cm, weight: 92.9 ± 15.1 kg). Circumferences were taken using a retractable tape measure placed on the skin by trained researchers. Three measurements were taken and averages were calculated and entered into the equation. Compression shorts and swim caps were worn for ADP measurements and lung volumes were predicted. DXA was completed per manufacturer specifications. **RESULTS:** Average BF% was $21.6 \pm 4.8, 21.9 \pm 4.8$, and 26.2 ± 7.1 for DXA, Circ, and ADP, respectively. Differences between ADP and DXA were statistically significant ($p < .001$). Compared with DXA, BF% estimates were accurate within $\pm 1.0\%$ in 31.1% and 8.9% of subjects for Circ and ADP measurements, respectively. Circ overestimated BF% in 57.7% of subjects, while ADP overestimated BF% in 93.3% of subjects. **CONCLUSION:** When comparing the accuracy of Circ and ADP with DXA, Circ had a nearly identical average and SD, while the average was 4.6% higher for ADP with a larger SD (4.8 vs. 7.1). Circ was within $\pm 1\%$ of DXA in nearly 1 in 3 subjects, while ADP was as accurate in fewer than 1 in 10 subjects. ADP overestimated BF% in 42 of the 45 subjects. Furthermore, the highest BF% overestimation for any individual was 7.1% for Circ in contrast to 11.5% for ADP. The results of this study suggest that in a male Navy population, use of circumference measurements to estimate BF% is more accurate than ADP and in close agreement with DXA measurements.

3314 Board #2 June 1 8:00 AM - 9:30 AM
The Influence of Gender and Body Composition on Pool-Based Anaerobic Power and Capacity

Jacquelyn N. Zera¹, Emma Connell¹, Elizabeth Nagle, FACSM², Takashi Nagai³, Mita Lovalekar², John P. Abt, FACSM⁴, Scott M. Lephart, FACSM⁴, Bradley Nindl, FACSM². ¹John Carroll University, University Heights, OH. ²University of Pittsburgh, Pittsburgh, PA. ³Mayo Clinic, Rochester, MN. ⁴University of Kentucky, Lexington, KY. (Sponsor: Elizabeth Nagle, FACSM)
 Email: jzera@jcu.edu
 (No relevant relationships reported)

Recent evidence has shown that a tethered 30-second maximal swim (TST) is a valid and reliable measure of anaerobic power and capacity in swimmers. Consistent differences between males and females exist in both land and water-based measurements of force production, with land-based differences heavily influenced by body weight and muscle mass. However, the influence of body size and composition has not been investigated for the TST. **Purpose:** To explore gender differences in anaerobic power (F_{peak}) and capacity (F_{mean}) during a TST, and to explore the influence of body total body mass (TBM), and body composition (percent body fat (%BF) and

fat free mass (FFM)) on gender differences. **Methods:** Thirteen males (Age = 22.54 ± 3.1 years; BMI = 24.63 ± 2.5 kg·m⁻²; %BF = 13.92 ± 5.1%) and fifteen females (Age = 20.67 ± 4.5 years; BMI = 23.36 ± 2.9 kg·m⁻²; %BF = 25.80 ± 7.9%) completed a TST, as previously described in the literature. Body composition was assessed via air displacement plethysmography. Independent t-tests were used to determine absolute differences between males and females for F_{peak} and F_{mean} . Additionally, the influence of TBM, %BF, and FFM on gender differences for F_{peak} and F_{mean} during a TST was determined using a backwards stepwise linear regression analysis. **Results:** Males produced significantly higher F_{peak} ($p < 0.001$) and F_{mean} ($p = 0.008$), compared to females. However, when adjusted for measures of body composition, FFM was significant for F_{peak} ($p = 0.002$) and F_{mean} ($p = 0.001$), and gender was not significant ($p = 0.694$ and $p = 0.136$, respectively). **Conclusions:** Although gender differences were observed for mean and peak force production, results of the present investigation revealed that fat free mass significantly contributed to force production, regardless of gender. Therefore, force production and sprint swimming performance may benefit from gains in muscle mass, although more research is needed in the form of training studies. Additional research should investigate the influence of the ratio of fat mass and fat free mass on buoyancy, body position, and the balance required to achieve optimal force production and sprint swimming performance.

3315 Board #3 June 1 8:00 AM - 9:30 AM

Fat-Free Mass Index in a Diverse Sample of Male Collegiate Athletes

Bradley S. Currier, Patrick S. Harty, Jessica M. Moon, Shane A. Ponder, Richard A. Stecker, Hannah A. Zabriskie, Andrew R. Jagim, Chad M. Kerkisick, FACSM. *Lindenwood University, St. Charles, MO.*

(No relevant relationships reported)

Fat-free mass index (FFMI) is a body composition metric that has been employed to assess relative muscularity, with a 28.1 kg/m² upper limit reported in male athletes. FFMI is calculated by dividing fat-free mass by squared height, though further height corrections via linear regression may be required to normalize FFMI in taller individuals. To date, only two investigations have reported height-adjusted FFMI (FFMI_{Adj}) in males. **PURPOSE:** The purpose of this study was to report height-adjusted FFMI data and natural upper limits of FFMI in male collegiate athletes. **METHODS:** The body composition of 209 male collegiate athletes from 10 sports (Mean ± SD; Age: 20.7 ± 1.9 years, Height: 182.9 ± 6.7 cm, Weight: 90.8 ± 16.8 kg, Percent Body Fat: 15.6 ± 5.3 %) was measured using dual-energy x-ray absorptiometry. The height adjustment was calculated by regressing unadjusted FFMI against height in all athletes above the median unadjusted FFMI. The slope of this line was used to adjust all FFMI values. The natural upper limit for FFMI_{Adj} in this sample was determined by calculating the 97.5th percentile of all values. FFMI_{Adj} data were assessed for normality using the Shapiro-Wilks test. One-way ANOVAs with Tukey *post-hoc* comparisons were used to determine between-sport differences. **RESULTS:** The slope of the line used in height adjustment was -0.014 ($p = 0.631$). A paired-samples t-test revealed a significant difference (0.041 kg/m², $p < 0.001$) between unadjusted and adjusted mean FFMI values. The overall mean FFMI_{Adj} was 22.8 ± 2.8 kg/m². FFMI_{Adj} was not normally distributed and was log transformed prior to analysis. Significant between-sport differences ($p < 0.001$) in FFMI_{Adj} were identified. Upper limits (97.5th percentile) for FFMI_{Adj} were found to be 28.32 kg/m² for the entire cohort while upper limits for rugby and baseball were found to be 29.1 kg/m² and 25.5 kg/m², respectively. **CONCLUSION:** This study reported FFMI_{Adj} values in a diverse cohort of male collegiate athletes, providing data for the first-time in several sports. These values can be used to guide nutritional and exercise interventions and provide coaches with standardized information regarding the potential for further fat-free mass accretion in male athletes.

3316 Board #4 June 1 8:00 AM - 9:30 AM

Gender and BMI Differences in Body Image Among College Freshmen

Ruth N. Henry, Matthew D. Ruiz, William C. Vantrease, David Bender. *Lipscomb University, Nashville, TN.* (Sponsor: Kent Johnson, FACSM)

(No relevant relationships reported)

Research in the area of body image has shown that females have more dissatisfaction with their bodies than males, but that males also have concerns with some aspects of body image. Instructors in wellness courses designed for college freshmen have the opportunity to address these challenges.

Purpose: to determine which components of body image display gender differences, and whether gender differences in certain aspects of body image are related to BMI. **Methods:** The Body Self-Image Questionnaire was administered to students in a freshman Wellness course as a part of their physical fitness assessment which included BMI (N=130 F, 50 M). Data were analyzed with a 2 x 2 factorial ANOVA to evaluate both effects of BMI and Gender and their interactions. All nine subscales of the BSIQ were included: Overall Appearance Evaluation (OAE), Fatness Evaluation

(FE), Health/Fitness Evaluation (HFE), Health/Fitness Influence (HFI), Attention to Grooming (AG), Social Dependence (SD), Height Dissatisfaction (HD), Negative Affect (NA), and Investment in Ideals (II). For the analysis, BMI values <25.0 kg/m² were classified as "normal" (NW); values ≥25 kg/m² were categorized as "overweight" (OW).

Results: In SD, there was a significant main effect for gender, with females scoring higher in the factor of social dependence ($p = 0.138$). There was a main effect for gender in HD, with males being more dissatisfied with their height than females ($p = 0.103$). An interaction existed between gender and BMI for height dissatisfaction, with a greater gender disparity in HD in normal weight students (M>F) than in OW students, where differences almost disappeared. The main effect for gender in FE indicated that females view themselves as fatter than males ($p = 0.015$); not surprisingly, there was also a main effect in FE for BMI ($p < 0.0001$; OW>Nor). A main effect for BMI existed in OAE ($p < 0.0001$; Nor>OW); II ($p = 0.0373$; Nor>OW); HFE ($p < 0.0001$; Nor>OW); and NA ($p = 0.0003$; OW>Nor). A gender-BMI interaction existed in HFI ($p = 0.0098$) indicating that OW males felt that health and fitness influenced feelings about their bodies more so than OW females; in Nor students, gender differences were very small. **Conclusion:** The belief that females have more body image concerns than males is valid in some components of body image, and BMI attenuates some gender differences.

3317 Board #5 June 1 8:00 AM - 9:30 AM

Impact of Body Fat Percent on Heart Rate of Moderate-Intensity Aerobic Activity

Wenhao Liu, FACSM, Istvan Kovacs, Austin McClinton.

Slippery Rock University, Slippery Rock, PA.

Email: wenhao.liu@sru.edu

(No relevant relationships reported)

PURPOSE: To better understand the relationship between body fat percent (%BF) and aerobic capacity, this study examined how %BF would impact heart rate (HR), maximal HR% (%HRmax) and HR reserve% (%HRR) when walking at 3.0 mph among young adults.

METHODS: The three-site skinfold measure was administered to 176 university students (mean age: 20.82±1.49; 102 males and 74 females) in the US and converted to %BF using the conversion tables by Jackson et al. (1985). The ACSM satisfactory ranges of %BF (2014, 10%-22%BF for men and 20%-32%BF for women) were used to divide participants into three %BF groups: Normal, Lean, and Obese. HRmax was calculated with "220-age", resting HR (after lying on the floor for five minutes) was measured using HR monitors (Sigma PC26.14), and HRR was calculated with "HRmax-resting HR". Finally, HR at the end of a three-minute treadmill walking at 3.0 mph was measured, which was also used to compute %HRmax (HR ÷ HRmax × 100%) and %HRR [(HR - Resting HR) ÷ HRR × 100%] of the walking. One-way MANOVA was used to examine differences in HR, %HRmax, and %HRR of the three-minute walking among the three %BF groups.

RESULTS: There were 90 participants in Normal, 64 in Lean, and 22 in Obese group. No age difference ($p > .70$) was found among the three %BF groups (Normal 20.71±.90, Lean 20.94±2.79, Obese 20.95±1.50). However, significant differences (p values ranged from .000 to .003) were observed in HR, %HRmax, and %HRR for the three-minute walking at 3.0 mph among the three %BF groups. Specifically, significant differences were identified in HR in all the three pairwise comparisons: Lean (95.56±10.27) vs. Obese (112.14±9.82), Lean vs. Normal (104.58±11.24), and Normal vs. Obese; in %HRmax in all the three pairwise comparisons: Lean (48.03±5.29) vs. Obese (56.34±4.91), Lean vs. Normal (52.48±5.64), and Normal vs. Obese; and in %HRR between Lean (22.89±7.35) and Obese (30.22±6.07) and between Lean and Normal (26.85±6.99).

CONCLUSIONS: The %BF classified with ACSM %BF ranges has significant impact on HR among young adults when walking at 3.0 mph, a moderate-intensity (3.5-MET) activity. Specifically, when walking at 3.0 mph, lean individuals demonstrate significantly lower HR, %HRmax, and %HRR than normal and obese individuals; and normal individuals show significantly lower HR and %HRmax than obese individuals.

3318 Board #6 June 1 8:00 AM - 9:30 AM

Anthropometric Characteristics Of NCAA Division III Swimmers

Heather Milton, Susan Edmond. *NYU Langone Health, New York, NY.*

Email: heather.milton@nyumc.org

(No relevant relationships reported)

There is an assumption among competitive swimmers that certain body types are predisposed to perform better. This assumption may be in part due to research on young swimmers that suggests that greater standing (StH) and seated height (SH), arm span (AS), and the surface areas of the arm and foot increase swimming speed. However, literature on these variables in adult swimmers does not exist. Further, despite literature supporting the negative correlation between body fat percentage (BF) and performance in a variety of sports, the literature on swimmers suggests BF

is not a leading contributor to faster swimming speeds. There exists a need to explore the association between anthropometric characteristics and performance among adult competitive swimmers.

PURPOSE: To evaluate the association between anthropometric characteristics of National Collegiate Athletic Association Division III (DIII) male and female swimmers and performance determined by qualifying for NCAA national competition. **METHODS:** 54 Subjects (25 F) were evaluated pre-season for StH and SH, arm circumference (AS) and upper arm length (AL), hand length (HL) and width (HW), foot length (FL) and width (FW), and weight (WT) and BF in accordance with standard methods. At midseason, BF and AS were repeated. Means (M) and standard deviations (SD) for all variables among male and female swimmers were reported. Logistic regression analyses were performed to determine the association between each anthropometric measure and qualification for Nationals competition controlling for gender. **RESULTS:** Nineteen (35.2%; 11 [37.9%] male and 8 [32.0%] female) qualified for Nationals. With the exception of seated height and left hand length ($p=0.05$), both of which showed a positive association, regression analyses revealed that there were no statistically significant differences between anthropometric characteristics and qualification for Nationals. **CONCLUSIONS:** Results suggest that greater SH and left HL have a positive effect on swimming performance, but there was no association between any other anthropometric variable and qualification for Nationals. These findings suggest that differences in swimming performance among DIII swimmers are likely due to other factors, such as biomechanical, intrinsic physiological and psychosocial attributes.

3319 Board #7 June 1 8:00 AM - 9:30 AM
Body Composition Changes Following NFL Combine Preparation Training
 Jeremy R. Townsend¹, Jordan LuAllen², William C. Vantrease¹, Megan D. Jones¹, Ann M. Toy¹, Ian Hunter¹, Kent D. Johnson, FACSM¹. ¹Lipscomb University, Nashville, TN. ²Ignition Athletic Performance Group, Nashville, TN. (Sponsor: Kent D. Johnson, FACSM)
 (No relevant relationships reported)

The NFL scouting combine and college pro-days implement a battery of anthropometric and performance tests to assess college football players attempting to play in the NFL. As such, athletes commonly undergo specific training and nutrition regimens to optimize combine performance to increase their chances of signing with an NFL team. **PURPOSE:** To observe body composition changes following a training program of different lengths designed to prepare athletes for NFL combine and pro-day performance. **METHODS:** Seventeen male collegiate football players (21.9±0.43 y, 1.89±0.06 m, 106.7±15.3 kg) participated in a NFL combine preparation program. The combine preparation training consisted of 4 resistance training sessions per week and 6 days per week of position and combine test-specific training. Athletes participating in this program were also provided dietary counseling by a nutritionist to improve dietary habits. Pre- and Post- training, body mass (BM), body fat percentage (BF%), fat mass (FM), total body water (TBW), and lean body mass (LBM) were assessed via bioelectrical impedance analysis (BIA). Since all athletes did not join the program on the same date we divided athlete data into two groups: (1) those that completed 7-8 weeks of training (n=10) and, (2) those that completed 4-6 weeks of training (n=7). Data were analyzed by separate repeated measures analysis of variance (ANOVA) for each variable. **RESULTS:** Regardless of group, the combine preparation training program produced significant increases in body mass ($p=0.004$; $\Delta +1.14\pm1.36$ kg), TBW ($p=0.045$, $\Delta +1.24\pm2.31$ kg), and LBM ($p=0.041$, $\Delta +1.67\pm2.97$ kg). No significant ($p>0.05$) main effect of time was observed for BF% or FM. Additionally, there were no significant differences between groups for variable. Of the 17 participants, 3 players were drafted and were on active rosters for the 2018 NFL season, 1 participant was drafted and signed a practice squad contract, with 5 other participants signing undrafted free agent contracts with various NFL teams. **CONCLUSION:** Data suggests that significant changes in body mass, TBW, and LBM can be achieved as a result of NFL combine training even when the training program is of short duration. Furthermore, in these highly trained athletes, even 8 weeks of training may be too short to observe significant improvements in FM or BF%.

3320 Board #8 June 1 8:00 AM - 9:30 AM
Skinfold Thickness As A Predictor Of 3200m Performance For Trained, Male Runners
 Jake Till, Nathan Goslin-Klemme, Preston Kauder, Elaina Biechler. Loras College, Dubuque, IA. (Sponsor: Vincent Paolone, FACSM)
 Email: jacob.till@loras.edu
 (No relevant relationships reported)

Greater levels of adiposity have traditionally been linked to a decrease in distance running performance, as excess weight and body fat have been seen to increase energy expenditure and power output necessary to complete the task of efficient locomotion.

The researchers of the current study hypothesized runners with less appendicular fat would have a biomechanical advantage over runners predisposed to appendicular fat storage. **PURPOSE:** To determine the predictive power of traditional skinfold sites, including chest, midaxillary, triceps, subscapular, abdomen, suprailliac, thigh, calf, and biceps, on performance in a 3200m time trial for trained male distance runners. **METHODS:** Participants were 22 members of a NCAA Division 3 men's cross country team. Skinfold measurements were recorded for each of the nine-sites on each of the athletes using a skin caliper. The athletes then completed a 3200m time trial. This data was then used to run a multiple-regression to determine the importance of each site to time trial performance. **RESULTS:** The subjects had an average body fat percentage of 12.8%, ±4.5%, and an average 3200m time of 10:48 ±48s. The regression analysis revealed that 58.1% of the variance in 3200m time trial performance was predicted by the model using the nine sites (biceps, suprailliac, thigh, chest, subscapular, calf, midaxillary, abdomen, and triceps) as predictors ($p<0.05$). When co-varied out, chest, midaxillary, and abdomen were significant ($p<0.05$) predictors of 3200m performance. Increased chest and abdomen fat storage significantly predicted increased finish time ($p=0.037$, $B=0.206$ min) and ($p=0.023$, $B=0.117$ min). Increased midaxillary fat storage significantly predicted decreased finish time ($p=0.023$, $B=-0.166$ min). When co-varied out, triceps, calf, biceps, subscapular, suprailliac and thigh fat storage were not significant predictors ($p > .05$). **CONCLUSIONS:** Skinfold thickness in the chest, midaxillary, and abdomen were significant predictors of 3200m performance in trained college males, while skinfold thickness in the triceps, subscapular, suprailliac, thigh, calf, and biceps were not. Appendicular fat storage may not be as important to performance as hypothesized in homogeneous well trained male endurance runners.

3321 Board #9 June 1 8:00 AM - 9:30 AM
Bilateral Lean Mass and Dynamic Balance Asymmetry in Collegiate Athletes
 Guadalupe Herrera, Vipa Bernhardt. Texas A&M University-Commerce, Commerce, TX.
 (No relevant relationships reported)

Introduction: Laterality, or lateral dominance may lead to asymmetry in muscle mass and strength, which in turn could lead to differences in stability and balance. Muscular asymmetry and dynamic balance asymmetry have been independently linked with increased injury risk. For example, athletes with >4cm anterior reach distance differences (Δ ARD) were found to be at significantly higher risk to incur injuries. However, it is unknown if there is an association between muscle mass asymmetry and dynamic balance. Nor is it known if these factors change throughout the sports' seasonal periods (i.e., off-, pre-, and post-season). The purpose of this preliminary analysis was to analyze differences between lower body lean mass and dynamic balance in collegiate athletes and to examine if associations exist between the two variables during different seasons. Methods: NCAA Division II student-athletes were recruited in their respective off- or pre-season. Lean mass was assessed via dual energy x-ray absorptiometry. Dynamic balance was assessed via lower quarter Y Balance Test and Δ ARD was calculated. Pearson correlation was used to examine associations. Results: 109 athletes (67W/42M) from six sports have been recruited (see table). There were no significant correlations ($p > 0.05$) between differences in lower body lean mass and Δ ARD in either off- or pre-season ($r^2=0.003$ and $r^2=0.001$, respectively). 51% of athletes in off-season and 48% in pre-season exhibited >4cm Δ ARD. Conclusion: In this preliminary report, no correlation was found between lower body lean mass asymmetry and dynamic balance asymmetry. Concerning was our finding that about half of the athletes showed dynamic imbalances, indicating higher injury risk. Further data collection will determine the extent of the changes in muscle mass and dynamic balance asymmetry over one full competitive season.

Subject characteristics			
Sport	n	Height (cm)	Weight (kg)
Football	18	185.8 ± 5.7	106.8 ± 18.1
Softball	18	167.0 ± 5.3	76.5 ± 10.8
Basketball (W)	6	174.9 ± 9.1	69.5 ± 10.3
Basketball (M)	5	192.5 ± 8.3	88.3 ± 8.0
Track & Field (W)	20	168.2 ± 7.8	63.2 ± 9.8
Track & Field (M)	13	180.8 ± 7.6	81.0 ± 15.6
Volleyball (W)	15	173.8 ± 6.5	69.0 ± 8.1
Golf (W)	8	164.5 ± 8.2	61.1 ± 5.1
Golf (M)	6	177.8 ± 8.2	74.5 ± 9.2

3322 Board #10 June 1 8:00 AM - 9:30 AM
Effects Of Oral-contraceptive Use On Strength, Power And Body Composition In Trained Women
 Vargas Salvador¹, Romance Ramón², Petro Jorge L.³, Espinar Sergio⁴, Bonilla Diego A.⁵, Schoenfeld Brad J.⁶, Kreider Richard B., FACSM⁷, Benítez-Porres Javier². ¹EADE-University of Wales Trinity Saint David, Málaga, Spain. ²University of Málaga, Málaga, Spain. ³Universidad de Córdoba, Montería, Colombia. ⁴BetterbyScience, Málaga, Spain. ⁵Universidad Distrital Francisco José de Caldas, Bogotá, Colombia. ⁶CUNY Lehman College, New York, NY. ⁷Texas A&M University, Texas, TX. Email: salvadorvargasmolina@gmail.com
 (No relevant relationships reported)

Oral contraceptives consumption has been identified as a usual strategy for birth control among athletes. Nevertheless, its impact on body composition and sports performance remains unknown due to the heterogeneity in the formulation of these products and individual factors such as the menstrual cycle, age or sports discipline. **PURPOSE:** The aim of this study was to evaluate the effect of oral-contraceptive use on strength and body composition changes in trained women undergoing regimented resistance training (RT). **METHODS:** Twenty-three resistance-trained women (age 27.4±3.4 years; height 162.7±6.1 cm; body weight 60.5±7.8 kg; BMI 22.9±2.7 kg·m⁻²) were randomized to either a non-oral contraceptive (n=11, NOC) or an oral contraceptive (n= 12, OC) group. After a 3-week familiarization period, all participants performed four sessions of RT per week over the course of an 8-week non-linear program. Dual X-ray absorptiometry was used to measure lean body mass and fat mass. Muscle power was measured by the countermovement jump (CMJ) test using a jump contact mat, and maximal strength was assessed by the one-repetition maximum (1RM) test in the back squat (SQ) and bench press (BP). **RESULTS:** OC significantly increased lean body mass [1.4±1.4(CI: 0.5, 2.3) kg; p= 0.007]; however, no changes were observed in the NOC group [0.7±1.1(-0.2, 1.5) kg; p= 0.0741]. No significant changes were seen in regard to fat mass in both OC [0.4±1.8(-0.7, 1.5) kg; p=0.437] and NOC [0.3±0.8(-0.2, 1.0) kg; p= 0.220]. Both OC and NOC increased upper-body 1RM [6.7±3.6(4.4, 8.9) kg; p<0.01] and [4.8±1.8(3.4, 6.1) kg; p<0.01], respectively; likewise, increased lower-body 1RM [11.9± 6.7 (7.7, 16.2) kg; p< 0.01] and [15.6±5.4 (11.7, 19.4) kg; p< 0.01], respectively. No significant changes were found in CMJ in both OC and NOC [0.7±1.1 (-0.1, 1.6) cm; p= 0.911] and [0.7±1.1(-0.1, 1.6) cm; p= 0.69], respectively. **CONCLUSIONS:** OC use in conjunction with RT produces similar increases in measures of strength and power compared to NOC in trained women and has potentially beneficial effects on lean body mass. Supported by University of Málaga (Campus of International Excellence Andalucía Tech).

3323 Board #11 June 1 8:00 AM - 9:30 AM
Relationships Of Waist Circumferences Measured At Different Anatomical Sites With Body Fat In Chinese Adults
 Lin Wang, Chaoran Yang. *Shanghai University of Sport, Shanghai, China.* (Sponsor: Stanley Sai-chuen HUI, FACSM) Email: wanglin.sus@gmail.com
 (No relevant relationships reported)

In large-scale population surveys and public health screenings, the use of simple anthropometric indices has become popular for identifying individuals who are overweight and obesity. Waist circumference (WC) has been extensively investigated as an indicator of abdominal obesity and health risks among adults. However, standardized protocols for WC measurement have yet to be established. **PURPOSE:** This study aims to determine relationship between body fat and different WC sites in Chinese adults. **METHODS:** A total of 213 Chinese adults aged 18-35years old participated in the study. WC was measured at five sites: immediately above the iliac crest (WC1), immediately below the lowest rib (WC2), midpoint between the lowest rib and the iliac crest (WC3), 1 cm above the umbilicus (WC4), and at the narrowest waist (WC5). Body fat mass (FM), body fat percentage (%BF), abdominal fat mass (FM in abdominal) and abdominal percentage fat (%BF in abdominal) were determined through dual-energy X-ray absorptiometry. Pearson correlation was used to analyze the relationships of WCs with FM, %BF, FM in abdominal, and %BF in abdominal. Levels of significance were set at P < 0.05. **RESULTS:** For males, the measured WCs were strongly correlated with FM and FM in abdominal (p < 0.001), and significantly correlated with %BF and %BF in abdominal (p < 0.001). For females, the WCs were significantly correlated with FM, %BF, and %BF in abdominal (p < 0.001). **CONCLUSIONS:** The WCs were correlated significantly with FM, %BF, FM in abdominal, and %BF in abdominal both in Chinese males and in Chinese females.

3324 Board #12 June 1 8:00 AM - 9:30 AM
Association Between Body Composition and Bone Mineral Density in Elite Collegiate Athletes
 Jordan N. Brown. *Georgia Southern University, Statesboro, GA.* Email: jb17162@georgiasouthern.edu
 (No relevant relationships reported)

Individuals, such as collegiate athletes, that engage in increased levels of strenuous exercise often possess a lower body fat percentage (BF%) and increased fat-free mass (FFM). Additionally, repetitive progressive resistance training and participation in high-impact sports has been demonstrated to increase bone mineral density (BMD). Because collegiate athletes experience a high amount of repetitive loading, it may be expected that BMD would yield a relation to body composition. **PURPOSE:** The purpose of this study was to examine the relationship between body composition and BMD in elite college athletes. **METHODS:** Male (n = 45) and female (n = 33) athletes (ages 18-21 years) from a range of sports, including baseball, football, softball, and volleyball, participated in the study. Total BMD and body composition (i.e., BF% and FFM) were measured using dual-energy x-ray absorptiometry. Pearson's product moment correlations were used to assess all relationships between BMD, BF%, and FFM. **RESULTS:** In terms of males, Pearson's product correlation demonstrated a significant moderate-to-strong positive association between FFM and BMD (r = 0.79, p < 0.01). BF% showed a significant positive low-to-moderate correlation with BMD (r = 0.35, p = 0.02). For females, FFM showed a moderately positive association with BMD (r = 0.58, p < 0.01), while BF% provided a non-significant inverse correlation with BMD (r = -0.21, p = 0.23). **CONCLUSION:** FFM in both male and female collegiate athletes was positively associated with BMD. However, males displayed a positive BMD and BF% relationship, while females a non-significant, inverse association. These findings may reflect the diversity of female athletes (i.e., various sports) that were included within the analysis. For instance, sports that require a greater body mass to enhance performance and those that require a leaner physique were both included within one group which may have affected the BMD and BF% relationship.

3325 Board #13 June 1 8:00 AM - 9:30 AM
Comparison of Air Displacement Plethysmography and Multi-Frequency Bioelectrical Impedance Analysis for Body Composition Assessment
 Benjamin T. Gordon¹, Andrea Y. Arikawa², Kristin Gerkens², Andriana Gonzalez², Sara Boyd², Amber Baskin², Michele Bednarzyk². ¹Radford University, Radford, VA. ²University of North Florida, Jacksonville, FL. (Sponsor: Larry Durstine, FACSM)
 (No relevant relationships reported)

Body composition is a crucial component of health-related fitness. Two methods that are frequently used in clinical settings are air displacement plethysmography (ADP) and multi-frequency bioelectrical impedance (MF-BIA). ADP has been thoroughly validated relative to other various criterion methods. MF-BIA is newer technique relative to ADP, and does not have a substantial amount of validation. **PURPOSE:** To determine the correlation between ADP and a new model of MF-BIA. **METHODS:** The current project was a part of The RISE study, which is aimed at determining the associations between dietary supplement intake and biological and psychosocial measures, including body composition, inflammatory markers, dietary intake, stress, anxiety, and sleep. The current project aims to validate a new model of MF-BIA as a means of estimating body composition when compared to the more established ADP in adults who participate in the RISE study. The current sample consisted of 50 healthy and active individuals, 21 males with mean age 24.3 and 29 females with mean age 24.4. Mean body mass index was 25.2 kg/m² for males and 23.3 kg/m² for females. Participants were asked to come in for one study visit to measure their body composition sequentially using both methods of body composition. **RESULTS:** Average body fat percentages measured by the ADP were 28.8% (females) and 16.6% (males). For MF-BIA the average body fat percentages were 27.8% (females) and 16.9% (males). Further, average fat free mass estimated by ADP was 18.2 kg (females) and 13.8 kg (males). For MF-BIA average fat free mass was 18.3 kg (females) and 14.0 kg (males). A high correlation (Pearson's correlation coefficient, r=0.87) between the two methods was established. **CONCLUSIONS:** These findings indicate that there is a strong correlation between the two methods and MF-BIA provides comparable measurements of body composition in relation to an established method in ADP.

3326 Board #14 June 1 8:00 AM - 9:30 AM
Comparing a 3-Compartment Model to Criterion Measures for Estimating Body Composition in Athletes

Nicole C. Dahlenburg, Bryce Willian, Emily L. Langford, Ronald L. Snarr, Greg A. Ryan. *Georgia Southern University, Statesboro, GA.*

(No relevant relationships reported)

Multi-compartment models are emerging as a criterion method of analyzing body composition, thereby reducing the error associated with standalone laboratory measures. **PURPOSE:** The purpose of this study was to compare a 3-compartment model (3-C) with two gold standard lab measures (i.e., air displacement plethysmography (ADP) and dual-energy x-ray absorptiometry (DEXA)). **METHODS:** Sixty-nine male and forty-eight female athletes completed three body composition measures (i.e., DEXA, ADP, and bioelectrical impedance spectroscopy (BIS)). Body fat percentage (BF%) was calculated using a 3-compartment (3C) model, consisting of total body water (via BIS), body volume (via ADP), and body weight. For statistical analysis, a repeated measures ANOVA was used to compare ADP and DEXA against a 3-C model for all within gender comparisons. **RESULTS:** For males, results showed a significant mean difference when comparing 3-C (13.2±7.0%) and DEXA (16.5±9.5%; $p < 0.01$), but no difference between 3-C and ADP (12.0±8.0%; $p = 0.09$). For females, a significant mean difference was seen with 3-C (23.5±7.2%) and DEXA (28.5±6.6%; $p < 0.01$); however, there was no difference between 3-C and ADP (22.2±7.1%; $p = 0.34$). **CONCLUSION:** DEXA may provide overestimates of BF% for both male and female athletes, while ADP provided no significant differences when compared to a multi-compartment model.

3327 Board #15 June 1 8:00 AM - 9:30 AM
Body Composition Comparisons Via Dual Energy X-Ray Absorptiometry and Air Displacement Plethysmography in Collegiate Athletes

Greg A. Ryan, Stephanie A. Gibson, Michelle L. Eisenman, Emily L. Langford, Ronald L. Snarr. *Georgia Southern University, Statesboro, GA.*

Email: gryan@georgiasouthern.edu

(No relevant relationships reported)

Body composition is a highly important metric in regards to overall physical activity as well as sports performance. Most body fat percentage (BF%) measurements are recorded using two-compartment models, such as skinfold analyses, bioelectrical impedance analysis, or more accurately, via hydrostatic weighing or air displacement plethysmography (ADP). However, research has suggested that three-compartment models, like dual energy x-ray absorptiometry (DEXA), may provide more accurate recordings of BF%. However, limited research exists in comparing BF% obtained via two- and three-compartment models in collegiate athletes. **PURPOSE:** To compare BF% recordings via DEXA and ADP in Division-I collegiate male and female athletes. **METHODS:** Seventy-eight athletes (Male: $n = 45$ [age = 18.4 ± 1.0 y, height = 161.9 ± 55.5 cm, weight = 77.3 ± 32.5 kg]; Female: $n = 33$ [age = 18.0 ± 0.7 y, height = 146.3 ± 56.9 cm, weight = 55.9 ± 23.8 kg]) from multiple sports underwent BF% testing via DEXA and ADP. Both tests were completed on the same visit under supervision by the same test administrator. Hydration status was measured before testing to ensure that all athletes were properly hydrated prior to the test. Athletes were instructed to dress in accordance to the recommended protocols for both tests. Individual paired sample t-tests were run for BF% comparisons for whole group, male athletes, and female athletes. **RESULTS:** A significant mean difference existed for all athletes between DEXA (21.6 ± 10.3%) and ADP (16.4 ± 9.2%) when comparing BF% ($p < 0.01$, ES = 0.53). When factored for gender, male BF% exhibited a significant mean difference between DEXA (16.3 ± 9.5%) and ADP (11.8 ± 8.0%) ($p < 0.01$, ES = 0.51). Additionally, a significant mean difference for BF% was found in the female athletes between DEXA (28.5 ± 6.6%) and ADP (22.2 ± 7.1%) ($p < 0.01$, ES = 0.92). **CONCLUSION:** These results, which are consistent with previous research, indicate significantly greater BF% values for DEXA when comparing athletic populations.

3328 Board #16 June 1 8:00 AM - 9:30 AM
Resting Energy Expenditure And Body Composition In Crossfit

Marcio Souza¹, Maraline Sena², Andressa Lima³, Valden Capistrano Junior³, Monica Pinheiro³, Ana Paula Abdon³.

¹Federal University Of Minas Gerais, Belo Horizonte, Brazil. ²V Clinica De Nutricao, Fortaleza, Brazil. ³Federal University Of Ceara, Fortaleza, Brazil.

Email: marcionutricionista@yahoo.com.br

(No relevant relationships reported)

Crossfit is a training program created by Greg Glessman in 1995 and consists of performing high intensity functional movements. Some studies have already reported reduction of body fat and increase of metabolic rate. **PURPOSE:** To investigate differences in body composition and resting energy expenditure (REE) in CrossFit beginners and athletes using electrical bioimpedance (BIA) and indirect calorimetry (IC), respectively. **METHODS:** 28 individuals (14 male) aged 20-34 years were selected in CrossFit boxes and divided into two groups: CrossFit athletes (GA) and CrossFit beginners (GI). In baseline and after 4 weeks, participants were submitted to body composition and metabolic evaluation. Fat-free mass (FFM), fat mass (FM) and body fat percentage (BFP) were evaluated by BIA and REE and oxygen consumption ($\dot{V}O_2$) were investigated using IC. Participants continued to perform their CrossFit training, usually in accordance with the spreadsheet prescribed by their coaches. Statistical analyses used: Kolmogorov-Smirnov and T of Student. **RESULTS:** There were no differences between groups in baseline. After 4 weeks, female GA showed higher REE (1656.0 ± 78.7 vs 1455.7 ± 157.8, $P = 0.02$) and higher $\dot{V}O_2$ (240.4 ± 11.6 vs 211.3 ± 22.9, $P = 0.02$) when compared to female GI. Only female GA showed a significant increase in baseline energy expenditure (1415.0 ± 236.7 vs 1656.0 ± 78.7, $P = 0.03$) and a significant decrease in baseline body fat percentage (26.4 ± 1.7 vs. 25.2 ± 2.2, $P = 0.05$) between baseline and 4 weeks. In female GI, a reduction in fat mass (15.8 ± 5.7 vs 14.3 ± 5.7, $P = 0.05$) was observed, with no differences in others parameters. Among male groups, male GA showed higher REE (2275.0 ± 286.5 vs 1843.3 ± 336.8, $P = 0.03$) and greater $\dot{V}O_2$ (330.0 ± 41.2 vs 267.2 ± 48.6, $P = 0.03$) when compared to male GI after 4 weeks. But there were no differences for body composition and metabolic characteristics in the same male group, comparing baseline and 4 weeks evaluation. **CONCLUSIONS:** This study showed that 4 weeks of CrossFit training positively influenced REE and BFP, especially in female athletes when compared to beginners. Body composition was improved in both female groups. Among men, there were no differences and, probably, four weeks represent a short period to observe changes in body composition and resting energy metabolism in male groups.

3329 Board #17 June 1 8:00 AM - 9:30 AM
An Examination Of Upper Body Power And Fat-free Mass In Division-I Cheerleaders

Abigail C. Johnson, Michelle L. Eisenman, Emily L. Langford, Ronald L. Snarr, Gregory A. Ryan. *Georgia Southern University, Statesboro, GA.*

(No relevant relationships reported)

The sport of cheerleading requires extended bouts of great physical strength and coordination, particularly at the collegiate level. Upper body power (UBP) is vital to cheerleading performance, as many stunts require athletes to lift and propel themselves or teammates into the air. Additionally, large proportions of fat-free mass (FFM) may provide the ability for cheerleaders to execute advanced movements during competition. **PURPOSE:** The purpose of this study was to examine the association between UB and FFM in Division-I cheerleaders. **METHODS:** Male ($n = 12$) and female ($n = 33$) collegiate cheerleaders were assessed for height (cm), weight (kg), UB, and FFM. UB was determined using the medicine ball put test in which participants sat on an exercise bench at a 45-degree recline and were instructed to throw a medicine ball from the chest for maximum distance. Females and males used 15-lb and 20-lb medicine balls, respectively and completed two trials with a one-minute rest in between. FFM was assessed on the same visit to the laboratory via air displacement plethysmography. Spearman's rho correlations were used to determine all associations with FFM and UB for the entire group and genders. **RESULTS:** Results indicated a significant, strong, positive correlation ($r_s = 0.79$, $p < 0.01$) between UB and FFM for the entire group. Separating the participants by gender produced a significantly, strong, positive correlation for the female population ($r_s = 0.71$, $p < 0.01$); while the males demonstrated a non-significant, moderate correlation ($r_s = 0.45$, $p < 0.45$). **CONCLUSION:** Results suggest that FFM and UB are positively correlated in collegiate cheerleaders, although this relationship was exhibited particularly among females. The demand of UB associated with the sport may require greater amounts of FFM in order to properly execute advanced movements during competition.

3330 Board #18 June 1 8:00 AM - 9:30 AM

Body Composition and Muscle Characteristics of Junior Track and Field AthletesJanel S. Bailey, Rachael Irving, Eon Campbell. *University of the West Indies, Mona, Kingston, Jamaica.* (Sponsor: Melanie Poudevigne, FACSM)

Email: Janel_bailey@yahoo.com

(No relevant relationships reported)

PURPOSE: To characterize and evaluate the body composition and muscle characteristics profile of junior track and field athletes in the athletic preseason and postseason.**METHODS:** The study included 55 junior athletes. Age, height and weight ranged from 12-19 yrs, 157-191 cm, and 42.88-100.88kg, respectively. Body composition and muscle characteristics were measured using ultrasound technology. The two-compartmental model which divides the body into fat mass (FM) and fat free mass (FFM) was used for the analysis of body composition. Muscle cross sectional area (mCSA), muscle thickness (MT) and echo intensity (EI) were used to analyze muscle characteristics. Performance (fP) was quantified using the IAAF scoring system, where each time/distance, was assigned a score and fP calculated. Athletes were categorized into two groups, based on fP: (Group A- increase in performance, Group B- decrease in performance in terms of time or distance).**RESULTS:** Group B athletes had higher mean values for body %fat in the preseason. However, there was no significant change in %fat or regional fat thickness between preseason and postseason, irrespective of performance group. Though not significant, ($p > 0.05$) %fat and waist circumference increased in group B athletes, but decreased in group A athletes. Significant correlations were found between change in muscle cross sectional area in the waist ($p < 0.05$, $r = 0.63$) and thigh ($p < 0.05$, $r = 0.87$), with performance in all athletes**CONCLUSIONS:** Significant differences in body composition parameters between group A and group B athletes at preseason, highlights the importance of maintaining optimal body composition in the offseason. Changes in muscle characteristics in preseason and post-season may influence athletic performance more than changes in body composition over the same period.

3331 Board #19 June 1 8:00 AM - 9:30 AM

Seasonal Body Composition Changes in Division I Cross Country RunnersKatie R. Hirsch, Malia N.M. Blue, Gabrielle J. Brewer, Austin M. Peterjohn, Abbie E. Smith-Ryan, FACSM. *University of North Carolina at Chapel Hill, Chapel Hill, NC.* (Sponsor: Abbie Smith-Ryan, FACSM)

Email: ktrose23@live.unc.edu

(No relevant relationships reported)

Body composition can significantly impact performance and injury risk, particularly in cross country, where a small build and low percent body fat are typically desirable. Body composition goals for an athlete may vary year-to-year, depending on training goals, years of competitive training, and access to specialized training staff. Tracking body composition throughout a collegiate career is important for optimal health and performance. **PURPOSE:** To evaluate changes in body composition across a first, second, third, or fourth year of competition in Division I cross country runners.**METHODS:** Pre and post season measures of body composition were evaluated in first season (N=25), second season (N=24), third season (N=13), and fourth season (N=10) Division I National Collegiate Athletic Association cross country runners (Total: N=46; male=25; female=21) between the years of 2014 to 2017. Total and regional body composition (fat mass [FM], percent body fat [%BF], lean mass [LM], bone mineral content [BMC], and armLM, legLM) was assessed using dual-energy x-ray absorptiometry. **RESULTS:** First year runners significantly increased weight (change [Δ] ± SD; 1.6 ± 2.2 kg; $p = 0.001$), LM (1.6 ± 1.3 kg; $p < 0.001$), BMC (0.03 ± 0.05 kg; $p = 0.008$), and armLM (0.1 ± 0.3 kg; $p = 0.047$). Second year runners significantly increased weight (1.1 ± 1.8 kg; $p = 0.005$), LM (1.2 ± 1.2 kg; $p < 0.001$), armLM (0.1 ± 0.3 kg; $p = 0.019$), and had a small but significant decrease in BMC (-0.02 ± 0.03 kg; $p = 0.002$). There were no significant changes in body composition in third or fourth year runners. **CONCLUSIONS:** First and second season Division I cross country runners experience significant changes in body composition, primarily increases in LM, while third and fourth year runners experience minimal changes. Changes are likely influenced by the addition of strength and conditioning and nutrition staff that are not available in high school. The first two seasons may be key times for developing body composition characteristics in runners that can maximize performance and minimize injury throughout their career.

3332 Board #20 June 1 8:00 AM - 9:30 AM

Multi-Frequency Bioimpedance Reliability and Validity for Assessing Total and Segmental Body Composition in College-Aged MalesSaori Braun¹, Alexa Hayes¹, Garrett Stadler¹, Tucker Goesch¹, Morgan Goldammer¹, Steven Fleck, FACSM². ¹University of Wisconsin-Eau Claire, Eau Claire, WI. ²Andrews Research and Education Foundation, Gulf Breeze, FL.

Email: braunsi@uwec.edu

*Reported Relationships: S. Braun: Industry contracted research; InBody USA.*Bioimpedance analysis (BIA), which may be affected by hydration status, is frequently used to assess total and segmental body composition for research purposes. However, the reliability and validity of BIA in determining body composition in all populations including well hydrated college aged males has not been determined. **PURPOSE:** To determine the reliability of direct segmental multi-frequency BIA and its validity against dual energy x-ray absorptiometry (DXA) in a population of normally hydrated college-aged males. **METHODS:** Body composition was measured in the early morning 3 times in the following order: 1) BIA, 2) DXA, and 3) BIA, all in the same session lasting < 30 minutes. Immediately prior to body composition measurement, a urine sample was collected and analyzed for urine specific gravity (USG). To ensure normal hydration, a USG of 1.022-1.028 encompassing slightly dehydrated, euhydrated, and well hydrated statuses was required for study participation.**RESULTS:** A total of 102 males (mean age = 20.35 ± 1.38 years) were included in the analyses. Intra-class correlations between the two BIA determined fat free mass (FFM) of total body, right arm, left arm, trunk, right leg and left leg were .974, .961, .965, .963, .994, and .994, respectively. Two-tailed paired samples *t*-tests showed all comparisons of DXA FFM (bone mineral content [BMC] + lean mass) compared to the average of the two BIA FFM (comparable to DXA BMC + lean mass) to be significantly different ($p < .001$) except for the trunk ($p = .242$). Segmental BIA FFM underestimated segmental DXA FFM by ≤ 1.05kg, while total body BIA FFM overestimated total body DXA FFM by 2.2kg. **CONCLUSIONS:** Multi-frequency BIA is reliable in determining total and segmental FFM. The significant differences between DXA and BIA in determining segmental FFM may be due to body composition derived from DXA is based on attenuation of x-ray to determine BMC, lean tissue, and fat mass while; body composition derived from BIA is based on impedance of body water content.

3333 Board #21 June 1 8:00 AM - 9:30 AM

Test-retest Reliability Of Bioimpedance Spectroscopy For The Analysis Of Body Composition In Physically Active MalesTyler W.D. Muddle, Patrick M. Tomko, Ryan J. Colquhoun, Mitchel A. Magrini, Nile F. Banks, Nathaniel D.M. Jenkins. *Oklahoma State University, Stillwater, OK.*

(No relevant relationships reported)

No previous studies, to our knowledge, have examined the reliability of bioimpedance spectroscopy (BIS) for the evaluation of body composition. **PURPOSE:** To evaluate the test-retest reliability of BIS for the assessment of total body water (TBW), extracellular water (ECW), and intracellular water (ICW) content, as well as fat mass (FM), fat-free mass (FFM), and body fat percentage (BF%) in physically active males. **METHODS:** Sixteen males (Mean ± SD, 25 ± 3 y, 90 ± 11 kg, 176 ± 6 cm) were assessed at two visits, separated by 2 – 7 days. During each visit, participants rested quietly for 3 – 5 min in a supine position with their arms abducted ≥ 30° away from their torso and legs separated prior to their assessment. Two single-tab electrodes were placed on the right side of the body 5 cm apart on both the dorsal surface of the wrist and dorsal surface of the ankle, respectively. The BIS device was used to estimate TBW, ECW, and ICW (liters; L) based on Cole modelling with Hanai mixture theory, which were then used to calculate FM (kg), FFM (kg), and BF%. Reliability was examined by calculating the intraclass correlation coefficient (ICC; model 2,1) and standard error of measurement (SEM). The coefficient of variation (CV) was calculated by expressing the SEM relative to the grand mean (%). The 95% confidence interval (CI) for each ICC was calculated and used to test the null hypothesis that each ICC was equal to zero. Systematic variability was assessed for each variable via a paired *t*-test. **RESULTS:** Reliability statistics are displayed in Table 1. None of the dependent variables displayed systematic variability ($p > 0.05$). 'Excellent' relative and absolute reliability was observed among all body water (ICC = 0.91 – 0.99; CVs = 1.08 – 3.50%) and body mass (ICC = 0.95 – 0.99; CVs = 1.10 – 6.99%) measurements. **CONCLUSION:** These results indicate that the BIS device used in this study allows for the reliable assessment of TBW, ECW, ICW, FM, FFM, and BF% in physically active men.**Table 1.**

	Visit 1	Visit 2	p-value	ICC _{2,1}	SEM (MS _p)	CV (%)	95% CI
TBW (L)	52.0 ± 5.9	51.8 ± 6.0	0.34	0.99	0.56	1.08%	0.97 – 1.0
ECW (L)	20.6 ± 2.5	20.7 ± 2.4	0.72	0.99	0.25	1.20%	0.97 – 1.0
ICW (L)	31.4 ± 3.5	31.6 ± 4.1	0.62	0.91	1.10	3.50%	0.77 – 0.97
FM (kg)	18.2 ± 5.5	18.8 ± 6.3	0.26	0.95	1.29	6.99%	0.87 – 0.98
FFM (kg)	71.1 ± 8.1	70.8 ± 8.1	0.40	0.99	0.78	1.10%	0.97 – 1.0
BF%	20.2 ± 4.7	20.3 ± 4.9	0.52	0.97	0.80	3.98%	0.92 – 0.99

3334 Board #22 June 1 8:00 AM - 9:30 AM
Comparison of Bioelectric Impedance Analysis for Tracking Body Composition Changes Across a Basketball Season

Jana L. Arabas¹, Liz Jorn¹, Monica L. Hunter¹, Jerry L. Mayhew¹, William F. Brechue, FACSM². ¹Truman State University, Kirksville, MO. ²A. T. Still University, Kirksville, MO. Email: jlarabas@truman.edu
 (No relevant relationships reported)

Body composition assessment has become an integral part of the year-round training schedule for athletes. This may be especially important in women athletes due to the potential for disordered eating. Development of low-cost bioelectric impedance analysis devices (BIA) make them attractive for determining changes in body composition components at different times in the training cycle. Question remains concerning the accuracy of these devices to track body composition changes over the yearly training and competitive cycle compared to a standard laboratory procedure. **PURPOSE:** To compare the accuracy of selected BIA devices compared to dual-energy X-ray absorptiometry (DEXA) for tracking body composition across a college women's basketball season. **METHODS:** Twelve NCAA Division-II women basketball athletes (age = 20.1 ± 1.2 yr, height = 175.0 ± 5.6 cm, weight = 70.2 ± 4.4 kg, %fat = 27.8 ± 2.8%) were measured prior to the season (T1), after pre-season conditioning (T2), at mid-season (T3), and at the end of the season (T4) using 7 single-frequency BIA devices and DEXA. **RESULTS:** Repeated-measures ANOVA indicated that body mass (p = 0.19) and DEXA %fat (p = 0.08) did not change significantly over the course of the season. A method x trial factorial ANOVA of %fat and fat-free mass (FFM) with repeated measures over the second factor indicated that 2 BIA devices were not significantly different from corresponding DEXA values while all others significantly underestimated DEXA %fat. Lin's concordance correlation between BIA devices and DEXA were varied at each phase from low of $\rho_c = 0.17$ to high of $\rho_c = 0.84$, with no consistence across time. Rank-order correlations of BIA devices with DEXA were also inconsistent across time ranging from $r = 0.40$ to $r = 0.72$. **CONCLUSIONS:** Compared to the DEXA standard, single-frequency BIA devices may not provide adequate tracking of %fat or FFM in women across a basketball season.

3335 Board #23 June 1 8:00 AM - 9:30 AM
Using Skinfolts and Bioelectrical Impedance for Tracking Body Composition across a Soccer Season

Liz Jorn¹, Jacob Gunn¹, Ian McCluskey¹, Jerry L. Mayhew¹, William F. Brechue, FACSM². ¹Truman State University, Kirksville, MO. ²A. T. Still University, Kirksville, MO. Email: ljorn@truman.edu
 (No relevant relationships reported)

Assessment of body fat (%fat) is common across yearly training cycles for many athletes, although questions remain concerning the accuracy of assessment methods. **PURPOSE:** To compare various methods for determining body composition in male soccer players across a yearly cycle. **METHODS:** Body composition was assessed in collegiate male soccer players (n = 13; age: 20.2 ± 1.2 yrs) prior to winter resistance training (Phase 1), following 8-weeks of resistance training (Phase 2), 8-weeks of spring skills training (Phase 3), and 14-weeks of a summer individualized training program (Phase 4). %Fat was determined at each phase using dual-energy X-ray absorptiometry (DEXA), 6 athletic SKF equations, and two bioelectrical impedance devices (arm: A-BIA; leg: L-BIA). SKF sites were measured by one experienced investigator throughout. **RESULTS:** A phase x method factorial ANOVA of %fat with repeated measures over the second factor indicated all prediction methods significantly, but consistently underestimated DEXA %fat (average difference =

11.8 ± 2.1%) despite moderate to high correlations with DEXA (r = 0.57 to 0.81). Of the SKF equations, a 7-SKF model, previously produced in our laboratory using DEXA as the criterion measure, had the closest %fat estimate (16.5 ± 3.0%) but a low correlation (r = 0.64) with actual %fat (DEXA: 18.0 ± 3.9%). Jackson-Pollock 3-, 4-, and 7-sites equations significantly underestimated %fat by 8.9% to 9.2% with the highest correlation resulting from the 4-site equation (r = 0.81). A-BIA (13.6 ± 4.9%) and L-BIA (13.4 ± 5.8%) comparably underestimated %fat (-4.8 ± 4.4%) with similar correlations against DEXA (r = 0.57 and 0.59, respectively). Significant negative correlations for differences between SKF predicted %fat and DEXA %fat (r = -0.66 to -0.94) indicated greater underestimation by SKF occurred at higher %fat and body mass values. A similar tendency was noted for differences between BIA %fat and DEXA %fat (r = -0.58 to -0.89).

CONCLUSIONS: All prediction techniques produced significantly lower estimates of %fat in male college soccer players across a year-long training cycle. Despite underestimation, each method provided consistent measure by phase and can be used to effectively track changes across a season. Prediction errors were typically greater at greater DEXA %fat and body mass values.

3336 Board #24 June 1 8:00 AM - 9:30 AM
A Matter Of Fat? Body Composition In Relation To Vo2max Improvements In Division II Female Athletes

Kallie LaValle, Joseph D. Ostrem. Concordia University - St. Paul, St. Paul, MN.
 (No relevant relationships reported)

PURPOSE: Body composition is a significant factor in the determination of relative maximal oxygen consumption (VO2max) (Kenney, Wilmore, & Costill, 2015). Historically, O2 consumption reported in ml/kg/min considers O2 consumption related to fat free mass (FFM). A training program that facilitates an increase in FFM and/or a decrease in fat mass (FM) and body fat percentage (BF%) would inherently increase relative aerobic capacity and may optimize performance throughout the competitive season (Castagna, et al. 2013).

The purpose of the study was to determine the relative aerobic capacity response via Graded Exercise Testing (GXT) in relation to body composition changes in female Division II collegiate athletes following a pre-season conditioning program.

METHODS: Nine female college athletes (age = 20±1 yrs) participated in the study. Subjects performed a modified Balke GXT assessment on a treadmill to failure. Prior to performing the modified Balke GXT, subjects had their body composition assessed utilizing a Bod Pod (COSMED, Rome, Italy). All laboratory assessments were performed in the kinesiology lab at Concordia University - St. Paul, MN. Aerobic fitness and body composition were assessed before and after an 8-week pre-season interval training program. Paired t-tests evaluated mean differences for pre- and post-training variables within body composition and GXT assessments.

RESULTS: The measured VO2max via GXT (43.7 vs. 44.0 ml/kg/min, P=0.57) was not significantly increased and body composition components (FFM: 51.3 vs. 51.8 kg, P=0.49; FM: 16.0 vs. 15.9 kg, P=0.93; BF%: 23.9 vs. 23.5%, P=0.78) were also not significantly affected over the 8-week pre-season training period.

CONCLUSIONS: The 8-week pre-season conditioning program showed improvements, although not significant, among VO2, FFM, FM, and BF%. Further studies with a greater number of participants could provide appropriate power to accurately determine the anthropometric and physiological changes experienced throughout the program.

3337 Board #25 June 1 8:00 AM - 9:30 AM
Comparison of Regional and Global Bone Mineral Densities in Male and Female College Athletes

Monica L. Hunter¹, Jana L. Arabas¹, Liz Jorn¹, Brianne R. Morgan¹, Jerry L. Mayhew¹, William F. Brechue, FACSM², Laurel M. Wentz³. ¹Truman State University, Kirksville, MO. ²A. T. Still University, Kirksville, MO. ³Appalachian State University, Boone, NC. Email: mlh7428@truman.edu
 (No relevant relationships reported)

The advent of dual-energy X-ray absorptiometry (DEXA) has prompted an increase in research concerning the response of bone to exercise training. Previous investigations have focused mainly on female athletes and their susceptibility to stress fractures and low bone mineral density (BMD). Recent information suggests that male athletes may also suffer from relative energy deficiency in sports which could affect their bone health. However, direct comparisons of sport-specific differences and sex-differences in BMD within specific sports have not been fully explored. **PURPOSE:** To compare regional and total BMD between men and women athletes in comparable sports.

METHODS: NCAA Division-II men (n = 115) and women athletes (n = 95) in four sports [soccer (SOC), basketball (BB), cross-country (XC), swimming (SW), and baseball/softball (BS)] were measured for regional and total BMD and lean mass (LM) using (DEXA). Inactive men (n = 23) and women (n = 27) served as a control group (CON). **RESULTS:** Men were taller and heavier and had greater regional and

LM than women. A sex x sport multivariate ANOVA, with the influence of height and weight removed by covariance, revealed that men had significantly greater regional BMD ($p < 0.005$) than women in the arms, legs, pelvis, and total body. XC and SW had significantly lower BMD than CON which were lower than SOC, BS, and BB with no significant difference among the latter groups. The sex x sport interaction was not significant ($p = 0.15$), except for leg BMD where women swimmers (1.153 ± 0.081 g/cc) had a significantly lower value than other groups (1.405 ± 0.151 gm/cc). BMD had a nonsignificantly higher correlation with LM ($r = 0.61$) than with body mass ($r = 0.58$) when sex was held constant.

CONCLUSIONS: Regional BMD appears to be uniquely dependent on sport participation and sport-specific training, but the pattern of bone development appears independent of sex. Men and women athletes in sports that require more intense ground contact and perhaps more resistance training have greater regional and total BMD, suggesting varying levels of bone stress are associated with training for different sports. The degree of stress on bones of the arms does not seem sufficient to differentiate between these sports or inactive individuals.

3338 Board #26 June 1 8:00 AM - 9:30 AM

Comparison of Abdominal Fat among Positions and Ethnicities in College Football Players

Brianne R. Morgan¹, Monica L. Hunter¹, Richard M. Schumacher¹, Laurel M. Wentz², Jerry L. Mayhew¹, William F. Brechue, FACSM³. ¹Truman State University, Kirksville, MO. ²Appalachian State University, Boone, NC. ³A. T. Still University, Kirksville, MO.
Email: brm7215@truman.edu
(No relevant relationships reported)

Body types in American football vary dramatically, but the underlying premise is one of achieving greater size within any position. In order to reach the theoretical size required for a given position, players may perform extensive resistance training and consume large quantities of food without much concern for body composition. Recent investigation has suggested that the accumulation of abdominal or visceral fat may have serious long-term health consequences. However, limited information is available on the extent of abdominal fat accumulation in collegiate football players. **PURPOSE:** To compare the level of android adiposity among Caucasian and African-American football players in different playing positions. **METHODS:** Backs (BA, $n = 57$) and linemen (LM, $n = 47$) were measured for body composition using by dual-energy x-ray absorptiometry (DEXA). Android fat (AF) was identified as the region from the iliac crest to a height 20% distance below the chin. Ethnicity was categorized as Caucasian (CAU, $n = 74$) and African-American (A-A, $n = 30$) based on self-report. **RESULTS:** There was a significant difference ($p < 0.001$) in %fat between linemen ($27.4 \pm 7.5\%$) and backs ($16.8 \pm 4.3\%$) but not between ethnicities (CAU = $22.1 \pm 8.1\%$ vs A-A = $20.4 \pm 7.7\%$), with no significant interaction ($p = 0.96$). The same pattern was evident in AF with a significant difference between positions (LM = 3.03 ± 1.56 kg vs BA = 1.37 ± 1.75 kg), a non-significant difference between ethnicities (CAU = 2.32 ± 1.98 vs A-A = 1.63 ± 1.42 kg), and a non-significant interaction ($p = 0.54$). When body mass was held constant by covariance, there was no significant difference between positions (LM = 1.75 ± 1.95 vs BA = 2.26 ± 1.804 kg), ethnicities (CAU = 2.23 ± 1.35 vs A-A = 1.79 ± 1.371 kg), or for interaction ($p < 0.14$). AF was more highly correlated with body mass in LM ($r = 0.90$) than in BA ($r = 0.26$) and more highly correlated with body mass in A-A ($r = 0.91$) than CAU ($r = 0.63$).

CONCLUSIONS: These findings suggest that the amount AF in college football players is largely related to body size. Accounting for difference in body size eliminates the difference between playing positions and ethnicities. Further research should compare athletes to nonathletes of different ethnicities and sizes to determine if similar patterns exist.

3339 Board #27 June 1 8:00 AM - 9:30 AM

Comparison of Various Body Composition Measures for Division-I Collegiate Male Athletes

Gina R. Hogan, Michelle L. Eisenman, Emily L. Langford, Ronald L. Snarr, Greg A. Ryan. Georgia Southern University, Statesboro, GA.
(No relevant relationships reported)

Estimates of body composition are critical for athletic populations as variations in body fat percentage may impact performance, power, and general overall health. However, most laboratory and field-based devices estimate body composition using algorithms based upon and intended for general populations. Therefore, these algorithms may not be applicable to special populations, specifically male athletes. **PURPOSE:** The purpose of this investigation was to compare various field and laboratory measures of body composition in division-I male athletes against a criterion of air displacement plethysmography (ADP). **METHODS:** Sixty-nine Division-I collegiate male athletes, from various sports, performed five body composition measures (i.e., bioelectrical impedance spectroscopy (BIS), hand-to-foot bioelectrical impedance analysis (HF-BIA), foot-to-foot bioelectrical impedance analysis (FF-BIA), three site skinfold

(SF), and ADP). Each participant performed all measures on the same visit to the laboratory. A repeated measures ANOVA was used to determine differences between body composition measures against the criterion of ADP. **RESULTS:** When compared to ADP ($12.2 \pm 1.1\%$), results indicated a significant mean difference with BIS ($18.1 \pm 6.8\%$; $p < 0.01$) and HF-BIA ($18.5 \pm 6.0\%$; $p < 0.01$). There were no statistical differences between ADP and FF-BIA ($12.1 \pm 6.5\%$; $p = 1.0$) or ADP and SF ($13.2 \pm 8.6\%$; $p = 1.0$). **CONCLUSION:** Results indicate that field measures of body composition (i.e., FF-BIA and SF) may be applicable to athletic populations; whereas, laboratory measures (i.e., BIS and HF-BIA) may tend to overestimate body composition in male athletes. Therefore, new algorithms estimating body composition in athletes may be warranted for laboratory based devices.

3340 Board #28 June 1 8:00 AM - 9:30 AM
Utility of Anthropometric Indices to Estimate Changes in Adiposity in Response to an Exercise Intervention

Jacob E. Erickson¹, Michael Fedewa², Elizabeth Hathaway³, Simon Higgins⁴, Ellen Evans, FACSM¹, Michael Schmidt¹. ¹University of Georgia, Athens, GA. ²University of Alabama, Tuscaloosa, AL. ³University of Tennessee-Chattanooga, Chattanooga, TN. ⁴Elon University, Elon, NC.
Email: jericks219@gmail.com
(No relevant relationships reported)

In cross-sectional analyses, anthropometric measures are generally well correlated with clinical measures of adiposity such as those from dual-energy X-ray absorptiometry (DXA). However, it is unclear whether anthropometric measures are sensitive enough to accurately quantify longitudinal changes in central and whole-body adiposity in response to short term exercise interventions with minimal weight change. **PURPOSE:** To examine the relative agreement between anthropometric and DXA measures of change in adiposity following a 6-week cycling exercise intervention. **METHODS:** Overweight/obese women ($n = 53$, 18-24 years old, 66% White, 17% Black, 17% Other) participated in the exercise intervention. Anthropometric measures included body mass index (BMI) and natural waist (NW) circumference. DXA measures included absolute trunk fat (TrkFat), whole body absolute fat (TotFat), and percent fat (%Fat). Baseline anthropometric and DXA measures were compared using Pearson correlations, as were changes (Δ) in each measure across the intervention. **RESULTS:** Mean \pm SD at baseline for each of the measures were: NW (88.7 ± 10.8 cm), BMI (30.5 ± 5.0 kg/m²), TrkFat (16923.3 ± 5991.3 g), TotFat (35826.4 ± 9813.2 g), %Fat ($44 \pm 5.8\%$). Δ for each of the measures were: NW (-0.8 ± 0.4 cm), BMI (-0.2 ± 1.0 kg/m²), TrkFat (-482 ± 1029.8 g), TotFat (-693.6 ± 1773.6 g), %Fat ($-0.8 \pm 1.3\%$). The association between baseline NW and TrkFat was much stronger at baseline ($r = .93$, $p \leq .001$) compared to the correlation between post-intervention Δ ($r = .57$, $p \leq .001$). Similarly, correlations between baseline BMI and DXA measures were stronger (TotFat: $r = .90$, $p \leq .001$; %Fat: $r = .68$, $p \leq .001$) than correlations between Δ measures (TotFat: $r = .68$, $p \leq .001$; %Fat: $r = .34$, $p = .013$). **CONCLUSION:** Anthropometric indices may not accurately reflect Δ in body composition during short duration lifestyle interventions. This may be due to factors such as cumulative intra-rater measurement errors when assessing waist circumference and the inability of BMI to differentiate changes in lean and fat mass over time. More direct measures (e.g., DXA) may be needed to accurately assess Δ in body composition, especially when these changes are of modest magnitude.

3341 Board #29 June 1 8:00 AM - 9:30 AM
Body Composition Characteristics and Knee Injury Prevalence of NCAA Division I Women's Soccer and Lacrosse

Gabrielle J. Brewer, Malia N.M. Blue, Katie R. Hirsch, Austin M. Peterjohn, Samantha A. Kelchner, Darin A. Padua, Abbie E. Smith-Ryan, FACSM. University of North Carolina - Chapel Hill, Chapel Hill, NC. (Sponsor: Dr. Abbie E. Smith-Ryan, FACSM)
Email: gjbrewer@live.unc.edu
(No relevant relationships reported)

Body composition is directly linked to athletic performance and may influence injury risk and recovery. Female Division I soccer and lacrosse players are at a high risk for lower limb injuries specific to the knee joint throughout their competitive careers. Return to play criterion vary; evaluation of body composition may be an important element of clearance. **PURPOSE:** The purpose of this study was to characterize pre-season body composition and injury prevalence among female Division I soccer and lacrosse players using dual-energy x-ray absorptiometry (DEXA). **METHODS:** Sixty Division I Women's Soccer ($n = 27$) and Lacrosse ($n = 33$) athletes (Mean \pm SD: age: 19.8 ± 1.4 yrs, height, 167.3 ± 6.2 cm, weight, 64.9 ± 8.0 kg.) completed a whole body DEXA scan to determine fat mass (FM), percent body fat (%fat), lean mass (LM), segmental lean mass [right leg lean mass (RLM); left leg lean mass (LLM)], and bone mineral content (BMC). History of lower extremity injury (ACL and other knee injuries) throughout a career was self-reported using a validated questionnaire. Measurements were taken pre-season (August 2018). **RESULTS:** Soccer and lacrosse

players combined (n=60) demonstrated the following body composition characteristics: total body FM (15.23 ± 4.8 kg), total body LM (46.96 ± 4.7 kg), and BMC (2.78 ± 0.3). There were significant differences between sports in %fat and segmental LM (LLM and RLM). Lacrosse athletes had higher %fat compared to soccer athletes: (mean difference [MD] ± SD: 2.5 ± 2.3%; p=0.034). Segmental leg LM (LLM, RLM) was higher in both legs of soccer athletes (LLM MD: 0.08 ± 0.54kg; p=0.004, RLM MD: 0.89 ± 5.2kg; p=0.001). In the full sample, there was no significant difference (p=0.139) between RLM and LLM. When evaluating injured vs. not injured athletes in the full sample, 45% of athletes reported a knee injury; %fat was significantly higher for athletes with no injury history (MD: 2.5±2.4%; p=0.046). **CONCLUSIONS:** These findings suggest that Division I soccer and lacrosse players who have returned to play following a lower extremity injury do not experience differences in segmental leg lean mass between the left and right leg. Based on the elite level of these teams, these data could portray optimal characteristics of successful athletes returned to play.

3342 Board #30 June 1 8:00 AM - 9:30 AM

Parental Socioeconomic Status and Skeletal Muscle Mass among Chinese College Students

Cong Huang¹, Cheng Li², Ying Tian³, Qiang Wang³, Zhengxue Song³. ¹Zhejiang University, Hangzhou, China. ²Chonnam National University, Gwangju, Korea, Republic of. ³Shenyang Normal University, Shenyang, China.
Email: hcngman@yahoo.com
(No relevant relationships reported)

PURPOSE: The purpose of this study was to determine the association between parental socioeconomic status and skeletal muscle mass in college students.

METHODS: A cross-sectional study including 2194 college freshmen (537 males; 1657 females) was conducted in Shenyang, China. Data on body composition, health check-up, and self-reported questionnaire were available from all participants. Skeletal muscle mass assessment was performed by bioelectrical impedance analyzer (TANITA BC-420 MA). Information on parental socioeconomic status (educational levels, annual income, occupational status) was collected via questionnaires. Educational levels were divided into 4 categories: primary school, middle school, high school, and ≥ college. Annual income was divided as <15000, 15000-29999, 30000-49999, and ≥50000 CNY. Occupational status was classified into 4 groups: non-employment, self-employment, blue-collar workers, and white-collar workers. Analysis of covariance was used to adjust the confounding effect of sex, age, ethnicity, hometown location, smoking status, alcohol use, sleep duration, and body mass index.

RESULTS: Mean (standard deviation) body muscle mass was 54.9 (7.8) kg in male students and 39.2 (4.3) kg in female students. Multivariate analysis showed that college freshmen with higher paternal (mean [95% confidence interval]: primary school, 42.2 [41.7, 42.7]; middle school, 42.9 [42.6, 43.2]; high school, 43.6 [43.2, 43.9]; ≥ college, 43.2 [42.8, 43.5], *P* for trend < 0.001) and maternal (primary school, 42.2 [41.7, 42.7]; middle school, 42.9 [42.6, 43.2]; high school, 43.5 [43.1, 43.8]; ≥ college, 43.4 [43.1, 43.8], *P* for trend < 0.001) educational level tended to have higher skeletal muscle mass after adjustment for potential confounding factors. On the other hand, skeletal muscle mass was not associated with parental annual income and occupational status in this study.

CONCLUSIONS: Our study found a positive association between parental educational level and body muscle mass in Chinese college students. Further longitudinal studies on association of parental socioeconomic status with youth muscular mass and function are needed.

3343 Board #31 June 1 8:00 AM - 9:30 AM

Diagnostic Accuracy of Adipose Evaluation Indexes to Identify Obesity and Predict Osteoporosis in Chinese Adults

Wei Luo¹, Lei Ai², Yue Zhou³, Biao Sun⁴. ¹Nanjing Sport Institute, Nanjing, China. ²Jiangsu Research Institute of Sports Science, Nanjing, China. ³Beijing Sport University, Beijing, China. ⁴Nanjing Sport Institute, Nanjing, China.
(No relevant relationships reported)

Objective: To develop more appropriate indicators and cutoffs for different sexes and ages in Chinese adults for earlier prevention of obesity and osteoporosis.

Design: Obesity detection difference was analyzed by chi-square test. Correlation analysis was used between adiposity evaluation indexes and body fat percentage (BF%)

and bone mineral density (BMD). Receiver operating characteristic curves detected BF%-defined obesity and BMD-defined osteoporosis. Diagnostic accuracy was assessed. Optimal cutoffs by sex and age group were determined by area under the curve, Youden index, and sensitivity.

Setting: Physical examination sites in Chinese urban areas.

Subjects: Representative samples from Han adults (702 men and 915 women) aged 20-59.

Results: Obesity prevalence increases from 7.73% (body mass index, BMI) to 26.16%

(BF%). BMI, waist-to-hip ratio (WHR), obesity degree (OBD), and BF% were correlated in all subjects (*r*=0.7, *P*<0.01). OBD thresholds of 20.5% and 14.65% for both sexes, respectively, are most applicable to 20-39-year-olds. BMI and WHR thresholds of 26.45 kg/m² and 0.9, respectively, are most applicable to 40-59-year-olds. WHR threshold of 0.9 is most applicable to 40-59-year-old women. The correlation was satisfactory between weight, BMI, OBD, and BMD in men. BMI and weight thresholds of 23.3 kg/m² and 70.55 kg are respectively most applicable to 20-39 and 40-59-year-old men.

Conclusions: BMI, OBD, and WHR are valuable for obesity diagnosis in young people and women. Traditional cutoffs should be revised by sex and age. The most applicable index differed by sex and age. Weight, BMI, and OBD are valuable for men in osteoporosis screening.

3344 Board #32 June 1 8:00 AM - 9:30 AM

The Relationship Between Body Composition with Peak Force and Anaerobic Power in Collegiate Baseball Players

Jeremy R. Pearson, Tanuj Wadhi, Jacob T. Rauch, Justin Thiel, Jody C. Andersen, Jay O'Sullivan, Eduardo O. De Souza. *The University of Tampa, Tampa, FL.*
Email: jeremy.pearson@spartans.ut.edu
(No relevant relationships reported)

While total lean body mass accretion (TLBM) has been shown to have a positive association with performance in professional baseball players (Hoffman et al., 2009), there is a paucity of data demonstrating the relationship between body composition with power performance in collegiate athletes. **PURPOSE:** To investigate the relationship between multiple body composition parameters with peak force and anaerobic power in division II collegiate baseball players. **METHODS:** This was a retrospective study in which four years of body composition data was analyzed to determine its association with peak force and anaerobic power performance for 95 collegiate baseball players (age: 21.1±1.0 yrs.; height: 1.84 ±0.05m; body mass: 87.9±11.1kg). Each subject performed a DEXA scan as well as a performance test of either a countermovement vertical jump (CMJ) (n=66) and/or a Wingate test (WIN) (n=43). Pearson's correlation coefficient was used to analyze the association between body composition parameters (i.e., TLBM, lower body lean mass [LBLM], body fat percentage [BF] and body mineral component [BMC] with vertical jump peak force [CMJPF] and anaerobic power (i.e., absolute peak power [PP] and absolute average power [AP] on the Wingate test. **RESULTS:** TLBM was strongly correlated to WIN (PP: *r*=0.777; *p*<0.0001, AP: *r*=0.808; *p*<0.0001), but only moderately correlated to CMJ (CMJPF: *r*=0.488; *p*<0.001). LBLM was also strongly correlated to WIN (PP: *r*=0.0660; *p*<0.0001, AP: *r*=0.738; *p*<0.0001) but only moderately correlated to CMJ (CMJPF: *r*=0.467; *p*=0.002). BF had a weak correlation with WIN (PP: *r*=0.244; *p*=0.049, AP: *r*=0.295; *p*=0.042) and no significant correlation with CMJ (CMJPF: *r*=0.026; *p*=0.869). BMC was strongly correlated to WIN (PP: *r*=0.713; *p*<0.0001, AP: *r*=0.776; *p*<0.0001) and moderately correlated to CMJ (CMJPF: *r*=0.519; *p*<0.0001). **CONCLUSION:** Our data suggests a strong positive relationship between lean body mass, including bone, with anaerobic power but only a moderate relationship with peak force. Moreover, BMC was strongly correlated to performance probably because athletes with more TLBM had greater BMC. Surprisingly, there was no association between body fat percentage and performance.

3345 Board #33 June 1 8:00 AM - 9:30 AM

Weight Change and Hydration Status in Elite Puerto Rican Wrestlers in Preparation for the National Championship

Enid C. Rivera-Velázquez¹, Carmen Nevárez-Alonso², Farah A. Ramirez-Marrero, FACSM¹, Lucía del R. Martínez-Colón¹. ¹University of Puerto Rico, Rio Piedras Campus, San Juan, Puerto Rico. ²University of Puerto Rico, Medical Sciences Campus, San Juan, Puerto Rico.
(No relevant relationships reported)

Rapid weight loss is a very common strategy used in weight class sports, such as wrestling. Risky weight loss methods like fasting, fluid restriction and increased sweating are very common practices used to attain competitive weight. Acute weight gain, as a recovery strategy, after the weigh-in day has also been observed. **PURPOSE:** To determine weight change and hydration status of elite Puerto Rican wrestlers in preparation for the 2015 National Wrestling Competition. **METHODS:** Wrestlers of the national adult pre-selection (15 males, 9 females, ages 17-34 years) were evaluated. Body weight (BW) and hydration status based on urine specific gravity (USG) were determined one week before, the day of the official weigh-in and one hour before on the day of the competition. Questionnaires were administered to evaluate methods used to "make weight". Repeated measures ANOVA (post-Hoc Bonferroni) was used to identify changes in BW and USG between the measurement times. Independent sample t-test was used to detect differences between sex. **RESULTS:** Body weight decreased from 68.9±14.0 to 66.95±13.5 kgs from the week

before the competition to the day of the weigh-in, and then increased to 68.2±13.8 kgs from weigh-in to the day of the competition ($F=27.33$, $p<.001$). USG increased significantly from 1 week before to the weigh-in (1.024 ± 0.006 vs. 1.028 ± 0.007 g/ml) and decreased on the competition day (1.025 ± 0.0073) ($F=4.32$, $P=.019$). No differences were found between sex in relative weight change (%) and USG. More than 80% of the athletes were classified as significantly dehydrated (USG >1.020) during the evaluations. Fasting, exercise with plastic suits and fluid restriction, were among the most common weight loss methods reported. **CONCLUSION:** These results indicate that wrestlers of the national adult pre-selection of Puerto Rico did not accomplish adequate hydration status on the day of the competition, even though partial weight gain was achieved. Education programs for adequate weight and hydration management is highly recommended.

3346 Board #36 June 1 8:00 AM - 9:30 AM
Predicting Percent Body Fat from Waist-to-Height Ratio Using a Regression Model

Stephanie Gerlach, Ann Gibson, FACSM. *University of New Mexico, Albuquerque, NM.*

(No relevant relationships reported)

Relative body fat (%BF) is a predictor of health status. Waist-to-height ratio (WtHR) better indicates disease outcome and adiposity-related disorders than does BMI or waist circumference (WC). **PURPOSE:** Develop a %BF prediction equation from WtHR, weight (wt), age and sex. **METHODS:** White, black, and Hispanic adults (70 men, 71 women; 30±10 yr; 79.6±20.5 kg; 171±12 cm) volunteered for the IRB-approved study. Participants gave written consent and followed pre-test guidelines. Duplicate measurements of WC (narrowest portion of torso), barefoot height (cm) and wt (kg) were averaged. Dry land residual volume (RV) was assessed via helium dilution; the average of 2 values ± 0.1L were used to correct body volume (Vb) from hydrostatic weighing (HW). Tare weight, water density, the average of the 3 heaviest underwater weights within 0.1kg, and RV were included in the Vb calculation. Body density (dry weight/Vb) was converted to %BF using the Siri (1961) formula. A multiple regression analysis was performed to establish a prediction equation from WtHR, wt, age and sex. Statistical analyses were conducted using R; $p<.05$ indicated significance. **RESULTS:** WtHR, wt, age and sex were significant predictors of %BF ($p<.005$). For each sex, %BF increased with each unit increase in WtHR, kg body wt, and yr of age. Wt and WtHR were negatively correlated with sex ($r = -.145$ men; $r = -.434$ women, $p<.05$); %BF and WtHR were positively correlated with age ($r = .461$ men; $r = .389$ women, $p<.05$). For the sample, $\%BF = 19.415 + 0.544 * WtHR + 0.130 * wt + 13.650 * sex$ (men = 0; women = 1) + $0.259 * age$. For the women, %BF was higher at all ages ($b=13.65$, $SE_b=1.356$, $p<.001$). Weight has a stronger effect ($p<.001$) and WtHR has a lower effect ($p<.01$) on %BF in women than men and all participants combined. The resulting sex-specific equation for women is: $\%BF = 31.65 + 0.42 * WtHR + 0.23 * wt + 0.25 * age$. For the men, wt is a lower and age a stronger predictor of %BF than in women. The resulting sex-specific equation for men is: $\%BF = 20.85 + 0.55 * WtHR + 0.08 * wt + 0.27 * age$. **CONCLUSION:** Sex-specific %BF prediction equations for men and women have been established from WtHR, weight, age and sex. These equations await validation with an independent sample. Regardless, %BF can be easily predicted from simple anthropometric data collected in most any setting by technicians needing minimal training.

3347 Board #36 June 1 8:00 AM - 9:30 AM
The Relationship Between BMI, Lean Mass, and Body Fat Percentage with Balance in Collegiate Archers

Branden Ziebell, Jared Feister, Andy Bosak, Russel Lowell, Madeline Phillips, Hannah Nelson, Taylor Sanders. *Liberty University, Lynchburg, VA.* (Sponsor: Dr. James Schoffstall, FACSM)

(No relevant relationships reported)

For shooting sports, static balance and stability can have a dramatic impact on successful athletic performance and may be a key contributing factor in determining the difference between an elite vs an intermediate archer. More specifically, archers need to have a firm foundation and adequate balance during practice and competition. Prior studies, using various types of athletes, have evaluated the relationship between body composition and flexibility, coordination, etc. However, there appears to be no prior studies that compared BMI, body fat percentage (BF%), leg lean mass (LLM), and trunk lean mass (TLM) with balance in archers. **PURPOSE:** To investigate the potential relationship between BMI, BF%, LLM, and TLM on balance in collegiate archers in order to determine if archers should consider incorporating training to improve body mass or segment lean mass. **METHODS:** After having height (170.73 ± 7.48 cm), weight (71.02 ± 13.31 kg), and age (20 ± 1.55 yrs) recorded, 11 (7 males, 4 females) collegiate archers had their body composition (ie. BF%, LLM, TLM, and BMI) assessed. Then, after the completion of a general dynamic warm-up and a series of flexibility tests (ie. sit and reach, back scratch test, and trunk extension), subjects had their balance, with a balance system, evaluated via an athletic single leg assessment feature. During that assessment, the individual performed a single leg

stance on a platform that decreased the amount of friction underneath the platform over 30 seconds and scoring was determined by how much movement occurred with the center of pressure. **RESULTS:** There was no relationship between balance and BF% ($p = .790$ $r = -.091$) and a low correlation occurred with balance and BMI ($p = .387$ $r = .290$). However, there was a moderately high correlation between balance and TLM ($p = .028$ $r = .656$) and a high correlation between balance and LLM ($p = .003$ $r = .801$). **CONCLUSIONS:** BF% appears to have no relationship with balance, while BMI has very little impact. Yet, LLM and TLM may influence static balance. Future research may be required to evaluate LLM and TLM with balance using a larger population in order to further explore this potential relationship and perhaps further understand the factors that affect balance.

3348 Board #36 June 1 8:00 AM - 9:30 AM
Relationship Between Physical Activity Level With Body Composition And Physical Fitness Of Students From Ilhabela, Brazil

José Matheus O. Estivaleti¹, Carolina Gonzalez², Tatiane Figueiredo², Maurício dos Santos², Luís Oliveira¹, José D.S. Guedes³, Victor K. R. Matsudo². ¹*Nove de Julho University (UNINOVE), São Paulo, SP, Brazil.* ²*Center of Studies of the Physical Fitness Research Laboratory from Sao Caetano do Sul (CELAFISCS), São Caetano do Sul, SP, Brazil.* ³*School of Medical Sciences of Santa Casa de São Paulo (FCMSCSP), São Paulo, SP, Brazil.*

(No relevant relationships reported)

Low level of physical activity in children and adolescents has several negative implications for health, such as overweight and decreased physical fitness. **PURPOSE:** Describe and compare the body composition and physical fitness of schoolchildren according to the recommendation of physical activity, measured by accelerometry. **METHODS:** The sample consisted of 73 schoolchildren, 37 boys and 36 girls, from 9 to 11 years of age, participating in the Mixed-Longitudinal Project of Growth, Development and Physical Fitness from Ilhabela. The variables analyzed were: body weight (kg), height (cm), BMI (kg/m^2), skinfolds (mm), circumference (cm), agility (shuttle run/ sec), flexibility (sit and reach), speed (50 meters/ sec) and upper (hand grip/ kg), lower limb (vertical jump/ cm) strength, and abdominal strength (rep). The measures followed the CELAFISCS standardization. Physical activity was measured objectively by means of an accelerometer (ActiGraph, GT3X). Schoolchildren were divided into two groups: a- reached the PA recommendation (≥ 60 min/ day), b- not reached the PA recommendation (< 60 min/ day). To verify data normality, Shapiro Wilk test was used. Comparison of the schoolchildren who did or did not reach the physical activity recommendation was made by t-test and Mann-Whitney U test. The level of significance was set at $p < .05$. **RESULTS:** Schoolchildren who reached the recommendation had significantly lower values compared to those who did not meet, respectively for adiposity (sum of 7 skinfolds) 66.1 cm vs 100.4 cm; body weight 34.3 kg vs. 40.5 kg; height 141.1 cm vs. 144.1 cm; speed 10.1 secs. vs. 10.4 secs. and agility 12.6 secs. vs. 13.5 secs. No significant difference was found in upper and lower limb strength and abdominal strength. **CONCLUSION:** Children who fulfilled the recommendation of physical activity presented a better body composition, speed, and agility than the children who were insufficiently active.

Table 1. Comparison of the mean values of body composition and physical capacity of schoolchildren, according to compliance with the recommendation of physical activity. Mixed-Longitudinal Project of Growth, Development and Physical Fitness from Ilhabela, 2015-2018, SP, Brazil.

	(≥ 60 min/day)		(<60 min/day)		$\Delta\%$
	\bar{x}	σ	\bar{x}	σ	
Weight (kg)	34.3	6.2	40.5	11.1	18.1 *
Height (cm)	141.1	7.5	144.1	11.3	2.1 *
BMI (kg/m^2)	17.1	2.1	19.1	3.4	11.7 *
Sum of 7 skinfolds (mm)	66.1	35.2	100.4	50.4	51.9 *
Lower limb strength (cm)	26.4	5.6	26.6	6.7	0.8
Upper limb strength (kg)	16.8	4.1	18.7	5.8	11.3
Flexibility (cm)	24.2	5.5	26.3	6.7	8.7
Agility (sec)	12.6	1.2	13.5	1.7	7.1 *
Speed (sec)	10.1	1.2	10.8	1.4	6.9 *
Abdominal strength (rep)	28	7.5	24.7	10.1	-12

* significant difference between the means by the t-Student or U Mann-Whitney test; $p < .05$.

3349 Board #37 June 1 8:00 AM - 9:30 AM

Anthropometry Among Non-sedentary Elderly Tendency Analysis Of Adiposity Over Three Decades

Jão da Silva Junior¹, Rafael Benito Mancini¹, Carolina Gonzalez Beltran¹, Tatiane Kosimenko Ferrari², Timoteo Leandro Araujo³, Sandra M. Matsudo⁴, José da Silva Guedes⁵, Victor K. Matsudo¹. ¹CELAFISCS, São Paulo, Brazil. ²Universidade de São Paulo- USP, São Paulo, Brazil. ³UNIFUMF Faculdades Metropolitanas Unidas, São Paulo, Brazil. ⁴Universidad Mayor, Santiago, Chile. ⁵Santa Casa, São Paulo, Brazil.
(No relevant relationships reported)

Purpose: To analyze the adiposity tendency of non-sedentary elderly women over three decades. **Methods:** The study is part of the Mixed Longitudinal Project of Physical Fitness and Aging of SCS. Sample comprised female subjects, 50 years-old and older, involved in a PA program totalizing 6367 individuals. It was measured subscapular, tricipital and suprailiac skinfold. To analyze the trend, the sample was divided into age groups: 50 to 59 years, 60 to 69 years and 70 years and over. **Statistical analysis:** Polynomial regression models were estimated. In the modeling process, the mean of each one of the anthropometric variables was considered as dependent variable (Y) and the years of evaluation as independent variable (X). For each anthropometric variable, the model that presented the highest statistical significance (p) and the best accuracy measure (r²) was selected. The trend was considered significant when the estimated model obtained p < 0.05. **Results:** Triceps skinfold presented a negative trend over the three decades analyzed. In the age group of 50 to 59 years, the mean triceps skinfold decreased .01 mm every year. In the age group of 60 to 69 years, there was a decrease of .09 mm every year. In the age group of 70 years and over, the mean decreased of .16 mm. Subscapular and suprailiac and 3 skinfolds mean increased .01 mm every year in the three age groups analyzed. In the age group of 60 to 69 years, the mean of 3 skinfolds increased .01 mm. In the age group of 70 years and over, the subscapular mean increased of .16 mm in each year; while suprailiac presented an increase of .01 mm every year; and the 3 skinfold mean increased of .01 mm every year. **Conclusion:** Elderly women of all age groups showed a tendency to increase central adiposity and decrease the peripheral region, suggesting that a centripetal fat redistribution occurs with aging.

Table. Trend analysis of skinfolds among non-sedentary elderly according to age group

	50 to 59 years			60 to 69 years			70 years and over		
	Model	r ²	p	Model	r ²	p	Model	r ²	p
Triceps skinfold (mm)	y = 23.16 - 0.01x	0.48	0.0012	y = 21.85 - 0.03x	0.24	0.0390	y = 20.45 - 0.16x	0.26	0.0007
Subscapular skinfold (mm)	y = 24.32 + 0.01x	0.93	0.0000	y = 21.65 + 0.28x	0.86	0.0000	y = 19.91 + 0.16x	0.66	0.0000
Suprailiac skinfold (mm)	y = 23.36 + 0.49x	0.77	0.0000	y = 20.73 + 0.01x	0.73	0.0000	y = 19.29 + 0.01x	0.81	0.0000
Mean of 3 skinfold (mm)	y = 22.54 + 0.01x	0.90	0.0000	y = 21.52 + 0.01x	0.75	0.0000	y = 19.84 + 0.01x	0.29	0.0217

a: first-order regression model; b: second-order regression model; c: third-order regression model.

3350 Board #38 June 1 8:00 AM - 9:30 AM

VO_{2max} and Dual Energy X-Ray Absorptiometry Results in NCAA Division I Tennis Players

Karina L. Wilson, Jason R. Lytle, Steven E. Martin, Stephen F. Crouse, FACSM. *Texas A&M University, College Station, TX.* (Sponsor: Stephen F. Crouse, FACSM)
(No relevant relationships reported)

Purpose: Describe VO_{2max} and body compositions using dual x-ray absorptiometry (DXA) in NCAA Division I male tennis players. **Methods:** Nine (9) male NCAA Division I tennis players (age 19.6 ± 1 yr, height 183.6 ± 5.9 cm, weight 75.6 ± 5.3 kg) who were in pre-season were tested as part of their athletic training program. Each subject underwent a DXA scan two weeks prior to their VO_{2max} test. VO_{2max} tests were conducted using the Bruce protocol (mL/kg/min). On the day of the test, athletes were instructed to consume their normal free-living breakfast and not engage in strenuous activity including team workouts prior to the test. Subjects ran to volitional exhaustion and peak exercise times and VO_{2max} numbers were recorded. Blood pressures were monitored according to the ACSM guidelines before, during, and after the exercise. After the completion of the test, data were analyzed to determine VO_{2max}, max heart rate (HR) which was recorded using a 12-lead ECG, and ventilatory threshold during exercise. **Results:** Results shown in Table 1. **Conclusion:** With respect to published norms for men that are matched to age, the players' measured VO_{2max} average would be ranked in the 90th percentile and deemed excellent for VO_{2max} based on the ACSM guidelines. The highest recorded VO_{2max} from the study is ranked in the 95th percentile and deemed superior. Based off the ACSM guidelines, the average for the body fat percentage falls in the 55th percentile and is deemed fair. The leanest player of the group is in the 80th percentile and deemed excellent.

Player	Age (kg)	Height (cm)	Weight (kg)	% Body Fat	Lean Body Mass (lb)	Fat Mass (lb)	Measured VO _{2max} from Metabolic Cart (ml/kg/min)	Measured Max HR (BPM)	Ventilatory Threshold Heart Rate (BPM)
1	20.1	182.9	73.9	9.6	62.9	6.7	64.3	200	174
2	19.2	175.3	68.0	21.9	52.2	14.6	54.3	188	158
3	21.9	175.3	68.0	20.3	57.3	9.3	53.2	190	159
4	19.3	188.0	83.0	14.5	67.3	11.4	64.4	183	167
5	18.9	180.3	73.5	13.4	59.7	9.3	71.5	191	186
6	19.2	185.4	77.1	14.4	62.8	10.5	69.4	183	161
7	19.5	186.7	78.5	17.6	63.8	13.7	70.1	188	167
8	20.0	193.0	81.7	13.4	66.9	10.4	54.2	200	175
9	18.5	185.4	76.7	12.5	63.6	9.1	67.3	188	169
mean ± sd	19.6 ± 1.0	183.6 ± 5.9	75.6 ± 5.3	15.3 ± 3.9	61.8 ± 4.8	10.5 ± 2.4	63.2 ± 7.4	190.1 ± 6.2	168 ± 8.9

3351 Board #39 June 1 8:00 AM - 9:30 AM

Effect of Moderate Intensity Physical Activity and Modality on Measures of Body Composition in Males

Brian Tyo, Kate Early, Clayton Nicks, James Davis, Cory Gibson. *Columbus State University, Columbus, GA.* Email: tyo_brian@columbusstate.edu
(No relevant relationships reported)

Exercise prior to body composition measures using air displacement plethysmography (ADP) and bioelectrical impedance (BIA) is generally contraindicated. Blood flow redistribution varies when using modalities such as treadmill walking (TW), leg cycling (LC) and arm cycling (AC) that may contribute to inaccuracies. Understanding the effect of physical activity using modalities on the accuracy of these devices have practical benefits. **Purpose:** To determine the effect of moderate intensity physical activity using different exercise modalities on body fat percent (BF%) measured by ADP, whole body bioelectrical impedance (WBIA), upper body bioelectrical impedance (UBIA), and lower body bioelectrical impedance (LBIA). **Methods:** Seventeen male participants (33.1 ± 9.3 y; 23.0%-49.0% body fat) were included in the study. Participants exercised using TW, LC, and AC (45%-55% heart rate reserve) for 30 minutes on different days including a control condition. BF% was measured pre-exercise (PreE), immediately post-exercise (PE0), 15 minutes post-exercise (PE15), 30 minutes post-exercise (PE30), 45 minutes post-exercise (PE45), and 60 minutes post-exercise (PE60) using ADP, WBIA, UBIA and LBIA at each time point. **Results:** No differences were found during the control for PreE BF% for ADP (18.2 ± 9.9%), WBIA (17.8 ± 7.6%), UBIA (17.8 ± 6.5%), and LBIA (15.6 ± 8.0%). There was no effect of time during the control on BF% except when using UBIA (p=0.03). Using ADP, BF% at PE0 was significantly less than all other time points following TW and LC (p<0.05). Following AC, PE0 was significantly different from PE15-PE60, but not PreE (p=0.06). Using LBIA, after TW only BF% measured at PE15 and PE45 was significantly less than PreE (p<0.05). **Conclusion:** BF% measured by ADP after exercise decreases with all modalities, but generally returns to PreE measures within PE15. WBIA and UBIA BF% are not affected by exercise modality over time. However, LBIA BF% tends to decrease following TM but returns to PreE measures within 60 minutes.

3352 Board #40 June 1 8:00 AM - 9:30 AM

Comparison of Different Methods Used to Assess Body Composition in College Aged Athletes

Parker Nally, Heath Pierce, Jared Hall, Colin Shaw, Holley Sirois, Erica Blodgett, Megan Janard-Howell, Christopher Gouws, Jacob Coviello, Taylor Littlefield, MacKenzie Dwyer, Hana Laramie, Erin Tuttle, Paul Visich. *University of New England, Biddeford, ME.* Email: pnally@une.edu
(No relevant relationships reported)

With the prevalence of obesity increasing to almost 40% as of 2016 and the vast amount of health complications known to be associated with being overweight or obese, knowing one's body composition is increasingly important. The American College of Sports Medicine has recommended values for % body fat that places individuals into different categories (from very lean to very poor), based on sex and age. However, these categories of % body fat are based on the use of Skinfold Thickness measurements. There are now numerous ways in which to assess body composition and we don't know the variability that may exist between these methods. **PURPOSE:** The purpose of this study was to compare the most common methods of measuring body composition that are currently being used today in order to determine- 1) how much of a difference exists between the different techniques, and 2) the relationship of the different methods of measuring body composition. **METHODS:** Thirty-nine healthy males (age=20±2 y; body weight=97.38±21.26 kg; height=1.79±0.06m) had their body composition assessed five different ways. Prior to each testing day subjects completed a 10-12 hour fast, did not exercise, and had a Urine Specific Gravity of <1.02. Body composition assessments included skinfold (SF) thickness (Lange Skinfold Caliper), Dual Energy X-Ray Absorptiometry (DXA);

GE Advanced Prodigy DXA Encore V17 Software), Ultrasound Thickness (US; BodyMetrix), Bioelectric Impedance (BIA; Tanita Body Composition Analyzer, BF-350), and Underwater Weighing (UWW; Exertech Floatweight System). **RESULTS:** Body fat % for US was 17.62±6.82%, SF 17.69±7.59%, UWW 21.94±8.97%, BIA, 23.64±7.74%, and DXA 24.98±8.63%. In comparison to DXA, % fat was significantly greater than US, SF, and UWW (p<0.001). In respect to the relationship to DXA, correlations ranged from .873 (DXA vs. BIA p=0.001) to .957 (DXA vs SF p=0.001). **CONCLUSIONS:** These results suggest that a difference in body fat up to 7.36% can be observed between the different methods assessed. However, the relationship between the different methods is fairly strong. Due to the large variability observed in the different body composition methods assessed, it would suggest the need for developing recommended standard ranges based on the body composition assessment utilized.

3353 Board #41 June 1 8:00 AM - 9:30 AM
Agreement Between Two Bioimpedance Spectroscopy Devices and DXA for Body Composition

Bjoern Hornikel¹, Zackary S. Cicone¹, Clifton J. Holmes¹, Bailey A. Welborn¹, Michael R. Esco, FACSM¹, Jordan R. Moon², Todd Freeborn¹. ¹University of Alabama, Tuscaloosa, AL. ²Impedimed, Inc., Carlsbad, CA. (Sponsor: Michael R. Esco, FACSM)
 Email: bhornikel@crimson.ua.edu
 (No relevant relationships reported)

Bioimpedance spectroscopy (BIS) has been used as an alternative to the more expensive and invasive dual-energy x-ray absorptiometry (DXA) to estimate body composition. **PURPOSE:** To determine the agreement between two BIS devices in comparison to DXA for measuring body fat percentage (%Fat), fat-free-mass (FFM), and fat-mass (FM). **METHODS:** Ninety-five subjects (m = 35, f = 60; 30 ± 15 years; 170 ± 8.0 cm; 72.6 ± 14.8 kg) participated in the study. Both devices utilized whole body right side measurements, one device (BIS₁) in supine and the other (BIS₂) in standing position. Measurements were taken during a single visit following an 8-12 hour fast. **RESULTS:** Bland-Altman analysis revealed BIS₁ significantly underpredicted values for %Fat (mean differences ± 95% limits of agreement: 3.09 ± 4.97%) and FM (2.85 ± 5.99kg) and significantly overpredicted FFM (1.15 ± 4.98kg) in comparison to DXA. When compared to DXA, BIS₂ significantly underpredicted values for %Fat (1.69 ± 5.16%) and FM (1.81 ± 6.25kg). No significant difference existed between BIS₂ and DXA for FFM (0.08 ± 5.32kg). Correlations between both BIS₁ and BIS₂ and DXA for FM, FFM, and %Fat were very strong (r ≥ 0.92). **CONCLUSIONS:** While BIS₁ and BIS₂ indicated some bias when calculating FM, FFM, and/or %Fat, the limits of agreement were fairly narrow, indicating both to be acceptable alternatives to DXA for clinical practice in males and females aged 18-82 years with BMIs 18-39.5 kg/m². This study was funded by Impedimed, Inc

3354 Board #42 June 1 8:00 AM - 9:30 AM
The Effect of Acute Exercise-Induced Fluid Loss and Fluid Consumption on Percent Body Fat

Paul T. Cutrufello, Michael J. Landram, Andrew C. Venezia. *The University of Scranton, Scranton, PA.* (Sponsor: Curt B. Dixon, FACSM)
 Email: paul.cutrufello@scranton.edu
 (No relevant relationships reported)

Acute exercise fluid loss, as well as fluid consumption, have been shown to impact body composition assessment using multiple methods of assessment. However, to our knowledge no study to date has examined percent body fat (%BF) using skinfold measurements (SF), air displacement plethysmography (ADP), dual energy x-ray absorptiometry (DXA), and type-A ultrasound (US) under exercise conditions while also controlling for exercise-induced fluid loss. **PURPOSE:** To determine the effect of acute exercise-induced fluid loss and fluid consumption on %BF determined by SF, ADP, DXA, and US before exercise, after exercise, and after fluid consumption. **METHODS:** Thirty-two college-aged men (20.8 ± 1.1 yrs) participated in this study and were randomly assigned to one of three groups: one group consumed water during exercise and after exercise (with water; n=11), a second group consumed water only after exercise (without water; n=11), and a third group served as the control group (n=10). Participants reported in a euhydrated state (Usg < 1.020). %BF was determined using SF, ADP, DXA, and US. Participants then performed 30 min. of exercise at 70% heart rate reserve (HRR) on a cycle ergometer in a room at 28.3-29.4°C. Twenty-thirty min. after exercise %BF was determined a second time. Water equal to the BM lost during exercise was consumed and %BF was measured a third time 60 min. later. **RESULTS:** Body mass (BM) was significantly reduced post-exercise in the without water group (79.7±9.4; 78.8±9.5 kg; p<0.001) but not in the group exercising with water (82.5±7.4; 82.3±7.3 kg; p=0.210). %BF was significantly less post-exercise compared to pre-exercise in the without water group (14.3±4.4; 12.6±4.9 %; p=0.017) when using ADP. In both the with water (16.8±4.5; 18.8±4.2 %; p=0.001) and without water (12.6±4.9; 14.7±5.0 %; p=0.011) groups, %BF significantly increased after fluid consumption when using ADP. No significant effects were observed for DXA, US, or

SF determined %BF after exercise and fluid consumption. **CONCLUSION:** Acute exercise and fluid consumption impacted ADP determined %BF, but did not have a significant effect on %BF determined by DXA, US, and SF.

3355 Board #43 June 1 8:00 AM - 9:30 AM
Decline In Aerobic Capacity Or Increase In BMI?

Xiong Qin, Weimo Zhu, FACSM, Zezhao Chen. *University of Illinois at Urbana and Champaign, Urbana, IL.* (Sponsor: Weimo Zhu, FACSM)
 Email: xiongq2@illinois.edu
 (No relevant relationships reported)

PURPOSE: Aerobic capacities, specifically VO₂max, of children and youth, have been found declining over the second half of 20th century according to the secular trend analyses (see e.g., Tomkinson et al., 2007). Since body mass index (BMI) is often a part of VO₂max prediction, this study was to examine the impact of changed BMI on the declined VO₂max.

METHODS: First, 50th percentiles of 8-11 yr. boys and girls' BMI and 1-mile-Run-Walk (1MRW) performance in 1987 National Children and Youth Fitness Study (NCYFS II) were used to estimate their VO₂max using the equation of Cureton et al. (1995): VO₂max (ml/kg/min) = (-8.41*Time)+(0.34*Time^2)+(0.21*Age*Sex)-(0.84*BMI)+108.94. Second, BMIs in the prediction were replaced by the BMI 50th percentiles of 8-11yr. boys and girls in 2015-2016 NHANES. Finally, the difference between 1987 and 2015-16 estimated VO₂max were computed and compared.

RESULTS: Impact of BMI changes on the estimated VO₂max by age and sex was summarized below:

CONCLUSIONS: Even when running performances stay the same, the changes in BMI between 1987 and 2015-16 could lead 1-7% decline in estimated VO₂max of 8-11 children and youth, indicating that weight management should be a part of fitness and health promotion in children and youth.

Age in Yr., Sex	BMI-1987 (kg/m ²)	BMI-2015-16 (kg/m ²)	1987-1MRW Time (min)	1987-VO ₂ max (ml/kg/min)	2015-16-VO ₂ max (ml/kg/min)	Change (ml/kg/min)	% Change
8, Male	16.38	16.95	10.65	45.86	45.38	-0.48	-1%
9, Male	16.88	18.10	10.17	46.29	45.27	-1.02	-2%
10, Male	17.03	19.00	9.87	46.86	45.20	-1.66	-4%
11, Male	16.03	20.10	9.05	49.52	46.10	-3.42	-7%
8, Female	16.27	17.85	11.53	43.50	42.18	-1.32	-3%
9, Female	16.88	17.30	11.22	43.21	42.85	-0.36	-1%
10, Female	17.03	19.40	11.23	43.07	41.08	-1.99	-5%
11, Female	16.83	20.00	11.25	43.22	40.56	-2.66	-6%

3356 Board #44 June 1 8:00 AM - 9:30 AM
Regional Differences In Bone Mineral Density Vary With Whole Body Z-scores In College Track Athletes

James M. Smoliga, FACSM, Justin D. Waller, Kevin R. Ford, FACSM. *High Point University, High Point, NC.*
 Email: jsmoliga@highpoint.edu
 (No relevant relationships reported)

Track and field athletes are susceptible to musculoskeletal injuries due to a combination of insufficient recovery and excessive training. Stress fractures in these athletes are common, especially in distance runners, and are associated with decreased regional and whole body bone mineral density (BMD). **PURPOSE:** To determine if college track and field athletes with low BMD experience loss of BMD in the ribs (RIB) to compensate for musculoskeletal loading of the lower extremity. **METHODS:** 110 NCAA Division 1 track and field athletes (57 males, 53 females) underwent whole body and bilateral hip dual energy x-ray absorptiometry (DXA) scans. Whole body Z-scores and BMD for standard sub-regions, including RIB, were automatically computed by DXA software. Proximal, middle, and distal regions of the femur (F_{PROX}, F_{MID}, F_{DIST}) and tibia (T_{PROX}, T_{MID}, T_{DIST}) were objectively identified and BMD for each sub-region was computed. In the hip scans, femoral neck (F_{NECK}), Ward's triangle

(F_{WARD}), and total hip BMD were computed. The mean BMD of both sides was computed for each sub-region, and a ratio between BMD of each respective sub-region and the ribs was computed. Participants were then divided into quintiles by whole body Z-score. A linear mixed effect model was used to determine whether the sub-regional BMD parameters and ratios differed between quintile groups. Pairwise comparisons were used to determine differences between quintile groups if a main effect was significant (p<0.05). **RESULTS:** There were significant main effects for BMD to differ by each sub-region (p<0.001 for all), with the lowest quintile group always having significantly lower BMD than that of each of the upper three quintiles. However, the only significant ratios were that of F_{MID}:RIB (p=0.019) and F_{DIST}:RIB (p=0.019). Pairwise comparisons revealed the upper quintile group had significantly lower ratios for these two parameters than all other quintile groups. **CONCLUSION:** Decreased BMD in RIB and all sub-regions of the legs, combined with elevated F_{MID}:RIB and F_{DIST}:RIB ratios, suggest that BMD is lost from the ribs at a greater rate than it from specific regions of the legs in athletes with the lowest whole body Z-scores. Future research should explore the clinical implications of this finding for stress fracture risk and long-term bone health in athletes.

3357 Board #45 June 1 8:00 AM - 9:30 AM

The Prevalence of Body Composition Criterion Methods for Validation Studies in Humans

Laurie A. Milliken, FACSM¹, Timothy G. Lohman². ¹University of Massachusetts Boston, Boston, MA. ²University of Arizona, Tucson, AZ.
Email: laurie.milliken@umb.edu
(No relevant relationships reported)

PURPOSE: To determine the recent prevalence of body composition criterion methods in validation studies of total body percent fat or fat free mass. **METHODS:** A literature search was performed to identify studies between 2013 - 2018 using the following key words: four component model, validation, body composition, and fat using Medline. Only human studies published in English were included. One person (L. Milliken) screened all articles and coded the results to identify the criterion and comparison methods used. For all studies where multi component models were used, a further note was made regarding what methods comprised those models. All methods were summarized to capture the prevalence of methods used in the literature for body composition validation studies. **RESULTS:** A total of 176 articles were identified; 128 measured total body composition or body volume articles and were included. Some studies used more than one criterion method. 10.9% of studies used a 2 component (2C) model, 67.2% used a 3C model and 10.9% used a 4C model as a criterion method. The most common 2C, 3C, and 4C models respectively were air displacement plethysmography (ADP) (9.3%), dual-energy x-ray absorptiometry (DXA) (62.5%) and ADP/DXA/total body water (TBW) (7.8%). 3.9% of studies used an inappropriate 3C or 4C model by using bioimpedance spectroscopy (BIS) in place of TBW by isotope dilution. The criterion methods used in order of prevalence were DXA (62.5%), 4C (10.9%), ADP (9.4%), isotope dilution (7.0%), magnetic resonance imaging (4.7%), 3C not including DXA (4.7%), bioelectrical impedance analysis (3.9%), and underwater weighing (1.6%). **CONCLUSIONS:** Body composition validation studies are dominated by DXA as a criterion method which may not be appropriate in all situations. Also, researchers are incorrectly using field methods rather than laboratory methods (most commonly using BIS for TBW) as part of the 4C model in validation studies. The gold standard for body composition validation studies remains the 4C model with TBW determined by isotope dilution.

3358 Board #46 June 1 8:00 AM - 9:30 AM

Body Composition in Lean Athletes: Which Ultrasound Sites Best Predict Fatness Measured by DXA?

Gabriela Alfonso. University of Colorado at Colorado Springs, Colorado Springs, CO.
Email: galfonso@uccs.edu
(No relevant relationships reported)

PURPOSE: Ultrasound (US) has been used for over 50 years as a way of measuring fat thickness comparable to skin folds in predicting body fat. Recent advances in US (Müller et al, 2016) have increased objectivity and accuracy in measuring fat thickness. This study was designed to compare the new US approach with DXA %fat as the criterion method in male and female athletes. **METHODS:** Three centers (Perth, Colorado, Lisbon) performed whole body DXA method on 16 competitive athletes (n=48; age: 23.5 ± 4.2 years, weight: 69.2 ± 11.1 kg, height: 174.4 ± 8.6 cm, BMI: 22.6 ± 2.4 kg/m²). Three ISAK Level 1 and US trained observers at each center measured 8 standardized US sites, as described by Müller et al (2016), on each athlete capturing 3 sets of measurements per subject. Observer 1 data were combined from each center for both female and male athletes to create Observer 1 sample (n=48); two other sets of data were collated by combining Observer 2 and 3 data, each n=48. Step down regression and correlational analyses were examined for relationships between DXA %Fat and all 8 US sites.

RESULTS: Significant correlations between DXA %fat and all 8 US sites (r=.52 - .87, p<0.01) were found. Using step down multiple regression analyses all 8 sites were entered into the analyses to predict DXA %fat. Three sites for females (lower abdomen (LA), medial calf (MC), distal triceps (DT); p<0.001, SEE=2.4-2.6%); and two sites of three sites for males: LA, MC, and erector spinae (ES) (p<0.01; SEE=1.8-2.2%), and upper abdomen (UA), MC, ES (p<0.01; SEE=1.9%) were found to be the best predictors.

CONCLUSIONS: These findings show that US can predict DXA %fat with low SEE's in both male and female athletes.

3359 Board #47 June 1 8:00 AM - 9:30 AM

Body Fat Assessed With Electrical Impedance Myography Compared With DXA In Professional Athletes

Juan R. Lopez-Taylor, Roberto Gabriel Gonzalez-Mendoza, Francisco Torres-Naranjo, Alejandro Gaytan-Gonzalez, Juan Antonio Jimenez-Alvarado, Edna Elvira Jauregui-Ulloa, Marisol Villegas-Balcazar. Universidad de Guadalajara, Guadalajara, Mexico.
(No relevant relationships reported)

Electrical impedance myography (EIM) has been compared with DXA in physically active subjects, but its accuracy in professional athletes has not been explored. **PURPOSE:** To compare the body fat estimated with a commercial EIM mobile device with body fat measured with DXA. **METHODS:** We evaluated the body fat percentage (BF%) of 28 professional male soccer players (19 - 34 years old, BF% 14.95 ± 2.43) with a whole body DXA scan (Hologic®) and a mobile EIM device (Skulpt® Chisel). The EIM was assessed at ten anatomical sites (abdomen, biceps, calves, chest, forearms, hamstrings, lower back, quadriceps, shoulders, and triceps). The BF% was estimated for each anatomical point and for the sum of all according to the manufacturer's instructions. We calculated mean differences in BF% (DXA - EIM) and their 95% limits of agreement. DXA and EIM BF% were analyzed for correlation with intra-class correlation coefficient and compared with ANOVA and Dunnett post hoc test. **RESULTS:** There were strong correlations between DXA BF% and EIM BF% assessed at abdomen, chest, lower back, quadriceps, hamstrings, and all sites. Moderate to low correlations were observed for shoulders and triceps. Biceps, calves, and forearms showed no significant correlation. Similarly, DXA BF% was different to EIM BF% at calves and forearms only (p<0.05). From the other anatomical sites, the lowest mean difference was observed at hamstrings and the biggest at biceps. However, the narrowest limits of agreement were observed at quadriceps and the widest at chest. BF% estimated using all sites showed similar results as obtained evaluating BF% at quadriceps (Table). **CONCLUSIONS:** The EIM mobile device was useful to accurately estimate BF%, even evaluating a single anatomical site when compared with DXA in professional soccer players. This device may be helpful for body composition assessment on the field. However, its accuracy in other athletic populations and its applicability for follow-up warrants further research.

Anatomical site	Mean	-2SD	+2SD	ICC	Range LA
All sites	1.95	-2.65	6.55	0.64	9.2
Quadriceps	-1.97	-6.07	2.14	0.61	8.21
Triceps	-0.50	-5.30	4.29	0.48	9.59
Biceps	-2.34	-7.30	2.61	0.13	9.91
Shoulders	-0.63	-6.46	5.21	0.50	11.67
Hamstrings	-0.29	-6.24	5.66	0.61	11.9
Abdomen	2.16	-4.24	8.57	0.75	12.81
Lower back	1.33	-5.23	7.89	0.62	13.12
Chest	0.62	-6.71	7.96	0.67	14.67
Forearms	-3.19*	-8.34	1.95	0.04	10.29
Calves	-5.31*	-10.88	0.25	0.005	11.13

ICC: Intraclass correlation coefficient; Range LA: Absolute range on limits of agreement (95%); SD: Standard deviation. * Significant differences with DXA (p<0.05).

3360 Board #48 June 1 8:00 AM - 9:30 AM
Influence of Circumference Measurements and Body Composition on Estimating Resting Metabolic Rate in Healthy Adults

Kristi Chase, Kyle Patek, John Walker, FACSM, Joni Mettler.
Texas State University, San Marcos, TX.
 Email: klc280@txstate.edu
 (No relevant relationships reported)

Measurement of resting metabolic rate (RMR) is an important factor for weight management. Previous research has reported several variables to estimate RMR such as body size, percent fat (%BF), age, and sex; however, little is known regarding the effect of circumference measures in estimating RMR. **PURPOSE:** The purpose of this study was to develop a model to estimate RMR using waist circumference (WC), an easily obtainable measure, and cross-validate it to previously published models. **METHODS:** Subjects were 140 adult men and women, ages 18-65 years. RMR was measured through indirect calorimetry, %BF was measured through air displacement plethysmography, and fat mass and fat-free mass were determined from %BF and weight. Other variables collected were: weight, height, age, sex, ethnicity, body mass index, WC, hip circumference, waist-to-hip ratio, waist-to-height ratio, and %BF estimated from bioelectrical impedance analysis. Subjects were randomly divided into derivation and cross-validation samples. A multiple regression model was developed to determine the most accurate estimation of RMR in the derivation sample. The cross-validation sample was used to confirm the accuracy of the model and to compare the accuracy to published models. **RESULTS:** The best predictors for estimating RMR were body weight, $r = 0.70$, $p = 0.031$, age, $r = -0.30$, $p = 0.012$, and sex, $r = 0.51$, $p = 0.018$. Other factors failed to account for significant variation in the model. The derived equation for estimating RMR is: $RMR \text{ (kcal/day)} = 843.11 + 8.77(\text{weight}) - 4.23(\text{age}) + 228.54(\text{sex}, M = 1, F = 0)$, $R^2 = 0.68$, $SEE = 173 \text{ kcal/day}$. Cross-validation statistics were: $R^2 = 0.54$, $p \leq 0.05$, $SEE = 199 \text{ kcal/day}$, and total error = 198 kcal/day. In published models, R^2 ranged from 0.47 to 0.57, SEE ranged from 192 to 213 kcal/day, and total error ranged from 212 to 1311 kcal/day. **CONCLUSIONS:** Cross-validation to published models for estimating RMR were similar to those of the derived model; however, the total error in the derived equation was lower than any of the previously published models. Several published models considerably overestimate RMR compared to the current model. The results of this study suggest that RMR can be reasonably estimated with easily obtainable measures which allow for estimation and implementation of RMR for weight management in clinical practice.

G-35 Free Communication/Poster - Fitness
Assessment

Saturday, June 1, 2019, 7:30 AM - 11:00 AM
 Room: CC-Hall WA2

3361 Board #49 June 1 9:30 AM - 11:00 AM
Health and Fitness Differences Between Urban and Rural Costa Rican Older Adults

Luis Solano-Mora¹, Mónica Salazar-Villanea², Luis E. Araya-Ortega², Esmeralda Valdivieso-Mora³, David K. Johnson⁴, Yamileth Chacón-Araya², José Moncada-Jiménez². ¹National University, Heredia, Costa Rica. ²University of Costa Rica, San José, Costa Rica. ³University of Kansas, Lawrence, KS. ⁴University of California, Davis, CA.
 Email: jose.moncada@ucr.ac.cr
 (No relevant relationships reported)

Costa Rica has one of the highest life expectancies in America, even higher than the United States. Studies addressing health and fitness in Latin American urban and rural older adults are scarce. **PURPOSE:** The purpose of the study was to test the hypothesis that older adults from rural areas present fewer negative health conditions and higher fitness than older adults from urban zones. **METHODS:** 298 participants aged 60 to 85 (Urban n = 188, Rural n = 110) completed a 29-item chronic diseases questionnaire and performed the Senior Fitness Test: a) 6-min walking test (6-MWT), b) 30-s Chair to-Stand Test, c) 30-s Arm Curl Test, d) timed up- and go test (TUG), balance time, and handgrip strength (HGS). Categorical variables were analyzed with non-parametric Chi² and continuous variables with 2 x 2 ANOVA (residency zone x gender). **RESULTS:** Urban women reported more chest pain ($\chi^2 = 6.05$, $p = 0.014$), more pacemakers ($\chi^2 = 4.70$, $p = 0.030$), diabetes ($\chi^2 = 3.98$, $p = 0.046$), and osteoarthritis ($\chi^2 = 5.08$, $p = 0.024$) than rural women. Urban men reported more chronic low back pain ($\chi^2 = 5.65$, $p = 0.017$) and depression ($\chi^2 = 3.90$, $p = 0.048$) than rural men. A higher diastolic blood pressure was observed in urban compared to rural older adults (Urban = 76.2 ± 0.9 mmHg kg vs. Rural = 70.2 ± 1.3 mmHg; $p \leq 0.001$). Urban older adults showed better balance time than rural older adults (Urban

= 22.8 ± 0.8 s vs. Rural = 18.4 ± 1.2 s; $p = 0.003$). Performance was similar between urban and rural older adults on the 6-MWT, 30-s Chair to-Stand, 30-s Arm Curl, TUG, and HGS tests ($p > 0.05$). **CONCLUSION:** In spite of having similar physical fitness performance, Costa Rican urban men and women showed an overall negative health profile compared to rural older adults. Balance was the only functional variable positively observed in urban older adults.

3362 Board #50 June 1 9:30 AM - 11:00 AM
A Comparison of Back Squat & Safety Squat Bar on Measures of Strength, Speed, and Power in NCAA Division I Baseball Players

Richard Meldrum, Mark DeBeliso, FACSM. *Southern Utah University, Cedar City, UT.* (Sponsor: Mark DeBeliso, FACSM)
 Email: r.meldrum00@gmail.com
 (No relevant relationships reported)

Squat exercise variations are considered a cornerstone of resistance training (RT) programs. Understanding the effectiveness of differing squat exercise variations is important for coaches and athletes in order to optimizing the effectiveness of a RT program. **PURPOSE:** The current investigation examined a comparison of the standard Olympic barbell loaded back squat (BS) with a squat performed with the safety squat bar (SSB). **METHODS:** Twenty eight Division I male baseball players (19.2 ± 1.1 years, 182.5 ± 5.6 cm, 87.6 ± 5.1 kg) participated in a RT program comprised of two workout sessions a week for nine weeks, performing either a BS or SSB utilizing an autoregulatory progressive resistance periodization protocol, concurrent with their existing, season-specific, RT program. Pitchers (n=14) utilized the SSB bar with the goal of minimizing stress on the shoulder and elbow joints during the execution of the squat. The non-pitchers (n=14) performed the Olympic barbell BS. Lower body strength (estimated 1RM squat: kgs), sprint speed (54.86 m sprint: secs), and vertical jump (VJ: cms) were assessed prior to and following the RT training period. **RESULTS:** The VJ had a significant positive improvement from pre to post RT for both the BS (pre: 74.6 ± 8.1, post: 76.5 ± 8.0) and SSB (pre: 72.4 ± 7.6, post: 75.3 ± 8.3) groups ($p < 0.05$). The estimated squat 1RMs had a significant positive improvement from pre to post RT for both the BS (pre: 136.2 ± 11.0, post: 166.1 ± 23.7) and SSB groups (pre: 112.3 ± 14.9, post: 152.6 ± 22.0) ($p < 0.05$). The 54.86 m sprint did not improve significantly from pre to post RT for either the BS (pre: 7.12 ± 0.33, post: 7.05 ± 0.26) or SSB groups (pre: 7.27 ± 0.17, post: 7.19 ± 0.20) ($p > 0.05$). When comparing gain scores between each group there were no significant difference between the BS and SSB groups for either 54.86 m sprint or VJ ($p > 0.05$). However, the estimated squat 1RM gain score for the SSB was significantly greater than the BS group ($p < 0.05$) noting that the effect size of change from pre to post RT was 2.69 and 2.71 standard deviations for the BS and SSB groups respectively. **CONCLUSION:** Given that both squat modalities yielded approximately equal improvements in VJ and lower body strength, coaches and athletes can consider the SSB variation of the squat as a viable option for developing lower body strength and power.

3363 Board #51 June 1 9:30 AM - 11:00 AM
Assessment of Bilateral Glenohumeral Posterior Capsule Tightness in Recreational Golfers

Andrew Cannon, PT, SCS, MHS, CSCS, Jessica Wagner, Kevin Finn, FACSM. *Merrimack College, North Andover, MA.*
 Email: cannona@merrimack.edu
 (No relevant relationships reported)

Andrew Cannon; Jessica Wagner; Kevin Finn FACSM
 Merrimack College, N. Andover, MA

Comparison of Glenohumeral Posterior Capsule Tightness between Golfers and Non-Golfers
Abstract

The primary movement of the golf swing is habitually unidirectional. Consistently the leading side, (left side of a right handed golfer) and the trail side, (right side of a right handed golfer) are asked to perform remarkably different tasks with an overall shoulder injury prevalence of between 8-16%.

Purpose. The current study examined glenohumeral posterior capsule mobility of the leading shoulder compared to the trail shoulder in recreational golfers and non-golfers. **Methods.** Participants were twenty-two recreational golfers (15 males, 7 females) mean age 38.8 years (SD = 18.85) with at least two years of prior experience golfing and thirteen non-golfers (7 males, 6 females) with a mean age of 33.1 years (SD = 12.35). All participants had bilateral glenohumeral posterior capsule mobility measured as medial epicondyle distance from exam table in inches via side lying horizontal adduction of the non weight bearing upper extremity with scapula manually stabilized. **Results.** Golfers exhibited a statistically significant ($P < .001$) asymmetry of glenohumeral posterior capsule mobility in their leading shoulder compared to the trail shoulder. The non-golfing participants demonstrated no statistically significant difference in right to left glenohumeral posterior capsule mobility exhibiting relatively equal measurements bilaterally. **Conclusions.** The sample of golfers demonstrated an asymmetry in glenohumeral posterior capsule mobility in leading to trail shoulders

that was not seen in the non-golfing population. Clinical consideration should be given to this asymmetry in training and care of the golfing athlete especially as it relates to limitations in shoulder mobility and motion.

3364 Board #52 June 1 9:30 AM - 11:00 AM
Adjusted Muscle Strength Evaluation Using Directional and Continuous Jump Motion Test by 3D Motion Analysis

Tamotsu Kitabayashi¹, Kosho Kasuga². ¹Tokyo University of Science, Tokyo, Japan. ²Gifu university, Gifu, Japan. (Sponsor: Kiyoji Tanaka, FACSM)
 (No relevant relationships reported)

PURPOSE: To study adjusted muscle strength evaluation methods using directional and continuous jump motion tests (vertical, forward, backward), this study compares basketball players with general students and examines differences between the groups and directional differences.

METHODS: Subjects were two groups ; General Students (14 male students) and Basketball Students (10 male students). Vertical, forward and backward jumps were each measured twice for maximum exertion (100%) and adjusted exertion (50%). The first vertical jump with full strength and then immediately after landing, adjusted exertion in each direction (50% exertion) (vertical, forward, backward) were measured using 3D motion analysis (Kinect2 (Microsoft)). Difference in average value in single jump measurement (50%) and continuous measurement (50%) using absolute values (cm) was verified and two factor ANOVA was conducted for differences between the groups (basketball vs. general) using relative values (%) and for differences among each direction (vertical, forward, backward). For the multiple comparison test, the Bonferroni method was used. The level of significance was set at 5%.

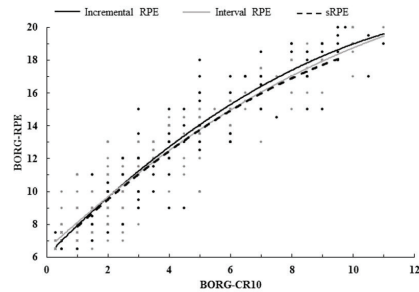
RESULTS: In single jump and continuous measurements, the general student group showed close to 50% exertion in the order of forward, vertical, and backward jumps. The basketball group showed 50% exertion in the order of forward, backward, and vertical jumps. The order of superiority tended to be different between the two groups. Additionally, compared to the single jump measurement, continuous measurement showed that both the general student and basketball groups demonstrated close to 50% exertion and particularly in the continuous measurement, differences between the two groups tended to become more noticeable in the backward jump.

CONCLUSIONS: For two groups, there are different directions in which adjusted exertion are likely to occur. By continuous jump measurement with initial movement maximum exertion, it is possible to evaluate accurate adjustment abilities and competitive qualities.

3365 Board #53 June 1 9:30 AM - 11:00 AM
Comparison Of RPE Rating Scales For Session RPE

Blaine E. Arney, Reese Glover, Andrea Fusco, Cristina Cortis, Jos J. de Koning, FACSM, Teun van Erp, Salvador Jaime, Richard P. Mikat, FACSM, John P. Porcari, FACSM, Carl Foster, FACSM. University of Wisconsin-La Crosse, La Crosse, WI.
 Email: arney.blaine@uwlax.edu
 (No relevant relationships reported)

Purpose: The Session RPE (sRPE) is an accepted method of monitoring training in athletes in many different sports. It is based on the Category-Ratio (0-10) RPE scale (BORG-CR10) developed by Borg. There is no evidence how substitution of the Borg 6-20 RPE scale (BORG-RPE) might influence the sRPE. **Methods:** Systematically training, recreational level athletes from different sport disciplines performed six, randomly ordered, 30-minute interval training sessions, at intensities based on peak power output (PPO), designed to be easy (50%PPO), moderate (75%PPO) or hard (85%PPO). sRPE was obtained 30-min post-exercise using the BORG-CR10 or BORG-RPE and compared for matched conditions. **Results:** The average percent of heart rate reserve (%HRR) was well-correlated with sRPE from both BORG-CR10 (r = 0.76) and BORG-RPE (r = 0.69). The sRPE from BORG-CR10 and BORG-RPE were very strongly correlated (r = .90) at matched times. **Conclusions:** Although producing different absolute numbers, sRPE derived from either BORG-CR10 or BORG-RPE provide substitutable estimates of perceived exercise training intensity.



3366 Board #54 June 1 9:30 AM - 11:00 AM
Reliability and Validity of Hip Rotation Strength Tests: Systematic Error Due to Tester Hand Dominance

Connor Fedge¹, Tim Tyler². ¹PRO Sports Physical Therapy of Westchester, Scarsdale, NY. ²Nicholas Institute of Sports Medicine and Athletic Trauma, Lenox Hill Hospital, New York, NY. (Sponsor: Malachy P McHugh, FACSM)
 Email: connorfedge@gmail.com
 (No relevant relationships reported)

PURPOSE: Manual muscle testing using hand held dynamometry (HHD) is commonly utilized and for a more objective measure. Deficits in hip rotation strength have been linked to lower extremity pathology, but measurement reliability is unknown. The purpose of this study was to assess the reliability and validity of hip internal (IR) and external (ER) rotation strength in three positions. **METHODS:** Right and Left Hip IR and ER strength was measured using HHD in 20 patients, (30 ± 12 years, 9 women, 11 men), using 3 tests (seated, supine, side-lying), at two different time points (Test 1, Test 2), by two different testers (A and B). Strength was reported as torque (Nm/kg). Intratester and intertester relative reliability were assessed using intraclass correlation coefficients (ICC). Absolute reliability was assessed using 95% limits of agreement (LOA). **RESULTS:** Torque was highest for the seated tests, followed by the supine (13% lower than seated), and side-lying (25% lower than seated). There was a systematic difference between left and right legs for the seated and side-lying tests: the left side was stronger than right side for IR (Seated: 7% p=0.044, Side-lying: 9% p=0.04); right side 7% stronger than left side side-lying ER (p=0.008). Inter- and intratester ICCs are reported in Table 1. **CONCLUSIONS:** Hip ER and IR strength testing had poor intra- and intertester reliability. The right/left difference in seated and side-lying tests, suggest indicate tester hand dominance may be a confounding factor. These data highlight the need for more reliable hip rotation strength testing.

Table 1.

Intertester ICC								
Supine		Seated		Side-Lying				
Test 1	Test 2	Test 1	Test 2	Test 1	Test 2			
IR R	0.67	0.47	IR R	0.88	0.67	IR R	0.50	0.53
IR L	0.48	0.30	IR L	0.71	0.41	IR L	0.70	0.69
ER R	0.63	0.75	ER R	0.84	0.79	ER R	0.15	0.57
ER L	0.35	0.60	ER L	0.77	0.74	ER L	0.56	0.32
Intratester ICC								
Supine		Seated		Side-Lying				
A	B	A	B	A	B			
IR R	0.83	0.39	IR R	0.84	0.54	IR R	0.71	0.43
IR L	0.66	0.37	IR L	0.61	0.58	IR L	0.75	0.69
ER R	0.75	0.79	ER R	0.89	0.70	ER R	0.42	0.44
ER L	0.70	0.51	ER L	0.92	0.51	ER L	0.88	0.33

3367 Abstract Withdrawn

3368 Board #56 June 1 9:30 AM - 11:00 AM
Handgrip Fatigue and Forearm Girth in Intermediate Sport Rock Climbers

Grace MacDonald¹, Jacob W. Manning², Szu-Ping Lee¹, Charli Aguilar¹, Nathaniel G. Bodell¹, Jack Young¹, Brian Schilling¹, James W. Navalta, FACSM¹. ¹University of Nevada Las Vegas, Las Vegas, NV. ²Southern Utah University, Cedar City, UT. (Sponsor: Dr. James Navalta, FACSM)
Email: grace.macdonald@duke.edu
(No relevant relationships reported)

Rock climbing has been increasing in popularity both recreationally and competitively. Indoor sport rock climbing is a type of climbing where the climber ascends a wall using artificial rocks (hand and foot holds) and is attached to a safety rope. Despite this increase in popularity of the sport, the physiological responses to sport climbing as an exercise to specific muscle groups are not well defined in literature. **PURPOSE:** The purpose of this study was to quantify the change in handgrip strength over a 30-minute bout of continuous climbing, specifically in intermediate sport climbers. An additional aim of this study was to quantify any change in forearm girth over a bout of climbing and compare it to the change in strength and to identify if there is a relationship between the two. **METHODS:** Ten intermediate rock climbers [Age: 26.7±6.7 years; Height: 174.5±6.12 cm; Mass: 68.14±8.21 kg; Body Fat %: 15.75±.63 %; Years Climbing: 7.3±4.69 years;] consented to participate and completed baseline handgrip strength (via handgrip dynamometer) and forearm girth (via tape measure). A climbing questionnaire indicated each participant's rock climbing ability and defined them as intermediate climbers. Each participant ascended one of two 5.9 YDS (Yosemite Decimal System) routes as many times as possible within 30 minutes. After each ascent, heart rate, handgrip strength and forearm girth was measured. Data were analyzed using repeated measures ANOVA and correlation with significance accepted at the p≤.05 level. **RESULTS:** Dominant handgrip strength decreased by 22% (p=0.009) and non-dominant handgrip strength decreased by 23% (p=0.002) compared to pre-climb. Dominant and non-dominant forearm girth increased by 4.4% (p=0.001, p=0.001). The average heart rate while climbing was 71±4.2 % of age-predicted HRmax. The rest times in between ascents were 1:22±33 sec. **CONCLUSIONS:** These results show that over a 30 minute bout of climbing, intermediate climbers' handgrip strength decreases and forearm girth increases. It is possible that with longer rest times, handgrip strength would not decrease as substantially. These results contribute to the existing literature and increase understanding of the physiological demands of indoor sport rock climbing.

3369 Board #57 June 1 9:30 AM - 11:00 AM
Biomechanical Comparison of Court Shoes for Indoor Sports Performance

Jolene Lim¹, Govindasamy Balasekaran, FACSM¹, Dianna Thor¹, Anthony Bert², Davy Lim², Jia Bin Fang². ¹Nanyang Technological University, Singapore, Singapore. ²Institute for Sports Research, Singapore, Singapore.
(No relevant relationships reported)

PURPOSE: To compare biomechanical factors between court shoes for indoor sports performance. **METHODS:** The Mizuno Wave Lightning Z (M_{WL}), ASICS Blade 5 (A_{BS}), Rocket 7 (A_{R7}), and Blast 6 (A_{B6}) court shoes were compared. 12 male Singapore handball players (age: 23.7 ± 5.8 years; height: 1.78 ± 0.056 m; weight: 69.6 ± 9.5 kg; shoe size 10.1 ± 1.0) participated in the randomized, counter-balanced study. Participants performed the vertical jump and Illinois Agility Run Test during each session, for four test sessions. Rate of perceived exertion (RPE), comfort, and fit variables were measured before and after both physical tests. **RESULTS:** No significant differences were found in maximum jump height (M_{WL}: 46.083 ± 3.059 cm, A_{BS}: 46.333 ± 2.774 cm, A_{R7}: 45.083 ± 3.777 cm, A_{B6}: 46.083 ± 3.965 cm; p = 0.341), maximum jump force (M_{WL}: 1.304 ± 0.116 N, A_{BS}: 1.283 ± 0.074 N, A_{R7}: 1.300 ± 0.088 N, A_{B6}: 1.304 ± 0.066 N; p = 0.831), and maximum landing jump force (M_{WL}: 3.212 ± 1.312 N, A_{BS}: 2.836 ± 0.850 N, A_{R7}: 2.986 ± 0.979 N, A_{B6}: 3.164 ± 1.628 N; p = 0.730) during the vertical jump. Significant differences were found between all shoes in the total time taken during the agility run (p = 0.020). A_{BS} resulted in better total time (A_{BS}: 17.493 ± 0.453 s, M_{WL}: 18.052 ± 0.432 s; p = 0.002), Straight run 4th quarter (A_{BS}: 1.575 ± 0.065 s, A_{B6}: 1.619 ± 0.062 s; p = 0.043), and Weave run 1st half (A_{BS}: 1.819 ± 0.096 s, A_{R7}: 1.873 ± 0.039 s; p = 0.019) timings. No significant difference was found in RPE values after vertical jump (M_{WL}: 1.917 ± 1.782, A_{BS}: 1.917 ± 1.443, A_{R7}: 1.833 ± 1.642, A_{B6}: 1.667 ± 1.435; p = 0.769) and agility run (M_{WL}: 6.250 ± 1.658, A_{BS}: 5.917 ± 1.929, A_{R7}: 6.000 ± 1.595, A_{B6}: 6.333 ± 1.826; p = 0.727). No significant differences were found in comfort and fit variables, even though A_{B6} had the highest overall comfort (A_{B6}: 11.867 ± 2.225, M_{WL}: 10.233 ± 2.814, A_{BS}: 11.850 ± 2.650, A_{R7}: 10.525 ± 2.650; p = 0.050) and most consistent fit variables (Shoe length: 4.08 ± 0.5, Heel region: 4.08 ± 0.515, Forefoot width: 3.75 ± 0.753, Collar: 4.08 ± 0.669; p = 0.341). **CONCLUSION:** Participants performed fastest during the agility run when

wearing ASICS Blade 5, although participants found that the ASICS Blast 6 was more comfortable and had the most consistent fit. Future research should focus on improving both shoes to enhance comfort and at the same time improve capacity in sports performance.

3370 Board #58 June 1 9:30 AM - 11:00 AM
Characterization Of The Fitness In The Military Personnel Of The Colombian Army Training Schools.

Daniel F. Aparicio Gomez, Rodrigo Cubides Amezcuita, Laura E. Castro Jimenez, Angelica M. Puentes, Ana I. Garcia Muñoz, Camilo Lozada Gutierrez, Paula Melo Buitrago, Ivan D. Chavarro Castañeda. *Escuela Militar de Cadetes - Ejercito Nacional de Colombia, Bogotá, Colombia.*
Email: danapago@gmail.com
(No relevant relationships reported)

Military personnel must assume demanding physical activities during both tactical and physical training in military installations or theaters of operations. In military operations, high levels of aerobic capacity and muscular strength are required, that is why adequate fitness (aerobic endurance, muscular endurance, strength, flexibility, body composition) is an important factor in the performance and survival. **PURPOSE:** To determine the fitness of the military personnel in training of the different schools of the Colombian Army. **METHODOLOGY:** Cross-sectional study with an analytical component, where morphological and physiological variables were measured in 120 senior Military students in the three military training schools (ESMIC-Officers, EMSUB-NCOs and ESPRO-soldiers). The body composition was evaluated by electrical bioimpedance after checking the pre-test protocol conditions. The explosive strength of the upper and lower limbs was assessed in a jump platform, with the Push-Up and Squat Jump tests without load. The flexibility was assessed by the "Sit and Reach" test, the maximum consumption of VO₂ with the "Léger" test and the prehensile force was evaluated by dynamometry. The comparisons were made using one-way analysis of variances (ANOVA) and post hoc tests. **RESULTS:** The comparison between the fitness of the students of the schools, showed differences in the consumption of VO₂ (49.8 vs 48.3 vs 53.5 ml / min / kg, p = 0.001), flexibility (4.5 vs. 3.2 vs 10 cm, p = 0.001), prehensile strength (44.4 vs 37.1 vs 48.3 kilograms, p = 0.001), flight time in the Squat Jump test (481.6 vs 451.1 vs 482.4 milliseconds, p = 0.001), flight time in the Push Up test (404.6 vs 316.7 vs 375.5 milliseconds, p = 0.001), body mass index (23.5 vs 23.7 vs 22.4 weight / height², p = 0.027) and an absolute value of fat-free mass (56.4 vs 52 vs 56 kg, p = 0.009). **CONCLUSIONS:** Although the training plan of the Colombian Army is standardized, it was found that there are differences in the fitness of personnel in military training, which could be due to the differences in intensity, volume, duration, density and frequency of training. Supported by internal Grant 001-2017 / Technological Support Command, Ejército de Colombia.

3371 Board #59 June 1 9:30 AM - 11:00 AM
A Comparison Of Physiological And Anthropometric Characteristics Among Senior And Young Elite Endurance Athletes

Ferenc Ihász¹, Eliza Tóth¹, Lili Kósa¹, Krisztina Szabó². ¹Eötvös Lóránd University, Budapest, Hungary. ²University of Pécs, Pécs, Hungary. (Sponsor: Kevin J. Finn, FACSM)
(No relevant relationships reported)

Aging is a multi-factorial process. The relative contributions of decreases in maximal heart rate, stroke volume, and oxygen extraction rates as well as changes in body weight and composition to the age-related decline in maximal oxygen uptake (VO₂max) are unclear. **PURPOSE:** The purpose of this study is to compare the differences in body size and cardiorespiratory fitness among young and senior elite endurance athletes. **METHODS:** This study measured anthropometric and physiological data on 29 elite endurance athletes (mountain and road bikers, cross-country runners) made up of 12 young athletes (YA), ages 24±5.9 yrs. and 17 senior athletes (SA) ages 52±3.6 yrs. The Research Ethics Committee of ELTE University approved the study. Laboratory measurement of metabolic parameters was performed using a 2-min progressive treadmill protocol of 8 km×h⁻¹ at 3% grade, 8 km×h⁻¹ at 6% grade, 9 km×h⁻¹ at 6% grade, 10 km×h⁻¹ at 8% grade, 10 km×h⁻¹ at 10% grade, 11 km×h⁻¹ at 12% grade with additional 3% increase in grade per 2-min stage until volitional exhaustion. Anaerobic threshold (AT) was determined using ventilatory equivalents from the Vmax C29 Sensesmics (Yorba Linda, CA, USA) software. **RESULTS:** No significant differences were found between the groups' mean height (YA 178.7 ± 7.3 vs SA 174.5 ± 6.2 cm) and body mass (YA 72.8 ± 7.5 vs SA 75.8 ± 7.7 kg). Young athletes (YA) spent nearly twice as much time on the treadmill (YATST: 895 ± 114 sec.) as their senior counterparts (SATST: 529 ± 170 sec.) and their mean VO₂max was significantly higher (57.62±7.55 vs. 40.46±8.59 mL x kg⁻¹ x min⁻¹). However, only 11% of the YA total power was spent under anaerobic conditions, as compared to 43% for the SA group. The ratio of time spent in the aerobic zone during complete load calculated from the means of the values of ventilation (VE), breathing

rate (BF) and absolute aerobic capacity (VO₂max) at the AT and peak load (PE) was 80% for senior athletes (SA) and reached a value of 90% ($p < 0.05$) in the young athletes (YA). **CONCLUSIONS:** The difference between the performances of the two groups is not surprising. However, remarkable is the asymmetry of the metabolic performance of the senior athletes (SA), which may carry other pathological hazards. It is therefore important to pay great attention to the physiological characteristics of the age related performance sport.

3372 Board #60 June 1 9:30 AM - 11:00 AM

A Longitudinal Study of Muscular Fitness in Korean National Firefighters

Hyunjoo Kang¹, Kyoungmin Noh², Wook Song², Chungkun Lee², Seiyong Park², Jungjun Park³, Hanjoon Lee⁴, Dongil Seo⁵, Yeonsoon Ahn⁶. ¹*Soonchunhyang University, Asan, Korea, Republic of.* ²*Seoul National University, Seoul, Korea, Republic of.* ³*Pusan National University, Pusan, Korea, Republic of.* ⁴*Ulsan University, Ulsan, Korea, Republic of.* ⁵*Dongkuk University, Gyeongju, Korea, Republic of.* ⁶*Yonsei University, Wonju, Korea, Republic of.*
Email: violethjk@naver.com
(No relevant relationships reported)

Firefighting is a physically demanding profession that requires optimal muscular fitness levels. Until now, there have been no studies investigating longitudinal changes and characteristics of the muscular fitness of firefighters. **PURPOSE:** To investigate the changes in the results of Korean firefighters' muscular fitness test over 6 years for each gender. **METHODS:** Muscular fitness test data was received from the National Fire Service Academy and represented firefighters working in Seoul from 2011 to 2016. We analyzed the muscular fitness from a total of 30,933 people over a 6-year period. The data was made using ANOVA and multiple regression analysis.

RESULTS: Grip strength shows statistically significant differences between genders (Fmale = 256.808, Ffemale = 10.856, both $p < .001$) every year. Records show that grip strength decreased as age increased ($B = -.345$); records also show that grip strength improved in later years ($B = .717$). The results show that males' grip strength was higher than that of females ($B = 22.295$). Back strength increased each year showing statistically significant improvement for each gender (Fmale = 1061.565, Ffemale = 44.921, both $p < .001$). Records show that back strength decreased as age increased ($B = -1.173$); records also show improvements from year to year ($B = 6.114$). As the years went on, male firefighters saw a bigger improvement than female firefighters ($B = 80.276$). Sit-up records each year show statistically significant differences between genders (Fmale = 515.581, Ffemale = 23.336, both $p < .001$). Sit-up results decreased as firefighters aged ($B = -.395$); sit-ups increased each year ($B = 1.252$). Results among males were higher than among females ($B = 10.948$).

CONCLUSIONS: This study provided basic data on firefighter muscular fitness tests and practical information that can be used to training programs. The characteristics of firefighter's tasks show that female firefighters need to perform their duties under the same conditions as male firefighters. However, results show that female firefighters are not testing as well in those three categories. Female firefighters should be required to carry out some tasks in emergency situations. Supported by the Field-oriented Support of Fire Fighting Technology Research and Development Program funded by NFA (MPSS- Fire safety-2017-87)

3373 Board #61 June 1 9:30 AM - 11:00 AM

Convergent Validity and Relative Reliability of Hexoskin during a Maximal Field Test

Monoem Haddad, Feryel Dalansi, Mariam Kharbach, Azam Mohamed, Zlatan Aganovic. *Qatar University, Doha, Qatar.*
Email: mhaddad@qu.edu.qa
(No relevant relationships reported)

PURPOSE: The aim of the study was to determine the convergent validity and relative reliability of a wearable metric Hexoskin "the smart shirt" during a maximal field test in measuring Heart Rate (HR) variables: resting HR and peak HR.

METHODS: Variables were recorded simultaneously by the Hexoskin and Polar Team Pro 3. Fourteen professional male Handball players (age 21.8 ± 2.4 years) participated in the study voluntarily completed two trials of 400 m shuttle run test (10 shuttles), separated by 48h to 72h.

RESULTS: Nearly perfect ($r=0.93$) and trivial ($r=0.009$) correlations have been shown in resting HR and peak HR, respectively, between Hexoskin and Polar Team Pro 3 results. Good ($ICC=0.715$) and low ($ICC=0.081$) intraclass correlation coefficient measured by Hexoskin.

CONCLUSIONS: The findings indicate that Hexoskin has high validity and relatively good reliability in measuring resting heart rate and it can be used in slow activities/ motions. However, it seems that quick movements affect the cardiac sensor and leads to an abnormal recording using Hexoskin.

3374 Board #62 June 1 9:30 AM - 11:00 AM

Cardiovascular Fitness In Recreational Athletes Prior To And After Anterior Cruciate Ligament Reconstruction

Dean M. Cordingley¹, Sheila McRae¹, Jeff Leiter¹, Greg Stranges², Peter MacDonald². ¹*Pan Am Clinic Foundation, Winnipeg, MB, Canada.* ²*Pan Am Clinic, Winnipeg, MB, Canada.*

(No relevant relationships reported)

Emphasis of most rehabilitation programs following anterior cruciate ligament reconstruction surgery (ACLR) is on range of motion and strength, with little, if any, focus on the recovery of cardiovascular fitness. **PURPOSE:** To evaluate cardiovascular fitness of recreational athletes from injury to 12-months post ACLR. **METHODS:** This was a prospective case series. Patients were recruited from a sports medicine clinic with an ACL rupture confirmed on MRI. Participants must have been involved in aerobic sport at least twice a week based on self-report. Study time points were baseline (as soon after injury as possible; T1), 6 (T2)- and 12-months (T3) post-ACLR. The primary outcome measure was relative VO_{2 peak} as measured during a graded aerobic exercise test (GXT) on a bike ergometer (Monark, Ergonomic 894E) using a metabolic measurement system (Oxycon Mobile, Carefusion). Secondary outcomes were absolute VO_{2 peak}, Tegner activity score, and ACL-Quality of Life. Repeated measures ANOVA was performed to compare within groups between time points. **RESULTS:** Nineteen patients (13 male /6 female) consented at mean age of 22.9 ± 4.8 years. Baseline testing and surgery were performed 78 ± 48 and 152 ± 81 days post injury, respectively. Preoperative relative VO_{2 peak} was 33.7 ± 6.3 mL·kg⁻¹·min⁻¹, at T2 was 32.7 ± 8.9 mL·kg⁻¹·min⁻¹ and at T3 was 32.7 ± 9.3 mL·kg⁻¹·min⁻¹ ($p > 0.05$). Based on ACSM cardiorespiratory fitness classifications by age and gender, there was no change in distribution from T1 to T3 ($p=0.88$). Tegner scores decreased from pre-injury to T1 (7.6 ± 1.5 vs. 3.2 ± 1.9 ; $p < 0.001$), and improved by T3 (5.1 ± 2.1 ; $p=0.003$), but did not recover to pre-injury levels ($p < 0.001$). ACL-QOL increased from T1 (32.9 ± 15.5) to T2 (53.5 ± 13.4 ; $p < 0.001$) and to T3 (70.3 ± 18.7 ; $p=0.008$). Relative VO_{2 peak} and Tegner score were not correlated at T1 but were at T3 ($r=0.735$, $p=0.001$). **Conclusion:** Recreational athletes were aerobically deconditioned at two months post-ACLR rupture and did not improve with 12-months of rehabilitation following ACLR. Pre-injury aerobic fitness level could not be determined, but participants may have become deconditioned waiting for surgery. Without a conscious effort to promote aerobic fitness, recreational athletes may return to play at a suboptimal performance level with increased risk of injury.

3375 Board #63 June 1 9:30 AM - 11:00 AM

Effects of a Psyching Up Technique on Maximum Deadlift Ability: A Pilot Study

Barbara N. Sanchez¹, Matthew K. Beeler¹, Carl M. Maresh, FACSM¹, William J. Kraemer, FACSM¹, Brett A. Comstock². ¹*Ohio State University, Columbus, OH.* ²*Bloomsburg University, Bloomsburg, PA.*
Email: sanchez.1094@osu.edu

(No relevant relationships reported)

PURPOSE: Psyching-up techniques for maximal lifting efforts are common practice among recreational and professional athletes. The use of psyching-up techniques have shown positive effects on bench press and handgrip performance, and on more complex actions such as the standing broad jump and sprinting. This has not been examined on the deadlift. The purpose of this study was to investigate the influence of a self-selected psyching up technique on maximum performance deadlift.

METHODS: Five resistance trained men (mean \pm SD: 22.60 ± 1.67 year, 98.76 ± 6.94 kg, 4.7 ± 1.64 years training experience, 2.15 ± 0.42 deadlift strength to weight ratio) consented to participate in the study. The men had a self-reported one repetition maximum deadlift of at least one and a half times their body weight and had training experience using power lifts (power clean, deadlift, squat, or other main power lifts). Subjects were familiarized with the deadlift test protocol and observed for proper form. A cross-over study design was used in which each participant was randomly assigned to either a distraction technique or a self-selected psyching up technique prior to a maximum deadlift effort. The two trials were separated by a minimum of 72 hours. The distraction technique involved the participant having to count backwards from 100 for 100 seconds prior to exerting a maximal deadlift effort. The psyching up technique involved the participant using the self-selected psyching-up technique that they routinely used during their training for 100 seconds prior to exerting a maximal deadlift effort. A dependent t-test was used to analyze the psyching up technique on maximal weight deadlifted.

RESULTS: There was no significant difference ($t(4) = -.512$, $p > .05$) between the self-selected psych-up technique (204.93 ± 48.75 kg) and the distraction technique (205.75 ± 48.92 kg) on maximal deadlift performance.

CONCLUSION: Within the limitations of this study, a self-selected psyching up technique provided no significant advantage on maximal weight lifted in the deadlift exercise compared to a distraction technique in experienced male lifters. Further investigation is recommended using a large sample size.

3376 Board #64 June 1 9:30 AM - 11:00 AM
Effect of Treadmill Protocol on Attainment of VO_{2max} Criteria in Collegiate Women Athletes

Lauren M. Biscardi, Margaret T. Jones, FACSM, Jennifer B. Fields, Justin J. Merrigan, Jason B. White. *George Mason University, Fairfax, VA.* (Sponsor: Margaret T. Jones, FACSM)
 Email: lbiscardi@gmu.edu
 (No relevant relationships reported)

When performing the same test protocol, athletes from sports of differing metabolic demands may vary in the achievement of physiological criteria that are indicative of attaining maximal oxygen consumption (VO_{2max}).

PURPOSE: To examine whether the attainment of VO_{2max} criteria differs in two sports with differing metabolic demands as a result of the graded exercise treadmill test (GXT) protocol used.

METHODS: Twenty-nine National Collegiate Athletic Association Division 1 women athletes (basketball (WBB): n=11; lacrosse (WLAX): n=18) completed a continuous GXT to volitional fatigue. Speed increased following each 1-minute stage with a 1% constant grade. VO_{2peak} indicated the highest VO_2 value reached during a single test, while VO_{2max} indicated the subject's functional limit was reached. The criteria to attain VO_{2max} were: VO_2 plateau of <0.15 L/min with an increase in the last two workloads; maximum heart rate (HR_{max}) within 10 bpm of age-predicted heart rate max; respiratory exchange ratio ($RER \geq 1.10$); rating of perceived exertion (RPE, 1-10 scale) >8 ; blood lactate (LAC) collected 5-min post-test ≥ 8 mmol/L. The attainment ≥ 3 of 5 criteria was required for VO_{2max} . Independent t-tests were used for comparison of values between teams, and chi-squared test was used for comparison of criteria attainment. Alpha level was set at $p < 0.05$.

RESULTS: Relative VO_{2peak} values did not differ between teams (WBB: 55.3 ± 8.1 ; WLAX: 53.8 ± 5.4 mL·kg⁻¹·min⁻¹). The percent of athletes that met each of the five criteria were: plateau (WBB: 55%, WLAX: 56%), HR_{max} (WBB: 27%, WLAX: 39%), RER (WBB: 0%, WLAX: 17%), RPE (WBB: 55%, WLAX: 44%), LAC (WBB: 100%, WLAX: 83%). More WLAX attained VO_{2peak} than VO_{2max} (55% vs. 45%). WBB was evenly distributed between VO_{2peak} (50%) and VO_{2max} (50%). There was no statistical difference between WBB and WLAX in VO_{2max} or the number of athletes from each team who met each individual criterion. Significant differences between teams were observed for LAC (WBB 13.3 ± 1.7 , WLAX 10.3 ± 2.3 mmol/L; $p=0.001$) and RER (WBB 0.96 ± 0.05 , WLAX 1.04 ± 0.09 ; $p=0.002$).

CONCLUSION: These findings suggest physiological responses to a fixed VO_{2max} protocol may vary between sport teams of different metabolic demands. Consideration should be given to such variations when selecting test protocols and interpreting results.

3377 Board #65 June 1 9:30 AM - 11:00 AM
Evolution Of Exercise-related Dyspnea In Response To Anxiety-provoking Or Relaxing Situations In Healthy Subjects

Elise Piroux, Sarah Rouas, Jennifer Camel-Toueg, Gilles Caty, Grégory Reyckler. *Institut de Recherche Expérimentale et Clinique, Brussels, Belgium.*
 (No relevant relationships reported)

Exertional dyspnea, characterized as a symptom of discomfort or difficulty in breathing, is a common complaint in healthy individuals and in many pathologies. Previous studies have shown that emotions including anxiety and stress influenced the perceived unpleasantness of dyspnea. **PURPOSE:** The aim of this study was to investigate the effects of relaxing and anxiety-provoking situations on exercise-related dyspnea, heart and respiratory rates, blood pressure, mood state, anxiety and depression in healthy subjects. **METHODS:** Twenty-two healthy adults were included in this randomized cross-over study. Each participant performed three submaximal cycling exercise for 30 minutes on three separate days in a randomized order: a neutral condition (NC) with no particular effect, a relaxing condition (RC) where each subject listened to relaxing music and an anxiety-provoking condition (APC) where a horror movie was broadcast. Heart and respiratory rates, blood pressure, dyspnea using the Multidimensional Dyspnea Profile (MDP) and modified Borg scales, mood state using the Profile of Mood States (POMS), anxiety and depression using the Hospital Anxiety and Depression scale (HADS) were evaluated before and 5 minutes after each intervention. In addition, heart and dyspnea rates were measured throughout the intervention. **RESULTS:** Dyspnea and heart rates increased more with APC than NC (1.68 ± 0.15 vs 1.32 ± 0.12 RPE, $p < 0.01$ and 138 ± 2 vs 119 ± 1 bpm, $p < 0.001$). In addition, submaximal exercise with APC showed a higher increase than NC in the subscales "breathing discomfort" (2.50 ± 0.18 vs 1.86 ± 0.11 , $p = 0.02$) and "emotional response domain" (6.82 ± 1.55 vs 0.95 ± 0.34 , $p < 0.001$) of MDP, global POMS score (11.73 ± 3.58

vs -4.64 ± 2.3 , $p < 0.001$) and HADS-Anxiety subscale (8.59 ± 1.27 vs 3.27 ± 0.61 , $p < 0.001$) and the dyspnea rates (0.64 ± 0.12 vs 0.14 ± 0.07 RPE, $p < 0.001$). No significant difference were observed between NC and RC. **CONCLUSION:** Exercise-related dyspnea and anxiety increased with APC in healthy subjects. In contrast, results did not show difference in any parameters with RC. Many activities and daily life situations can lead the patient with a chronic disease to experience dyspnea. Future studies should investigate strategies to reduce dyspnea in chronic diseases and in fine, improve quality of life of these patients.

3378 Board #66 June 1 9:30 AM - 11:00 AM
Oro-nasal Mask Versus Two-way Non-rebreathing Valves For Maximal Aerobic Capacity Testing In Astronauts

Roxanne E. Buxton¹, Meghan Downs², Richard Scheuring³, Staci Latham², James Crowell⁴, Elizabeth Goetichius¹, Andrew FJ Abercromby³. ¹University of Houston, Houston, TX. ²KBRWyle, Houston, TX. ³National Aeronautics Space Administration, Houston, TX. ⁴MEI Technologies, Houston, TX.
 Email: roxanne.e.buxton@nasa.gov
 (No relevant relationships reported)

INTRODUCTION: Astronauts complete maximal aerobic capacity (VO_{2pk}) testing as part of their annual fitness assessment (AFA) as well as several times once assigned to an International Space Station mission. Historically, the 2-Way T-Shape Non-Rebreathing valve with a mouthpiece and nose clip (mouthpiece) has been used in these tests. The testing procedure was updated to use the oro-nasal mask (mask) for the AFA starting in June 2017. Astronauts who used the mask during their AFA requested it be certified to be used for all mission associated tests. Considering the criticality of the data and the schedule constraints of astronauts, it is imperative that the requested hardware change provide data with equivalent reliability and repeatability as provided by the mouthpiece. **PURPOSE:** To assess the reliability of mask vs. mouthpiece by comparing submaximal and VO_{2pk} data within subjects (approximately 1 year apart). **METHODS:** Each of 17 active astronauts completed a VO_{2pk} test with the mouthpiece (first) and the mask (second) for their AFA. The VO_{2pk} test was conducted on a cycle ergometer with a metabolic cart. The nominal protocol started with a 3 minute warm-up at 50 Watts (W) and increased 25W every minute until volitional fatigue (Light: 45W start; 15W increase). The VO_{2pk} were compared between tests and the expected day-to-day variation ($\pm 5\%$) was used as the threshold for determining agreement between tests. Submaximal values were plotted and evaluated visually for deviations between mask and mouthpiece. **RESULTS:** VO_{2pk} values were more than 5% different, despite similar test times, between mouthpiece and mask in 6 of 17 comparisons, 3 of which were higher with the mask ($9.0 \pm 5.9\%$) while 3 were lower ($-10.8 \pm 2.0\%$) with the mask. The submaximal data did not indicate a leak in either apparatus during these tests. An Astronaut Strength & Conditioning Rehabilitation specialist confirmed that the measured differences in VO_{2pk} of these 6 astronauts was consistent with observed changes in exercise habits during the year that separated the two tests. **CONCLUSION:** After being presented with the results of this data mining effort the mask was accepted for use in all tests, accepting that, if a leak is detected without resolve, the test will be repeated (if schedule allows) and remaining tests will be completed with the mouthpiece.

3379 Board #67 June 1 9:30 AM - 11:00 AM
What Type Of Exercise Is Appropriate For An Optimistic Affective Mind-set?

Yusuke ITAYA¹, Sinji SATO², Cgang Hsiao Yun¹, Shingo OTUKI². ¹Nozaki Tokushukai Hospital, Daito, Japan. ²Osaka Sangyo University, Daito, Japan.
 Email: itaya515@outlook.com
 (No relevant relationships reported)

PURPOSE "Affective mind-set" is a mental frame or lens that selectively organizes. Previous reports proved that activation of the left anterior brain region is linked with the optimistic affective mind-set. Aerobic exercise such as moderate-intensity interval training (MIT) and moderate continuous training (MCT) activates the frontal area of the left hemisphere, which gives euphoric feelings. However, whether interval training is appropriate for stimulating an optimistic affective mind-set is unknown. We hypothesized that interval, rather than continuous, training activates the left brain. This study aimed to evaluate which exercise can activate the left brain more by using three different kinds of bicycle exercise. **METHODS** The participants were six healthy male volunteers. The three bicycle exercises used were MCT, MIT, and high-intensity interval training (HIT). Exercise intensity was considered in the assessment of the peak heart rate (PHR) induced by the cardiopulmonary exercise test. A 70% PHR was defined as moderate intensity; and 90% PHR, as high intensity. The MCT protocol included 3 min of warm-up (WU) and 40 min of moderate-intensity (70% PHR) continuous exercise, 3 min of cooldown (CD), and 10 min of rest. The MIT protocol was composed of a 3-minute WU, 4 term of moderate-intensity (70% PHR) exercise, active rest (45% PHR), 5-min CD, and 10-min rest. The HIT protocol was composed of

a 3-min WU, 4 term of high-intensity (90% PHR) exercise with active rest (70% PHR), 3-min CD, and 10-min rest. Brain activity was measured using electroencephalography (EEG; NegPos, Neuro Sky). EEG was performed during each session. Data were the mean values obtained at WU, CD, and 5-min rest. Δ CD-WU and Δ Rest 5-min WU were calculated. The three groups were compared via one-way analysis of variance, with the Bonferroni test for post hoc comparison. **RESULTS** A slight difference was observed among the three groups in Δ Rest 5-min WU (MIT: 42.0 \pm 42.6, HIT: -19.5 \pm 48.6, MCT: -3.8 \pm 14.8, $p < 0.057$). Δ CD-WU was not significantly different among the groups (MCT: -2.7 \pm 15.8, MIT: 39.1 \pm 43.7, HIT: -16.2 \pm 51.1, $p < 0.11$). WU and CD showed no significance differences among the three groups (WU: $p < 0.25$, CD: $p < 0.51$). **CONCLUSION** MIT is the most appropriate exercise for an optimistic affective mind-set. I have no financial relationships to disclose.

3380 Board #68 June 1 9:30 AM - 11:00 AM
Test-retest Reliability Of An Isokinetic Fatigue Test

Giovanna C. Ramos¹, Tyler J. Neltner¹, Emily E. Grammer¹, Cameron J. Addie¹, Marisa K. Straughn¹, Jordan M. Glenn¹, Michelle Gray¹, Nicole E. Moyer¹, Jennifer L. Vincenzo¹, Kylie K. Harmon², Lee E. Brown, FACSM¹. ¹University of West Florida, Pensacola, FL. ²University of Central Florida, Orlando, FL.
 (No relevant relationships reported)

By performing muscular testing, such as an isokinetic fatigue test, it is possible to assess anaerobic capacity and measure how muscles perform when isolated. This might also identify weak points and which movements might be related to compensation. However, test-retest reliability is key to obtaining consistent results of muscular function. **PURPOSE:** To establish isokinetic fatigue test-retest reliability when testing without familiarization. **METHODS:** 22 masters (53 \pm 5 years), competitive female cyclists completed 2 separate 50-repetition knee extension tests (T1 and T2) on a Biodex isokinetic dynamometer, separated by one-week with no familiarization. **RESULTS:** Test-retest reliability (intra-class correlation coefficients; ICC), were calculated between T1&T2 scores for fatigue index (T1 38.8 \pm 9.5%; T2 43.7 \pm 6.9%), time to peak torque (T1 280.5 \pm 59.8ms; T2 284.1 \pm 69ms) average power (T1 99.0 \pm 19.4W; T2 100.5 \pm 20.6W), and average peak torque (T1 36.6 \pm 6.3N·m; T2 37.5 \pm 7.1N·m). ICCs between trials exhibited excellent reliability (.93-.97) for all variables except time to peak torque (ICC=.35) and fatigue index (ICC=.65). **CONCLUSION:** There was strong test-retest reliability for strength and power measurements in masters female cyclists during an isokinetic knee extension fatigue test. However, the test was unreliable for its purpose in determining rate of fatigue. Practitioners should seek other forms of knee extension fatigue measurement.

3381 Board #69 June 1 9:30 AM - 11:00 AM
Forearm Circumference as a Sarcopenic Indicator in Older Mexican Population. A Preliminary Study

Ermilo Canton-Martínez¹, Juan R. Gallegos-Ramírez¹, Iván Rentería¹, Patricia C. García-Suárez¹, José Moncada-Jiménez², Alberto Jiménez-Maldonado¹. ¹Universidad Autónoma de Baja California, Campus Ensenada, Mexico. ²University of Costa Rica, San José, Costa Rica.
 Email: jose.moncada@ucr.ac.cr
 (No relevant relationships reported)

The 10.5% of the total Mexican population is 60 years and older, and it is expected that by the year 2050, the older adult population reaches 28.7 million inhabitants. The “fragility phenotype in the older adult”, characterized by sarcopenia or loss of skeletal muscle mass and dynapenia or loss of muscle strength, affect functional capacity by impairing neuromuscular functions. **PURPOSE:** To determine the association between handgrip muscle strength and anthropometric variables associated with muscle mass in a sample of female Mexican older adults. **METHODS:** Volunteers were 40 healthy women (Age = 61.15 \pm 6.1 yr.; Body Mass Index [BMI] = 27.9 \pm 7.4 kg/m²) residing in Ensenada, Baja California, Mexico. A hand dynamometer (BioRadio, Great Lakes NeuroTechnologies, Cleveland, OH), was used to measure handgrip strength on the dominant hand. The maximal circumference of the dominant forearm was measured following the protocol by the International Society for the Advancement of Kinanthropometry. Bioelectrical impedance analysis (InBody 770; Cerritos, CA) was used to measure body composition. Appendicular skeletal muscle (ASM) relative to BMI and skeletal muscle index (SMI) relative to height (m²) were analyzed as anthropometric sarcopenic indicators. **RESULTS:** The older adult’s mean handgrip strength and forearm circumference were 17.0 \pm 3.3 kg and 25.5 \pm 2.3 cm, respectively. The ASM relative to BMI was 0.6 \pm 0.1 and the SMI relative to height was 6.7 \pm 0.8. Handgrip strength was related to arm circumference (r = 0.56, p = 0.0001, 95% CI= 0.31, 0.75, R²= 0.32), and SMI relative to height (r = 0.37, p = 0.01, 95% CI= 0.08, 0.62, R²= 0.14). The ASM relative to height was unrelated to handgrip strength (r = 0.12, p = 0.45, 95% CI= -0.20, -0.42, R²= 0.01). **CONCLUSIONS:** Reduced handgrip strength and SMI were observed in the female participants

compared to international norms. Forearm circumference and SMI relative to height might be considered appropriate assessment measures to explore sarcopenic condition in female Mexican older adults.

3382 Board #70 June 1 9:30 AM - 11:00 AM
Aerobic Fitness And Body Composition Of Individuals With Anterior Cruciate Ligament Reconstruction

Ashley N. Triplett, Christopher M. Kuenze. Michigan State University, East Lansing, MI. (Sponsor: James M. Pivarnik, FACSM)
 Email: Triple18@msu.edu
 (No relevant relationships reported)

Anterior cruciate ligament reconstruction (ACLR) requires 6 to 9 months of rehabilitation, often resulting in long periods of sedentary behavior. Following rehabilitation, only 45% of patients fully return to pre-injury level of sport participation, placing them at elevated risk of developing a physically inactive lifestyle. It is unknown whether ACLR negatively impacts aerobic fitness and body composition in the months following surgery. **PURPOSE:** To compare body composition and aerobic fitness between women with ACLR and healthy controls. **METHODS:** Nine women with ACLR (<5 yrs post-ACLR, age=21.2 \pm 3.9 yrs) and seven healthy women (age=22.4 \pm 3.7 yrs) with no injury history completed the Tegner Activity Scale to assess current physical activity level. Body fat percentage (%BF) was estimated using air displacement plethysmography. A graded exercise test using a cycle ergometer was performed by all participants to evaluate aerobic fitness (VO_{2peak}), defined as the highest 20 sec VO₂ attained during the test. Maximal heart rate (HR_{max}) and time to exhaustion (mins) were measured. Variables were compared between groups using Mann-Whitney U tests due to limited sample size. **RESULTS:** Individuals with a history of ACLR had significantly higher %BF than controls (ACLR=33.5 \pm 6.5%, healthy=24.4 \pm 5.2%) (p=0.008) and significantly lower relative VO_{2peak} (ACLR=32.1 \pm 5.0 ml/kg/min, healthy=40.6 \pm 4.4 ml/kg/min) (p=0.008). No differences were observed in absolute VO_{2peak} (ACLR=2.4 \pm 0.3 L/min, healthy=2.5 \pm 0.3 L/min) (p=0.61) or time to exhaustion (ACLR=13.0 \pm 1.8 mins, healthy=14.2 \pm 2.3 mins) (p=0.25) on the cycle. **CONCLUSION:** Women with a history of ACLR may have greater %BF than women who have not experienced a significant lower extremity injury. No significant difference was found in aerobic fitness between the groups as absolute VO_{2peak} is typically evaluated in cycle protocols. Although individuals with ACLR displayed lower relative VO_{2peak}, this was most likely due to differences in body weight between groups rather than fitness. Excessive %BF and low aerobic fitness are risk factors for chronic disease and premature mortality; therefore, it is concerning that these young women returning to activity post-ACLR have poorer body composition profiles than healthy women in this pilot study.

3383 Board #71 June 1 9:30 AM - 11:00 AM
Achievement of Healthy Fitness Zone by Academic Major in College Students from Puerto Rico

Lucia del R. Martínez-Colón¹, Maniliz Segarra¹, Mairym Villalobos¹, Israel Almodovar-Rivera², Maritza J. Ruiz-Nieves¹, Farah A. Ramirez-Marrero, FACSM¹. ¹University of Puerto Rico, Rio Piedras Campus, San Juan, PR. ²University of Puerto Rico, Medical Sciences Campus, San Juan, PR.
 Email: lucia.martinez1@upr.edu
 (No relevant relationships reported)

Healthy fitness components such as body composition, cardiorespiratory endurance, and muscle strength are associated with disease risk and premature mortality. Factors influencing health related fitness in college-aged students are unclear, and academic major has not been yet considered. **PURPOSE:** To assess and compare the achievement of healthy fitness zone (HFZ) by academic major in college students from Puerto Rico. **METHODS:** College students (331 females, 258 males, 18-25 years of age) enrolled in elective courses at the Physical Education Department of the University of Puerto Rico (PR), completed the Fitnessgram® assessment protocol. Achievement of HFZ was determined for each component: strength-endurance fitness (SEF) with push-up, curl-up, and trunk lift; flexibility fitness (FLF) with back-saver sit and reach, and shoulder stretch; body composition fitness (BCF) with BMI, and %fat; and cardiorespiratory fitness (CRF) with the 20-m PACER test. Students were also classified according to their academic major: teacher education (TE), physical education (PE), natural sciences (NS), business administration (BA), and others (OP) including social sciences, humanities, communication, and general studies. Frequencies and percentages of students achieving the HFZ in each component were determined, and Chi-squares used to detect differences by academic major and sex. **RESULTS:** HFZ for the SEF component was achieved by 68% of participants, FLF by 52%, BCF by 61%, and CRF by 26%. More males than females were in the HFZ for SEF (75 vs. 57%, P=0.001), and CRF (41 vs. 12%, P<0.001); while more females than males were in the HFZ for BCF (65 vs. 52%, P=0.001). More PE majors were in the HFZ in SEF (82% vs 68, 59, 66 and 54% for TE, NS, BA and OP majors, respectively; P<0.01) and CRF (48% vs 27, 14, 34 and 19% for TE, NS, BA and OP

major, respectively, $P < 0.001$). No differences were observed by academic major for FLF and BCF. **CONCLUSION:** Although a relatively high proportion of students achieved HFZ criterion in SEF, BCF and FLF; the low proportions achieving CRF, particularly females, is of concern. Results also suggest that academic major must be considered when developing strategies to promote the achievement of HFZ in critical health components such as CRF and SEF among college students in PR. Supported by FIPI/DEGI/UPRRP.

3384 Board #72 June 1 9:30 AM - 11:00 AM

Fitness Fights Fires: Examining the Relationship between Physical Fitness and Firefighting Ability

Annamarie Chizewski¹, Richard Kesler², Allyson G. Box¹, Steven J. Petruzzello, FACSM¹. ¹University of Illinois Urbana-Champaign, Urbana, IL. ²Illinois Fire Service Institute, Champaign, IL. (Sponsor: Steven J. Petruzzello, FACSM)

(No relevant relationships reported)

The physical demands of firefighting are evident, and a high level of physical fitness is required to perform the job safely. Despite the clear need for adequate physical fitness, the majority of firefighters (FF) remain unfit for duty. Regular exercise is an effective strategy to prevent/attenuate multiple health risks, as well as improve health and job performance. **PURPOSE:** To investigate the relationship between physical fitness (i.e., cardiovascular endurance and muscular endurance) and performance on the Academy FF Challenge (AFC). **METHODS:** During the first (week 1) and last (week 7) weeks of the FF academy, FF recruits¹ ($n=54$; 26.76 ± 4.16 yrs; 100% male) physical fitness and FF ability were assessed. Physical fitness was assessed via cardiovascular endurance (estimated $\dot{V}O_{2max}$ via 1.5-mile run time) and muscular endurance (60-second sit-ups and push-ups and Young Men's Christian Association (YMCA) bench press), while FF ability was assessed via total completion time on the AFC (Keiser Sled, Self-Contained Breathing Apparatus maze, victim drag, hose advance, equipment carry, and ladder set-up). **RESULTS:** Physical fitness predicted significant variance in FF ability at Week 1 ($R^2=0.48$; $P < 0.001$) and Week 7 ($R^2=0.47$; $P < 0.001$) after accounting for age and BMI. Specifically, cardiovascular endurance accounted for 28.9% ($FA(3, 50) = 22.83$) and 36.4% ($FA(3, 50) = 28.70$) unique variance, while muscular endurance accounted for 11.4% ($FA(6, 47) = 3.45$) and 10.2% ($FA(6, 47) = 3.02$) unique variance on FF ability at week 1 and 7, respectively. **CONCLUSIONS:** Firefighting is a challenging occupation that requires these individuals to be in peak physical condition. Targeting FFs early in their careers and highlighting the importance of fitness is extremely vital to developing healthy, safe, and efficient FFs. By better understanding the relationship between physical fitness and firefighting ability, exercise specialists, researchers, and physicians may be able to better prescribe exercise in this population.

3385 Board #73 June 1 9:30 AM - 11:00 AM

Developing Criterion-Referenced Standards for Cardiorespiratory Fitness Among Canadian Adults Aged 18-69 Years

Justin J. Lang¹, Emily Wolfe Phillips¹, Heather Orpana¹, Deepa Rao¹, Leonard A. Kaminsky, FACSM², Robert Ross, FACSM³, Grant R. Tomkinson⁴. ¹Public Health Agency of Canada, Ottawa, ON, Canada. ²Ball State University, Muncie, IN. ³Queen's University, Kingston, ON, Canada. ⁴University of North Dakota, Grand Forks, ND. (Sponsor: Dr. Robert Ross, FACSM)

Email: justin.lang@canada.ca

(No relevant relationships reported)

PURPOSE: Cardiorespiratory fitness levels among adults are an important indication of general health. The aim of this project was to develop criterion-referenced standards for estimates of cardiorespiratory fitness in Canadian adults aged 18-69 years using a nationally representative sample, and body mass index (BMI) as the criterion measure. **METHODS:** Cross-sectional data were obtained from cycles 1 (2007-09) and 2 (2009-11) of the Canadian Health Measures Survey. The modified Canadian Aerobic Fitness Test (mCAFT) was used to predict cardiorespiratory fitness (as $\dot{V}O_{2max}$). Measured height and weight were used to calculate BMI. Obesity was classified as having a BMI greater than $30 \text{ kg} \cdot \text{m}^{-2}$. Receiver operating characteristic curves were used to identify cardiorespiratory fitness standards that optimized both sensitivity and 1-specificity (Youden's J) for males and females, separately, across five age groups (i.e., 18-29, 30-39, 40-49, 50-59, and 60-69 years).

RESULTS: A total of 4,967 participants (53% female, $M_{age} = 41.0 \pm 13.8$ years) were retained for the present analyses. The area under the curve ranged from 0.79-0.86 in males, and 0.85-0.92 in females. The optimal standards for cardiorespiratory fitness using BMI as the criterion measure ranged from $13.1\text{-}31.7 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ for males, and $16.9\text{-}32.6 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ for females. The cardiorespiratory fitness standards were slightly higher for females in comparison with males when matched for age.

CONCLUSIONS: These cardiorespiratory fitness standards may be useful in public health settings, particularly in Canada. Future research should further investigate other criterion measures, and research should validate these cut-points to see if they adequately discriminate individuals with chronic diseases.

3386 Board #74 June 1 9:30 AM - 11:00 AM

Relationship Between Maximal Respiratory Muscle Pressure and Strength and Anthropometric Variables in Healthy Young Adults

Andrea P. González, Francisco J. Pizarro, Oscar Achiardi. Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile.

Email: andreaucm@gmail.com

(No relevant relationships reported)

Traditionally, evaluation and training of respiratory muscle strength (RMSt) have been planned and performed independently of gender. RMSt, measured as maximal inspiratory and expiratory pressures (MIP and MEP, respectively), has been related to musculoskeletal characteristics, such as muscle mass and strength, which might be aspects that influence RMSt development. These musculoskeletal features usually differ among genders, and therefore, it seems plausible that their relationships with RMSt would be different as well, for women and men. This might be an important issue, as assessment and training of RMSt maybe should be planned in accordance of the patient's gender.

PURPOSE: to determine the correlations between RMSt and musculoskeletal characteristics, for women and men.

METHODS: After obtaining informed consent from each participant, 71 young adults (41 men, 30 women, age 21.6 ± 3.5 and 21.7 ± 1.4 years, respectively) with normal BMI, were assessed in RMSt with MIP and MEP, general muscle strength (GMSt) with a back and leg dynamometer, and chest, arm, thigh and leg corrected perimeters (CP), according to the ISAK protocol. Normal distribution of data was confirmed with D'Agostino and Pearson test and Pearson's r coefficient was used to determine correlations between RMSt and GMSt and anthropometric variables. A p value < 0.05 was considered of statistical significance.

RESULTS: In women, the only correlation found was a direct and moderate correlation between PEM and GMSt ($r=0.46$; $p=0.01$). As for men, PIM had direct and moderate correlations with GMSt ($r=0.53$; $p < 0.01$), arm CP ($r=0.44$; $p < 0.01$), thigh CP ($r=0.40$; $p < 0.01$) and chest CP ($r=0.47$; $p < 0.01$), and a direct and weak correlation with leg CP ($r=0.36$; $p < 0.05$); PEM had a direct and moderate correlation with GMSt ($r=0.40$; $p < 0.01$).

CONCLUSIONS: According to these findings, gender would be an important aspect to be considered when planning RMSt assessment and training, as musculoskeletal mass and strength in women and men would be related to RMSt in a different manner, and therefore, having different implications in RMSt development.

3387 Board #75 June 1 9:30 AM - 11:00 AM

Health Related Fitness Comparison between 1st Year and 4th-6th Year College Students in Puerto Rico

Emmanuel Hernández-Torres¹, Maniliz Segarra¹, Mairym Villalobos¹, Israel Almodovar-Rivera², Farah A. Ramirez-Marrero, FACSM¹, Lucía del R. Martínez¹. ¹University of Puerto Rico, Rio Piedras Campus, San Juan, Puerto Rico. ²University of Puerto Rico, Medical Sciences Campus, San Juan, Puerto Rico.

Email: emmanuel.hernandez3@upr.edu

(No relevant relationships reported)

First year of college is a critical transition period when young adults begin to make lifestyle choices influencing long-term behaviors and health. Cardiorespiratory fitness (CRF) and body fat (BF) are two health-related fitness (HRF) components known to increase disease risk and premature mortality. These components are also known to negatively change during 1st year in college; however, little is known about changes in all health-related fitness components through college years. **PURPOSE:** To evaluate and compare HRF between 1st year and 4th-6th year college students in Puerto Rico.

METHODS: College students taking elective courses at the Physical Education Department of the University of Puerto Rico, were divided in two groups based on academic year: 1st year (28 females, 48 males; 18.5 ± 1.1 years of age) and 4th-6th year (184 females, 114 males; 21.8 ± 1.0 years of age). HRF was assessed using the Fitnessgram® protocol including measures of height, weight, skinfolds (triceps, calf, and abdomen), push-ups, curl-ups, trunk lift, back saver sit and reach, shoulder stretch, and PACER. Non-parametric Wilcoxon-Rank tests were used to detect differences between groups and between sex, and Chi-square analysis to detect differences by healthy fitness zone (HFZ) classification. **RESULTS:** Compared with 1st year, 4th-6th year students had higher BF (19.6 ± 6.6 vs. $23.5 \pm 6.8\%$, $P < 0.001$), and lower number of curl-ups (45.3 ± 22.8 vs. 32.4 ± 20.9 , $P < 0.001$), push-ups (21.8 ± 11.8 vs. 15.8 ± 12.3 , $P < 0.001$), and $\dot{V}O_{2max}$ estimated from PACER (42.4 ± 8.6 vs. $32.3 \pm 7.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, $P < 0.001$). No group differences were observed for BMI, trunk lift, and flexibility. A higher proportion of 1st year students classified in the HFZ compared to 4th-6th year in curl-ups (90 vs. 71%, $P = 0.002$) and PACER (49 vs. 16%, $P < 0.001$). A higher proportion of males classified in the HFZ compared with females in push-ups (79 vs. 64%, $P = 0.003$), sit and reach (91 vs. 71%, $P < 0.001$), and PACER (40 vs. 10%, $P < 0.001$); while more females classified in the HFZ in shoulder stretch (84 vs. 65%, $P < 0.001$) and BMI (69 vs. 57%, $P = 0.03$). **CONCLUSION:** Important declines in HRF

components associated with cardiorespiratory and muscle health between 1st and 4th-6th year college students highlights a critical need for interventions promoting healthier lifestyles in this young age group.

3388 Board #76 June 1 9:30 AM - 11:00 AM

Acute Effect of Ischemic Preconditioning on Special Judo Fitness Test

Jeferson Vianna¹, Aline Aparecida de Souza Ribeiro², Jefferson Da Silva Novaes³, Daniel Godoy Martinez¹, Luiz Guilherme Da Silva Telles³, Mateus Camaroti Laterza¹, Leandro Raider², Patrícia Panza¹, Victor Machado Reis⁴. ¹Universidade Federal de Juiz de Fora, Juiz de Fora, Brazil. ²Center of Higher Education of Valença / Dom André Arcoverde Educational Foundation, Brazil, Valença, Brazil. ³Rio de Janeiro Federal University, Brazil, Rio de Janeiro, Brazil. ⁴University of Trás-os-Montes and Alto Douro, Portugal, Portugal.
Email: jeferson.vianna@ufjf.edu.br
(No relevant relationships reported)

Ischemic preconditioning improves the physical fitness of athletes of different sports modalities. However, until now, there is no evidence of the effect of ischemic preconditioning (IPC) on the performance of judo athletes.

PURPOSE: Verify the acute effect of IPC on the Special Judo Fitness Test (SJFT) performed by judo athletes. **METHODS:** The study involved 17 judo athletes (age=21.35 ± 3.46 years, practice experience=8.94 ± 3.88 years, height = 1.73 ± 0.9m, body mass=69.34 ± 10.94kg). In the first session, they answered the questionnaires, underwent the anthropometric evaluation and the familiarization of the SJFT. The SJFT was used to evaluate the athletes' physical fitness. In the second and third sessions, two experimental protocols were performed in a randomized and counterbalanced manner: a) IPC (3 cycles x 5 min ischemia at 220 mmHg / 5 min reperfusion at 0 mmHg) + SJFT and b) SHAM (3 cycles x 5 min ischemia at 20 mmHg / 5 min reperfusion at 0 mmHg) + SJFT. A 30 minute interval between the experimental protocols and the SJFT and 72 hours between the 2nd and 3rd sessions was observed. Statistical tests of variance homogeneity and Student's t test were performed to verify possible differences between the IPC and SHAM groups in the following measures: number of throws in the SJFT per series, total number of throw in the SJFT and SJFT index. The magnitude of the difference between IPC and SHAM conditions was assessed using the effect size (d=Cohen's). **RESULTS:** The IPC performed a larger number of throws in the SJFT per series (p=0.004, d=0.50, moderate effect) compared to SHAM. When we analyzed the total number of throws we found a significant difference between the IPC and SHAM groups (p=0.001, d=0.37, small effect). The SJFT index showed a significant difference between IPC and SHAM (p=0.001, d=0.50, moderate effect). **CONCLUSION:** IPC improves the physical fitness of judo athletes.

3389 Board #77 June 1 9:30 AM - 11:00 AM

Does Dynamic Stretching Warm-up Influence Hockey Players' Anaerobic Performance During A Wingate Anaerobic Test?

Rodrigo Villar¹, Alexander Schleper², Robert Anzalone².
¹University of Manitoba, Winnipeg, MB, Canada. ²Franklin Pierce University, Rindge, NH.
Email: rodrigo.villar@umanitoba.ca
(No relevant relationships reported)

PURPOSE: The aim of this study is to determine whether dynamic stretching warm-up prior to the Standard National Hockey League Wingate Anaerobic Test (DSW+SNHL) would improve anaerobic performance compared with the Standard National Hockey League Wingate Anaerobic Test (SNHL) of hockey players. **METHODS:** Twenty volunteer ice hockey players (ten males and ten females) visited the laboratory twice to perform the DSW+SNHL and SNHL in a randomized and counterbalanced order. If participants performed the DSW+SNHL on the first day of testing, then they performed the SNHL on the second day of testing and vice versa. The dynamic stretching warm-up consisted of ten different dynamic movements that lasted ~six minutes and targeted the prime movers and the main joints involved in the skating technique. The Wingate Anaerobic Test was comprised of a thirty-second maximal effort sprint performed on a mechanical cycle ergometer with workload representing 7.5% of the participant's body mass. Peak power output (PPO), relative peak power (RPP), anaerobic capacity (AC), and anaerobic fatigue index (AFI) were calculated and compared between conditions (DSW+SNHL and SNHL). **RESULTS:** Paired T-test or Wilcoxon Signed Rank Test analyses showed that for PPO, there were no statistically significant differences between DSW+SNHL (855.3±168.7 W) and SNHL (831.9±159.1 W) (p=0.105). For RPP and AFI, statistical analyses showed that there were marginal trends (p=0.055 and p=0.062, respectively) between DSW+SNHL (RPP=11.8 ± 1.5; AFI=48.9±8.7%) and SNHL (RPP=11.5±1.4; AFI=51.0±9.4%). AC showed statistically significant differences between DSW+SNHL (618.7±117.5 W) and SNHL (585.5±110.0 W) (p=0.0008). **CONCLUSION:** The dynamic stretching warm-up did not improve peak power output, but relative peak power and anaerobic fatigue

index may benefit from dynamic stretching warm-up. However, anaerobic capacity performance improved when dynamic stretching warm-up was performed prior to the standard National Hockey League Wingate Anaerobic Test. **Research supported by New Hampshire-INBRE through an Institutional Development Award (IDeA), P20GM103506, from the National Institute of General Medical Sciences of the NIH".**

3390 Board #78 June 1 9:30 AM - 11:00 AM

Validation of an 8-minute Self-Paced Graded Exercise Testing Protocol to Elicit Maximal Responses

Nicholas M. Beltz, Bo Orton, Nicole Fraser, Dawnell Franklin, Jake Johnson. University of Wisconsin-Eau Claire, Eau Claire, WI.
Email: beltznm@uwec.edu
(No relevant relationships reported)

Recent examinations have turned to the development and validation of a 10-min self-paced graded exercise testing protocol. The 10-min duration was chosen because it represents the mean value of the recommended 8-12min ideal protocol duration; however, literature exists suggesting that an 8min duration may be more appropriate to elicit maximal exercise responses. Furthermore, a gender effect may exist to explain the finding. **PURPOSE:** We sought to examine maximal exercise responses during an 8-min self-paced (8SPV), 10-min self-paced (10SPV) and standardized graded exercise testing (GXT) treadmill protocols. **METHODS:** Sixteen recreationally active males (n=8) and females (n=8) completed three separate tests in a randomized order: a) 8SPV consisting of eight 1-min stages of increasing speed clamped by the Borg RPE₆₋₂₀ scale, b) 10SPV consisting of five 2-min stages clamped of increasing speed clamped by the Borg RPE₆₋₂₀ scale, c) traditional Bruce protocol as the GXT. 8SPV and 10SPV maintained a 3% grade. A two-way (gender x protocol) ANOVA with repeated measures was employed to examine differences in maximal responses between protocols. Paired samples t-tests were used to examine the difference in maximal velocity between 8SPV and 10SPV. **RESULTS:** No gender effects were revealed. Maximal values for 8SPV, 10SPV and GXT were similar (p > 0.05) for oxygen consumption (48.0±5.6; 51.8±10.5; 51.4±7.5 mL·kg⁻¹·min⁻¹), heart rate (193±11; 195±9; 194±13 beats·min⁻¹), respiratory exchange ratio (1.11±0.07; 1.12±0.06; 1.13±0.05), ventilation (103.2±22.4; 113.0±30.3; 112.3±33.0 L·min⁻¹), respectively. Maximal velocity for 8SPV and 10SPV were also similar (15.1±3.1 vs. 14.6±2.7 km·hr⁻¹, p > 0.05). **CONCLUSION:** Given no differences between protocols, 8SPV may serve as a valid and time efficient option to elicit maximal responses during self-paced exercise in recreationally trained college-aged men and women.

3391 Board #79 June 1 9:30 AM - 11:00 AM

Thirty Years Aerobic Power Secular Trend in an Epidemiological Transition Community

Victor K. Matsudo¹, Wesley Dornelas¹, Timoteo L. Araujo¹, José da Silva Guedes², João da Silva Junior¹. ¹CELAFISCS, São Paulo, Brazil. ²Santa Casa, São Paulo, Brazil.
(No relevant relationships reported)

PURPOSE: To analyze the aerobic power in male students in a region with typical epidemiological shift (city of Ilhabela).

METHODS: The study is part of the Mixed-Longitudinal Study on Growth and Development from Ilhabela, organized by CELAFISCS since 1978. Sample consisted of 197 boys, aged from 12 to 14 years-old, divided in 4 groups: 1978 (n=41), 1988 (n=43), 1998 (n=61), and 2008 (n=52). Aerobic power was predicted through a cycle-ergometer submaximal test, that provided VO₂max in absolute and relative values. An ANOVA one way, with a post-hoc Scheffé, was taken to analyze the values. A p < .01 was taken as a significant one.

RESULTS: VO₂max in l/min and ml/kg/min values were, respectively, in 1978: 2.4 l/min and 61.7 ml/kg/min; in 1988: 2.0 l/min and 51.4 ml/kg/min; in 1998: 1.9 l/min and 44.5 ml/kg/min; and in 2008: 1.6 l/min and 33.6 ml/kg/min. It represented a VO₂ max decline of 41% in l/min and of 58.6% in ml/kg/min when 1978 data were compared to 2008. As another sign of aerobic deterioration, an increase of 10 bpm was observed in rest heart rate. In the same period it was observed an increase of 11.4 kg in body weight, and an increase of BMI from 17.1 to 18.1.

CONCLUSIONS: It was observed a marked decline in the aerobic power in absolute and relative values, between 1978 and 2008, suggesting a deterioration in physical activity level in that community.

- 3392** Board #80 June 1 9:30 AM - 11:00 AM
Physical Activity Characteristics of Recreational Doubles Pickleball
 Benjamin D. Boudreaux, Michael D. Schmidt. *University of Georgia, Athens, GA.* (Sponsor: Robert R. Kraemer, FACSM)
(No relevant relationships reported)

Pickleball is the fastest growing racquet sport in the United States and is particularly popular among older adults. Because the typical frequency, intensity, and duration of play is undefined, the extent to which Pickleball participation can contribute to meeting physical activity guidelines is unknown. **PURPOSE:** To estimate the typical frequency, intensity, and duration of physical activity during recreational pickleball play. **METHODS:** A convenience sample of 25 players (59.0 ± 15.8 yrs) wore an Actigraph GT3X+ on their waist and rated their perceived exertion (RPE) for 2 to 5 games of recreational doubles play. Data were collected in 5-sec epochs and the Sasaki (2011) cutpoints were used to calculate the percent of game play spent in light, moderate and vigorous intensity activity. Players also reported their typical pickleball participation (frequency, duration, and subjective exertion level) during the past 3 months via an online survey. **RESULTS:** Players reported playing pickleball 96-240 minutes per session for 2-6 days per week (537.5 ± 381.3 mins/week). On average, $63.5 \pm 14.3\%$ of game play was at moderate or higher intensities ($47.1 \pm 10.3\%$ at moderate) based on Actigraph estimates. This was in general agreement with self-reported intensity levels (11.8 ± 1.3 on RPE scale). Assuming only 50% of reported weekly pickleball participation is spent in actual game play, it is estimated that players typically engage in an average of 162.5 ± 140.8 mins/week (range: 53.8- 526.2 mins/week) moderate and vigorous intensity activity during play. **CONCLUSIONS:** For most recreational pickleball players, over half of the duration of doubles play is spent at a moderate or higher intensity. This suggests that participation in recreational pickleball may be a viable strategy for increasing health enhancing physical activity in adults. However, the physical activity characteristics of pickleball play should be examined using alternative measures of intensity and in larger, more diverse, samples of players.

- 3393** Board #81 June 1 9:30 AM - 11:00 AM
Relationship Between Bone Mineral Density & Grip Strength in Collegiate Athletes
 Connor J. Collum, Ron L. Snarr, Greg A. Ryan, Emily L. Langford, Michelle L. Eisenman. *Georgia Southern University, Statesboro, GA.*
(No relevant relationships reported)

Increases in bone mineral density (BMD) and hand-grip strength (HG) are important indicators of repetitive loading and resistance training. While the assessment of BMD is not always feasible, HG may provide an indicator of overall bone health. However, this relationship has yet to be determined in elite athletes. **PURPOSE:** The purpose of this study was to determine the relationship between HG and BMD in male and female NCAA collegiate athletes.

METHODS: Sixty-nine male and forty-eight female athletes from various sports (e.g., basketball, football, tennis, soccer) agreed to participate in this study. For each athlete, BMD was measured via dual energy x-ray absorptiometry; while HG was assessed with a hand-grip dynamometer. Each participant completed three HG trials for each hand with the elbows flexed at a 90-degree angle. Pearson's product correlations were used to determine the significance of the relationship between BMD and HG measurements.

RESULTS: Pearson's product correlations demonstrated a moderate-to-strong significant association between BMD and HG for both the dominant ($r=0.75, p<0.01$) and non-dominant hand ($r=0.72, p<0.01$) in the entire group. For males, BMD displayed a significantly low-to-moderate correlation with both dominant ($r=0.49, p<0.01$) and non-dominant ($r=0.46; p<0.01$) HG. For females, BMD exhibited a significant moderate correlation between HG in the dominant ($r=0.55; p<0.01$) and non-dominant ($r=0.49; p<0.01$) hand.

CONCLUSIONS: Results suggests that repetitive loading, along with increased resistance training, particularly in collegiate athletes may reflect this association between BMD and HG strength. While only HG strength was measured, stronger relationships may exist between BMD and lower body strength, as the athletes tested in the current study engaged in primarily lower-body dominant sports.

- 3394** Board #82 June 1 9:30 AM - 11:00 AM
Correlation Between Activity-type Heart Rate Estimated Energy Expenditure and Indirect Calorimetry
 Tony P. Nuñez¹, Nicholas M. Beltz², Benjamin C. Thompson, FACSM¹. ¹*Metropolitan State University of Denver, Denver, CO.* ²*University of Wisconsin--Eau Claire, Eau Claire, WI.* (Sponsor: Benjamin C. Thompson, FACSM)
 Email: tnunez1@msudenver.edu
(No relevant relationships reported)

Estimating energy expenditure (EE) during exercise is important for tracking energy balance as well as maintaining EE as an individual becomes more accustomed to exercise. Technological advances have led to the purported ability of heart rate (HR) monitors to accurately estimate EE based on user indicated activity (e.g., resistance training, interval training, etc.). However, the accuracy of these devices using "multi-sport" has yet to be established. **PURPOSE:** To determine the accuracy of user indicated activity HR chest strap monitors for estimating EE. **METHODS:** Fourteen males ($n=14$) ages 20-36 yrs completed two circuit weight training protocols with integrated high-intensity interval training. Both trials were equated for total volume-load and lasted exactly 43.25 min. Following the exercise portion, each participant completed a 20-min excess post-exercise oxygen consumption measurement. Prior to each exercise protocol the HR monitor watch was set using individual subject anthropometric data and age. Heart rate was continuously monitored during the trials by watch device and portable metabolic analyzer. Comparisons of EE (kcal) were performed between estimations by HR monitor and via indirect calorimetry. Device comparisons for EE were made using paired t-tests, Pearson correlation and Bland-Altman analysis (SPSS v22; $p \leq .05$). **RESULTS:** Estimated EE was significantly higher with the user indicated activity HR monitor chest strap compared to indirect calorimetry (596.9 ± 121.2 kcal vs. 484.2 ± 44.9 kcal, $p<.001$). Correlational analysis determined there was a significant moderate-strong positive relationship between HR monitor and indirect calorimetry ($r=0.56, p=.002$) Average HR during the protocol was 149.7 ± 14.3 bpm and percent-maximum HR was $78.5 \pm 5.9\%$. **CONCLUSION:** Despite accounting for activity type in the EE estimation software, HR derived estimations of EE appear to be far higher than those estimated by indirect calorimetry during high-intensity activity. Specifically, this is true for vigorous intensity exercise as indicated by %HRmax.

- 3395** Board #83 June 1 9:30 AM - 11:00 AM
Comparison of Student Administered vs Computerized Test Results in the Wingate Anaerobic Test
 Nathan Hammon¹, Adam Keath¹, Jacob Cooper¹, Jennifer Bossi². ¹*Anderson University, Anderson, SC.* ²*Winthrop University, Rock Hill, SC.* (Sponsor: Janet Wojcik, FACSM)
 Email: nhammon@andersonuniversity.edu
(No relevant relationships reported)

PURPOSE: The Wingate test (WAnT) is an exercise test designed to measure anaerobic capacity and peak power output. WAnT procedures are conducted through observation of the number of revolutions on a stationary bike. The number of counted revolutions is then used to calculate power output at five-second increments for 30 seconds. It is suspected that student counts can introduce error and lack precision particularly in partial revolutions. The purpose of this study was to examine the deviation between student's calculations and computerized measurement.

METHODS: Undergraduate exercise physiology students ($N=28$) were selected to conduct the WAnT procedure. Student observations were collected using the Monark 894E ergometer so that computerized power ratings could be collected simultaneously to student counts. Student results were then directly compared to scores from the Monark software.

RESULTS: A paired samples t-test revealed that student estimates of peak power were significantly lower ($M = 676.72$ W, $SD = 260.09$) than computerized testing results ($M = 714.78$ W, $SD = 286.04$), with a statistically significant mean underestimate of 38.05 W, 95% CI [4.96, 71.14], $t(27) = 2.36, p = .026, d = .446$. Additionally student fatigue index calculations ($M = 43.9\%$, $SD = 9.7\%$) underestimated power drop compared to the computerized results ($M = 53.3\%$, $SD = 14.8\%$), with a statistically significant mean underestimation of 9.4% , 95% CI [5.38%, 13.42%], $t(27) = 4.80, p < .01, d = .907$.

CONCLUSIONS: The WAnT procedure can be an effective tool for measuring anaerobic capacity for both sports performance and research purposes, however, this study found that there were significantly different values between computer derived testing results and human counting. Therefore when a high level of precision is required, it is recommended that WAnTs are conducted using the computerized software to maximize accuracy, especially when being administered by students. In the classroom, exercise physiology instructors should emphasize practice of WAnT administration to ensure more accurate measurements.

3396 Board #84 June 1 9:30 AM - 11:00 AM
Physiological Responses of Arena Polo Players during Simulated Game Play

Abby Pritchard, Samuel Barthel, David Ferguson. *Michigan State University, East Lansing, MI.*
 (No relevant relationships reported)

Arena polo is surging in popularity as compared to outdoor polo due to the reduced space and horse requirement. Limited information exists on the physiological demands of polo with no information for arena players. **PURPOSE:** To document the oxygen consumption (VO_2), ventilation (VE), and respiratory exchange ratio (RER) in conjunction with heart rate (HR) involved in arena polo to better inform players of the physical requirements of participation. **METHODS:** VO_2 , VE, RER, and HR were measured in triplicate with random assignment of horses using a portable telemetric oxygen analyzer coupled with a heart rate monitor on a convenient sample of five female arena polo players (Age: 27 ± 6 yr; Weight: 73 ± 13 kg; Height: 177 ± 3 cm). Data were recorded on each player during designated riding sessions which included a prescribed and free choice warmup, mock gameplay (chukker), and five-minute recovery. Descriptive statistics for each variable (Mean \pm SE) were calculated for each time period. A one-way ANOVA was performed to determine differences between time periods within a session, and a linear regression was used to determine if horses affected the physiological responses. **RESULTS:** Descriptive statistics are presented in Table 1 showing an increase in VO_2 , VE, and HR for free choice and chukker. Horse had no effect ($P > 0.05$) on HR ($r^2 = 0.04$), VE ($r^2 = 0.03$), VO_2 ($r^2 = 0.06$), or RER ($r^2 = 0.13$). **CONCLUSION:** Arena polo constitutes intense exercise with gameplay that mimics increased physiological demands comparable to traditional sports above warmup and recovery. Horse does not influence physiological responses, indicating that competition intensity is the primary driver of metabolic demand.

Table 1. Mean \pm SE of heart rate (HR), ventilation (VE), oxygen consumption (VO_2), and respiratory exchange ratio (RER) of arena polo players during each time period. ^{abc}Values within a column lacking a superscript differ ($P < 0.001$).

	HR (bpm)	VE (L/min)	VO_2 (mL/min/kg)	RER
Warmup	139 \pm 1 ^b	37 \pm 1 ^b	17.4 \pm 0.3 ^b	0.97 \pm 0.01
Free Choice	164 \pm 2 ^a	61 \pm 2 ^a	23.3 \pm 0.6 ^a	0.97 \pm 0.02
Chukker	169 \pm 1 ^a	57 \pm 1 ^a	24.9 \pm 0.4 ^a	0.96 \pm 0.01
Recovery	136 \pm 2 ^b	26 \pm 1 ^c	10.8 \pm 0.5 ^c	0.98 \pm 0.01

3397 Board #85 June 1 9:30 AM - 11:00 AM
Exploring Upper Quarter Y-Balance Test Biomechanical Strategies in Active College Students

Kevin Masson, Tal Amasay, Alissa Bello, Parry Meredith, Jessica Aquino. *Barry University, Miami, FL.*
 (No relevant relationships reported)

The Upper-Quarter Y-Balance test (UQYBT) is frequently used to assess shoulder function and stability, and core stability. UQYBT consists three reaching tests in push-up position, Superior-Lateral Reach (SR), Inferior-Lateral Reach (IR), and Medial Reach (MR). Several studies identified differences between genders, sports, and pathologies. However, mechanical strategies during the UQYBT were not explored between the reaching tests.

PURPOSE: To identify vertical ground reaction force (Fz) and center of pressure area (CPa) patterns globally between the three reaching tests and moderated by gender, and handedness. **METHODS:** Twenty college students participated, eight females (25 ± 5 yrs; 65 ± 11 kg; 164 ± 5 cm) and 12 males (23 ± 4 yrs; 83 ± 17 kg; 179 ± 7 cm). After 10 min warm up on an arm ergometer, participants performed three trials of UQYBT on a force plate. The highest scores for each test for each arm were collected and further analyzed. The average of the three reach scores, composite score (COMP), were calculated for each arm. All scores were normalized to the right arm's length. Fz was normalized to body weight in push-up position and CPa was calculated for each test. ANOVAs tests were used. **RESULTS:** No differences in force were observed between %MRFz, %IRFz, %SRFz ($80 \pm 22\%$, $81 \pm 16\%$, $90 \pm 23\%$, $p = 0.06$) and in area between IRCPa, MRCPa, SRCPa (126 ± 159 mm², 123 ± 119 mm², 127 ± 124 mm², $p > 0.05$). Females carried less body weight in the plank position ($66 \pm 3\%$ vs. $71 \pm 5\%$, $p < 0.01$) and had a higher score in the UQYBT %IR ($89 \pm 15\%$ vs. $78 \pm 9\%$, $p < 0.01$). No differences were observed in %SR ($75 \pm 15\%$ vs. $70 \pm 12\%$, $p > 0.05$), %MR ($97 \pm 8\%$ vs. $97 \pm 8\%$, $p > 0.05$), and %COMP ($87 \pm 11\%$ vs. $82 \pm 8\%$, $p = 0.07$). The non-dominant arm portrayed higher forces in %MRFz ($89 \pm 19\%$ vs. $70 \pm 21\%$, $p < 0.01$), %IRFz ($86 \pm 14\%$ vs. $75 \pm 17\%$, $p < 0.05$), %SRFz (98 ± 19 vs. $81 \pm 24\%$, $p < 0.05$). However, no differences were observed in UQYBT, %IR ($82 \pm 13\%$ vs. $82 \pm 13\%$, $p > 0.05$), %SR ($73 \pm 13\%$ vs. $71 \pm 14\%$, $p > 0.05$), %MR ($99 \pm 9\%$ vs. $96 \pm 8\%$, $p > 0.05$), and %COMP ($85 \pm 10\%$ vs. $83 \pm 9\%$, $p > 0.05$). **CONCLUSION:** Globally, no differences in Fz and CPa patterns were identified in UQYBT. Similar results were found between genders. In contrast,

differences in Fz were identified in the handedness condition, while no differences found in the UQYBT scores, which may be related to compensation mechanism in the non-dominant arm.

3398 Board #86 June 1 9:30 AM - 11:00 AM
The Role of Asymmetrical Strength Deficit on Balance and Fall Risk in a Mature Population.

Glen Reid, John Wygand, FACSM, Robert M. Otto, FACSM, John Petrizzo. *Adelphi University, Garden City, NY.* (Sponsor: Robert M. Otto, FACSM)
 Email: glenreid@mail.adelphi.edu
 (No relevant relationships reported)

The bilateral deficit (BLD) refers to the phenomenon where the sum of force from each leg is individually greater than the force produced of both legs simultaneously. Muscular strength is often measured in one limb and this tends to be stronger in the dominant leg, and the average or sum of strength in both legs is used for analysis. In many individuals, especially older populations, there can be a difference in muscular strength between each leg, which is termed the asymmetrical difference. There is a paucity of information regarding the asymmetrical difference on fall risk. **Purpose:** The purpose was to evaluate single leg strength and asymmetrical deficits relative to balance performance and fall risk in an active elderly population. **Methods:** 7 male and 5 female (Age: 72.3 ± 5.8 yr, Height: 169.7 ± 11.2 cm, Body Mass: 77.2 ± 15.8 kg) volunteered to participate. Subjects were healthy, asymptomatic, ≥ 65 years and participated in exercise an average of twice per week (including resistance and cardiovascular exercise). Leg strength was assessed with a unilateral (UL) 12-RM single-leg (left & right) and a bilateral leg protocol (BL) on a variable resistance leg press machine and balance was assessed with both the Bilateral Comparison Test (BCT) and the Fall-Risk Screening Test (FRST) on the Biodex Balance System. Familiarization trials preceded testing by a minimum of 72 hrs. with balance tests performed first followed by strength tests. **Results:** 5 participants displayed an asymmetrical difference (1.32 ± 1.8 kg). Pearson correlation statistical analysis revealed no significant relationship with overall balance performance (8.26 ± 2.27 composite score, $r = -0.151$, $p < 0.05$) and no significant difference between right UL (1.24 ± 0.36 overall sway, $r = -0.174$, $p < 0.05$) and left UL (1.34 ± 0.60 overall sway, $r = 0.405$, $p < 0.05$). **Conclusion:** This small sample of active seniors failed to provide a significant correlation between an asymmetrical deficit and balance performance. An asymmetrical deficit does not appear to increase the chance of falls in older adults in this cohort. A larger sample size and a comparison to a sedentary population may provide additional insight.

3399 Board #87 June 1 9:30 AM - 11:00 AM
Alpha And Beta Wave Eeg Activity During A Self-paced Vo₂Max Test In Middle-aged Adults

Nicholas J. Hanson¹, Rachel Dykstra¹, Collin Garner¹, Timothy Michael, FACSM¹, Michael Miller¹, Cory Sheadler². ¹Western Michigan University, Kalamazoo, MI. ²Northern Kentucky University, Highland Heights, KY.
 Email: njhanson@gmail.com
 (No relevant relationships reported)

Electroencephalography (EEG) is a non-invasive method of assessing electrical activity of the brain, and can be used during exercise. Previous studies using younger adults have shown a decrease in relative power spectral density (PSD) toward the end of a maximal exercise test, suggesting an inhibitory role of the prefrontal cortex at high intensities. However, this response is not consistent between studies, and unknown in middle-aged individuals. **PURPOSE:** To determine how brain activity changes throughout a self-paced incremental maximal exercise test in middle-aged adults. **METHODS:** This study included ten middle-aged (49.1 ± 3.2 years) recreationally active individuals (3 men, 7 women). A self-paced VO_2max (SPV) test was performed on a cycle ergometer, while subjects wore a wireless EEG electrode strip. This test consisted of five 2-min. stages using prescribed rating of perceived exertion (RPE) levels of 11, 13, 15, 17 and 20 (in that order). A ParvoMedics metabolic cart was used to analyze expired gases. Alpha (8-13 Hz) and beta (13-30 Hz) wave activity in the prefrontal and motor cortices (PFC and MC) were determined via PSD using Welch periodograms. Values were compared to an eyes open resting condition taken prior to exercise. Repeated-measures ANOVAs were used to determine the effect of test stage on EEG activity. **RESULTS:** The mean VO_2max was 37.6 ± 7.2 ml·kg⁻¹·min⁻¹. Relative PSD in both the alpha and beta frequency bands increased with corresponding increases in exercise intensity. In the PFC, there was a significant main effect of test stage in both the alpha and beta frequencies ($p = .013$ and $.034$) respectively. In the MC, the main effect of time was significant in the alpha ($p = .033$), but not the beta ($p = .080$) frequency. Large increases in relative PSD were seen in the transition from RPE17 to RPE20 (e.g. 7.6 ± 2.0 $\mu\text{V}^2 \cdot \text{Hz}^{-1}$ to 16.1 ± 4.6 in the MC beta wave analysis). **CONCLUSIONS:** This study suggests that for middle-aged individuals, there is no decline in EEG activity in either the prefrontal or motor cortices during a maximal

exercise test. As a result of increasing RPE levels, there was a concomitant increase in relative PSD. These results also corroborate previous studies showing RPE17 as an important threshold for determining optimal cognitive function during exercise.

3400 Board #88 June 1 9:30 AM - 11:00 AM
Bilateral Weight Distribution Asymmetry in the Functional Movement Screen Deep Squat

Mary C. Hemmer, Louis R. Castro, Eric P. Scibek, Matthew F. Moran. *Sacred Heart University, Fairfield, CT.*
(No relevant relationships reported)

The functional movement screen (FMS) deep squat (DS) is used to identify movement deficiencies and potentially predict injury. While evidence does not support the predictive validity of FMS scores, useful information can still be obtained. Weight shifts are often observed in the FMS DS, but current literature lacks information about asymmetrical weight distribution. **PURPOSE:** To determine the amount of weight distribution asymmetry in physically active young adults during the FMS DS. **METHODS:** Nineteen physically active participants (11 F, 8 M, 20.2 ± 1.0 yo) were recruited and granted informed consent. Participants performed three trials of the FMS DS with feet flat (FF) followed by three trials with elevated heels (EH) elevated on a 2x6 board. Trials were completed on two embedded force plates (1200Hz). Vertical ground reaction force (vGRF) data were used to determine asymmetry in bilateral weight distribution. Six reflective markers placed bilaterally on the greater trochanter, lateral femoral epicondyle and lateral malleolus were tracked with a 10-camera motion analysis system (120Hz). A Matlab script processed the data and computed knee flexion angle and vGRF asymmetry at squat initiation and full squat. Paired samples t-tests with a significance level of 0.05 were used. **RESULTS:** A significant increase ($p < 0.01$) in knee flexion occurred in the EH squat condition (Left 105.9 ± 20.2°, Right 105.8 ± 20.5°) compared to FF (Left 100.8 ± 22.5°, Right 101.0 ± 23.1°). On average, participants experienced >5% asymmetry (0% being perfectly symmetric) for the starting position and full squat position during both FF and EH. There were no significant differences in weight distribution symmetry in the starting position ($p = 0.31$) between squat conditions. The EH condition did not significantly change weight distribution symmetry ($p = 0.69$) in the full squat position. Within squat condition, there was no significant differences between weight distribution symmetry from the starting position to the full squat position (FF: $p = 0.76$, EH: $p = 0.43$). **CONCLUSION:** Bilateral weight distribution asymmetry was present in the FMS DS both with flat and elevated heels in physically active participants. Coaches and trainers should consider implementing training programs to optimize biomechanical function during the FMS DS.

3401 Board #89 June 1 9:30 AM - 11:00 AM
Effect of a Suspension Training Certification Curriculum on Health Related Fitness and Functional Movement

Emily G. Hilliard¹, Megan Jackson¹, Alexander McDaniel¹, Ann T. Shields¹, Rachel E. Williams¹, Ryan Swiezy¹, Courtney K. Milleson¹, Adrian Gonzalez¹, Andrew Ortiz¹, Brad Hollingsworth¹, Sarah Noland¹, Raechel Santee¹, Phillip Morie¹, Lauren Ackerman¹, Emma Schmid¹, Kelsey Bryan¹, Frances M. Livingston¹, Tiago Barreira², Wayland Tsch¹. ¹*University of North Carolina Wilmington, Wilmington, NC.* ²*Syracuse University, Syracuse, NY.* (Sponsor: Dr. Robert Boyce, FACSM)
(No relevant relationships reported)

INTRODUCTION: There is limited research on the fitness benefits of certification courses offered in higher education. **PURPOSE:** To identify the fitness and functional movement effects from a 14-week, didactic, active learning suspension training certification course. **METHODS:** Forty-two participants (30 females; 12 males; Age = 25.6 ± 10.0 yrs; Height = 169.4 ± 9.8 cm; Body Mass = 69.7 ± 15.4 kg) in a suspension training curricular course completed 28 applied-learning sessions over a 14-week period. Initial 9 weeks were instructor-led educational lectures, workouts, and critique of techniques, whereas, the latter 5 weeks were student-led exercise programming and workouts for curricular evaluation. Throughout each 40-minute exercise session, six body positions were utilized across push, pull, rotational, squat, and lunge movements. Pre- and post-fitness assessments included body composition, muscular endurance, muscular strength, flexibility, and a functional movement screen (FMS). Dependent t-tests were used to determine if there were mean changes in fitness-related and functional movement status. Due to multiple comparisons, Bonferroni correction was used, therefore, alpha level was set at .007. **RESULTS:** There were no significant changes in mean body mass, fat mass, and lean mass. There were, however, significant positive changes in mean percent body fat (24.0% ± 9.8% to 22.9% ± 10.5%), sit-and-reach (41.5 ± 9.2 to 44.0 ± 7.9 cm), quantity of push-ups (25.9 ± 11.5 to 32.0 ± 13.5), handgrip dynamometer (83.1 ± 29.5 to 90.6 ± 30.5 kg), and FMS (14.9 ± 2.4 to 16.5 ± 2.2) values. **CONCLUSIONS:** Students participating within the 28-session suspension

training curriculum experienced significant decrements in percent body fat and gains in flexibility, upper body muscular endurance, upper body muscular strength, and functional movement screening scores.

3402 Board #90 June 1 9:30 AM - 11:00 AM
Physiological Differences Between Motorized and Non-Motorized Treadmill Running

Mary Stenson. *College of St. Benedict/St. John's University, St. Joseph, MN.*
 Email: mcstenson@csbsju.edu
(No relevant relationships reported)

Non-motorized treadmills (NMT) are designed to replicate overground exercise and are used in fitness testing, simulation of team sport exercise, and sprint training. Limited research describes differences in physiological responses between running on a curved NMT and motorized treadmill (MT) at the same speed. **PURPOSE:** Examine physiological differences between running on a NMT and a MT at the same speed and identify at which MT grade the physiological response to running on a MT is similar to a NMT at the same speed. **METHODS:** Ten active females ran at three speeds (2.68, 3.13, and 3.58 m/s) on a curved NMT and a standard MT. Five participants also ran at 3.13 m/s and 4%, 6%, and 8% grades on the MT. $\dot{V}O_2$, blood lactate, heart rate, and rating of perceived exertion were compared between treadmills at each speed and grade using ANOVAs and paired samples *t* tests. **RESULTS:** NMT $\dot{V}O_2$ was significantly greater at 2.68 m/s (40.89 ± 2.13 vs. 35.73 ± 1.92 ml/kg/min; $p < 0.01$) and 3.13 m/s (47.7 ± 4.06 vs. 42.29 ± 2.14 ml/kg/min; $p = 0.004$), but not significantly different from MT at 3.58 m/s (50.30 ± 5.76 vs. 47.64 ± 2.73 ml/kg/min; $p = 0.085$). NMT blood lactate concentration was significantly greater at 3.13 m/s (8.83 ± 2.55 vs. 6.02 ± 2.75 mmol/L; $p < 0.01$) and 3.58 m/s (11.63 ± 2.25 vs. 8.10 ± 2.74 mmol/L; $p < 0.01$). At 3.13 m/s and a MT grade of 8%, $\dot{V}O_2$ ($r = -1.46$, $p = 0.22$) and blood lactate ($t = -2.64$, $p = 0.06$) were not significantly different from NMT at 3.13 m/s. **CONCLUSIONS:** The physiological response to running on a NMT was significantly greater than a MT at submaximal speeds. A greater non-oxidative contribution to running at 3.58 m/s on the NMT is likely due to runner position on the curved belt. Running on a MT at an 8% grade produces similar $\dot{V}O_2$ and blood lactate responses to running on a NMT at the same speed. Practitioners prescribing NMT exercise should consider exercise intensity and effect of the NMT incline.

3403 Board #91 June 1 9:30 AM - 11:00 AM
Functional Assessment of the Upper Limb: Support for Isotonic Measurement Devices

Mercedes K. Steidley, Emily L. Roessel, J. Mark VanNess, Natalie R. Schlenker, William P. Lydon, Sarah R. McDowell, Courtney D. Jensen. *University of the Pacific, Stockton, CA.*
(No relevant relationships reported)

Accurate evaluation of arm strength and function is important to prevent injury, aid rehabilitation, and enhance training. Traditional assessments involve isokinetic devices (e.g., Cybex) to determine post-injury abilities. However, this method is confined to a linear motion and fails to mimic normal isotonic movement patterns. Instruments that measure isotonic motions in three-dimensional space may be more appropriate. **PURPOSE:** Compare upper limb isokinetic force characteristics to those produced in isotonic actions. **METHODS:** 35 healthy college students (12 women, 23 men) performed biceps curls and triceps extensions of the dominant arm on one of two machines: Cybex HUMAC NORM isokinetic dynamometer (N=17) or Proteus (N=18), which measures upper limb motion in three-dimensional space using magnetically-mediated resistance. Subjects performed practice trials to minimize learning effects. After completing testing, we used independent and paired-samples t-tests to compare peak force ratios of biceps and triceps generated by the different testing devices. **RESULTS:** Peak biceps torque on the Cybex was 25.9 ± 8.5 ft-lb; peak triceps torque was 24.3 ± 6.3 ft-lb. On average, it took the biceps approximately 62% longer to reach peak torque than it did the triceps ($p < 0.001$). The isokinetic biceps-triceps strength ratio was 1.07:1 ± 0.22:1. This ratio was different between men and women ($p < 0.001$). Among men, it was 1.28:1 ± 0.16:1. Among women, it was 0.99:1 ± 0.20:1. This ratio was also different when compared to peak power calculated by Proteus ($p = 0.033$). In our sample, isotonic, free-motion testing associated with a higher and more variable biceps-triceps strength ratio: 1.38:1 ± 0.99:1. **CONCLUSION:** Performance prediction models and return-to-play testing batteries have traditionally captured functional profiles through isokinetic testing. Restricting movement to a limited range of isokinetic motion results in an inaccurate depiction of what a patient or an athlete does outside of the clinic. Isotonic resistance permitting three-dimensional assessment may be able to provide a more optimal analysis of upper limb function, which translates more directly to athletic and therapeutic contexts. More research is needed to understand how these values may help personalize training and rehabilitation programs.

3404 Board #92 June 1 9:30 AM - 11:00 AM
Special Fitness Judo Index Test to Evaluate Sports Performance According to the Training Stage In Athletes

Luis Del Valle, Calvin Illescas, FACSM. *Confederacion Deportiva Autonoma De Guatemala, Guatemala, Ciudad, Guatemala.* (Sponsor: Dr. Calvin Illescas, FACSM)
 Email: calvinimd@gmail.com
 (No relevant relationships reported)

Through precise training for the athlete we can improve their specific physical condition for each sport discipline, in the same way the tests we perform to see the metabolic changes according to the corresponding pathways to the sport activity must try to be as specific as possible and simulate sports techniques. **PURPOSE:** To analyze with specific judo fitness test, the sports performance according to the training stage in athletes. **METHODS:** Descriptive study, n = 18, 11 males, 7 females of the Judo Senior Team, age 20.4 ± 3.9 years, with a range of 15 to 29 y. The same test was performed three times, every 4 months. The test is performed to assess the sports training in judo. The first and second tests, 11 athletes were evaluated, and in the 3rd test, 16 athletes participated. The fitness index tests are specific, analyze the performance with Judo technique ("Ippon-sevi-nage"), the Index consists of the measurement of the maximum heart rate of effort (MHRE) plus the heart rate at the minute of recovery at the end of the test, in beats per minute, divided by the number of techniques, made from the 1st 15 seconds (s), 10 s recovery, 2nd 30 s, 10 s recovery and 3rd 30 s work, and the heart rate at the minute of recovery. It started at 0900 hrs, with an ambient temperature 20°C, monitoring the heart rate, during rest, warm-up, maximum effort and at one minute of recovery using PolarV800 heart rate monitors. Additional instruments used were writing board, sheets of bond paper, pencil, whistle and a chronometer. The information was tabulated in Microsoft Excel 2016. **RESULTS:** in the 1st test, 11 athletes, men (7), the results were, 4, 36.4% good, 1, 9% very good, 2, 18.2% excellent; women (4), 1, 9% bad and 3, 27.3% regular, in the 2nd test, 11, men (8), 1, 9% bad, 1, 9% regular, 3, 27.3% good and 3, 27.3% excellent; women (3), 1, 9% regular and 2, 18.2% good and in the 3rd, (16), men 10, 2, 12.5% regular, 6, 37.5% good and 2, 12.5% excellent; women 6, very bad 1, 6.3%, 2, 12.5% regular and 3, 18.7% good. **CONCLUSION:** With the special fitness Judo Index test we can track the sports preparation of judo athletes and evaluate their performance specifically with Judo technique ("Ippon-sevi-nage").

3405 Board #93 June 1 9:30 AM - 11:00 AM
Physiological Demands of Hard Shoe and Soft Shoe Irish Dancing: A Pilot Study

Madison P. Trebour, Jo P. Morrison, Laura Q. Jimenez, Tim G. Coffey, Madison M. Cutten. *Longwood University, Farmville, VA.*
 Email: madison.trebour@live.longwood.edu
 (No relevant relationships reported)

MP. Trebour, MM. Cutten, TG. Coffey, LQ. Jimenez, JP. Morrison. Longwood University, Farmville, VA 23909
Purpose: Irish Step Dance is a form of dance characterized by maintaining an upright posture and primarily moving the lower extremities with two different shoe styles. Soft shoe (SS) dance requires light and delicate movements, while hard shoe (HS) dance requires forceful and powerful movements. Irish dance competition pieces can last 30-60 seconds and performance pieces can last 10 minutes. The purpose of this study was to characterize the cardiorespiratory demands of female recreational Irish dancers. **Methods:** Seven female dancers (35.8 ± 9.6 y; 166.6 ± 7.5 cm; 79.1 ± 13.1 kg) volunteered for HR monitoring during three separate 45 min classes (n=16 measurements). Classes consisted of a mixture of HS and SS dancing. Three female dancers (28.0 ± 13.9 y; 168.7 ± 1.2 cm; 76.5 ± 15.2 kg) volunteered for $\dot{V}O_2$ testing. Dancers completed a three minute reel and treble reel dances while wearing soft and hard shoes. Steady-state data were analyzed from the last 30 sec of the three minute dance test. The order of testing was randomized and the same piece of music was used for all dances. **Results:** The mean HR for a class session was 128 ± 14 bpm (69.7 ± 9.3 %HR_{max}). The mean maximal HR achieved in class was 184 ± 10 bpm (93.9 ± 8.7 %HR_{max}). There was no significant (p<0.05) difference in $\dot{V}O_2$ (HS 23.33 ± 7.51 ml/kg/min; SS 23.57 ± 6.17 ml/kg/min), R-value (HS 1.31 ± 0.05 ; SS 1.31 ± 0.12), HR (HS 184.7 ± 8.7 bpm; SS 185.0 ± 2.0 bpm), or %HR_{max} (HS 96.3 ± 3.2 %HR_{max}; SS 94.5 ± 3.7 %HR_{max}) for HS and SS dance. **Conclusions:** The class data suggest that Irish dance classes are a moderate intensity activity with vigorous intensity intervals. Hard shoe and soft shoe Irish dance are physiologically demanding aerobic activities with anaerobic contribution. Despite differences in dance style these data suggest that there is no difference between the metabolic demands of HS and SS Irish dancing.

3406 Board #94 June 1 9:30 AM - 11:00 AM
Elite Orienteering Athletes In Standardized Time-trial And Distance-trial Tests Own Better Physiological And Psychological Indicators On Treadmill

Chia-Chih Lin¹, Guan-Yu Lin². ¹*National Dong Hwa University, Hualien, Taiwan.* ²*National Taiwan Normal University, Taipei, Taiwan.*
 Email: cclin@gms.ndhu.edu.tw
 (No relevant relationships reported)

Orienteering founded in north europe is now gradually popular worldwide. However, how to train focus on event specificity has not been established well. **PURPOSE:** The goal of this preliminary study is to explore physiological and psychological characteristics of elite orienteering players. **METHODS:** Ten elite orienteering athletes (OA) (age: 25.4 ± 8.9 yrs; BMI: 20.2 ± 1.7 ; training: 9.2 ± 2.8 hrs/wk; 5 males and 5 females; $\dot{V}O_{2max}$: 48.8 mL/kg/min) and ten elite running athlete (RA) (age: 21.0 ± 1.5 yrs; BMI: 20.8 ± 1.1 ; training: 12.8 ± 2.7 hrs/wk; 5 males and 5 females; $\dot{V}O_{2max}$: 52.7 mL/kg/min) were recruited to attend a time-trial and a distance-trial treadmill tests in counterbalanced order. Athletic performance of participants were at least national level. Both tests were interspersed by 4 segments of mental games (named Peak in Apple Store) representing the capacity of problem solving, memory, concentration, and thinking agility in sequence. While playing mental games, participants kept on running with their effort. Performance indicators and ECG/EEG signals /game scores were analyzed using independent t test and mixed design of repeated measures respectively. Statistical significance was set at $p < .05$. **RESULTS:** Better performance of time/distance trials (1084 min vs. 1100 min; 3338 m vs. 3211 m) in OA and most all indicators of OA were better than those of RA in main effect. Results indicated that attention index (55.6 vs. 44.3), game score (10929 vs. 8817) and %HRR (77.3 % vs. 67.6 %) of OA were significantly higher than those of RA during mental games in time-trial test ($p < .05$) in main effect. **CONCLUSIONS:** We conclude that elite orienteering athletes own stronger power for mental management while keeping on higher intensity of running. Introducing mental challenges on running may enhance training effect of orienteering.

G-36 Free Communication/Poster - Methodology

Saturday, June 1, 2019, 7:30 AM - 11:00 AM
 Room: CC-Hall WA2

3407 Board #95 June 1 8:00 AM - 9:30 AM
Accuracy Of The Equations For $\dot{V}O_{2max}$ In Aerobically Trained Women.

Sergio A. García Corzo, Moises Arturo Cabrera Hernandez, Luis Javier Tafur Tascon, Yecid Mina Paz, Carmen Ximena Tejada Rojas, Hugo Hurtado Gutierrez. *Institucion Universitaria Escuela Nacional del Deporte, Cali, Colombia.*
 (No relevant relationships reported)

PURPOSE: Evaluate the accuracy of the $\dot{V}O_{2max}$ equations for aerobically trained Colombian women. **METHODS:** Estimated values of $\dot{V}O_{2max}$ of the equations were compared with those of $\dot{V}O_{2max}$ measured in a maximum cycloergometer test (MCT). When examining the constant error (CE), standard error of estimation (SEE), total error (TE), the comparison of means (Student's t-test), the Bonferroni correction was used to adjust the level of significance, Pearson correlation coefficient (r) and Lin's concordance correlation coefficient (CCC). A total of nine female cyclists and three female triathletes were volunteers for this study. **RESULTS:** The athletes were aged 23.7 ± 5.8 years, with weight 54.2 ± 4.8 kg and height 161.1 ± 3.6 cm. They reached a maximum workload power of 262.5 ± 29.8 W and a $\dot{V}O_{2max}$ of 55.5 ± 7.3 mL.kg⁻¹.min⁻¹ (2992.1 ± 327.3 mL.min⁻¹). Table 4 depicts the results of the comparison analyzes for absolute and relative values. Only equations 1 and 5 show CE values significantly different from zero, both for absolute and relative values. There were significant positive correlations between the CE and $\dot{V}O_{2max}$ through the MCT values for equations 2, 5 and 6 in the relative values, and only for equation 5 in the absolute values. CCC rated all the equations with poor concordance.

Table 4. Comparison of absolute and relative values of VO₂max predicted from the equations.

Equation	VO ₂ max ml.min ⁻¹ (mean ± ED)	CE (media ± DE)	p value	r	SEE (ml. min ⁻¹)	TE (ml. min ⁻¹)
1	3271.3 ± 336.7	-279.2 (202.1)	.001	0.87*	161.3	339.7
2	2879.5 ± 282.6	112.7 (203.2)	.081	0.85*	172.4	224.8
3	2840.5 ± 305.1	151.6 (191.4)	.019	0.87*	161.3	237.9
4	2985.1 ± 321.5	7.0 (195.1)	.903	0.87*	161.3	187.0
5	2125.9 ± 132.0	866.2 (368.3)	.000	0.27	315.1	935.3
6	2957.3 ± 301.1	34.8 (193.4)	.546	0.87*	161.3	188.4
7	3131.4 ± 320.8	-139.2 (197.5)	.033	0.87*	161.3	234.8
	ml.kg ⁻¹ .min ⁻¹ (mean ± ED)					
1	60.6 ± 6.7	-5.1 (3.6)	.001	0.81*	4.3	6.2
2	53.4 ± 5.7	2.2 (3.8)	.078	0.78*	4.6	4.3
3	52.6 ± 6.1	2.9 (3.6)	.019	0.81*	4.3	4.5
4	55.3 ± 6.5	0.2 (3.6)	.852	0.81*	4.3	3.5
5	39.4 ± 2.9	16.1 (7.1)	.000	-0.12	7.3	17.5
6	54.8 ± 5.9	0.7 (3.6)	.500	0.81*	4.3	3.6
7	58.0 ± 6.4	-2.5 (3.6)	.036	0.81*	4.3	4.3

* = p value < 0.05

CONCLUSION: Equations 3, 4 and 7 meet all the statistical criteria used to evaluate the accuracy of the prediction in this study; however, none of the equations was rated as good concordance, when using the CCC method.

3408 Board #96 June 1 8:00 AM - 9:30 AM The Development and Validation of a Functional Capacity Test for Dancers

Allison M. Seifert¹, Vincent J. Paolone², Elizabeth M. Mullin², Sarah Zehnder². ¹American International College, Springfield, MA. ²Springfield College, Springfield, MA.

(No relevant relationships reported)

A peak functional capacity test that is incremental in nature, varying in intensity, and includes movements familiar to dancers is a necessary and important addition to the dance specific fitness tests in the current literature. **PURPOSE:** To design and validate a peak functional capacity test that is appropriate in time, intensity, and movement specificity to the dancer. **METHODS:** The Seifert Assessment of Functional Capacity for Dancers (SAFD) was developed using previous valid and reliable functional capacity protocols, published research in dance specific fitness tests, and consult with content experts. Final test parameters included 3 min. stages of increasing intensity utilizing both speed and difficulty of movements, continued until exhaustion. Following pilot testing, a survey of content experts supported the validity of the SAFD. Female dancers (N = 13) completed a total of four separate sessions, a familiarization trial of the SAFD, SAFD trial 1, a peak treadmill test, and SAFD trial 2. Each test measured time to exhaustion, peak oxygen consumption (VO₂peak), respiratory exchange ratio (RER), heart rate (HR), blood lactate (BLA-), and rate of perceived exertion (RPE). Tests were terminated upon volitional exhaustion or a total of three cues regarding poor movement quality or inability to keep pace with the metronome. Interclass Correlation Coefficients were used to assess reliability, while validity was analyzed using Pearson Product Moment Correlations. **RESULTS:** Strong correlations (≥.7) were found between time to exhaustion, VO₂peak, HR and RPE between SAFD trials. No significant (p > .05) differences existed in any of the physiological variables between the SAFD trials. Significant (p < .05) relationships were found between time to exhaustion, VO₂peak, HR, BLA-, and RPE between the SAFD and the treadmill test. **CONCLUSION:** The strength of key physiological correlations of time to exhaustion, VO₂peak, HR, and RPE provide strong evidence for the SAFD being both reliable and valid. Although the threshold value for correlation was not met in neither RER nor BLA-, results do present a particularly meaningful set of values to the physiology practitioner and thus, further support the conclusion that the SAFD is both a reliable and valid method of assessing peak functional capacity in the dance population.

3409 Board #97 June 1 8:00 AM - 9:30 AM

Examining the Learning Effect On An Isokinetic Fatigue Test Protocol

Tyler J. Neltner¹, Giovanna C. Ramos¹, Emily E. Grammer¹, Cameron D. Addie¹, Marisa K. Straughn¹, Jordan M. Glenn¹, Michelle Gray¹, Nicole E. Moyer¹, Jennifer L. Vincenzo¹, Kylie K. Harmon², Lee E. Brown, FACSM¹. ¹University of West Florida, Pensacola, FL. ²University of Central Florida, Orlando, FL.

(No relevant relationships reported)

When performing repeated repetitions of a task, the body becomes familiar with the task and can become more efficient. This is known as the learning effect and can alter performance. **PURPOSE:** To examine the learning effect when fatigue testing without familiarization. **METHODS:** 22 masters-aged [53±5 years], competitive female cyclists completed 3 separate 50-repetition knee flexion/extension tests on a Biodex isokinetic dynamometer, separated by one-week with no familiarization. **RESULTS:** No significant differences [Wilks Λ>.05] existed between trials, indicating no learning effect was associated with the tests for any variable: a) peak torque (T1 50.7±10.4 N·m; T2 53.0±11.5 N·m; T3 56.6±11.0 N·m), b) relative peak torque (T1 36.2 ± 6.7 N·m/kg; T2 37.9 ± 7.5 N·m/kg; T3 39.2 ± 7.3 N·m/kg), c) torque generated at 30° (T1 27.1 ± 10.0 N·m; T2 26.4 ± 10.2 N·m; T3 26.6 ± 9.4 N·m), d) torque generated at 0.18 s (T1 45.7 ± 9.0 N·m; T2 47.4 ± 10.1 N·m; T3 50.1 ± 9.0 N·m), e) relative work completed (T1 50.2 ± 9.7 J/kg; T2 50.5 ± 9.0 J/kg; T3 51.5 ± 10.9 J/kg), or f) total work completed (T1 2548.4 ± 524.4 J; T2 2544.8 ± 516.0 J; T3 2615.3 ± 579.3 J). **CONCLUSION:** No learning effect was seen with the isokinetic knee extension/flexion fatigue protocol in masters-aged, female cyclists. Therefore, these findings would suggest that previous experience in isokinetic muscular fatigue testing does not alter subsequent performance.

3410 Board #98 June 1 8:00 AM - 9:30 AM

A Novel Assessment of Baseball Throwing Mechanics

Mason Jiang¹, William P. Lydon¹, Mark J. Vaness¹, Alexis C. King², Courtney D. Jensen¹. ¹University of the Pacific, Stockton, CA. ²University of Illinois Urbana-Champaign, Champaign, IL. Email: m_jiang1@u.pacific.edu

(No relevant relationships reported)

To remain competitive, collegiate athletes constantly seek novel methods of performance enhancement. As technological advancements permit more sophisticated assessments, it is important to appraise their utility. **PURPOSE:** To establish a mechanical profile of baseball throwing and to test which kinematic domains associate with on-field performance. **METHODS:** 18 collegiate baseball players (11 fielders, 7 pitchers) were tested using Proteus (Boston Biomotion, USA), which analyzes isotonic force production concurrently in all 3 planes. Players performed 5 consecutive throw motions against 3lb of magnetic resistance. Proteus software calculated power, velocity, explosiveness (rate of force development), endurance (maintenance of force characteristics), consistency (repeatability of movement), and range of motion (ROM). Across the total sample, these values were used to generate throwing profiles; among the subsample of pitchers, the values were used in linear regressions to predict in-season performance. **RESULTS:** Across all players, power was 118.4 ± 80.0, explosiveness was 82.9 ± 29.4, velocity was 6.0 ± 1.2, endurance was 97.2 ± 5.9, consistency was 86.5 ± 9.1, and ROM was 4.0 ± 0.6. Consistency was inversely related to power (R = -0.639; p = 0.004). Explosiveness was inversely related to endurance (R = -0.879; p < 0.001). Pitchers exhibited patterns for higher power, velocity, and explosiveness, but none reached significance (p > 0.10). ROM differed between groups: the pitchers' ball path traveled 20.6% farther in 3D space (p = 0.007). Controlling for height, it remained 18.5% farther (p = 0.012). Among pitchers, in-season earned run average (ERA) increased with power (R = 0.933; p = 0.002) and velocity (R = 0.931; p = 0.002) and decreased with consistency (R = -0.956; p = 0.001). Each additional point of power predicted an increase of 0.2 strikeouts per nine innings (p = 0.025) and a 0.2-point increase in ERA (p = 0.002). Each additional point of consistency, predicted 0.2 fewer strikeouts per nine innings (p = 0.047) and a 0.2-point decrease in ERA (p = 0.001). **CONCLUSIONS:** Novel instruments to assess pitching mechanics enable the generation of new normative data. Preliminary analyses suggest power and explosiveness are inverse to consistency and endurance, and they predict different performances on the field.

3411 Board #99 June 1 8:00 AM - 9:30 AM
Acute Effects of Neuromuscular Electrical Stimulation on Vertical Jump

Yusuf K. Kaire, Andrew Harveson, Dominick Sturz, Levi Garrett. *California Baptist University, Riverside, CA.*
 Email: ykaire@gmail.com
 (No relevant relationships reported)

Yusuf K. Kaire, Andrew Harveson, Dominick Sturz, Levi Garrett
 California Baptist University, CA
 Multiple studies have indicated improvements in muscular strength, power, and performance can be made over time using neuromuscular electrical stimulation (NMES). Yet no previous studies have conducted research into the effects of NMES on vertical jump immediately after isometric stimulation to the quadriceps group.
PURPOSE: To determine the acute effects of NMES on vertical jump. **METHODS:** A group of 24 participants were randomly divided into an experimental and a control group. All participants were pretested in the countermovement jump (CMJ) to determine maximum jumping height. Participants in the treatment group were treated with NMES to the quadriceps. Participants in the control group received sham treatment in identical testing conditions. All participants then engaged in a post treatment CMJ test. The difference between pretest and posttest jump scores was computed to determine the effects of treatment.
RESULTS: A paired samples *t*-test showed a statistically significant increase in experimental CMJ scores from pre-test ($M = 28.69, SD = 6.87$) to posttest ($M = 30.14, SD = 7.42$), $t(11) = 1.796, p < .05$. (Figure 1). A statistically significant decrease in control CMJ scores occurred from pre-test ($M = 30.72, SD = 6.51$) to posttest ($M = 29.18, SD = 6.24$), $t(11) = 1.796, p < .05$. The mean increase in experimental CMJ scores was 1.45 with a 95% confidence interval ranging from 26.61 to 33.67. The mean decrease in control CMJ scores was 1.54 with a 95% confidence interval ranging from 26.21 to 32.15. Cohen's *d* (.24) indicated a small effect size. **CONCLUSION:** The acute application of NMES to the quadriceps group lead to significant improvements in vertical performance.

3412 Board #100 June 1 8:00 AM - 9:30 AM
Correlation Analysis Of The Skulpt® And Bodpod®

Alyne L. Williams, Melissa Renee Cook, Ciro Moraes Costa De Castro, Annabell Kennell, Victoria Haller, Alex Seabeck, Alex Springer. *Indiana Wesleyan University, Marion, IN.*
 Email: aly.williams@indwes.edu
 (No relevant relationships reported)

The BodPod® (BP) is a standard, reliable tool for measuring body composition. A new body composition measurement tool called the Skulpt® (SK) was created recently. The SK is a form of bioelectrical impedance analysis that measures at three different sites, tricep, abdomen, and thigh, but little to no research exists examining the validity of this form of measurement. For this reason, this study sought to determine the accuracy of the SK compared to the BP. If the SK is determined to be accurate, the low cost and convenience of the SK would make measuring body composition more accessible and available to the general population. **PURPOSE:** The purpose of this study was to test the accuracy of the SK against the BP when measuring body composition. **METHODS:** This was accomplished by measuring body fat percentage using the BP first and then the SK on 91 participants. Subjects for this study included: female (50) and male (41) subjects. Demographic data of each subject was taken before the assessment as well as height (cm) and weight (kg). The body fat percentage results were analyzed using SPSS software. **RESULTS:** A Spearman's R correlation coefficient was calculated for the relationship between the body fat % measured from the SK and BP. A strong positive correlation was found $R = 0.904 (p < 0.000)$, indicating a significant direct relationship between the two variables. This suggests that a subject measuring a high % body fat on the BP also measures high on the SK. A paired-samples *t* test was calculated to compare the mean body fat % from the SK to the mean body fat % of the BP. The results conclude there was a statistical significant difference between the BP and SK of $p < 0.000$. An average of 5.55% difference was found between the results of the two measurement tools. The mean body fat % on the BP was 21.824 ($sd = 10.05$). The mean body fat % on the SK was 27.371 ($sd = 8.67$). **CONCLUSION:** Since there was significant difference found between BP and SK, the SK is not a recommended body fat measurement tool in research settings, but is acceptable to use in general population settings. However, the positive correlation shows the SK can differentiate between individuals with high versus low body fat. These findings suggest an individual could use the SK to track changes in body composition, an important factor in a person's overall health and wellness.

3413 Board #101 June 1 8:00 AM - 9:30 AM
Positional Difference in Linear Momentum During Vertical Jump in Division II College Football Players

Marquez R. Norford, Meghan K. Magee, Justine E. Fox, Scott E. Williams, Jonathan M. Kollars, Allison N. McCracken, Brett A. Comstock, Joseph L. Andreacci, FACSM, Kyle S. Beyer. *Bloomsburg University, Bloomsburg, PA.* (Sponsor: Joseph L. Andreacci, FACSM)
 Email: mrm16031@huskies.bloomu.edu
 (No relevant relationships reported)

Linear momentum, the product of body mass and velocity, is the key determinant of the outcome of collisions. In collision-based sports, such as American football, players with the greatest momentum tend to achieve more favorable outcomes during on-field collision, or tackles. Therefore, today's players are constantly seeking to increase mass without sacrificing velocity. However, no study has quantified linear momentum in American football players.
PURPOSE: To examine the positional differences in linear momentum during a vertical jump in Division II college football players.
METHODS: 56 male Division II college football players were assessed for height, body mass, and vertical jump. All players were categorized according to playing position into defensive back (DB), defensive line (DL), running/full back (RB), linebacker (LB), offensive line (OL), tight end (TE), and wide receiver (WR) groups; all other positions were excluded due to insufficient sample. Height and body mass were assessed using a stadiometer and digital scale, respectively. A vertical jump test was performed to determine jump height, which was then used to calculate vertical jump velocity. Vertical jump momentum (VJM) was calculated as the product of body mass and vertical jump velocity. Positional comparisons in VJM were made using one-way ANOVA with LSD post hoc comparisons. Alpha level was set *a priori* to $p \leq 0.05$. **RESULTS:** A significant main effect of position was observed for VJM ($p < 0.001$). Post hoc tests revealed that OL (439.6±44.7 Ns) had significantly higher VJM than DB ($p < 0.001$; 317.3±34.4 Ns), RB ($p = 0.001$; 371.7±24.7 Ns), LB ($p = 0.006$; 376±32 Ns), TE ($p = 0.013$; 377.4±51.9 Ns), and WR ($p < 0.001$; 338.6±25.0 Ns), while trending to be greater than DL ($p = 0.089$; 406.9±59.6 Ns). Also, DL had significantly greater VJM than DB ($p < 0.001$) and WR ($p = 0.001$), and trended to be greater than RB ($p = 0.068$). LB ($p = 0.009$), TE ($p = 0.013$), and RB ($p = 0.004$) had significantly greater VJM than DB, but only RB trended to be greater than WR ($p = 0.086$). **CONCLUSIONS:** While positional differences in VJM exist in collegiate American football, positions that regularly engage during game play (OL vs DL, WR vs DB, and LB vs RB vs TE) have no statistically significant differences. Therefore, these positions are most likely evenly matched when colliding on the field.

3414 Board #102 June 1 8:00 AM - 9:30 AM
Validity And Reliability Of The Ymca Submaximal Cycle Test Using An Electrically-braked Ergometer

Justin Kidd, Nicholas D. Luden, Michael J. Saunders, FACSM, Christopher J. Womack, FACSM. *James Madison University, Harrisonburg, VA.* (Sponsor: Christopher Womack, FACSM)
 Email: kiddjm@dukes.jmu.edu
 (No relevant relationships reported)

PURPOSE: Electrically-braked ergometers allow a consistent power output regardless of variances in pedaling cadence. The present study sought to test the effect of using an electrically braked ergometer on the validity and reliability of the YMCA submaximal cycle test.
METHODS: 22 male and 13 female subjects (19 - 31 y) completed one maximal treadmill test and four submaximal cycle tests (using the YMCA protocol) to measure and estimate VO_{2max} , respectively. The submaximal trials consisted of two tests performed using a friction-braked ergometer (Monark) and two using an electrically-braked ergometer (Viasprint). All measured and estimated VO_{2max} values were compared using repeated measures ANOVA and post-hoc tests using paired *t*-tests. Paired *t*-tests were also used to determine potential differences between repeated submaximal trials using the same ergometer. Pearson correlation coefficients were used to determine validity and reliability coefficients.
RESULTS: The treadmill VO_{2max} protocol yielded markedly higher ($P < 0.05$) values (50.3 ± 7.7 mL/kg/min) than the YMCA submax protocol using the friction-braked (40.8 ± 5.5 mL/kg/min) and electrically-braked ergometer (38.8 ± 4.5 mL/kg/min). Furthermore, estimated VO_{2max} using the friction-braked ergometer was higher ($P < 0.05$) than that observed using the electrically-braked ergometer. There were similar reliability coefficients for the friction-braked ($R = 0.63$) and electrically-braked ($R = 0.52$) ergometers. Lastly, a moderately strong ($R = 0.74$) relationship was observed between actual VO_{2max} and prediction error ($VO_{2max} - \text{estimated } VO_{2max}$).
CONCLUSIONS: Both Monark and Viasprint ergometers underestimated VO_{2max} in a sample of fit, young individuals. The magnitude of underestimation was greater in individuals with higher VO_{2max} values. Using an electrically-braked ergometer did not improve either validity or reliability of VO_{2max} estimates from the YMCA protocol.

3415 Board #103 June 1 8:00 AM - 9:30 AM

A New Functional Screening Tool For Lower Limb Injury Risk: A Retrospective Cohort Study

Liping Jiang¹, Shimeng Shi², Xiaojian Shi², Zonghan Yang², Gordon Waddington³, Jeremy Witchalls³, Roger Adams⁴, Doa El-Ansary⁵, Jia Han². ¹Tongji University, Shanghai, China. ²Shanghai University of Sport, Shanghai, China. ³University of Canberra, Canberra, Australia. ⁴University of Sydney, Sydney, Australia. ⁵Swinburne University of Technology, Melbourne, Australia.

(No relevant relationships reported)

PURPOSE: The aim of the current study was to develop a new screening instrument for lower limb functional assessment. **METHODS:** Fifty-three athletes (33M,20F; mean age: 19.4 ± 2.5years old) volunteered for the study. Athlete injury history and sport performance level (international, national, regional, recreational) were recorded. A lower limb functional screening tool was developed (the LoLiFST), based on 5 lower limb movements in different modes, planes, directions and at varying intensities. Both legs were assessed in a random order and each athlete was given a technique and a symptom score. Reliability was evaluated. Spearman's correlation was employed to examine the relationship between the measures and the incidence of injury. Receiver operating characteristic (ROC) analysis was employed to assess the instrument's capacity to classify injury status. **RESULTS:** (1) The test-retest reliability was 0.74. The inter-rater reliability was 0.95. (2) Twenty-five of the athletes had a history of low back or lower limb injuries in the past 12 months. (3) Both the technique and symptom scores from the LoLiFST were significantly correlated with the injuries ($p=0.290$, $P=0.035$; $\rho=0.390$, $P=0.004$), and the two scores were significantly inter-correlated ($\rho=0.354$, $P=0.009$). (4) When technique or symptom scores alone were included to differentiate between athletes with or without injury, the area under the ROC curve (AUC) scores were 0.668 ($P=0.036$, 95%CI: 0.520-0.815) and 0.722 ($P=0.006$, 95%CI: 0.582-0.862), respectively. With technique and symptom scores combined, the AUC discrimination score was 0.762 ($P=0.001$, 95%CI: 0.634-0.890). When sport performance level was added into the variable set, the AUC discrimination score was 0.834 ($P=0.00$, 95%CI: 0.728-0.939), meaning that 83.4% of cases can be correctly classified as low back or lower limb injured/non-injured using the decision point obtained from applying Youden's index to the ROC curve. **CONCLUSION:** The findings support the use of a functional movement screening tool that includes both technique and reported symptoms, that can be used in combination with sporting performance level to enhance capacity for identifying injuries. Future longitudinal studies are warranted to explore the validity of the LoLiFST in determining low back and lower limb injury risk.

3416 Board #104 June 1 8:00 AM - 9:30 AM

Comparison of Functional Tests of Leg Power in Collegiate Athletes

Spencer Sullivan, Niles Fleet, Peter Brubaker, FACSM.
Wake Forest University, Winston-Salem, NC. (Sponsor: Peter Brubaker, FACSM)

(No relevant relationships reported)

In the field of sports medicine, functional tests, such as the single leg hop for distance (SLHD) and single leg vertical jump (SLVJ), are often used to determine an athlete's return to competition. Many sports medicine facilities, including Wake Forest University (WFU), have invested in pneumatic resistance machines, such as the Keiser Air420 Leg Press, that precisely measure single leg power in Watts. However, little is known regarding the agreement of the data obtained from the functional tests and the Keiser Air420.

PURPOSE: To compare the results of the Keiser leg press to those of the SLHD and SLVJ in WFU athletes. **METHODS:** Data were obtained from 79 (40 males and 39 females) healthy student-athletes at WFU. After a warmup, each subject performed the SLHD and SLVJ (cm) and the Keiser leg press (W/kg) in random order with a 5-minute rest period between each test. The relationship between tests was examined with Pearson Correlation Coefficients. **RESULTS:** The means for the Keiser, SLHD, and SLVJ tests (listed right and left, respectively) were 15.4±3.7 W/kg and 14.9±3.6 W/kg, 170.6±27.8 cm and 172.9±28.0 cm, 36.2±7.4 cm and 36.2±7.8 cm, respectively. The correlations of leg power were statistically significant at an alpha level of 0.01. The SLVJ and Keiser scores (right leg $r=0.82$, left leg $r=0.83$) had a slightly higher correlation than the SLHD and Keiser scores (right leg $r=0.65$, left leg $r=0.70$). **CONCLUSIONS:** As suggested by the observed relationships, both the SLHD and SLVJ data correlate significantly with leg peak power results obtained from the Keiser Air420 in healthy, collegiate athletes. Thus, this study suggests low-tech/low-cost functional tests like the SLHD and SLVJ appear to be appropriate for evaluating leg power and return to competition in this population.

3417 Board #105 June 1 8:00 AM - 9:30 AM

Investigation of Optimal Depth Jump Box Height for Reactive Strength Index

Marisa K. Straughn¹, Cameron D. Addie¹, Giovanna C. Ramos¹, Tyler J. Neltner¹, Emily E. Grammer¹, Jeffrey D. Simpson¹, Ludmila Cosio Lima¹, Eric K. Greska², Lee E. Brown, FACSM¹.
¹University of West Florida, Pensacola, FL. ²University of Delaware, Newark, DE.

(No relevant relationships reported)

Reactive strength index (RSI) is used to assess athleticism through use of the stretch-shortening cycle for power and is determined by jump height over ground contact time. RSI is typically assessed utilizing an incremental drop jump test and while it is well-established that plyometric training positively impacts power production, the optimal depth jump box height for RSI remains unknown. **PURPOSE:** To measure RSI between different depth jump starting heights. **METHODS:** 20 college students were recruited for this study (M=13, F=7; age: 22.8±2.7y, height: 175.65±11.81cm, mass: 78.32±13.50kg) and were prepped using reflective markers on their ASIS and PSIS, bilaterally, which allowed for vertical jump height measurements. After a specific warm-up, subjects were instructed to perform three maximal DJs onto a force plate from five different heights: 30cm (DJ30), 45cm (DJ45), 60cm (DJ60), 76cm (DJ76), and 91cm (DJ91). A repeated measures ANOVA revealed no effect of sex but significant differences in RSI between starting heights (DJ30=1.36±0.11; DJ45=1.42±0.12; DJ60=1.35±0.12; DJ76=1.28±0.12; DJ91=1.16±0.11), with DJ45 and DJ60 being greater than DJ30, DJ76, and DJ91. **CONCLUSION:** A parabolic relationship was observed between depth jump box height and RSI, with the optimal depth jump starting heights being 45 and 60 cm. A potential avenue for future research would be to investigate training effects on RSI from various depth jump box starting heights.

3418 Board #106 June 1 8:00 AM - 9:30 AM

The Effects Of Different Local Muscular Endurance Training Protocols In Muscle Activity And Fatigue

CHRISTOS PAIZIS, CAROLE COMETTI, THOMAS DANIC, NICOLAS BABAULT. ISERM U1093-CAPS; Centre d'Expertise de la Performance, DIJON, France.

Email: Christos.paizis@u-bourgogne.fr

(No relevant relationships reported)

The present study assessed fatigue and neuromuscular changes after fatiguing submaximal horizontal chest press exercise between different strength trainings of concentric contractions intensities.

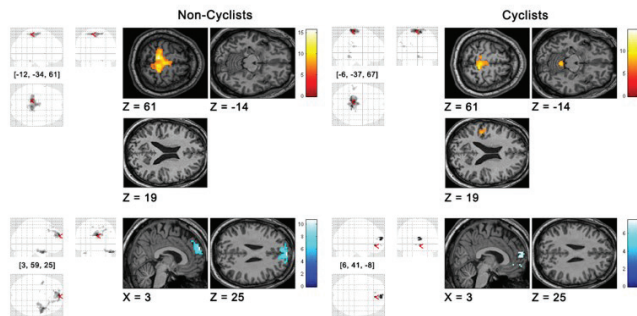
PURPOSE: The purpose of this study was to evaluate the effect of strength trainings with higher intensity contractions in EMG activity and fatigue. **METHODS:** Fifteen trained males (24.1±2.9 years old, 181.8±5.8cm, 83.6±9.6kg) performed four different strength trainings protocols in horizontal chest press (HCP) with different intensities of a load % one repetition maximum (RM) with a similar total impulse and similar rest. Strength trainings protocols consisted of: **A)** 3 blocks x (1 repetition (reps) of 95% RM - 1 rep of 90% RM - 3 reps of 80% RM - 5 reps of 70% RM - 8 reps of 60% RM - 8 reps of 50% RM - 12 reps of 45% RM - 15 reps of 30% RM - 12 reps of 20% RM) rest 5 sec between sets et 3 min between blocks; **B)** 2 blocks x (6 x 15 of 50% RM) rest 30 sec between sets et 3 min between blocks; **C)** 3 sets x (3 reps of 90% RM) rest 30 sec between sets and 1 min rest after block and 4 X (15 of 50% RM) rest 20 sec between sets and 1'40" rest after block and 3 X (15 of 50%) rest 20 sec between sets; **D)** 3 blocks x (6 x 10 reps of 50% RM) rest 10 sec between sets and 2'30" after bloc. The maximal voluntary isometric contraction torque (MVIC) was assessed in the HCP exercise before and after exercise. Electromyography (EMG) of the pectoralis major (P), anterior deltoid (AD), and the long head of the triceps brachii (TB) were assessed during the different exercises. **RESULTS:** Similar reductions of the MVIC (1227.5±184 vs 992±196 N; $P<0.01$) were observed after the four strength training protocols. EMG DA activity was greater in protocol C compared to the other protocols (0.956±0.336 vs 0.878±0.347 mV; $P=0.01$). EMG TB activity was greater in protocol C compared to the other protocols (0.534±0.194 vs 0.473±0.249 mV; $P=0.01$). EMG P activity was greater in protocol B and D compared to the A and C (0.343±0.115 vs 0.329±0.170 mV; $P=0.01$). **CONCLUSIONS:** The effect of strength endurance trainings with higher load % RM contractions compared to the others with a lower, affect similarly the loss of performance in the HCP exercise but with greater activity of DA and T muscles.

3419 Board #107 June 1 8:00 AM - 9:30 AM

Cyclists' Brain Cycling: An fMRI Study

Eduardo B. Fontes¹, Kell G. Costa¹, Henrique Bortolotti¹, Daniel A. Cabral¹, Andres Vivas¹, Erika Hussey², Nathan Ward², Brunno M. Campos³, Timothy D. Noakes⁴, Li M. Li³. ¹Federal University of Rio Grande do Norte, Natal, Brazil. ²Tufts University, Boston, MA. ³University of Campinas, Campinas, Brazil. ⁴University of Cape Town, Cape Town, South Africa. Email: eduardofontes@gmail.com
(No relevant relationships reported)

Functional and structural changes in the brain have been associated with regular aerobic exercise and expertise in several sports. A variety of neuroimaging techniques have revealed changes in brain activation with increased exercise intensity; however, how expertise modulates neural activation is still unclear for some sports, like cycling. **PURPOSE:** Using an adapted cycling MRI ergometer, we compared the neural patterns of cycling experts and non-cyclists during cycling periods of different intensities. **METHODS:** 22 participants were divided into two groups: 12 healthy adults who performed physical activity 4-6 h/week and 10 trained cyclists (>2 yrs of training and competitive experience, cycling 4-6 days/week for ~60 min). The participants performed an incremental test on an adapted cycling MRI ergometer while whole-brain activity was recorded with functional MRI. Using a one-sample t-test (p<0.05 family-wise error corrected for multiple comparisons), we identified the positive (activation) and negative (inhibition) blood-oxygenation-level-dependent responses associated with all cycling intensities in each group. **RESULTS:** The analysis revealed that both cycling experts and novices activated the precentral gyrus, postcentral gyrus, paracentral lobule and medial frontal gyrus (ts>11.1), while the cerebellum and insular cortex were activated only in cyclists (ts>6.83). In addition, both groups had inhibition of prefrontal cortical areas (ts>7.44) during cycling, but the non-cyclists had larger areas of the prefrontal cortex inhibited (ts>7.52). **CONCLUSION:** Cycling expertise impacts the modulation of subcortical and prefrontal brain areas during cycling. We believe that these findings suggest that regular practice of cycling may enhance the neural regulation of cognitive, motor and homeostatic resources during exercise at different intensities, which may explain the higher performance of cycling athletes.



3420 Board #108 June 1 8:00 AM - 9:30 AM

Comparison of Maximal Aerobic Capacity Between the Treadmill and a Skiing Ergometer

Hannah Nelson, Andy Bosak, Madeline Phillips, Russell Lowell, Branden Ziebell, Moroni de Moors, Anna Blackley, Adriel Lau, Abraham Frech, Abby McCarty. *Liberty University, Lynchburg, VA.* (Sponsor: Dr. James Schoffstall, FACSM)
(No relevant relationships reported)

Cross-country skiing is known to be an extremely aerobically demanding sport. Therefore, the use of a skiing ergometer (ie. SkiErg) to replicate similar aerobic training is increasing in use in lab and fitness settings. The SkiErg is widely used in gyms, research laboratories, and rehabilitation centers, and provides a low impact and total body cardiovascular and muscular endurance workout. Technique for training on the SkiErg can be quickly learned and adapted for immediate use by most individuals. Because of its lower cost and minimal required floor space, this piece of fitness equipment can be used at almost any location for exercise and training. Due to the benefits, convenience, and accessibility, the SkiErg may be a viable alternative max or peak graded exercise test (GXT) mode. To the best of the researchers' knowledge, a comparison of aerobic capacity between a SkiErg and treadmill has not been assessed. **PURPOSE:** To compare treadmill (TM) VO₂max values vs. those elicited from a SkiErg (SE) GXT. **METHODS:** Descriptive data (HT. = 176.1 ± 8.2 cm, WT. = 80.5 ± 10.1 kg, BF% = 15.1 ± 5.8%, age = 22.7 ± 2.4 yrs) was measured for 21 averagely fit college-age males. In a counterbalanced order and separated by 72 hours

of rest, each subject completed 2 GXT protocols to the point of volitional exhaustion on a TM and SE. Max or peak values for VO₂, HR, VE, and RER were compared between TM and SE using a Paired-Samples t-Test with an alpha level at p ≤ 0.05. Peak RPE was compared using a Wilcoxon Signed Rank Test. **RESULTS:** TM was significantly greater than SE in regard to mean VO₂max (51.1 ± 5.0 vs 44.5 ± 3.8 ml/kg/min, p < 0.01), HR (191 ± 11 vs 186 ± 10 bpm, p < 0.01), and RPE (19.6 ± 2.2 vs 18.3 ± 1.6, p = 0.039). TM was not significantly greater than SE regarding RER (1.2 ± 0.0 vs 1.2 ± 0.1, p = 0.862) or VE (146.2 ± 16.5 vs 144.3 ± 21.5 L/min, p = 0.614). **CONCLUSIONS:** The TM appears to yield higher max values for VO₂, HR, RER, VE, and RPE values compared to SE in college-age males. Although TM elicited higher values than SE, SE VO₂peak was only 15% lower than values measured from TM. This percent difference is comparable to other currently accepted alternative forms of aerobic capacity testing such as leg and arm cycle ergometers. Future studies should assess how gender, protocol variations, SE technique, or various athletic populations may impact VO₂ values during a peak SE GXT.

3421 Board #109 June 1 8:00 AM - 9:30 AM

Short-Term Back Squat Protocol Effect on 5km Run Performance

Matthew Barenie¹, Jordan Domenick², George Schweitzer³, Jason Bennett⁴, Paulina Shetty⁵, Edward Weiss². ¹Indiana University, Bloomington, IN. ²Saint Louis University, St. Louis, MO. ³Washington University, St. Louis, MO. ⁴Carroll University, Waukesha, WI. ⁵Johnson County Community College, Overland Park, KS. Email: matbaren@iu.edu
(No relevant relationships reported)

Purpose: Previous research indicates conflicting data on concurrent training. For instance, high intensity strength training, an uncommon training method for runners, has the potential to be beneficial as studies show it allows for enhanced fatigue resistance during high intensity endurance performance. Conversely, some evidence suggests high intensity strength training is harmful for endurance running performance and may alter fuel substrate utilization. Therefore, this study sought to determine the effects of a short-term, high repetition back squat training protocol on 5km run performance as well as on carbohydrate and fat oxidation rates. **Methods:** Fifteen runners [4 men, 11 women; 150+ minutes of endurance exercise per week; age = 22 ± 5.1y; 20.4 ± 5.2 body mass index] completed two weeks of a high repetition back squat training protocol consisting of three sets of 15-24 repetitions at 60% of one-repetition max (1RM), three times per week. Pre- and post-tests included a 5km timed run on an outdoor track, respiratory exchange ratio (RER) through indirect calorimetry during two different intensities of steady-state treadmill exercise (60% and 70% heart rate max (HRmax)), and 1RM for back squats. **Results:** Back squat 1RM significantly increased by 15% with training (48.0±27.9 to 56.7±30 kg, P = <0.001). However, no statistically significant differences were found in 5km times adjusted for heat-stress of outdoor conditions (Pre: 21.6±8.3 vs. Post: 21.1±8.0 minutes, P = 0.20), which potentially had a significant confounding effect on post-training outcomes. RER at 60% HRmax (Pre: 0.81±0.04 vs. Post: 0.79±0.05, P = 0.45) and 70% HRmax (Pre: 0.84±0.04 vs. 0.85±0.04, P = 0.85) was unchanged. **Conclusions:** Performing a high repetition back squat protocol for two weeks does not appear to impact 5km running time or alter the body's fuel utilization during exercise but is an effective way to improve lower body strength. Further studies are necessary in a temperature-regulated testing environment to determine whether high repetition strength training alters 5km running performance and fuel utilization.

3422 Board #110 June 1 8:00 AM - 9:30 AM

Proximity To Failure And Repetitions Per Set Effect Rpe Accuracy In The Squat, Bench Press, And Deadlift

Nicholas M. Sautter¹, Colby A. Sousa¹, Daniel J. Belcher¹, Joseph P. Carzoli¹, Trevor K. Johnson¹, Rebecca M. Cerminaro¹, Eric R. Helms², Chun-Jung Huang, FACSM¹, Michael Whitehurst, FACSM¹, Michael C. Zourdos¹. ¹Florida Atlantic University, Boca Raton, FL. ²Auckland University of Technology, Auckland, New Zealand. Email: mzourdos@fau.edu
(No relevant relationships reported)

The repetitions in reserve (RIR)-based rating of perceived exertion (RPE) scale has gained significant popularity. Previous data has shown that intra-set RIR predictions become more accurate closer to failure. However, research has yet to examine this concept in the deadlift. **PURPOSE:** This investigation examined proximity to failure and total repetitions per set on intra-set RPE accuracy. **METHODS:** Ten males (age: 25.0±4.0yrs, body mass: 84.1±14.3kg, training age: 6.9±4.0yrs) performed 4 sets to failure at 80% of one-repetition maximum (1RM) on the squat, bench press, and deadlift in successive weeks; in a counterbalanced order. During all sets, subjects indicated when they believed to be at a 6 and 9RPE (i.e. 4 and 1RIR). The RIR difference (RIRDIFF) was calculated by subtracting the predicted number of

repetitions from the actual number of repetitions performed. Thus, if 10 repetitions were performed, but a 9RPE was called after 7 repetitions (predicting 8 repetitions), then the RIRDIFF would have equaled 2 (i.e. RIRDIFF=10-8). The RIRDIFF at the called 6 and 9RPE was analyzed with a paired t-test and Pearson's correlations were used to assess the relationship between repetitions per set and RIRDIFF; significance was set at $p \leq 0.05$. **RESULTS:** The RIRDIFF across all sets of all exercises and within each individual exercise was significantly lower ($p < 0.01$) at the called 9 vs. 6RPE. Across all squat sets the RIRDIFF at 6RPE was 1.00 ± 1.13 vs. 0.67 ± 0.69 at the called 9RPE ($p = 0.04$, effect size-ES=0.35). Bench press RIRDIFF across all sets was 0.84 ± 0.81 at the called 6 vs. 0.51 ± 0.58 at the called 9RPE ($p < 0.01$, ES=0.46). Additionally, deadlift had an RIRDIFF of 1.12 ± 1.05 at the called 6RPE vs. an RIRDIFF of 0.56 ± 0.70 at the called 9RPE ($p < 0.01$, ES=0.62). Total repetitions performed per set were significantly related to a higher RIRDIFF (i.e. more inaccurate RPE ratings) on squat at 6RPE ($r = 0.47$, $p < 0.01$), and bench at 6RPE ($r = 0.50$, $p < 0.01$) and bench at 9RPE ($r = 0.60$, $p < 0.01$). There was no relationship between repetitions performed and RIRDIFF at the squat called 9RPE or either called RPE on the deadlift ($p > 0.05$). **CONCLUSIONS:** These results suggest that intra-set RPE ratings are more accurate closer to failure on all three exercises and that more repetitions per set may lead to more inaccurate RIR predictions on the squat and bench press.

3423 Board #111 June 1 8:00 AM - 9:30 AM
Standardization of the Technique for a Medicine Ball Throw Test

Mark G. Cullum, Kenneth R. Turley, FACSM. *Harding University, Searcy, AR.* (Sponsor: Kenneth R. Turley, FACSM)
 Email: mcullum@harding.edu
 (No relevant relationships reported)

Muscular power is an essential component of numerous activities. Maximal throws are sometimes used to assess upper body power, but the angle of the throw, which could make an impact on the distance achieved, is typically either controlled with complicated methods or not controlled at all in the existing literature

PURPOSE: Establish consistent and simple procedures to control the effort of a medicine ball throw protocol and establish the reliability and norms for the test. **METHODS:** 124 males and 96 females sat on the floor with their back against a wall, knees bent, and feet flat on the ground. On the adjoining wall a sheet of paper displayed lines at a 45 degree angle. After a technician aligned the subject's outstretched arms with the lines on the sheet, subjects were told to find a point of reference that they were pointing at with their hands. They then held a 6-pound medicine ball at their sternum and were instructed to launch the ball directly at the spot selected. Hand chalk was applied to the ball to indicate the landing spot. After three light practice throws subjects performed a maximal effort three times, with the distance from the wall to the nearest point of the landing spot determined. On a separate occasion 38 subjects completed the protocol a second time to establish test-retest reliability.

RESULTS: Subjects found the process for launching the ball at the proper angle simple to follow. Paired T-test revealed no significant difference between the best throw and the average of the two best throws ($p < 0.01$). Interclass correlation revealed a high test-retest reliability for the procedure ($r = 0.98$). Maximal throw distance showed moderate to good correlation with both height ($r = 0.72$) and weight ($r = 0.63$). The median distance for males was 223.4 inches, with 25th and 75th percentile values of 199.6 and 245.4 inches, respectively. The median distance for females was 143.1 inches, with 25th and 75th percentile values of 128.4 and 154.6 inches, respectively. Relative to height and weight, males and females had median values of 3.22 and 2.21 inches per inch of height, respectively, and median values of 1.27 and 0.99 inches per pound, respectively.

CONCLUSIONS: The protocol demonstrates high reliability and provides a simple mechanism to assist subjects in achieving the desired angle of launch.

3424 Board #112 June 1 8:00 AM - 9:30 AM
Effects of an Acute Strength and Conditioning Training Session on Dual Energy X-ray Absorptiometry Results

Sean T. Stanelle, Jason R. Lytle, Steven E. Martin, John S. Green, FACSM, Stephen F. Crouse, FACSM. *Texas A&M University, College Station, TX.* (Sponsor: Stephen F. Crouse, FACSM)
 (No relevant relationships reported)

In the use of dual x-ray absorptiometry (DXA) scans to obtain reliable measures of body composition, athletic staff must be aware of acute factors that may alter scan estimates, such as hydration status. **PURPOSE:** The purpose of this study was to determine if a strength and conditioning (S&C) training session, based upon what athletes regularly engage in, will alter body composition estimates (lean mass, fat mass, and bone mineral content) of a DXA scan. **METHODS:** The S&C session lasted ~ 90 minutes and consisted of upper and lower body resistance exercises and interval running. Twenty-two strength-trained subjects (15 men, 7 women, age 24 ± 2 yrs, height 174.2 ± 8.5 cm, weight 83.5 ± 15.0 kg) volunteered to participate in the study.

Each subject completed two standard DXA scans on the same day, before and after the S&C session. Following the consumption of a free-living meal prior to the first scan, subjects avoided all food intake until completing the second scan. Throughout the S&C session, subjects were encouraged to drink water ad libitum. **RESULTS:** The results of this study were analyzed via correlated t-test ($p < 0.05$ considered significant) and significant values are listed in Table 1 below. **CONCLUSION:** The acute physiological effects of a S&C session alter body composition measures obtained by DXA scan. Thus, athletic staff should consider the timing of DXA scans in relation to S&C sessions.

TABLE 1.

	Total mass (kg)	Arms tissue (% fat)	Arms total mass (kg)	Arms lean mass (kg)	Legs tissue (% fat)	Legs lean mass (kg)	Trunk lean mass (kg)
PRE	83.8 ± 14.9	20.5 ± 9.0	10.8 ± 2.3	8.3 ± 2.2	23.2 ± 8.3	21.5 ± 5.1	28.7 ± 5.1
POST	83.5 ± 15.2*	19.9 ± 9.1*	11.0 ± 2.5*	8.5 ± 2.4*	22.6 ± 8.7*	21.8 ± 5.0*	28.2 ± 5.4*

*Significantly different from PRE ($P < 0.05$)

3425 Board #113 June 1 8:00 AM - 9:30 AM
Effects Of A Short-term Core Stability Exercise On Functional Movement And Balance

Jiyeon Kim, Joungbo Ko, Jongil Lim, Hyejung Choi, Kyoungho Seo, Sukho Lee. *TEXAS A&M- San Antonio, San Antonio, TX.*
 (No relevant relationships reported)

Recently, the importance of maintaining the alignment of the human muscles and managing the left and right symmetry has been widely recognized in fields that study pain medicine, physical therapy and exercise rehabilitation. As a result, core stability exercise has been spotlighting. **PURPOSE:** To investigate the effects of a short-term core stability exercise on functional movement and balance in subjects with mild lower-limb discomfort. **METHODS:** Twenty people with mild lower-limb discomfort were randomly assigned to a non-training control (CG, n=10) and core stability exercise training group (EG, n=10). While CG maintained their daily routine, EG completed twenty 30-min training sessions consisted of 10 modified mat pilates program exercises aimed at increasing core stability. Functional movement, dynamic balance, and discomfort level were assessed before and after twenty sessions of core stability training using functional movement test, balance test and visual analog scale (VAS), respectively. Two-way (group by time) repeated measures ANOVA's were performed for all dependent variables, and the significance for all statistical tests was set at $p < .05$. **RESULTS:** EG demonstrated a significant increase in functional movement indicated by increased hurdle step (CG; -4.7 vs. EG; 25%, $p = 0.024$, group × time effect) and shoulder mobility (CG; -13.04 vs. EG; 5%, $p = 0.037$, group × time effect). The dynamic balance score was significantly improved only in EG for both limbs (right: EG = 7.7%, $p = 0.007$; left: EG = 8.10%, $p = 0.011$, time effect). A significant reduction of VAS score in ankle was exhibited in EG (EG; -74.76%, $p = 0.024$, time effect). **CONCLUSION:** This study highlights that twenty sessions of short-term core stability exercise can positively affect the lower limb's functional movement and balance ability in people with mild lower-limb discomfort.

3426 Board #114 June 1 8:00 AM - 9:30 AM
Validity And Reliability Of The Computrainer® During 40 km And 100 km Time-trials

David Jeker, Eric DB Goulet, Jonathan Gosselin, Jean M. Drouet, Jeff Béliveau. *University of Sherbrooke, Sherbrooke, QC, Canada.*
 Email: david.jeker@usherbrooke.ca
 (No relevant relationships reported)

The ecological validity of findings can substantially be improved when laboratory-based research studies use experimental designs attempting to emulate real-world exercise conditions. The exercise science literature contains ample of research that looked at the impact of various interventions using running and cycling time-trial (TT) protocols. Regarding cycling TT performances, the Computrainer® (CT), an electromagnetically brake bike trainer applying resistance to the rear wheel of a standard bike, has been extensively used for over a decade. Yet, it is unknown whether the CT provides valid and reliable power output data under TT conditions. **PURPOSE:** Determine the validity and reliability of two CTs during 40 km and 100 km TTs. **METHODS:** Power output data of two CT Lab® were compared against those of a calibration rig (Drouet, J.M. et al. Sports Eng. 2008. 15-22.) connected to left side of the crank axle of a road bike with a driving shaft, allowing direct measurement of the true workloads generated by both CTs. The measurement process consisted of comparing the power delivered by the calibration rig to the power displayed by the CTs. Power uncertainty delivered by the calibration rig is $\pm 0.9\%$. Each TT was performed under standardized conditions on two occasions with both CTs®. TTs were completed on a flat course and designed upon previously published results in elite/highly-trained cyclists. **RESULTS:** Mean power outputs generated by the two CTs for the 40 km and 100 km TTs were respectively of 359 ± 38 and 282 ± 56 watts. Mean biases between the CT 1 and the rig for the 40 km TTs varied from -0.8 to -0.7%, and between the CT 2 and the rig for the same distance from -2.7 to 3.6%. For the 100 km TTs, biases between the CT 1 and the rig ranged from -1.4 to -0.4%, whereas for the

CT 2 from -5.9 to -3.4%. For repeated trials, biases within 40 and 100 km TTs for CT 1 were < 1% whereas, for CT 2, bias was also < 1% for the 40 km TTs, but reached 2.5% for the 100 km TTs. **CONCLUSIONS:** Our results indicate that accuracy differs between CTs during 40 and 100 km TTs, suggesting that CTs should not be used interchangeably. Both CTs were shown to provide repeatable data for the 40 km TTs. Whereas for one CT this was also the case for the 100 km TT, for the other CT it was observed that the rig had to produce less torque on one of the two trials to keep the power output generated by CT constant.

3427 Board #115 June 1 8:00 AM - 9:30 AM
Exercise and Non-Exercise Methods for Determining Cardiorespiratory Fitness

Kelley Phillips, Elizabeth Yost, Amelia Wagenknecht, Sarah Heesacker. *University of Minnesota Duluth, Duluth, MN.*
 (Sponsor: Charles Fountaine, FACSM)
 (No relevant relationships reported)

Cardiorespiratory fitness (CRF) is a criterion measure expressed as maximal volume of oxygen consumption per unit of time (VO_{2max}). The criterion measure is closely related to functional capacity of the heart. Functional capacity of the heart has direct ties to risks associated with cardiovascular disease and cardiac mortality. CRF is traditionally measured using exercise protocols. Exercise protocols can be contraindicated for clinical high-risk populations. Instances where exercise tests are contraindicated, prediction equations have been useful to estimate CRF. **PURPOSE:** The purpose of this study was to determine the validity between a treadmill exercise test and a prediction equation to determine CRF level.

METHODS: Participants (N=25) were collegiate level students who were recreationally active and met physical activity standards. CRF was assessed using two methods, a Bruce treadmill test (BTT) and the World Fitness Level (WFL) prediction equation. The prediction equation used to estimate VO_{2max} uses age, body mass index (BMI), resting heart rate (RHR), physical activity index (PA-I) and is specific to gender. Women: $70.77 - (0.244 \cdot \text{age}) - (0.749 \cdot \text{BMI}) - (0.107 \cdot \text{RHR}) + (0.213 \cdot \text{PAI})$
 Men: $92.05 - (0.327 \cdot \text{age}) - (0.933 \cdot \text{BMI}) - (0.167 \cdot \text{RHR}) + (0.257 \cdot \text{PA-I})$. Participants completed the BTT on a separate day as the WFL questionnaire. Participants were asked to complete the BTT to volitional fatigue. Heart rate, blood pressure, and VO_{2max} were recorded. Pearson product-moment correlations, mean average percentage error (MAPE), and 95% limits of agreement were performed to assess validity.

RESULTS: The correlation between the treadmill test and questionnaire was moderate ($r = 0.75$, $r^2 = 0.56$), whereas the observed MAPE values were large (18%). The 95% limits of agreement for the mean difference between the treadmill test and questionnaire were poor (-18.94 mL · kg⁻¹ · min⁻¹ to 10.99 mL · kg⁻¹ · min⁻¹).

CONCLUSIONS: The results would suggest the WFL prediction equation is not a valid predictor for CRF. It is important to consider that the PA-I is subjective and may not accurately represent the true physical activity levels of the participants in this study.

3428 Board #116 June 1 8:00 AM - 9:30 AM
The Relative Intensity of Split Squat Exercise Performed on Stable vs Unstable Surfaces

Abigail LeBlanc, John Wygand, FACSM, John Petruzzo, Michele Aquino, Abigail LeBlanc. *Adelphi University, Garden City, NY.*
 (Sponsor: Robert M. Otto, FACSM)
 Email: abigailleblanc@mail.adelphi.edu
 (No relevant relationships reported)

The intensity of exercise may vary relative to the stability of the surface the exercise is performed on. There is limited data in regards to suspension training and whether it can modify the intensity of a resistance training session. Motor unit activation can be inferred through surface electromyography, therefore the recorded activity can translate to the relative intensity of a specific exercise. **Purpose:** The purpose of this study is to determine the magnitude of motor unit activation while performing a split squat on a stable surface (SS), and on an unstable surface (US) (suspension cables). **Methods:** 18 subjects (age 19 ± 3.7 y/o, height 166.7 ± 20.1 cm, weight 71.4 ± 11.0 kg, 9 ♀) volunteered to participate in a randomized cross over study. EMG electrodes were placed on four primary muscles (bicep femoris [BF], gluteus maximus [GM], rectus abdominis [RA], rectus femoris [RF]) involved in the split squat. Each participant was familiarized with the correct biomechanical movement of the split squat. All trials required the rear foot elevated 40.6 cm above the floor. Both SS and US trials were conducted with no external load present and required the subject to perform 5 correct repetitions at a 3-1-3 cadence. **Results:** EMG peak millivolts for the RF was 1.41 ± 0.27 & 1.45 ± 0.53, BF was 0.77 ± 0.52 & 0.22 ± 0.35, GM was 0.75 ± 0.28 & 0.96 ± 0.48, and RA was 0.19 ± 0.21 & 0.22 ± 0.11 for SS and US, respectively. Paired T test revealed a significant difference (p<.05) only for the GM trials. **Conclusion:** Although suspension training may create a new challenge while exercising, increased motor unit activation on the unstable surface may be limited to select muscles. Unstable surface training does not appear to increase the overall muscle activation for this given activity.

3429 Board #117 June 1 8:00 AM - 9:30 AM
Reliability of Single Limb Squat and Lateral Step Down Assessment in Novice and Expert Clinicians

Esther Kim¹, Richard A. Brindle², Clare E. Milner, FACSM¹.
¹Drexel University, Philadelphia, PA. ²High Point University, High Point, NC. (Sponsor: Clare Milner, FACSM)
 (No relevant relationships reported)

The single limb squat (SLS) and lateral step down (LSD) are common lower extremity tests used to assess gross lower extremity strength and motor control. **PURPOSE:** To compare intra-rater reliability of lower extremity tests between novice and expert clinicians between sessions. **METHODS:** Six licensed physical therapists (3 “novice” and 3 “expert”) rated 20 frontal plane video recordings of healthy adults who participated in a previous study performing the SLS and LSD. The sample size required to find a kappa of at least 0.50 with a 95% confidence interval of ±0.40 was estimated to be 18. Novice physical therapists were operationally defined as those within 3 years of initial licensure. Expert physical therapists were licensed for at least 10 years and held a board certification in either orthopedics or sports. Prior to data collection, clinicians practiced rating the SLS and LSD on a separate set of recordings. Kappa statistics were calculated based on previous reported formula and interpreted using a standard index. If bias or prevalence indices were above 0.5, the prevalence-adjusted bias-adjusted kappa (PABAK) was calculated. **RESULTS:** For the SLS, intra-rater reliability of all raters, except one, had moderate reliability or better. For the LSD, most raters had substantial reliability except for two raters, one novice and one expert, who had fair and moderate reliability, respectively. **CONCLUSIONS:** Our findings suggest using the SLS to assess lower limb strength and control given its higher reliability in novice and experts. The SLS rating was based on knee movement, while LSD was based on trunk, arm, pelvis, knee, and foot. The higher reliability on SLS than LSD may be due to evaluating only one component rather than several simultaneously.

Table 1: Intra-rater reliability of single leg squat and lateral step down test performance by novice and expert raters; kappa (95% confidence interval)

	Novice Clinicians			Expert Clinicians		
	1	2	3	4	5	6
Single Leg Squat (κ)	0.71 (0.40 -1)	0.79 (0.52 -1)	0.60 (0.25- 0.95)	0.89 (0.69 -1)	0.49 (0.10- 0.88)	0.90 (0.71 -1)
Lateral Step Down (PABAK)	0.70 (0.39 -1)	0.50 (0.12- 0.88)	0.70 (0.39 -1)	0.70 (0.39 -1)	0.70 (0.39 -1)	0.30 (-0.12- 0.72)

κ = unadjusted kappa; PABAK = prevalence-adjusted bias-adjusted kappa

3430 Board #118 June 1 8:00 AM - 9:30 AM
Correlation Of Functional Movement Screen (FMS) And Mobility, Activation, Posture, And Symmetry (MAPS) Among Older Adults

Christina M. Pierle¹, Nathan Futrell², Ann T. Shields¹, Haley O. Norris¹, Bailey E. Hester¹, Tiago V. Barreira³, Wayland Tseh¹.
¹University of North Carolina Wilmington, Wilmington, NC.
²Liberty Senior Living Management Services, Wilmington, NC.
³Syracuse University, Syracuse, NY. (Sponsor: Dr. Robert Boyce, FACSM)
 (No relevant relationships reported)

PURPOSES: 1) To determine the relationship between Functional Movement Screen (FMS) and Mobility, Activation, Posture, Symmetry (MAPS) within an older adult population, 2) to identify the number of “declined attempts” among the 7 FMS tests, and 3) to determine if there was a relationship between the FMS Deep Squat test scores and MAPS scores. **METHODS:** Informed consent was received from 97 volunteers between the ages of 69-95 years of age (65 females; 32 males; Age = 81.9 ± 5.8 yrs; Height = 165.9 ± 10.4 cm; Body Mass = 74.2 ± 15.0 kg) who were asked to complete the FMS and MAPS. Spearman correlation was run to determine the relationship between FMS and MAPS. The frequency of “declined attempts” was quantified for each of the 7 FMS tests. One-Way ANOVA was used to investigate the relationship between FMS Deep Squat and MAPS scores due to the categorical nature of the Deep Squat scores. **RESULTS:** Data revealed a significant but low-to-moderate correlation between FMS and MAPS (r=0.46). On average, there were 7 “declined attempts” per FMS test. Hurdle Step and Active Straight Leg Raise had the lowest “declined attempts” with 0, whereas Trunk Stability Push Up had the highest “declined attempts” with 17. One-Way ANOVA results showed a significant difference between groups (p < .001). Participants that scored a 2 on the Deep Squat had higher average MAPS scores compared to participants that scored 0 or 1 (p < .001). Participants that scored 1 on the Deep Squat had higher average MAPS scores than participants who scored 0 (p = .011). **CONCLUSIONS:** Of the 97 participants, as many as 18% declined

to attempt at least one of the 7 FMS tests, whereas all participants completed the MAPS assessment. A higher score on the FMS Deep Squat was related to a higher score on MAPS; however, given the 21% common variance, FMS and MAPS are not interchangeable. From a practical perspective, one cannot replace the other when assessing movement in older adults.

3431 Board #119 June 1 8:00 AM - 9:30 AM
Impact of Short Cranks on 3-Min All-Out Cycling Test and Critical Power Metrics

Boe M. Burrus¹, Jessie Armendariz², Brian M. Moscicki³.
¹Gonzaga University, Spokane, WA. ²Humboldt State University, Arcata, CA. ³Indiana University, Bloomington, IN. (Sponsor: Dr. Vincent Paolone, FACSM)
 Email: burrus@gonzaga.edu
 (No relevant relationships reported)

The 3-minute all-out cycling test (3MT) is a valid, practical, and time effective method for determining Critical Power (CP) and intensities used in training and competition for cyclists. Changing the crank length (CL) on a bicycle may affect an individual's ability to produce and/or maintain power output while cycling. A change in CP due to CL differences would lead to a change in the ability of the cyclist to maintain power output. **PURPOSE:** To determine the impact of short crank arms on the metrics of the 3MT. **METHODS:** A total of 9 recreationally trained male cyclists (27.6 ± 7.5 yrs.) participated in the study. Subjects completed an incremental cycle test to determine $\dot{V}O_{2peak}$ (57.4 ± 6.4 ml/kg/min; 366 ± 47 W) and gas exchange threshold (276 ± 59 W) to calculate the resistance for the 3MT. Session two consisted of a familiarization trial of the 3MT. For sessions three and four, subjects completed the 3MT using CLs of 145 (short crank, SC) and 175mm (normal crank, NC). CL was determined in a randomized counterbalanced format. T-tests were utilized to determine differences between outcome variables of the 3MT. **RESULTS:** Peak power and peak cadence were significantly higher in the SC trial compared to the NC trial (SC 531 ± 116 vs NC 496 ± 113 W, $p = 0.00$; SC 168.9 ± 9.2 vs NC 157.6 ± 8.9 RPM, $p = 0.00$). The mean cadence over the last 30 sec of the 3MT did not differ between CLs (SC 93.4 ± 13.9 vs NC 93.0 ± 13.0 RPM, $p = 0.79$), but the average pedal speed over the same 30 sec was significantly slower in the SC trial compared to the NC trial (SC 1.41 ± 0.21 vs NC 1.70 ± 0.23 m/s, $p = 0.00$). CP (SC 287 ± 41 vs NC 287 ± 46 W, $p = 0.97$) and work above end power (WEP) (SC 12.2 ± 4.0 vs NC 11.4 ± 3.4 kJ, $p = 0.08$) were not significantly different between CL trials. **CONCLUSION:** CP was not different in the current study and demonstrated that changing CL by as much 30mm may not be a major factor in maintaining submaximal power output when position on the bike is maintained between CLs. However, individual differences among the subjects reveal changing CL could affect CP by up to 20 watts; some individuals performed better with 175mm while others performed better with 145mm. Cyclists should begin testing CLs to determine if a CL outside of the typically prescribed norms of within 2.5mm of 172.5mm could possibly benefit their performance and comfort while cycling.

3432 Board #120 June 1 8:00 AM - 9:30 AM
Correlation Of Functional Movement Screen (FMS) And Mobility, Activation, Posture, Symmetry (MAPS) Among College Students

Annie G. Shirk, Michel J.H. Heijnen, Ann T. Shields, Minda Harvey, Cody Leviner, Sarah Noland, Jeremy Grissett, Brad Hollingsworth, Cameron Fitch, Brianna Auer, Emma Baer, Cassandra Berger, Victoria Grande, Laurel K. Koontz, Cassidy J. Smith, Morgan Sanderson, Brittni Moskus, Rebecca Edwards, Jeffrey Welch, Kennedie Pate, Sierra McCoy, Sarah Cox, Michaela Tran, Claire Campbell, Wayland Tseh. *University of North Carolina Wilmington, Wilmington, NC.* (Sponsor: Dr. Robert Boyce, FACSM)
 (No relevant relationships reported)

INTRODUCTION: Despite the growing popularity of functional assessment and corrective exercise prescription, there is limited research evaluating the correlation between two functional movement assessments: the Functional Movement Screen (FMS) and the Movement, Activation, Posture and Symmetry (MAPS). FMS is a commonly-used tool that takes approximately 20-25 minutes for a trained technician to subjectively score participants on 7 movements. MAPS is a novel assessment tool that takes about 45-60 seconds for a computer-based system to objectively score participants completing 1 movement. **PURPOSE:** To evaluate the relationship between FMS and MAPS among an apparently healthy, young adult population. **METHODS:** Two hundred and nineteen participants (140 Females; 79 Males; Age = 19.5 ± 1.7 yrs; Height = 169.4 ± 10.1 cm; Body Mass = 68.5 ± 15.5 kg) completed FMS and MAPS within a single testing session. Pearson's correlation coefficients were used to determine the relationship between FMS and MAPS, as well as FMS and the four individual MAPS components. **RESULTS:** A weak correlation was observed between FMS and MAPS ($r = 0.25$, $p < 0.001$). Furthermore, all individual MAPS components demonstrated a negligible to weak relationship with FMS ($r = 0.29$,

0.11, 0.12, and 0.06 for Mobility, Activation, Posture, and Symmetry, respectively). **CONCLUSION:** These findings suggest that FMS and MAPS are relatively independent of one another. From an applied perspective, one cannot replace the other in terms of evaluation. Future research will have to examine the value of MAPS as a tool to monitor improvements during exercise interventions.

3433 Board #121 June 1 8:00 AM - 9:30 AM
Agreement And Reliability Between Powertap™ Power Measurement Pedals And Velotron™ Load Generator Ergometer

Frank Plonka, Brandon Bastianelli, Andrea Workman, Stephen McGregor. *Eastern Michigan University, Ypsilanti, MI.*
 (No relevant relationships reported)

Title: Agreement and reliability between PowerTap™ power measurement pedals and Velotron™ load generator ergometer
Author Block: Frank Plonka, Brandon Bastianelli, Andrea Workman, Stephen McGregor. Eastern Michigan University, Ypsilanti, MI.
Abstract: The PowerTap P1 pedal based power meter allows for measurement of power at the pedal/rider interface independent of crank or hub. This allows for the use of the measurement of power at the pedal to examine putative effects of changes in components such as the crank. The Velotron cycle ergometer is an extensively used ergometer for laboratory testing.
Purpose: To test the agreement between a portable pedal power measurement system (PowerTap; PT, Saris, WI) and Velotron (VCE, Racermate, WA) stationary ergometer. Additionally, to determine the test-retest reliability of PT relative to VCE.
Methods: 16 trained cyclists and/or triathletes consented to procedures approved by the EMU-HRSC, which consisted of three visits. For visit 1, subjects completed an incremental trial on VCE and using indirect calorimetry (Parvomedics, CO) to determine power and ventilatory threshold (pVT) and $\dot{V}O_{2MAX}$. During visits 2 and 3, subjects warmed-up on VCE and then completed twelve, six-minute stages which consisted of pedaling at a given cadence while maintaining a power output equivalent to 70, 80, or 90 percent of pVT. The six min stages were randomized, power was measured at the pedal (PT), and the load applied by VCE. Linear regressions to determine agreement across power and intraclass correlations to determine reliability were performed using SPSS 24.0 (IBM, IL) with an alpha = 0.05.
Results: Across all absolute VCE power (125-305 watts), linear regression showed strong agreement ($r^2 = 0.94$; $p < 0.001$) between VCE and PT. Intraclass correlations showed strong agreement between tests ($r = 0.983$; $p < 0.001$). Overall, the ratio of PT/VCE was 0.98 and 0.97 and coefficients of variation were 5.6% and 4.1% for visits 2 and 3, respectively.
Conclusion: These results indicate that the PowerTap P1 power measurement pedal agrees strongly with the Velotron cycle ergometer and is reliable from a test-retest perspective. Therefore, a PowerTap pedal system can be used to evaluate the effects of component changes with the use of a Velotron ergometer.

3434 Board #122 June 1 8:00 AM - 9:30 AM
Novel Crank with Elastomer Spring Improves Effective Power in Trained Cyclists and Triathletes

Brandon M. Bastianelli, Andrea Workman, Stephen McGregor. *Eastern Michigan University, Ypsilanti, MI.* (Sponsor: Dr. Mark Peterson, FACSM)
 Email: bbastian@emich.edu
 (No relevant relationships reported)

Purpose Test claims a novel cycling crank (IMPACT, Huron Cycling, LLC) may increase effective cycling power. The crank incorporates an elastomer spring and is purported to return energy during the "dead spot" of the pedal revolution, thus improving the net transfer of external power.
Methods 15 trained cyclists/triathletes (38 ± 7 y, 74.5 ± 9.9 kg, 174.7 ± 6.6 cm) consented to procedures approved by the EMU-HRSC. The study consisted of three visits. During V1, subjects performed a graded exercise protocol on a Velotron (Racermate, WA) cycle ergometer (VCE) to determine ventilatory threshold (VT) (Parvomedics, CO) and power at VT (pVT). During V2 and V3, subjects warmed-up on VCE then completed twelve, six-minute stages which consisted of pedaling at a 85 rpm while maintaining a power output equivalent to 70, 80, or 90 % of pVT. Additionally, a cadence effect was tested at 80% pVT at 75, 85 or 95 rpm. The six stages were randomized, and each stage was completed twice; i) with a pin in the crank (CON),

and ii) without the pin (EXP). The pin eliminated the spring effect of the elastomer, thus making a traditional rigid crank. There was a minute rest between each stage, except when changing from EXP to CON (3 minutes) to change the pin and allow subject to drink. The VCE was used as the external load generator and power was also measured at the pedals (PowerTap P1, WI; PT) to determine if any difference in power between external load and power necessary to turn the cranks against the load was present. MANOVA statistical tests compared %pVT between PT and VCE and VO₂ in both EXP and CON ($\alpha=.05$).

Results

Across all conditions, there was a Large effect for EXP power being 1.3 % lower than CON ($p=.008$; $\eta^2=.028$). Although not significant, there were small effects for cadence at 80% pVT, where EXP was lower than CON, but to a greater extent at 85 and 95 than 75 rpm (77.7+ 2.8, 77.1+3.6 and 78.5+4.2 %, respectively, $\eta^2=.019$). There was no significant difference between VO₂ at each workload when expressed as a percentage of VT between EXP and CON. There were no significant differences by trial for any variables tested.

Conclusion

Lower power, but similar VO₂ during EXP compared to CON supports the notion that the IMPACT crank improves effective power during cycling. Although small in magnitude, the effect was large and could be of interest to competitive cyclists or triathletes.

**3435 Board #123 June 1 8:00 AM - 9:30 AM
A New Equation to Estimate VO_{2max} for a Racquet Sport Modality**

Jesus Barrera-Exposito¹, Elvis Alvarez Carnero². ¹Virgen de la Victoria-Martiricos Institute, Málaga, Spain. ²Florida Hospital. Translational Research Institute, Orlando, FL.

Email: jesusbarreraexposito@gmail.com

(No relevant relationships reported)

The 'padel' is a relatively new racquet modality (less than 30-year-old in USA) played in a 20x10 meters enclosed court. There is little information about its metabolic characteristics, and a lack of tests to estimate physiological performance on the field. The goal of this study was to describe body composition and aerobic capacity of amateur padel players; additionally, we aimed to develop an equation to estimate aerobic capacity (VO_{2max}) on padel players. **Methods:** Thirty-three male padel players with a valid direct VO_{2max} test were included in this analysis (36.4±5.9 years; BMI, 24.5±2.1 kg/m²; %fat mass (%FM), 20.5±5.7%). Body composition (lean mass and %FM) was measured by DXA; appendicular lean tissue was used to derive skeletal muscle mass (SMM). A specific progressive shuttle-run test was created to measure VO_{2max} inside the padel court; briefly, each player needed to run from one wall to the other wall of the court grasping his racquet, pace feedback was provided by a digital audio system, starting at 8.5 km/h the speed increased 0.5 km/h. VO_{2max}, anaerobic threshold (AT) and heart rate (HR) was directly measured by a portable indirect calorimeter over the all-out test. Stepwise multiple regression analysis was utilized to derive an equation to estimate VO_{2max}. The concordance coefficient correlation (ρ_c) was used to assess the accuracy of the equation. **Results:** Body composition and metabolic exercise variables are shown in table 1.

Table 1. Physiological characteristics of amateur padel players.

Variables		Mean	SD
Age	(years)	36.4	± 5.9
Lean	(kg)	61.5	± 5.7
SMM	(kg)	33.0	± 3.4
HR _{max}	(beats/min)	179	± 9
VO _{2max}	(l/min)	3.822	± 0.611
VO _{2max}	(ml/kg/min)	48.8	± 6.4
VO _{2max}	(ml/kg _{lean} /min)	62.7	± 6.3
AT	(ml/kg/min)	33.2	± 6.2
%AT	(%)	68.3	± 11.0
HR _{AT}	(beats/min)	134	± 21.8

SD, standard deviation; AT, %AT and HR_{AT} indicate oxygen uptake, % of VO_{2max} and HR at anaerobic threshold, respectively.

SMM and number of stages were the main predictors of absolute VO_{2max} ($R^2 = 0.72$, $P<0.001$); the equation was $VO_{2max} (L/min) = -0.00195 + 0.148 \times SMM (kg) - Stage (number)$. The ρ_c between measured and estimated VO_{2max} was moderately high ($\rho_c=0.807$). **Conclusions:** We have provided references for body composition and maximal aerobic capacity variables in amateur padel players and a new equation to estimated aerobic capacity from a specific test for the sport of padel. Larger and more heterogeneous datasets are necessary to validate these results.

**3436 Board #124 June 1 8:00 AM - 9:30 AM
Dual Stress Warm-Up Protocol Does Not Significantly Improve Anaerobic Performance**

Matthew P. Sacco¹, Margaret M. Glick¹, Eric C. Bredahl¹, Michael T. Lane², Jacob A. Siedlik¹. ¹Creighton University, Omaha, NE. ²Eastern Kentucky University, Richmond, KY.

(Sponsor: Joan Eckerson, FACSMS)

(No relevant relationships reported)

Dual stress challenges (e.g. paired physical and psychological challenges) have been shown to increase sympathetic activity above that of exercise alone. Although the rise in sympathetic activity represents a maladaptive increase in physiological load, there is a possibility that a dual stress challenge in a warm-up setting may optimize sympathetic activation while minimizing peripheral fatigue. **PURPOSE:** To determine whether a dual stress warm-up protocol improves performance on the 30 s Wingate Anaerobic Test (WAnT). **METHODS:** Thirteen college-aged subjects (Mean ± SD; age = 21 ± 3 yr; Height = 177 ± 9 cm; Weight = 81.8 ± 11.8 kg) volunteered to participate and completed a familiarization WAnT on a Monark cycle ergometer using a resistance of 7.5% bodyweight prior to testing. On two separate visits, separated by at least 3 d but no more than 1 wk, subjects randomly completed a WAnT preceded by either a 5 min warm-up at a resistance of 1.5% BW at a pedal rate of 70-80 rpm (CTRL) or the same warm-up while also completing the Paced Auditory Serial Test, which is a mental arithmetic challenge (EXPT). Zephyr Bioharnesses were used to record heart rate (HR) during the testing sessions. Difference in HR during the warm-up, and WAnT peak power, average power, and power drop were investigated using paired samples *t*-tests. **RESULTS:** There were no significant differences in performance or HR response during the warm-up between the CTRL and EXPT. **CONCLUSION:** These finding suggest that the addition of a mental task during a warm-up on a cycle ergometer has no effect on sympathetic activity or performance during a 30 s WAnT. The lack of significant findings may be due to the small sample size. Future work should focus on more challenging psychological stressors in conjunction with warm-up protocols to determine whether dual stress challenges can be utilized to optimize performance.

**3437 Board #125 June 1 8:00 AM - 9:30 AM
Vertical Jump Versus Kinematic Sequencing: Advanced Technology Doesn't Always Enhance Appraisal**

Margaret E. Bristow, Nathaniel J. Holmgren, J. Mark VanNess, Brian G. Graham, Joey Rossi, Courtney D. Jensen. University of the Pacific, Stockton, CA.

Email: m_bristow@u.pacific.edu

(No relevant relationships reported)

In an age when science informs sport, new technology for athlete appraisal is often adopted before it is tested. Sparta kinematic sequencing (Sparta Science Corp.) is an instrument for player assessment that's employment has outpaced its examination. **PURPOSE:** To evaluate the effectiveness of Sparta data in predicting basketball performance. **METHODS:** We analyzed 37 basketball players from a D1 collegiate basketball program over a 4-year period (2013-2014 through 2016-2017). Each player's vertical jump (VJ) was measured and tested on a Sparta force plate, which provides 3 proprietary outputs: Load, Explode, and Drive. On average, each player was tested 24.9 ± 20.3 times; there were 922 total observations evenly distributed over the 4 years and over year in school. The Sparta outputs were used to predict on-court performance of each athlete during each season that the values were collected via multiple linear regression analyses. The dependent variables were in-game statistics per 40 minutes of court time: points, rebounds, assists, blocks, and turnovers. **RESULTS:** Athletes played 19.3 ± 12.7 games per year. On average, they scored 12.8 ± 4.4 points, had 6.6 ± 2.7 rebounds, and turned the ball over 2.4 ± 1.0 times. Regression analyses found no significance with Load, Explode, or Drive in points per game, field goals per game, or assists per game. In each analysis all 3 Sparta outputs had negative associations that didn't reach significance while VJ had a positive association that failed to reach significance. Load predicted rebounds per game ($\beta=0.18$; $p<0.001$) and blocked shots per game ($\beta=0.03$; $p=0.021$). Explode and Drive had non-significant negative relationships and VJ had a non-significant positive relationship. Explode ($\beta=0.31$; $p=0.017$) and Drive ($\beta=0.304$; $p=0.011$) predicted more turnovers per game, VJ predicted fewer ($\beta=-0.982$; $p=0.020$), and Load had a non-significant positive association. Without controlling for the full Sparta profile, Explode associated with fewer rebounds ($p<0.001$) and more turnovers ($p=0.020$); it had no association with improvements in performance. **CONCLUSION:** Athletic programs are often quick to incorporate new technology believing that it equates to improved player assessment. More analyses are required before simple jumping analyses can be displaced by sophisticated equipment.

3438 Board #126 June 1 8:00 AM - 9:30 AM
Differences In Performance Traits In Intermittent Versus Continuous Exercise Testing Of Handball Players and Triathletes

Björn Sterzing, Tobias Ehlert, Sarah Breitbach, Perikles Simon. *Johannes Gutenberg University, Mainz, Germany.*
 Email: sterzing@uni-mainz.de
 (No relevant relationships reported)

External validity of endurance performance diagnostics may depend on type of sports. In order to reflect different load quality for the muscle specific endurance testing regimes have been developed for intermittent sports. Here we examined the influence of an intermittent versus a typical continuous step-wise progressive treadmill protocol on metabolic and cardiorespiratory parameters. **PURPOSE:** To determine if handball players (HB) in comparison to triathletes (T) show differences in typical submaximal lactate thresholds (LT and LT + 1.5 mmol), or in VO₂max depending on either continuous or intermittent type of a step-wise progressive exercise testing. **METHODS:** 13 HB and 13 T; mean (SD) age 24.7 (3.1 yrs) height 184.2 (7.2 cm), weight 82.7 (10.8 kg) with a training load of 6.8 (3.1) h/wk in HB versus 8.8 (3.3) h/wk in T. Each subject performed two treadmill protocols within one week. First a typical step-wise incremental treadmill test (CTT) starting at 6 km/h increasing every 3 min by 2 km/h until exhaustion. Second a step-wise incremental intermittent test (IMT) with steps split into 6x15s load phase interlaced with 6x15s active recovery. Load phase started at 8km/h and was increased every 3 min by 2 km/h, while active recovery remained at 6 km/h throughout all steps until exhaustion. VO₂max, velocity at LT, velocity at LT + 1.5 mmol/l lactate (LAT). **RESULTS:** VO₂max in ml/min/kg was not significantly different between sports and testing protocols (all 4 groups) with CTT for HB 50.5 (4.7) and T 53.2 (3.5), or with IMT 50.1 (3.7) in HB and 51.2 (4.2) for T. Velocity in km/h at LAT was not significantly different between all groups with CTT for HB 11.9 (0.8) and 12.4 (1.3) for T, or with IMT 11.2 (0.4) for HB and 11.5 (0.7) for T. For the LT in km/h we revealed in an analysis of co-variance a slightly significantly higher velocity of $\Delta V = 0.74$ km/h (95% CI = 0.03-1.45, $p < 0.04$) in T than in HB in CTT. **CONCLUSIONS:** We recruited a collective of HB and T with an almost comparable weekly training load. HB and T showed comparable typical performance trait characteristics for the higher work-load demand (VO₂max and LAT), which was even independent of type of test. The slightly better performance of T in specifically the continuous test setting principally reflects higher load and potentially a better adaptation to this type of working demand.

3439 Board #127 June 1 8:00 AM - 9:30 AM
A Comparison of Techniques for Estimating and Detecting Changes in Skeletal Muscle Cross-Sectional Area

Johnathon H. Moore¹, Cody T. Haun², Emily L. Grandprey³, Katelyn P. Joubert³, Christopher G. Vann¹, Paul A. Roberson¹, Petey W. Mumford¹, Matthew A. Romero¹, Shelby C. Osburn¹, C Brooks Mobely¹, Jordan R. Moon⁴, Michael D. Roberts⁵, Kaelin C. Young⁵. ¹Auburn University, Auburn, AL. ²LaGrange College, LaGrange, GA. ³Edward Via College of Osteopathic Medicine-Auburn Campus, Auburn, AL. ⁴ImpediMed, Inc., Carlsbad, CA. ⁵Auburn University, Edward Via College of Osteopathic Medicine-Auburn Campus, Auburn, AL.
 (No relevant relationships reported)

Muscle biopsy and subsequent histological analysis of muscle fibers is a criterion technique for determining hypertrophy of skeletal muscle in resistance- and endurance-trained individuals. However, due to the training necessary to complete the biopsy, and the invasive nature of the biopsy itself, alternative methods for depicting muscle fiber hypertrophy offer increased ability to gather data discerning skeletal muscle hypertrophy. Furthermore, such procedures require less training and are noninvasive. **PURPOSE:** This project sought to determine if estimated mid-thigh whole muscle cross-sectional area (CSA) is related to muscle fiber CSA from muscle biopsies. **METHODS:** Twenty-nine resistance-trained men (age: 21 ± 2 yrs, weight: 83.6 ± 11.0 kg, height: 178.7 ± 8.1 cm) underwent six weeks of total-body resistance training. Muscle biopsies were taken from the Vastus lateralis prior to and following training. Mid-thigh circumference and skinfold measurements (anterior, posterior, medial, and lateral) were used to estimate whole muscle mid-thigh cross-sectional area using the methods of Moritani and deVries. **RESULTS:** Whole-muscle CSA did not significantly increase from pre- (272.737 ± 37.401 cm) to post-training (277.286 ± 29.474 cm; $p = 0.201$). Muscle fiber CSA did not significantly increase from pre- (4068 ± 865 μm) to post-training (4221 ± 704 μm; $p = 0.368$). Additionally, pre muscle fiber CSA did not correlate to pre whole-muscle CSA ($r = 0.029$, $p = 0.882$). Also, Muscle fiber CSA percent change did not correlate with whole-muscle CSA percent change ($r = -0.064$, $p = 0.741$). **CONCLUSION:** Estimated whole-muscle CSA and muscle fiber CSA do not appear to correlate well. A lack of a relationship between the changes in these measurements following hypertrophy are puzzling and warrant further study.

3440 Board #128 June 1 8:00 AM - 9:30 AM
Is Core Temperature Influenced by Triathlon Wetsuit Models When Swimming in Warm Water?

Melissa J. Aure, Gabriela Guzman, Boram Lim, Cordero Roche, John A. Mercer, FACSM. *University of Nevada, Las Vegas, Las Vegas, NV.*
 Email: aurem1@unlv.nevada.edu
 (No relevant relationships reported)

Swim-related fatalities have raised safety concerns in the sport of triathlon. As a majority of deaths occur during the swim, there are strict guidelines related to water temperatures and the use of wetsuits in triathlon events governed by USA Triathlon (USAT). Due to the varying water temperatures, athletes can select from a wide variety of wetsuit models. Two main categories of wetsuit models are sleeveless and full sleeve. The use of a wetsuit in warm water may increase body heat storage and may result in an increase in core temperature. However, there are no data investigating the influence of triathlon wetsuit design on core temperature when swimming in warm water. **PURPOSE:** The purpose of this study was to examine the influence of wetsuit design on core temperature responses during swimming in warm water (25.5 °C). **METHODS:** Three experienced triathletes (mean ± standard deviation (SD), age 48 ± 4.93 years, height 1.73 ± 0.09 m, weight 71.62 ± 8.54 kg) participated in the study. At least 8 hours prior to attending the test session, participants swallowed an ingestible core temperature pill. Before beginning the test session, core temperature (T_c) data were transferred to the monitor and sample rate was set to 0.1 Hz (1 sample every 10 s). Testing consisted of a self-directed warm-up followed by a 500-m swim in an indoor pool (set to either 25-m or 50-m in length) for each condition: no wetsuit (NW), sleeveless wetsuit (SL), and full sleeve wetsuit (FS). Participants swam at a self-selected pace at a somewhat hard intensity (Borg Rating of Perceived Exertion = 13). Participants were required to rest until core temperature was within 0.5 °C of baseline before beginning the next condition. Core temperature data were transferred to the monitor after each swim. Average T_c during the first and last minute of each swim was computed for analysis. A 2 (time) x 3 (wetsuit condition) repeated measures ANOVA was used ($\alpha = 0.05$). **RESULTS:** T_c was not influenced by the interaction of time and wetsuit ($p > 0.05$) and there was no main effect for time ($p > 0.05$) nor wetsuit condition ($p > 0.05$). Mean values for T_c between NW, SL, and FS were 37.82 ± 0.44 °C, 37.64 ± 0.68 °C, and 37.64 ± 0.42 °C, respectively. **CONCLUSIONS:** These pilot results indicate that wetsuit design does not significantly influence thermoregulatory responses.

3441 Board #129 June 1 8:00 AM - 9:30 AM
Synchronous Music Does Not Appear to Change YMCA Bench Press Results

Rhiannon M. Seneli, Samantha R. Lang, Abigail C. Hammer, Alyssa M. Tompkins, Sandra Tecklenburg-Lund. *St. Ambrose University, Davenport, IA.*
 (No relevant relationships reported)

Listening to music while exercising is thought to enhance physical performance by enhancing focus, elevating mood, increasing motivation, and decreasing perceived effort. Research, however, has debated the actual effects of music on performance, as results of the ergogenic effect vary with different music types, modes of exercise, intensities, and training status. One of the variations observed both in and outside the laboratory is exercise which is synchronized with the rhythm of the music. It is unclear how synchronous music affects maximal exercise testing when a cadence is required as part of the protocol, such as during the YMCA bench press test. **PURPOSE:** The purpose of this study was to investigate the effect of synchronous music on the YMCA bench press test. **METHODS:** Sixteen subjects (6 males, 10 females, 22.1 ± 4.1 years) self reported being active or non-active according to ACSM physical fitness guidelines. Each performed a YMCA bench press test at a cadence of 60 repetitions per minute under two conditions: (1) using a metronome set at 60 bpm and (2) with pre-determined synchronous music with a beat of 120 bpm. With the metronome, each bench press repetition was completed with each beat, while the music trial required subjects to complete each repetition every other beat. The number of successful repetitions completed was recorded and means from each condition were compared using a dependent t-test ($\alpha = .05$). Individual differences between the conditions were also identified and the difference between conditions for active subjects ($n = 11$) was compared to non-active subjects ($n = 5$) using an independent t-test. **RESULTS:** There was no significant difference in the number of repetitions completed during the metronome condition (39.1 ± 22.3 repetitions) and the synchronous music condition (39.1 ± 23.1 repetitions, $p = .99$). There was also no significant difference in change of repetitions completed between active (0.5 ± 6.3 repetitions) and non-active subjects (-1.0 ± 8.3 repetitions, $p = .74$). **CONCLUSION:** Synchronous music did not have an effect on the YMCA bench performance. Because the test requires maximal effort, it may be that the beneficial distraction often caused by music was muted by the high intensity required for the exercise.

3442 Board #130 June 1 8:00 AM - 9:30 AM
Validity of a New Portable Metabolic Gas Exchange System
 Holly L. McClung¹, Leila A. Walker¹, David P. Looney¹, William J. Tharion¹, Alexander P. Welles¹, Heather M. Hansen¹, Adam W. Potter¹, Maxwell N. Rome², Christopher R. Chalmers², Reed W. Hoyt¹. ¹US Army Research Institute of Environmental Medicine, Natick, MA. ²Oak Ridge Institute for Science and Education, Oak Ridge, TN. (Sponsor: Scott Montain, FACSM)
 Email: holly.l.mcclung.civ@mail.mil
 (No relevant relationships reported)

Valid and reliable methods to measure oxygen consumption ($\dot{V}O_2$) and carbon dioxide production ($\dot{V}CO_2$) are required in the assessment of exercise capacity and energy expenditure. However, research is often restricted by financial and portability issues with existing open circuit spirometry, metabolic cart or portable devices. **Purpose:** Evaluate a new, light-weight and scalable metabolic system (CO₂/O₂ Breath & Respiration Analyzer, COBRA) against a criterion metabolic cart system (Parvomedics TrueOne 2400®, PARVO). **Methods:** Fourteen volunteers (13 male, 1 female; 24 ± 6 y (mean ± SD), 76 ± 13 kg BW, $\dot{V}O_{2peak}$ 3.8 ± 0.7 L·min⁻¹) performed four identical trials over two laboratory test days. The COBRA and PARVO were used to monitor four steady-state work rates: sitting rest, walk (23-36% $\dot{V}O_{2peak}$), jog (49-67% $\dot{V}O_{2peak}$), and run (60-76% $\dot{V}O_{2peak}$) on a treadmill in a laboratory (20 ± 0.5 °C; 45 ± 22 % RH). Simultaneous gas samples were averaged over 3-4 minute steady-state periods for each work intensity. Coefficient of determination and Concordance Correlation Coefficients (CCC) were used to evaluate the agreement between the systems when measuring $\dot{V}O_2$, $\dot{V}CO_2$, and minute ventilation (V_E). Systematic bias was examined to assess the accuracy of the COBRA. **Results:** The COBRA and PARVO produced highly correlated measures of $\dot{V}O_2$ (R²= 0.98), $\dot{V}CO_2$ (R²= 0.98) and V_E (R²= 0.99). The COBRA had very low bias compared to the PARVO for $\dot{V}O_2$ (0.01 ± 0.13 L·min⁻¹), $\dot{V}CO_2$ (0.06 ± 0.13 L·min⁻¹), and V_E (2.12 ± 2.75 L·min⁻¹). COBRA was in high agreement (CCC= 0.99) with the PARVO across each measure of $\dot{V}O_2$, $\dot{V}CO_2$ and V_E . **Conclusion:** The COBRA device is an accurate mobile metabolic system for measuring respiratory variables across a range of work intensities.
 Disclaimer: The views expressed in this abstract are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government.

3443 Board #131 June 1 8:00 AM - 9:30 AM
Relationship of OMNI Scale of Perceived Exertion to Heart Rate and RER During Incremental Exercise
 Christopher R. Chalmers¹, David P. Looney², Reed W. Hoyt², Alex P. Welles², William J. Tharion², Heather M. Hansen², Leila A. Walker², Maxwell N. Rome¹, Holly L. McClung². ¹Oak Ridge Associate Universities, Natick, MA. ²United States Army Research Institute of Environmental Medicine, Natick, MA. (Sponsor: Dr. Scott Montain, FACSM)
 Email: cchalmers@worcester.edu
 (No relevant relationships reported)

The OMNI rating of perceived exertion (RPE) scale is a subjective indicator of physiological strain experienced during aerobic exercise. Unlike its predecessor the Borg RPE scale, relatively few studies have examined the relationship between OMNI Scale reported and the measured heart rate (HR) and respiratory exchange ratio (RER) during exercise. **Purpose:** To analyze the strength of the relationship between RPE scores from the OMNI scale and HR and RER during incremental exercise. **Methods:** Twelve active military personnel (11 male, 1 female; 24 ± 5 yr; height, 175 ± 9 cm; body mass, 79 ± 14 kg) completed two trials over one test day. Each trial consisted of three exercise intensities (walk, jog, run) based on percentages of their maximal oxygen uptake (% $\dot{V}O_{2max}$) performed at baseline separated by a 20-30 minute rest between trials. Measures of RER were collected using a metabolic cart (ParvoMedics TrueOne® 2400), HR with a commercial chest belt monitoring system (Polar T31 Heart Rate Sensor), and RPE with the OMNI-walk/run scale (Adult OMNI Scale of Perceived Exertion 2004). **Results:** The calculated Pearson's correlation of coefficients for RPE was moderately correlated with HR (r=0.83) but weakly correlated with RER (r=0.47). The average RPE for walk (RPE, 2 ± 1), Jog (RPE, 4 ± 1), and Run (RPE, 6 ± 1) increased with each higher work rate. **Conclusion:** The OMNI RPE Scale is positively related to heart rate responses elicited by exercise, but is less correlated to changes in RER and therefore less indicative of the transition to greater reliance on glycolytic energy pathways.
DISCLAIMER: The views expressed in this paper are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the US Government. This research was supported in part by appointments to the Postgraduate Research Participation Program at the US Army Research Institute of Environmental Medicine administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the US Department of Energy and USAMRMC.

3444 Board #132 June 1 8:00 AM - 9:30 AM
A Comparison of Waist-to-Height Circumference Ratios to Standardized Measures of Overweight and Obesity
 David Q. Thomas, FACSM, Marin McElroy, Ayunna Moore, Jennifer Spring. *Illinois State University, Normal, IL.*
 (No relevant relationships reported)

Several methods have been used to screen people for overweight and obesity. Recently, waist-to-height circumference ratios have been gaining in popularity due to their ease of measure and focus on central adiposity. However, research on this method is lacking. **Purpose:** To determine the relationship between waist-to-height circumference ratios (WTHR) and more traditional methods (body mass index, waist-to-hip ratio, sum of skinfolds, and percent fat) of screening for overweight and obesity. **Methods:** Thirty-one volunteers (17 females and 14 males) ages 18-24 (20.8 ± 0.98 yrs.) participated in the study. After completing informed consent, each participant had height, mass, waist and hip circumferences, skinfolds (tricep, bicep, mid-axillary, abdominal, supra-iliac, anterior thigh, medial calf, and pectoral {men only}) and percent fat (via air-displacement plethysmography - ADP) measured. **Results:** Height (1.71 ± 0.10 m), mass (69.98 ± 14.20 kg), waist circumference (76.7 ± 8.61 cm), and hip circumference (98.94 ± 7.71 cm) were determined following standard procedures. Body mass index (BMI) was calculated by dividing mass in kg by height in meters squared (23.68 ± 3.27). Skinfolds (SF) were summed (111.20 ± 42.17 mm). Waist-to-hip (WTH) ratio (0.77 ± 0.06) and WTHR (44.77 ± 4.40) were calculated by dividing waist circumference by hip circumference (WTH) and by height (WTHR). Percent fat (21.06 ± 9.33) was measured by ADP. Pearson product-moment correlations for WTHR and BMI (r = 0.83), WTH (r = 0.63), SF (r = 0.57), and percent fat (r = 0.55) were calculated. **Conclusions:** Waist-to-height circumference ratios had a strong positive relationship with BMI and moderate positive relationships with WTH, SF, and percent fat. It appears that WTHR may be an acceptable alternative to screening for overweight and obesity. Since WTHR only involves the measure of height and waist circumference, this method has a high degree of feasibility. Its focus on central adiposity is an additional benefit. Further research is necessary to determine if these relationships hold true for other populations varying in age and body composition.

G-37 Free Communication/Poster - Predictive
 Saturday, June 1, 2019, 7:30 AM - 11:00 AM
 Room: CC-Hall WA2

3445 Board #133 June 1 9:30 AM - 11:00 AM
Can the Talk Test Be Used to Predict Training Induced Changes in Ventilatory Threshold?
 Carl Foster, FACSM, Kristen M. Deal, John P. Porcari, FACSM, Richard P. Mikat, FACSM, Cristina Cortis, Andrea Fusco. *University of Wisconsin-La Crosse, La Crosse, WI.*
 (No relevant relationships reported)

Purpose: To test the reliability of the talk test (TT) for tracking changes in ventilatory threshold (VT). **Methods:** Thirteen healthy college-age students (mean ± SD; age, 20.5 ± 1.91 years; BMI, 25 ± 2.8 kg/m²; Females=6) completed a TT and graded exercise test (GXT) before and after six weeks of increased training or detraining. The TT was used to predict VT by assessing the ability to talk comfortably during 3-minute exercise stages. The criterion measure of VT was respiratory gas exchange during the GXT using the v-slope method. Training and detraining were self-directed. Subjects recorded their exercise minutes and average rating of perceived exertion during the training session (sRPE) using the CR10 scale, which was used to calculate training LOAD. A two-way repeated measures analysis of variance (ANOVA) with Tukey's post-hoc analysis was used to detect differences between the change in power output (PO) during the TT and at VT (p < .05). **Results:** No significant differences were found between the PO at equivocal stage (EQ) of the TT (135 ± 29.8 W) and $\dot{V}O_2$ at VT (134 ± 32.4 W) (p > .05). There was no significant change between exercise baseline minutes (160 ± 7.6 minutes) and experimental minutes (213 ± 46.6 minutes) (p > .05). However, there was a significant change between sRPE and LOAD at baseline (4.5 ± 0.17 and 715 ± 204.7, respectively) and experimental (5.9 ± 0.23 and 1302 ± 228.5, respectively; p < .05). Baseline training loads were considerably more than the 150 min/week at moderate intensity (RPE=3) recommended by ACSM (2017) for basic fitness with 68% of subjects exceeding the recommendations. **Conclusion:** The TT was shown to be reliable in tracking changes in VT over time. The results suggest that tracking training induced changes in exercise capacity can be done using the simpler method of the TT.

3446 Board #134 June 1 9:30 AM - 11:00 AM
U.S. Navy Physical Readiness Test Modality Pilot Study
 Rebecca S. Weller¹, Douglas M. Jones¹, Katherine M. Wilson¹, Andrew J. Ordille¹, Dale A. Hirsch¹, John J. Fraser¹, Trevor B. Viboch¹, Aaron J. Wolf¹, Valerie M. Costantini¹, Heath Clifford², Jay H. Heaney¹, Melissa D. Laird¹. ¹Naval Health Research Center, San Diego, CA. ²21st Century Sailor, Millington, TN.
 Email: rweller223@gmail.com
 (No relevant relationships reported)

The U.S. Navy is transitioning from a culture of fitness testing to a more pervasive culture of functional fitness. The objective is to shift away from the current Physical Fitness Assessment, which evaluates general physical fitness levels and disease risk, toward more operationally relevant metrics of performance fitness and mission readiness. **PURPOSE:** To assess and down-select from 11 fitness tasks to 3-5 modalities for potential inclusion in an alternative Physical Readiness Test (PRT). **METHODS:** Forty-one active duty sailors (30 males; 11 females) completed traditional strength tests and 11 performance fitness modalities consisting of upper/lower body strength and power events, total body strength events, timed sprints/runs, and a core strength task. Modality down-selection was based on scalability, physical space and equipment requirements, safety, time and cost to administer, and correlations of sailors' individual performance on the new modalities to both their performance on traditional strength tests and most recent PRT (curl-ups, push-ups, 1.5 mile run). **RESULTS:** Seated medicine ball throw (SMBT)—the only modality that measured upper body strength and power—had a strong correlation with the 1 repetition maximum (1RM) bench press ($r=0.79$). Standing long jump (SLJ) evaluated lower body strength and power and had a moderate correlation with 1RM seated leg press ($r=0.50$) and 1.5 mile run ($r=0.59$). The repeated 300-yd shuttle run (300SR) assessed agility and aerobic/anaerobic capacity and was highly correlated ($r=0.82$) with participants' 1.5 mile run times on their most recent PRT. Forearm plank (FP) did not show significant correlations to traditional strength tests or previous fitness test scores (PRT), with the exception of a moderate correlation to PRT push-up scores ($r=0.51$). **CONCLUSION:** SMBT, SLJ, 300SR, and FP were the modalities recommended for inclusion in an alternative PRT. These new modalities evaluate more operationally relevant measures of performance fitness, thereby providing advanced knowledge of a sailor's physical capabilities and/or limitations. Future considerations should include a follow-on, large scale validation study to develop the appropriate norms and performance standards across gender/age brackets.

3447 Board #135 June 1 9:30 AM - 11:00 AM
Trauma Exposure Predicts Functional Movement Characteristics of Male Tactical Athletes
 Stephanie Coffin. Leidos/NHRC, San Diego, CA.
 Email: stephaniecoffin95@gmail.com
 (No relevant relationships reported)

Accumulating data have demonstrated a link between psychological distress and musculoskeletal injury (MSKI) prevalence. High levels of physical stress are commonly experienced during the career of a military tactical athlete, which can result in injury and subsequently affect functional movement (FM) outcomes. It is also plausible that trauma exposure (TE), a psychologically salient factor, may influence FM characteristics. It is vital to understand psychological predictors of FM in tactical athletes to optimize performance and to help attenuate MSKI incidents. **PURPOSE:** The primary objective was to determine the associations of combat exposure (CE) and TE with FM characteristics in tactical athletes. Secondary objectives were to explore the confounding influences of age and physical injury history as well as the mediating role of bodily pain. **METHODS:** Eighty-two male, active duty U.S. Navy Explosive Ordnance Disposal personnel (mean age \pm SD = 34.0 \pm 6.7 years) self-reported CE, TE, physical injury history, and bodily pain. FM characteristics (i.e., Functional Movement Screen [FMS], Y-Balance Test) were assessed by trained researchers, from which a composite functional status (CFS) measure was derived. Hypotheses were tested using correlational and multiple regression (causal steps) models. **RESULTS:** In unadjusted models, TE was inversely associated with FMS ($r = -0.32, p = .005$) and CFS ($r = -0.30, p = .009$). In adjusted models, these relationships were robust to the confounding influences of age and physical injury history. In causal steps models, TE and bodily pain were substantive, independent predictors of FMS ($R^2_{adj} = .20, p = .02$) and CFS ($R^2_{adj} = .18, p = .02$), implying additive, rather than mediated, effects. CE did not predict FM characteristics. **CONCLUSIONS:** To our knowledge, this is unprecedented evidence of the influence of TE on FM characteristics of male tactical athletes that is independent of age, physical injury, and bodily pain. The shared variance of TE and FM characteristics implies that the addition of TE, and other psychologically relevant constructs in association with FM, may advance FM theories. Including TE into physical assessments may not only optimize performance in the tactical environment, but also advance MSKI prevention and treatment.

3448 Board #136 June 1 9:30 AM - 11:00 AM
A New and Simple Prediction Equation For Health-Related Fitness: Use of Honest Assessment Predictive Modeling
 Peter D. Hart. Montana State University - Northern, Havre, MT.
 Email: peter.hart@msun.edu
 (No relevant relationships reported)

PURPOSE: Health-related fitness is a set of attributes that relate to the ability to perform physical tasks and also relate to health outcomes. To assess an individual on all health-related fitness attributes can be time consuming. Thus, it would be useful to fitness specialists if a simpler and valid assessment was available to measure overall health-related fitness. The purpose of this study was to employ honest assessment predictive modeling to find a parsimonious set of variables that can predict overall health-related fitness. **METHODS:** Data used for this study came from college students who completed a fitness test battery. An overall health-related fitness score (T-score) was constructed using maximal oxygen consumption (VO₂, ml/kg/min), 1RM bench press (BP, lb), maximal push-up repetition (PU, #), and percent body fat (PBF, %). The set of possible predictor variables consisted of participant age (yr), sex (male/female), body mass index (BMI, kg/m²), waist circumference (WC, cm), 1RM leg press (LP, lb), countermovement vertical jump (VJ, in), flexed arm hang (FAH, sec), physical activity rating (PAR, 0 thru 10), and sit-and-reach (SNR, cm). The honest assessment predictive modeling procedure included three steps: 1) development of competing models using a TRAINING dataset, 2) selection of an optimal model using a separate VALIDATION dataset, and 3) assessment of fitness score construct validity using a final SCORING dataset. **RESULTS:** Stepwise model selection with Schwarz Bayesian criterion (SBC) on the TRAINING data resulted in five possible models including sex, VJ, PAR, and WC. Results on the VALIDATION data indicated a three-variable model had the lowest average squared error (ASE) and consisted of sex, VJ, and PAR ($F=107.8, p<.001, R^2=.82, SEE=3.09$). Finally, predicted values from the SCORING data showed that athletes ($Mean=54.9, SD=5.1$) had a significantly ($p<.001$) greater mean fitness score than non-athletes ($Mean=39.8, SD=4.8$). **CONCLUSION:** This study presents a valid equation that can simply predict overall health-related fitness in college students.

3449 Board #137 June 1 9:30 AM - 11:00 AM
Ability to Predict Impending Volitional Exhaustion Based on Aerobic Capacity
 Dustin W. Davis, Jenna L. Carducci, Matthew J. Garver, Whitley J. Stone, Meera Penumetcha, Nicolas M. Philipp, Josie H. Hair, Jordan R. Elledge, Haley R. Williams, Matthew T. Oliphant, Zachariah S. Hopkins. University of Central Missouri, Warrensburg, MO.
 Email: dwdavis@ucmo.edu
 (No relevant relationships reported)

Maximal relative oxygen consumption (VO_{2max}), assessed via a treadmill test to volitional exhaustion, is the foremost measure of aerobic capacity in healthy, recreationally active young adults. Habitual exercise may improve the ability to perceive exercise difficulty and predict impending exhaustion. **PURPOSE:** The primary aim of this investigation was to determine if a correlation existed between VO_{2max} and time to test termination after participants indicated they were 30 s from volitional exhaustion. A secondary aim was to ascertain if participants more accurately predicted impending exhaustion during a repeated trial. **METHODS:** Participants completed a familiarization trial to minimize learning effects and determine treadmill speed for maximal testing. During the familiarization trial, participants self-selected a zero-grade jogging speed associated with a value of 12-13 on Borg's 6-20 RPE scale when steady-stated. This speed was used during two maximal tests separated by 36-72 h. During maximal testing, grade was increased 2% every two minutes until volitional exhaustion. VO_{2max} was measured as a 15-breath moving average via a metabolic cart. Participants were instructed before and during testing to tap on the treadmill when they perceived themselves to be 30 s from volitional exhaustion. **RESULTS:** Thirteen (Females: 8, Males: 5) recreationally active individuals (20.7 \pm 1.4 yrs., 72.4 \pm 12.3 kg) completed the protocol. Mean VO_{2max} during session 1 (10.00 \pm 2.46 min) was 47.0 \pm 7.4 ml·kg⁻¹·min⁻¹, and time to test termination after the tap was 36.2 \pm 7.4 s. Mean VO_{2max} during session 2 (10.08 \pm 2.38 min) was 47.5 \pm 7.7 ml·kg⁻¹·min⁻¹, and time to test termination after the tap was 40.0 \pm 18.5 s. No significant correlation was detected between VO_{2max} and time to test termination after the tap in session 1 ($r = -.032, p = .917$) or session 2 ($r = .315, p = .295$). A dependent t-test ($t(12) = -.800, p = .439$) did not reveal significant differences in time to test termination after the tap between session 1 and session 2. **CONCLUSIONS:** Aerobic capacity did not affect the ability of healthy, recreationally active young adults to predict impending volitional exhaustion during maximal treadmill running. Time to test termination after the tap did not significantly change during a repeated trial.

3450 Board #138 June 1 9:30 AM - 11:00 AM
Bilateral And Split Stance Isometric Midhigh Pulls Can Equally Predict Change Of Direction Ability

Brandon J. Richards, Mark Gifford, James K. Morrison, Ken Seaman. *University of New Brunswick, Fredericton, NB, Canada.*

Email: brandon.richards@unb.ca

(No relevant relationships reported)

The isometric midhigh pull (IMTP) has been shown to be able to predict change of direction (COD) ability. This is of interest for sports that require COD movements, as it could potentially be used to identify standout athletes in their respective sports. However, no literature to our knowledge has assessed split stance isometric midhigh pull (SSIMTP) as a predictor of COD ability compared to the IMTP. **Purpose:** The purpose of this study was to determine whether SSIMTP is a better predictor of COD ability than the IMTP. **Methods:** Seventeen (12M and 5F) university aged adults participated in the following study. Mean height, weight, and age were 176±8.6cm, 172±24.2kg, and 22±3 years, respectively. Participants completed two sessions randomized in order that were two to five days apart; four trials of the SSIMTP (two trials per lead leg) and the other session involved two trials of the IMTP. Each day also consisted of four trials of the 505-agility test. Two trials involved pivoting off of the left foot and two trials pivoting off of the right foot, which was randomized in order. **Results:** All results are Pearson Correlation Coefficients presented with their respective p-value. The combined peak force (PF) of the IMTP and the best 505-agility time for the left and right foot had r values of -0.648 (p<0.09) and -0.464 (p<0.08), respectively. The r values during the SSIMTP condition were -0.722 (p=0.02) and -0.462 (p=0.07) when the left leg is the lead leg and COD to the left and when the right leg is the lead leg and COD to the right, respectively. **Conclusion:** The main finding of this study is that the combined PF produced during the IMTP and the PF produced by the lead leg during the SSIMTP can both uniformly predict COD. For the SSIMTP condition, a significant strong inverse correlation exists between left COD ability and left leg when it is forward and a moderate inverse correlation between right COD ability and the right leg when it is forward. For the IMTP condition, there is a strong inverse correlation between the combined PF and COD ability to the left and moderate inverse correlation between the combined PF and COD to the right. Previous literature has found correlations between IMTP and COD ability anywhere between -0.47 to -0.89.

3451 Board #139 June 1 9:30 AM - 11:00 AM
Use Of A Clinic-Based ACL Prediction Algorithm In Division III Female Soccer And Basketball Players

Charles Ruot, Rachel Holick, Lindsay Edwards. *Hardin-Simmons University, Abilene, TX.* (Sponsor: Dr. Dennis O'Connell, FACSMS)

Email: cruot@hsutx.edu

(No relevant relationships reported)

During landing and pivoting movements female athletes have an increased lower extremity valgus alignment and knee abduction moment (KAM) making them four to six times more likely than males to sustain a sports-related, non-contact anterior cruciate ligament (ACL) injury. **Purpose:** To utilize a clinic-based ACL prediction algorithm developed by Myer, Ford and Hewett (2011) that determines the probability of high knee abduction moment (KAM) in Division III female soccer and basketball players. **Methods:** Twenty female athletes were recruited (n = 10 basketball, n = 10 soccer). Five measures were obtained and utilized in the prediction algorithm, namely tibial length, body mass, knee valgus, knee flexion range of motion, and quadriceps-to-hamstring isokinetic strength ratio. A prediction nomogram was applied to award a point value for each variable, which when summed generated a probability of high knee abduction moment (KAM). High KAM is associated with a higher risk of ACL injury. In each group a dependent t-test was used to compare KAM in the left and right leg. Significance was tested at p < 0.05. **Results:** The probability of high KAM in basketball and soccer players was higher in the left leg compared to the right leg. In soccer players, this difference in KAM between the left and right leg was significant (basketball: $t_L = 0.76 \pm 0.27$, $t_R = 0.71 \pm 0.24$, $t(9) = 0.82$, $p = 0.43$; soccer: $t_L = 0.64 \pm 0.31$, $t_R = 0.49 \pm 0.31$, $t(9) = 2.65$, $p = 0.03$). **Conclusion:** The higher KAM scores for the basketball players suggest that they may be at a greater risk for ACL injury compared to the soccer players. The significant difference in bilateral KAM scores in the legs of the soccer players suggests a greater risk of ACL injury in the left leg compared to the right leg. This difference may be attributed to leg dominance, although leg dominance was not measured in this study. The current study supports the use of a clinic-based ACL prediction algorithm to evaluate ACL injury risk of athletes when advanced biomechanical equipment is unavailable. Identification of risk of ACL injury allows for potential implementation of injury prevention training.

3452 Board #140 June 1 9:30 AM - 11:00 AM
Can a Field Based Neuromuscular Test Determine Readiness to Train in Female Team Sport Athletes?

Joel Prowting, Nick Hodgson, Rebecca Larson, Christopher Black, FACSMS, Jason Campbell. *University of Oklahoma, Norman, OK.* (Sponsor: Christopher Black, FACSMS)

Email: joel.prowting@ou.edu

(No relevant relationships reported)

Purpose: To determine if a field-based neuromuscular test (Counter Movement Jump (CMJ)) could accurately detect EIMD-related performance decrements incurred by repeated sprinting in female team sport athletes. **Methods:** 10 female athletes (Age: 21.7 ± 2.5y) performed an eccentrically-biased, repeated sprint protocol consisting of 5 sets of 8 maximal sprint (MS) trials (20m in length, 5m deceleration zones). Participants then immediately performed three CMJs on a force plate (FD4000, NMP ForceDecks Ltd, UK) to assess fatigue before beginning the next set of 8 sprints. Blood lactate and RPE were assessed following the completion of the sprint protocol. After 24-48h, participants returned to complete soreness ratings, 3 CMJs and 3 MSs. This process was completed 4 times (each "Trial" = 1 repeated sprint protocol visit + 1 24-28h follow up visit). **Results:** A number of CMJ metrics were significantly lower (p<0.05) when measured during the 24-48h follow up visits, however the only one that was consistently lower across all 4 trials was concentric RFD (N/s/kg) (Pre v 24-48h post: Trial 1 = 36.03 ± 16.81 v 20.64 ± 13.49; Trial 2 = 49.37 ± 32.29 v 29.44 ± 21.87; Trial 3 = 50.45 ± 40.86 v 27.59 ± 24.43; Trial 4 = 43.87 ± 32.37 v 31.01 ± 29.41). No significant differences (p>0.05) were found for peak or average velocity during the MSs across any trial. Lower body soreness was significantly greater (p<0.05) during the 24-48h follow up visits as assessed via a 0-10 visual analogue scale. The sprint protocol induced a high internal physiological load, evidenced by significantly elevated post-exercise blood lactate levels (pre: 1.51±0.50 vs post: 5.6±2.53). **Conclusion:** Concentric RFD determined using a CMJ was the best metric for detecting performance impairments, as it consistently declined 24-48h after completing a repeated sprint protocol. The other CMJ metrics, as well as MS performance did not decrease across all trials. A CMJ test that assesses concentric RFD may be a useful tool for coaches to determine readiness to train in female athletes. Future research should seek to replicate this protocol using higher sprinting volumes, to determine whether concentric RFD declines in a predictable dose-response manner. Limitations of this study were the small sample size and the lack of control for external damaging activity (i.e. rugby training).

3453 Board #141 June 1 9:30 AM - 11:00 AM
Predict Failure: Muscle Oxygen Dynamics In Elite Climbers During Finger Hang Tests

Andri Feldmann, Daniel Erlacher, Sandro Pfister. *University of Bern, Bern, Switzerland.*

Email: andri.feldmann@ispw.unibe.ch

Reported Relationships: A. Feldmann: Salary; Part-Time employment in development. Industry contracted research; private industry contribution. Ownership/interest/stock; own stocks.

Introduction: Failure in elite sport climbing is associated with an inability to maintain isometric muscle contraction. The ability to supply and utilize oxygen is the primary bioenergetic contributor to muscle contraction and can be examined locally using near-infrared spectroscopy (NIRS). Examining changes in NIRS derived muscle oxygenation (SmO₂) have shown to be related to changes in performance output during gripping exercises. **Purpose:** The aim of this study is to measure SmO₂ dynamics in a climbing specific test until task failure in varying conditions. Our prediction is that SmO₂ should be a good marker to predict task failure. **Methods:** Eight elite level climbers performed a finger-hang test with four different intensities maintaining grip until voluntary exhaustion. During each trial SmO₂ and time to failure (TTF) were measured. TTF was then compared to the minimally attainable value of SmO₂ (SmO₂min) and time to SmO₂min (TTmin). **Results:** Two-one-sided tests (TOST) resulted in SmO₂min equivalence for the high intensity conditions ($M_1 = 21.9\% SD_1 = 5.0\%$; $M_2 = 25.4\%$; $SD_2 = 6.5\%$; $M_3 = 24.1\%$; $SD_3 = 5.9\%$), $t(7) = 2.72$, $p = 0.015$; $t(7) = 3.85$, $p = 0.003$, but failed to show equality for the fourth and lowest intensity condition ($M_4 = 32.4\%$; $SD_4 = 8.8\%$), $t(7) = -1.01$, $p = 0.173$. Equivalence was also found between TTF and TTmin for the high intensity conditions. **Conclusion:** The duration with which oxygen is extracted and utilised changes, while the attainable SmO₂min remains constant at high intensity conditions and is related to the ability to maintain task performance.

3454 Board #142 June 1 9:30 AM - 11:00 AM
Prediction Of 1rm Bench Press From Repetitions To Fatigue In Untrained, Trained, And Athletic Men
 Jerry L. Mayhew¹, William F. Brechue, FACSM², Richard M. Schumacher¹, Monica L. Hunter¹, Jana L. Arabas¹, Bryan Mann³.
¹Truman State University, Kirksville, MO. ²A. T. Still University, Kirksville, MO. ³Miami University, Miami, FL.
 Email: jmayhew@truman.edu
 (No relevant relationships reported)

Numerous prediction equations have been developed to estimate one-repetition maximum (1RM) bench press in various subject populations. While many of these equations have been validated on various groups, rarely have groups of various levels of training been combined to evaluate the accuracy of separate and combined equations developed on participants of differing strength levels and training backgrounds. **PURPOSE:** To produce and evaluate 1RM bench press prediction equations developed on untrained, trained, and athletic men. **METHODS:** Untrained college men (UT, n = 166), resistance-trained college men (RT, n = 170), and college athletes (ATH, n = 179) were measured for 1-RM bench press and repetitions-to-fatigue (RTF) on separate days. RT men had trained 3 days/wk for 12 wks using a linear periodization program. ATH had trained for several years using either linear periodization or autoregulatory progressive resistance training. Linear regression equations were generated on validation samples of each group (UT = 119, TR = 120, ATH = 131) using a weight (RepWt) that produced between 2 and 10 RTF. **RESULTS:** All 3 groups differed significantly in 1RM (UT = 74.1 ± 15.5 kg, RT = 88.8 ± 21.7 kg, ATH = 136.2 ± 21.8 kg) but not in %1RM used for RTF (UT = 83.4% ± 7.4%, RT = 83.0% ± 5.5%, ATH = 83.4% ± 6.0%). Despite the nonsignificant difference in %1RM, ATH (6.7 ± 2.4) produced significantly more RTF than UT and RT men (6.1 ± 2.2 and 6.0 ± 2.1, respectively). Multiple correlations and standard errors of estimate (SEE) for group equations were similar for UT (R = 0.94, SEE = 5.7 kg), RT (R = 0.97, SEE = 5.3 kg), and ATH (R = 0.96, SEE = 6.1 kg). A global equation compiling all 3 groups had comparable results [1RM (kg) = 1.16 RepWt (kg) + 2.07 RTF - 9.4, R = 0.98, SEE = 6.2 kg]. Cross-validation of each equation on 25% randomly selected subsamples accurately predicted 89%-96% of each group within ±10% of actual 1RM. The global equation predicted slightly better in RT (94%) and ATH (96%) than in UT (87%). **CONCLUSIONS:** A newly developed global prediction equation appears to have acceptable accuracy for estimate 1RM bench press in men with varying resistance training backgrounds.

3455 Board #143 June 1 9:30 AM - 11:00 AM
Lower Limb Kinematic Assessment to Predict Water Polo Performance
 Cameron A. Williams, J. Mark VanNess, Joey Rossi, John Mayberry, Courtney D. Jensen. *University of the Pacific, Stockton, CA.*
 Email: c_williams29@u.pacific.edu
 (No relevant relationships reported)

Water polo requires leg muscle biosequencing that is different from weight bearing sports. The kinematics and forcefulness for each player could be optimized for different positions and help predict player success. Comparing vertical jump with kinematic biosequencing, and comparing each with athletic performance, may enhance training assessments. **PURPOSE:** To test the effect of vertical jump and Sparta Science force plate technology outputs on in-season performance of women's water polo players. **METHODS:** 14 Division 1 women's water polo players were evaluated during two consecutive seasons: 2015-2016 and 2016-2017. Statistics tabulated for each season were: Games played, shots, goals, shooting percentage, assists, steals, exclusions (EX), and exclusions drawn (DEX). All players were tested for vertical jump once a week during conditioning prior to resistance training using Sparta force plate and proprietary outputs, which calculated "Load" (rate of eccentric force), "Explode" (power generation during concentric force output), and "Drive" (neural impulse on timing and range of motion). Linear regression tested Sparta data on in-season performance outcomes. **RESULTS:** Athletes weighed 70.2 ± 8.6 kg, had a vertical jump of 30.7 ± 4.3 cm and Sparta Load of 45.4 ± 6.2, Explode of 34.8 ± 4.1, and Drive of 65.3 ± 10.0. On average, throughout each season, the athletes played 29.5 ± 6.3 games, took 92.7 ± 61.5 shots, scored 31.3 ± 8.1% of shots taken, had 24.3 ± 12.5 steals, and 16.4 ± 14.4 assists. Vertical jump predicted a higher shooting percentage ($\beta=0.010$; $p<0.001$), more steals ($\beta=0.820$; $p=0.043$), fewer assists ($\beta=-1.324$; $p=0.005$), and fewer EX ($\beta=-1.466$; $p<0.001$). Load predicted a lower shooting percentage ($\beta=-0.003$; $p=0.001$) and more EX ($\beta=0.284$; $p<0.001$) and DEX ($\beta=0.219$; $p=0.002$). Explode predicted a higher shooting percentage ($\beta=0.003$; $p=0.009$), more steals ($\beta=0.642$; $p<0.001$), and lower EX ($\beta=-0.454$; $p<0.001$). Drive predicted a higher shooting percentage ($\beta=0.002$; $p<0.001$), fewer assists ($\beta=-0.221$; $p=0.007$), lower EX ($\beta=-0.099$; $p=0.017$), and higher DEX ($\beta=0.107$; $p=0.017$). **CONCLUSION:** These findings indicate that both vertical jump and force plate biosequencing data may be useful predictors of water polo performance and could be employed to identify athletic capacities that need improvement.

3456 Board #144 June 1 9:30 AM - 11:00 AM
Use of Traditional and Modified Functional Movement Screening to Predict Balance with Military Load
 Eric M. Scudamore¹, Sandra L. Stevens², Dana K. Fuller², John M. Coons², Don W. Morgan, FACSM². ¹Arkansas State University, Jonesboro, AR. ²Middle Tennessee State University, Murfreesboro, TN. (Sponsor: Don W. Morgan, FACSM)
 (No relevant relationships reported)

Use of Traditional and Modified Functional Movement Screening to Predict Balance with Military Load

Eric M. Scudamore¹, Sandra L. Stevens², Dana K. Fuller², John M. Coons², Don W. Morgan², FACSM

¹Arkansas State University, Jonesboro, AR; ²Middle Tennessee State University, Murfreesboro, TN

PURPOSE: To determine if Functional Movement Screen (FMS) or modified Functional Movement Screen (mFMS) item scores predict dynamic balance scores of potential military recruits who wore a 24.2 kg military load. **METHODS:** Thirty physically-active males and females who displayed anthropometric and physical fitness characteristics typical of military recruits entering basic training completed FMS and mFMS. Torso-loaded balance was assessed as loaded composite reach distance (LCR) and loaded overall stability indices (LOSI) measured using the Y Balance test and Biodex Balance System, respectively. **RESULTS:** FMS composite scores exhibited the strongest relationship with LCR and participants with higher FMS composite scores (≥ 15) displayed higher LCR values compared to those with lower FMS composite scores (≤ 14). Analysis of FMS subscores using penalized regression indicated that an in-line lunge score of 1 predicted a shorter LCR (Coef for score of 2 = 6.86 (95% CI = 2.88, 10.93)); Coef for score of 3 = 8.36 (95% CI = 3.96, 13.70)) and a shoulder mobility score of 3 predicted better LOSI (Coef = -2.38 (95% CI = -3.56, -0.57)). Loaded shoulder mobility (Coef = -2.11 (95% CI = -4.12, -0.26)) and trunk stability push-up (95% CI = Coef = 1.61 (0.08, 3.13) scores of 3 also predicted better and worse LOSI, respectively. **CONCLUSION:** The in-line lunge item score from the FMS may be the best predictor of torso-loaded balance and the FMS may be more appropriate than items from a torso-loaded FMS battery in predicting torso-loaded balance in military recruits. Use of the FMS by clinicians may aid in mitigating musculoskeletal injuries in service members, thus minimizing losses that contribute to decreased military readiness.

3457 Board #145 June 1 9:30 AM - 11:00 AM
A Fitness Field Test to Predict VO₂max in Female Collegiate Field Hockey Players
 Jennifer Morton, Ian Klein. *Ohio University, Athens, OH.*
 (No relevant relationships reported)

Field hockey is a competitive sport requiring aerobic fitness. The gold standard method for determining aerobic fitness is a maximal oxygen consumption (VO₂max) test performed in a laboratory on a motorized treadmill (LAB) by a trained professional. The 30-15-intermittent fitness test (FIELD) is a new maximal effort running test designed to predict VO₂max on the field relative to a traditional treadmill graded exercise test (GXT).

PURPOSE: To compare the predicted VO₂max using the 30-15-intermittent FIELD test to the measured VO₂max LAB test in collegiate female field hockey players. **METHODS:** Nine (N=9) experienced female collegiate field hockey players (mean age=19.78±1.56 y, field hockey experience=8.80±2.49 y) were classified as healthy via a health assessment consisting of height, weight, and body fat (BF%). Each participant completed a LAB GXT test in a temperature-controlled laboratory using a metabolic cart and motorized treadmill, followed by the FIELD test a month later on a standardized turf field as a group under the same conditions. The FIELD test consists of a series of 30 second shuttle runs with 15 second intermittent walking breaks with an increase in speed every shuttle run of 0.5 km/h. The FIELD test uses an equation to predict VO₂max. Both tests were completed to exhaustion. All results are reported as mean±SD. Statistical significance was accepted at $\alpha=0.05$. Paired *t*-tests ($\alpha=0.05$) were utilized to compare means between groups. **RESULTS:** There was no significant difference between predicted VO₂max (FIELD 46.15±3.22 mL/kg/min) and measured VO₂max (LAB 48.68±6.94 mL/kg/min) ($p=0.102$). The percent difference between the LAB test and FIELD test averages was -4.25±8.37. There was a significantly greater percentage difference between the most fit participants (n=4) (-11.23±5.84) compared to the least fit participants (n=4) (+2.46±5.21) ($p=0.011$). **CONCLUSION:** The predicted VO₂max values using the FIELD test were similar as compared to the measured LAB test. However, greater percentage differences were seen in higher fit athletes. Coaches and athletes should consider the 30-15 intermittent field test as a potentially inexpensive and time efficient test for predicting VO₂max in a large group.

3458 Board #146 June 1 9:30 AM - 11:00 AM
Prediction of Lower Extremity Injuries from Vertical Jump Kinetic Data in Collegiate Athletes
 Marisa Pontillo, Brian Sennett. *University of Pennsylvania Health System, Philadelphia, PA.*
 Email: marisa.pontillo@uphs.upenn.edu
 (No relevant relationships reported)

Purpose: The vertical jump provides critical kinetic information regarding athletic performance, and can be quantified by the force-time (F-T curve) with defined phases of movement. Alterations in the efficiency of mechanisms used for force production could potentially lead to abnormal force dissipation and resultant injury. The purpose of this study was to identify which force plate variables from a vertical jump task could identify collegiate athletes who sustained a lower extremity injury. **Methods:** Vertical jump testing using a force plate with dedicated software (SpartaTrac system) was performed by all healthy varsity collegiate athletes at several intervals throughout the athletic year over 3 academic years. The testing procedure consisted of each subject performing a series of 6 consecutive vertical jumps. Injuries were documented by the team athletic trainers and verified with the health care organization's electronic medical documentation system. Injuries were defined as occurring no more than 60 days after a jump and defined as lower extremity by SIC8 10 code. 234 lower extremity injuries were identified. Subjects were matched by age, sex and sport. Vertical jump variables used were load, explode and drive, operationally defined as the average eccentric rate of force development, average concentric force, and concentric impulse, respectively. Logistic regression was used to determine if the battery of variables could predict whether or not an athlete would sustain a lower extremity injury. Additionally, athletes who sustained an ACL injury were identified, matched, and analyzed correspondingly. **Results:** Load, explode, and drive, when entered into the regression equation, showed the ability to predict lower extremity injury, $\chi^2=14.6$, $df=4$, $P<0.01$; with explode independently showing significant prediction at $P=0.02$. Load, explode, and drive also showed the ability to predict ACL injury, $\chi^2=13.92$, $df=3$, $P<0.01$, with load and explode independently showing significant prediction at $P<0.05$. **Conclusion:** The force plate variables collected from vertical jumps were able to identify athletes who sustained a lower extremity injury. Additionally, these variables were able to identify athletes who sustained an ACL injury.

3459 Board #147 June 1 9:30 AM - 11:00 AM
Validation Of A Cycle Ergometer Protocol In The Prediction Of $\dot{V}O_2$
 Alyssa A. Feher, Ashley L. Heffelfinger, Cassidy A. Barrett, Emily A. DeDonna, Alissa Rusbarsky. *Cedar Crest College, Allentown, PA.* (Sponsor: Michael D. Brown, FACSM)
 (No relevant relationships reported)

Protocols for the prediction of maximal oxygen uptake ($\dot{V}O_{2max}$) on a cycle ergometer have been criticized for either being too long or aggressive for individuals of variable fitness and/or disease status. Current protocols typically increase workload by adding resistance to the flywheel at a fixed RPM. Increases in RPM rather than resistance later in the test may provide increased physiological efficiency, yielding a more valid prediction of $\dot{V}O_{2max}$. **Purpose:** The purpose of this study was to design and validate a novel $\dot{V}O_{2max}$ cycle ergometer protocol using workload increments based on the subject's predicted heart rate reserve (HRR) in order to individualize the test protocol while adhering to well-documented $\dot{V}O_{2max}$ testing principles. **Methods:** Subjects included 12 females (20-27 y/o) who performed a $\dot{V}O_{2max}$ test using the new cycle ergometer protocol. Prior to testing, seat height on a Monark cycle ergometer was standardized with a 5-10 degree knee bend in the pedal-down position with the sole of the foot parallel to the floor. $\dot{V}O_2$, blood pressure, rating of perceived exertion (RPE), and heart rate using ECG were measured at rest and throughout the cycle ergometer exercise test, as well as the assessment of signs and symptoms. Workload increases were based on pre-determined Incremental Target Heart Rates (ITHR) using HRR. Stages commenced at a workload of 150 kgm/min (0.5 kg; 50 RPM) and were increased every 2 minutes by adding 0.5 kg or 1.0 kg resistance based on achievement of ITHR for each stage. When an ITHR representing $\geq 60\%$ HRR was achieved, workloads were increased by 10 RPM for each subsequent stage. Exercise tests were terminated when the subject could not maintain RPM or reached volitional exhaustion. Correlation between predicted (ACSM cycle equation) and measured $\dot{V}O_{2max}$ at peak workload was examined using Pearson's r . **Results:** The range for measured $\dot{V}O_{2max}$ was 20.7 - 37.4 mL/kg/min and 23.29 - 37.57 mL/kg/min for predicted $\dot{V}O_{2max}$. There was a statistically significant correlation between predicted and measured $\dot{V}O_{2max}$ ($r=0.894$; $p<0.001$). **Conclusion:** This novel cycle ergometer protocol was demonstrated to be a valid predictor of $\dot{V}O_{2max}$ for the population tested. Further testing on other diverse populations is warranted.

3460 Board #148 June 1 9:30 AM - 11:00 AM
Can A Simple Transfer Task Predict Lower-extremity Physical Function As Measured By Standardized Clinical Measures?
 Rachel Salyer¹, Ginny Frederick¹, Rachele Reed¹, Alison Berg¹, Chad Straight², Anne Brady³, Lauren Higgins³, Ellen Evans, FACSM¹. ¹The University of Georgia, Athens, GA. ²University of Massachusetts, Amherst, MA. ³University of North Carolina Greensboro, Greensboro, NC. (Sponsor: Ellen Evans, FACSM)
 Email: res69159@uga.edu
 (No relevant relationships reported)

PURPOSE: Lower-extremity physical function (LEPF) is associated with health outcomes such as risk for falling, physical disability, and mortality in older adults. Due to increasing evidence of disability onset occurring earlier in the lifespan, expanding assessment of functional status in middle-age adults is of growing importance. Furthermore, administering many of the current standardized objective tests (i.e. 6-Minute Walk Test, Timed Up and Go, and 30-second Chair Stand tests) in clinical settings is not feasible due to limited time, space, and equipment. Identifying simple, cost-effective assessments to evaluate LEPF status is paramount due to the potential for clinical application. Thus, this study aimed to evaluate if a simple transfer task could predict LEPF in middle-age and older adults. **METHODS:** Middle-age and older adults ($n=230$, 17% male; 52-89 yo; 29.1 ± 5.8 kg/m²) completed a transfer task (TRANSFER). This required them to start in a standing position, and without the use of assistive devices, sit on the floor, and return to a standing position as quickly as possible. LEPF was calculated using a composite Z-score based on scores from conventional and standardized 6-Minute Walk Test, Timed Up and Go, and 30-second Chair Stand tests. **RESULTS:** Bivariate correlations revealed that TRANSFER was associated with age ($r=0.27$, $p<0.01$), comorbidities ($r=0.33$, $p<0.01$), and BMI ($r=0.28$, $p<0.01$). Using linear regression analyses, TRANSFER was a significant predictor of LEPF Z-score (standardized $\beta=-0.73$, $p<0.01$) independently accounting for 39.6% of the variance after adjustment for covariates. **CONCLUSION:** Our results suggest that the ability to lower oneself to the ground and return to a standing position is a significant indicator of LEPF in middle-age and older adults. Further study is warranted to determine the clinical relevance of this simplified evaluation of LEPF and its ability to predict falls, physical disability, and mortality.

3461 Board #149 June 1 9:30 AM - 11:00 AM
The Association Between Step Frequency Test, Sprint And Agility Performance
 Terje Dalen, Truls V. Roaas, Håvard Lorås, Morten A. Aune, Tore K. Aune. *Nord University, Levanger, Norway.*
 Email: terje.dalen@nord.no
 (No relevant relationships reported)

A variety of training methods have been described in the literature to improve speed and agility. Step frequency, which is the rate at which steps can be reproduced, is one of the traditional step kinematic measure used to describe running technique. Previous research has illustrated the importance for faster acceleration (Murphy, Lockie, & Coutts, 2003). This has led athletes to investigate time in different step frequency training (i.e. ladder training) in order to gain increase in sprint or acceleration performance. **PURPOSE:** The purpose of this study was to investigate the association between two different step frequency test, sprinting and agility performance in sport science students. In addition, we aimed to investigate any gender differences in the association between variables. **METHODS:** The present study used a correlational research design in order to investigate the association between step frequency test (anterior-posterior and medial-lateral), agility test (5+5 meter) and 20-meter sprinting performance. Twenty-one male (height 181.1 cm, mass 79.6 kg) and seventeen female students (height 169.9 cm, mass 68.9 kg) sport science were included as subjects in the study. All subjects performed two different step frequency tests (anterior-posterior and medial-lateral), one agility test and a 20-meter sprint test. Pearson's correlation analysis were used in order to investigate the association between step frequency and sprint and agility performance. **RESULTS:** Overall, modest correlations between step frequency (anterior-posterior and medial-lateral) and sprint performance ($r=0.36$ and $r=0.42$, respectively ($p<0.05$)). In addition, this study found correlation between agility test and sprint test ($r=0.53$, ($p<0.001$)). No correlation were found between either of the step frequency tests and the agility test (5+5 meter). **CONCLUSIONS:** This study found modest association between step frequency tests and 20-meter sprint performance in sport science students. The fact that no association was found between step frequency tests and the agility test makes it difficult to conclude any relationship between step frequency test performance and acceleration performance.

3462 Board #150 June 1 9:30 AM - 11:00 AM

Do Physical Activity Behaviors Predict Fitness Gains To An Aerobic Exercise Trial?

Ryan J. Dougherty¹, Elizabeth A. Boots², Ozioma C. Okonkwo¹, Dane B. Cook, FACSM¹. ¹University of Wisconsin - Madison, Madison, WI. ²University of Illinois at Chicago, Chicago, IL. (Sponsor: Dane B. Cook, FACSM)

(No relevant relationships reported)

PURPOSE: Investigate whether baseline physical activity behaviors predict aerobic fitness adaptations following an individualized structured exercise intervention in an older adult population.

METHODS: Twenty-four cognitively healthy adults (age=64.8±4.6 years) from the Wisconsin Registry for Alzheimer's Prevention participated in this study. Subjects were randomized to an individualized 6-month treadmill training program (3x week; 70-80% heart rate reserve) or a control group. Baseline and post-intervention measurements included a maximal exercise test and 7 days of physical activity monitoring via accelerometry. Aerobic fitness was defined as the highest oxygen consumption (VO_{2peak} , ml/kg/min) value recorded during the exercise test and physical activity was defined as total minutes spent in moderate-vigorous physical activity. A repeated measure ANOVA design, adjusted for age, gender, APOE status, and BMI was used to examine changes in fitness. Bivariate Pearson correlations were used to investigate 1) the relationship between baseline physical activity and baseline fitness across the entire group (n=24) and 2) baseline physical activity and changes in fitness ($\% VO_{2peak}$) within participants randomized to the exercise intervention (n=12).

RESULTS: For the entire sample, baseline physical activity was significantly and positively associated with baseline fitness ($r = .452$; $p = .026$). Demonstrating the effectiveness of our trial we observed a significant group by time interaction for fitness ($p = .018$; $\eta^2_p = .260$), participants randomized to aerobic exercise displayed on average, a 17.5% increase in their fitness level. This observed fitness adaptation was weakly associated to baseline physical activity behaviors ($r = .25$).

CONCLUSIONS: Six-months of aerobic exercise training significantly improved fitness levels in our older adult population. As expected, baseline physical activity and fitness were positively associated. However, baseline physical activity did not predict aerobic fitness gains to a structured exercise training program. Future exercise trials with larger sample sizes are needed to determine whether it is necessary to recruit inactive participants.

3463 Board #151 June 1 9:30 AM - 11:00 AM

Body Composition Assessment Does Not Improve Prediction of VO_{2max} Using a Yo-Yo Intermittent Shuttle Test

Sherry Barkley, FACSM, Brooke Bleeker. *Augustana University, Sioux Falls, SD.*

Email: sherry.barkley@augie.edu

(No relevant relationships reported)

The gold standard for determining aerobic fitness is VO_{2max} testing, a time-consuming test which requires expensive equipment. The Yo-Yo Intermittent shuttle test is a field test purported to provide a more soccer-specific estimate of aerobic fitness, but its validity varies with the population being tested.

PURPOSE: To determine whether the addition of anthropometric measures and body composition data would strengthen the predictability of the Original Yo-Yo (YYO) test for estimating VO_{2max} for collegiate women soccer players.

METHODS: Division II female soccer players who completed fitness assessments as part of their normal pre-season evaluation were invited to participate. Thirty-one women (18-23 yrs) consented and 29 completed assessments. Fitness assessments were conducted during fall camp on a rest day. Measures of height, weight, waist circumference, and sum of 7 skinfolds were collected by a trained investigator; body fat percentage was estimated with the Bod Pod; VO_{2max} was measured on a motor driven treadmill with gas analysis using a ParvoMedics TrueOne metabolic system. The Yo-Yo test was performed as a group two days later. Regression analysis was used to determine which variables impacted the prediction equation, and correlation analysis was used to compare the original (YYO) and revised (YYR) Yo-Yo formulas against measured VO_{2max} .

RESULTS: Analysis showed that the Yo-Yo distance ($p = .00075$) but not anthropometrics and body composition ($p > 0.05$) significantly impacted the VO_{2max} prediction resulting in the following YYR formula: $VO_{2max} = (0.00574 \times \text{Yo-Yo distance (m)}) + 30.952$. Measured VO_{2max} (45.2 ± 1.1 ml/kg/min) was correlated with predicted VO_{2max} from YYR ($45.4 \pm .67$ ml/kg/min, $r = .58$) and YYO ($57.6 \pm .98$ ml/kg/min, $r = .58$).

CONCLUSION: The addition of body composition variables did not strengthen the ability of the Yo-Yo Intermittent shuttle test to accurately predict VO_{2max} in women soccer players.

3464 Board #152 June 1 9:30 AM - 11:00 AM

Ability Of Oddvar-holton Diagram To Predict Repetitions Achieved At 60% And 80% Loads In Females.

Peter M. Magyari, FACSM¹, Caleb Williams², Jeff T. Wight³, Mike Anton⁴. ¹University of North Florida, Jacksonville, FL. ²LaGrange College, LaGrange, GA. ³Jacksonville University, Jacksonville, FL. ⁴Airrostri Rehab Centers, San Antonio, TX.

(No relevant relationships reported)

To determine the appropriate load for resistance training (RT), exercise professionals (EPs) commonly have clients complete one repetition maximum (1RM) testing. Then, submaximal loads can be easily estimated for RT sessions and expected repetitions can be determined utilizing published prediction tables. **PURPOSE:** To determine the ability of Oddvar Holton (OH) diagram to accurately predict repetitions achieved at 60% and 80% loads in female lifters. **METHODS:** Participants were 19 college-aged (25 ± 4.3 years) females with a minimum of 2 months RT experience (average experience 76 ± 42 months). Three exercise sessions were completed under the supervision of certified EPs. For session one, 1RM testing was completed. For sessions two and three, participants completed as many reps as possible for 60% 1RM or 80% 1RM (load and order was randomized) for 8 cam-mediated variable resistance training exercises (bench press, leg press, shoulder press, pull-down, knee extension, knee flexion, elbow extension, and elbow flexion). First, for all 8 exercises, an error-score was calculated (for each individual) by comparing the actual number of repetitions completed to the OH 1RM prediction diagram. The OH predicted values for 80% 1RM and 60% 1RM were 11 reps and 30 reps, respectively. Then, for each exercise, the overall error score was calculated (mean error for all 19 subjects). A t-test was utilized to determine differences in mean error score between loads. **RESULTS:** For most exercises, the repetitions achieved deviated substantially from the expected repetitions (14 of 16 exercises deviated by 3+ repetitions). These findings were most extreme at lower loads: 60% load error scores (11.9 ± 2.7 reps) were significantly greater ($p < 0.01$) than 80% loads error scores (3.9 ± 1.4 reps). **Conclusion:** Considerable variability exists among females in the repetitions achieved versus the repetitions predicted by OH. In all exercises, greater deviations from expected values occurred at lower loads.

3465 Board #153 June 1 9:30 AM - 11:00 AM

Maximal Oxygen Consumption Prediction Equation For Athletes Undergoing Cardiopulmonary Exercise Testing On A Treadmill Ramp Protocol

Rodrigo P. Silva¹, Camila Duarte², Cássia Campi², Alan Barbosa¹, Bárbara Gonze¹, Evandro Sperandio¹, Marcello Romiti³, Antônio Gagliardi³, Rodolfo Arantes³, Victor Dourado¹. ¹Federal University of São Paulo (UNIFESP), Santos, Brazil. ²Metropolitan University of Santos (UNIMES), Santos, Brazil. ³Angiocorpore Institute of Cardiovascular Medicine, Santos, Brazil.

(No relevant relationships reported)

PURPOSE: To develop an equation for predicting VO_{2max} in athletes submitted to cardiopulmonary exercise test (CPT) using a treadmill ramp protocol. Secondly, we evaluated the influence of the use of supplements on VO_{2max} .

METHODS: 77 athletes were evaluated in a cross-sectional design. 65 percent of them were men (34.7 ± 7.9 years, BMI 24.7 ± 3.3) and 35 percent were women (36.8 ± 11.1 years, BMI 22.7 ± 2.5). The sample consisted of 66 percent of athletes practicing endurance sports, of which 55 percent were runners or triathletes. After participants answered an inquiry about the use of dietary supplements, time of practice and the weekly training volume, they underwent anthropometric evaluation, spirometry and CPT. CPT was performed on a treadmill using ramp protocol, where increments in speed and incline were empirically individualized. At least 14 mL/min/kg were added to the VO_{2max} estimate of active performers so that the test lasted 10 minutes on average. Following univariate analysis, we evaluated the predictors of VO_{2max} using stepwise multiple linear regression analysis.

RESULTS: BCAA (39 percent), creatine (13 percent) and whey protein (43 percent) were the most frequent responses in the survey about the use of supplements. VO_{2max} was 51.8 ± 9.2 and 44.1 ± 7.5 mL/min/kg for men and women respectively. In the univariate analysis significant correlations were found ($p < 0.05$) between VO_{2max} and age, sex, BMI, practice time, endurance sport modality, running practice, use of BCAA, use of creatine and use of supplements in general. In the multivariate model, running practice, age, BMI, sex, weekly training volume and supplement use in general together accounted for 68.4 percent of total VO_{2max} variability. The equation was: $VO_{2max} \text{ (ml/min/kg)} = 84.78 + (5.53 \times \text{running}) - (0.39 \times \text{age}) - (1.42 \times \text{BMI}) + (8.05 \times \text{sex}) + (0.21 \times \text{training volume}) + (2.95 \times \text{use of supplements})$.

CONCLUSIONS: The developed equation allows for individualized assessment of athletes using ramp warm-up protocol, as well as exploring dynamic physiological variables that are not properly evaluated in traditional staggered protocols.

3466 Board #154 June 1 9:30 AM - 11:00 AM

Predicting Metabolic Costs Of Heavy BackpackingDavid P. Looney, Peter N. Frykman, Laurie A. Blanchard, Christopher R. Chalmers, Eric O. Hansen, Everett A. Harman, Holly L. McClung, Scott J. Montain, FACSM, Adam W. Potter, William R. Santee. *USARIEM, Natick, MA.* (Sponsor: Dr. Scott J. Montain, FACSM)*(No relevant relationships reported)*

The US Army Load Carriage Decision Aid (LCDA) is a planning tool composed of biomedical models that predict Warfighter physiological responses during dismantled operations. The LCDA's metabolic model requires new equations to accurately predict the added metabolic cost of carrying varying types and amounts of military equipment. **Purpose:** Develop an equation for the LCDA metabolic model that better predicts the metabolic costs of carrying backpack loads.

Methods: Thirteen studies in which volunteers walked while carrying heavy pack loads were obtained for analysis. Treadmill speeds ranged between 1.1 - 1.8 m·s⁻¹ with maximum pack loads exceeding 55% body mass. We used k-fold cross-validation to test how well the new model generalized to new data. Equivalence of predicted and measured metabolic rates was tested using the two one-sided t-test (TOST). We compared the new backpacking equation's accuracy against the LCDA graded walking equation using the Concordance Correlation Coefficient (CCC).

Results: Predictions from the LCDA metabolic model were statistically equivalent to metabolic rates measurements during each step of the k-fold cross-validation ($p < 0.05$). Predictions from the new backpacking equation had a much higher correlation with measured energy expenditures (CCC, 0.93) than the existing LCDA graded walking equation (CCC, 0.44). The median absolute error was considerably lower for the backpacking equation (0.46 ± 0.36 W·kg⁻¹) versus the existing LCDA graded walking equation (1.61 ± 1.32 W·kg⁻¹).

Conclusions: The LCDA metabolic model accurately predicts the metabolic costs of backpacking. Military mission planners, backpackers, and trail walker can rely on improved guidance from the LCDA metabolic model for training, nutritional intake, and heat injury prevention.

The views expressed in this abstract are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government.

3467 Board #155 June 1 9:30 AM - 11:00 AM

Accuracy Of Indirect Calorimetry And Predictive Equations For The Measurement Of Resting Metabolic RateJason D. Waggoner. *Southeast Missouri State University, Cape Girardeau, MO.* (Sponsor: Thomas J. Pujol, FACSM)
Email: jwaggoner@semo.edu*(No relevant relationships reported)*

Indirect calorimetry is used to measure oxygen consumption for estimating resting metabolic rate (RMR). Laboratory devices are available for the measurement of RMR, such as the BodyGem[®] indirect calorimeter and the Vacumed VO₂ Lab metabolic measuring system. Established prediction equations, such as the Mifflin-St. Jeor (MSJ), Harris-Benedict (HB), and Fleisch, can also be used to provide an estimate of RMR.

PURPOSE: The purpose of this study was to compare the RMR of college-aged participants measured using a BodyGem[®] indirect calorimeter, a Vacumed VO₂ Lab metabolic cart, and established prediction equations. **METHODS:** Each participant (male = 15; female = 15; age = 22.7 ± 3.3 yrs; wt = 77.5 ± 14.5 kg; ht = 173.5 ± 9.6 cm) completed a thirty-minute supine resting session in a quiet environment. Five minutes of resting data were then collected using the Vacumed while in the supine position. Immediately thereafter, five minutes of resting data was collected using the BodyGem[®] indirect calorimeter while in the seated position. The RMR values for the HB and Fleisch prediction equations were calculated using the proprietary software utilized by the Vacumed metabolic system, while the MSJ estimate of RMR was hand-calculated. **RESULTS:** A repeated measures ANOVA showed a significant difference among the measurement methods (BodyGem[®] = 1995.0 ± 540.5 kcal; Vacumed = 1520.9 ± 452.5 kcal; MSJ = 1669.3 ± 242.9 kcal; HB = 1749.0 ± 275.1 kcal; Fleisch = 1690.3 ± 220.7 kcal) ($p < 0.001$). A Post hoc paired samples t-test indicated RMR measured using the BodyGem[®] was significantly higher than the Vacumed, HB, Fleisch, and MSJ ($p < 0.01$). The HB estimation of RMR was greater than that of the Vacumed measurement ($p < 0.025$). For the equations, the RMR estimate of the Fleisch was higher than the MSJ ($p < 0.025$), while the HB was greater than both the Fleisch and the MSJ ($p < 0.01$). **CONCLUSION:** The Vacumed VO₂ Lab metabolic cart measured RMR closer to the prediction equation estimates compared to the BodyGem[®] indirect calorimeter. Further research needs to be conducted comparing laboratory instruments to established prediction equations, on various populations, before those methods can be deemed accurate for measuring RMR.

G-38 Free Communication/Poster - TrainingSaturday, June 1, 2019, 7:30 AM - 11:00 AM
Room: CC-Hall WA2

3468 Board #156 June 1 8:00 AM - 9:30 AM

Effects Of A Pre-season Intervention On Hydration In Female Collegiate Volleyball AthletesAlyssa M. Pollard-McGrandy¹, Brian C. Rider², Adam M. Coughlin¹. ¹*Saginaw Valley State University, University Center, MI.* ²*Hope College, Holland, MI.* (Sponsor: Tamara Hew-Butler, FACSM)*(No relevant relationships reported)*

Urine specific gravity (USG) is commonly utilized to assess hydration status. Athletic performance has been shown to be affected by hydration status. In addition to nutritional and hydration practices, environmental conditions can also influence hydration status. Therefore, healthcare professionals should also consider environment, both indoor and outdoor, when assessing hydration. **PURPOSE:** To compare base-line USG to season-long urine collections following a one-time, pre-season hydration intervention. **METHODS:** Fourteen NCAA Division II female collegiate volleyball athletes participated in this study. Urine was collected in sterile cups in the hours preceding either a game or practice. Collections were roughly two weeks apart, starting August 25th and ending November 4th, 2017, resulting in eight total collections. The hydration intervention consisted of information and guidelines presented to the team and coaching staff. The intervention was administered verbally immediately following base-line urine collection. Written guidelines were left with athletes and coaching staff. Urinalysis was conducted via reagent strips. Data was analyzed via SPSS v.22 with an a priori level of 0.05. Subsequent urinalyses were compared to the baseline urinalysis. **RESULTS:** USG statistically decreased from base-line to the second collection and did not statistically differ again until the final three collections (base-line = 1.021±0.008, 1.007±0.003*, 1.015±0.008, 1.013±0.006, 1.020±0.016, 1.014±0.005*, 1.011±0.008*, and 1.013±0.003*, * $p < 0.05$ compared to baseline). **DISCUSSION:** The hydration intervention illustrated a short-term effect on USG. A correlation between USG and environmental temperatures was evaluated post hoc for the final six urine collections, arguably when the effects of the intervention had subsided. The coefficient of determination (r^2) revealed that 35.7% of the difference in USG was due to the environmental temperature, which was statistically significant ($r = 0.597$, $p < 0.05$). **CONCLUSION:** The intervention appeared to have a limited impact on USG. Differences in USG were evident again later in the season (late October to early November). Further analysis demonstrated a statistical influence of cooler temperatures on lower USG near the end of season.

3469 Board #157 June 1 8:00 AM - 9:30 AM

The Effects of Back Squats and Front Squats on Sprint Speed and Vertical Jump within Active IndividualsAfton Staheli Balderree, Mark DeBeliso, FACSM. *Southern Utah University, Cedar City, UT.**(No relevant relationships reported)*

The back squat (BSQ) is among the most popular resistance training (RT) modalities for the purpose of increasing muscular strength and power output. Front squats (FSQ), while not as popular as the BSQ, are arguably another squat modality that may improve muscular strength/power. **PURPOSE:** This study compared the effects of performing the BSQ and FSQ on squat strength, sprint speed, and vertical jump (VJ). **METHODS:** Active individuals both male ($n=9$, age: 30.6±7.6 yrs, height: 179.1±3.8 cms, mass: 87.8±7.8 kgs) and female ($n=16$, age: 29.4±6.5 yrs, height: 165.3±5.9 cms, mass: 68.5±10.7 kgs) were separated into two groups via a randomized matched pair design based on initial one repetition maximum (1-RM) squat strength. Both experimental groups employed linear periodization RT protocols differing only in that one group executed the BSQ and the other group performed the FSQ as the lower body exercise. No additional lower body auxiliary movements were performed in the study. The dependent variables (DV's) of VJ, 36.6 meter sprint speed, and 1-RM squat strength were collected prior to and following the 6-week RT period. Dependent t-tests were used to compare the DV's from pre to post RT intervention within experimental groups. Independent t-test were used to compare the gain scores for each of the DV's between experimental groups. **RESULTS:** The VJ had a significant improvement from pre to post RT for both the BSQ (pre: 52.9±10.1, post: 56.0±10.9 cm) and FSQ (pre: 47.4±10.9, post: 49.9±12.1 cm) groups ($p < 0.05$). The 36.6 m sprint improved significantly from pre to post RT for both the BSQ (pre: 5.9±0.7, post: 5.6±0.5 sec) and FSQ (pre: 6.3±0.7, post: 5.8±0.6 sec) groups ($p < 0.05$). The squat 1-RMs also improved significantly from pre to post RT for both the BSQ (pre: 100.5±34.2, post: 110.3±36.6 kgs) and FSQ (pre: 77.8±31.0, post: 87.5±29.1 kgs) groups ($p < 0.05$). When comparing gain scores between each group there were no significant differences between the BSQ and FSQ groups for any of the DV's ($p > 0.05$). **CONCLUSION:** Within the parameters of this study, both FSQ and BSQ RT programs improved muscular strength, power and

sprint speed in active individuals. Coaches and active individuals may consider the FSQ and BSQ as interchangeable squat modalities providing squat modality variability within RT protocols.

3470 Board #158 June 1 8:00 AM - 9:30 AM
Impact Forces When Exercising On The Freebouncer™

John Porcari, FACSM, Megan Thiel, Nagmeh Gheidi, Susan Bramwell, Abigail Ryskey, Carl Foster, FACSM. *University of Wisconsin-La Crosse, La Crosse, WI.*
 (No relevant relationships reported)

The Freebouncer™ Fitness and Rehab Machine consists of a spring-loaded platform attached to a metal frame and has characteristics similar to those of a mini-trampoline. The Freebouncer™ purportedly reduced the impact forces on the lower body during an aerobic workout. **PURPOSE:** This study was designed to compare the ground reaction forces (GRF) and loading rate (LR) when subjects exercised on the Freebouncer™ compared to walking and running on a treadmill and double leg-bouncing on a mini-trampoline. **METHODS:** Eighteen volunteers (9 M and 9 F) between 19-28 years of age completed 4 conditions, in random order: walking at 3.0 mph on a motorized treadmill, running at 6.0 mph on a motorized treadmill, double-leg bouncing on a mini-trampoline at 80 jumps/min, and double-leg bouncing on the Freebouncer™ at 60 bounces/min. During all testing plantar forces were collected using Loadsol in-shoe sensors. Data were recorded during the last 10 seconds of each trial, with 5 representative strides being analyzed for GRF and LR. **RESULTS:** The GRF (Freebouncer™ = 564 ± 126.2 , walking = 918 ± 232.5 , mini-trampoline = 1415 ± 353.2 , running = 1668 ± 395.4) and LR (Freebouncer™ = 518 ± 260.2 , walking = 5315 ± 1094.1 , mini-trampoline = 7454 ± 1898.1 , running = 14555 ± 3895.7) when exercising on the Freebouncer™ were significantly lower ($p < .05$) when compared to walking and running on a treadmill and double-leg bouncing on a mini-trampoline. **CONCLUSION:** These findings suggest that the Freebouncer™ is an excellent low-impact option for individuals looking for an alternative aerobic exercise modality compared to more traditional modes of exercise.

3471 Board #159 June 1 8:00 AM - 9:30 AM
Effects of Whole Body Vibration Training on Muscular Strength and Balance Ability of Elderly Men

Li Peng, Jie Zeng, Li Huang. *South-West University, Chongqing, China.* (Sponsor: Weimo Zhu, FACSM)
 (No relevant relationships reported)

PURPOSE: As we age, various functional functions of our body such as muscular strength and balance ability will gradually decline. The decline of muscular strength associated with aging is a major cause of decreased balance ability and gait instability. The purpose of this study was to examine the effects of whole-body vibration training (WBVT) on muscular strength and balance ability of elderly men. **METHODS:** 30 elderly men aged 60-79 years, who met the inclusion criteria, were recruited and randomly assigned into training and control groups. Training group carried out 12-wk WBVT at the same amplitude (3mm) and frequencies (25-30Hz) on the Power-Plate vibration platform, while control group had no any training. Muscular strength of back and knee, static and dynamic balance ability were measured respectively by portable digital muscle strength tester (microFET3, American) and dynamic balance assessment training system (Biodex-950-440, American) before and after the experiment. **RESULTS:** The core and lower extremity muscular strength of the subjects in training group were significantly enhanced after 12-wk WBVT, with the average increase of dorsal extensor muscular strength by 15.3% and extensor knee muscular strength by 7.42%; with the eyes open, the overall (1.93 ± 0.49 vs. 1.70 ± 0.27), left-and-right (1.71 ± 0.42 vs. 1.57 ± 0.51) static balance index decreased significantly and the overall (4.86 ± 0.21 vs. 3.41 ± 0.29), fore-and-aft (4.51 ± 0.30 vs. 2.53 ± 0.14), left-and-right (4.21 ± 0.26 vs. 2.95 ± 0.18) static balance index with the eyes closed also decreased significantly; the dynamic balance scores in the front (36.63 ± 12.41 vs. 38.72 ± 16.27), left (43.95 ± 16.42 vs. 47.52 ± 16.51) and right (44.34 ± 14.92 vs. 47.39 ± 18.91) enhanced significantly. Meanwhile, there was no obvious change in muscular strength and balance ability in the control group at the end of experiment. **CONCLUSIONS:** It was concluded that the core and lower extremity muscular strength as well as static and dynamic balance of elderly men could be improved with a 12-wk WBVT.

3472 Board #160 June 1 8:00 AM - 9:30 AM
Energy Contributions of Short-distance Running with Change of Direction in Tennis Baseline Practice

Bo Li, Xiaotian Li, Lu Jin, Yuchao Cao, Xinxin Wang, Lv Miao, Wei Yang, Yongming Li. *Shanghai University of Sport, Shanghai, China.* (Sponsor: Carl Foster, FACSM)
 Email: 412001625@qq.com
 (No relevant relationships reported)

Short-distance running with change of direction (SR-COD) is one of the baseline practice regularly performed in tennis training, but the energy contributions of this practice is relatively lacking.

Purpose: To investigate the energy contributions of tennis SR-COD, with the emphasis on the duration, distance, and frequency.

Methods: 16 collegiate male tennis players (22.2 ± 1.7 yrs, 175 ± 5 cm, 69.2 ± 6.1 kg) volunteered to this study. Two duration (1 and 2 min), two distance (1 and 2 min) and two frequency (20 and 30 stroke/min) were utilized, i.e. 1min-2m-20stroke/min, 2min-2m-20stroke/min, 1min-4m-20stroke/min and 1min-2m-30stroke/min. A portable spirometric system (K4b², Cosmed, Italy) was utilized to measure the ventilatory activities. Capillary blood from earlobe was collected and analyzed with blood lactate analyzer (Biosen C-line, EKF, Germany) prior to and post the test. The aerobic (Aer), anaerobic lactic (Anl), anaerobic alactic (Anal) energy contributions were calculated with the method based on the accumulated oxygen uptake and blood lactate during the practice, as well as the fast part of the oxygen uptake kinetics during the recovery. The relative energy contributions from the corresponding three pathways were also calculated as Aer%, Anl%, and Anal%.

Result: The energy contributions of SR-COD was Anal 37.4~40.1kJ (32.1~41.7%), Anl 15.1~33.5kJ (14.8~30.4%) and Aer 37.8~100.8kJ (33.9~61.9%), respectively. With the increase of duration, distance and frequency, there was no significant change in Anl, there was significant increase in Anal and Aer ($P < 0.05$, except Aer when increasing frequency). Further, %Anal decreased with the increase of duration, distance, and frequency ($P < 0.05$). %Anl enhanced significantly with the increased distance and frequency ($P < 0.05$), but declined insignificantly with increased duration ($P < 0.05$). %Aer increased significantly with longer duration ($P < 0.05$), but reduced with longer distance and higher frequency ($P < 0.05$).

Conclusion: Longer duration of SR-COD mainly increases the stimulation on Aers system, while longer distance and higher frequency of SR-COD mainly increases the stimulation on Anl energy. These findings should be taken into account when designing the SR-COD training program in tennis.

3473 Board #161 June 1 8:00 AM - 9:30 AM
The Effects Of Leg-drive On Bench Press Performance: Results Of A 5-week Training Study

Jacob K. Gardner¹, Kelsey L. Miller¹, Justin T. Chia², Brent Peterson¹. ¹*Biola University, La Mirada, CA.* ²*Western Washington University, Bellingham, WA.*
 Email: jake.gardner@biola.edu
 (No relevant relationships reported)

Among common resistance training methods, the bench press is often implemented to train upper body strength. Recently, curiosity regarding the potential impact of lower extremity involvement on overall bench press performance has gained in popularity. While the effectiveness of bench press training on strength has been shown in the literature, many suggestions as to the importance of leg-drive have been offered. Yet, to our knowledge, no studies have evaluated the impacts of leg-drive technique on bench press performance. **PURPOSE:** To determine if bench press training with leg-drive elicits similar strength characteristics to a standard bench press in strength and body fat measures after 5 weeks of bench press only training. **METHODS:** 23 apparently healthy, college-age men were randomized into two groups: standard bench press (STD) ($n = 12$, age 22.2 ± 2.3 yrs, height 173.2 ± 6.8 cm, mass 75.1 ± 7.5 kg), and leg-drive (LD) ($n = 11$, age 22.5 ± 1.9 yrs., height 176.8 ± 5.0 cm, mass 82.0 ± 10.4 kg). Pre and post analyses of bench press 1-repetition maximum (1RM), and changes in body fat percentage were conducted. Average bench-press volume was determined on a weekly basis. The training consisted of two sessions per week for five weeks of either standard bench press or bench press using leg-drive. For each session, participants completed four sets of bench press to volitional fatigue at 80% of his 1RM. During week three of training, a new 1RM was conducted to determine whether to move the participant up in weight. A 2 x 2 repeated measures ANOVA (RMANOVA) was conducted for 1 RM and body fat, and a 2 x 5 RMANOVA was conducted for average weekly lifting volume. **RESULTS:** Significant condition main effects were found with both groups experiencing an approximate 5% increase in 1RM strength (p -values < 0.001), and an approximate 0.5% reduction in body fat percentage ($p = 0.040$). A condition main effect was found for average lifting volume ($p = 0.041$) and post-hoc analysis revealed that week three was significantly higher than all other weeks. No significant group main effects were observed for any of the variables (all p -values $>$

0.05). **CONCLUSIONS:** Five weeks of bench press training did result in favorable strength outcomes for both groups, but leg-drive focused training did not produce noticeable changes in performance compared to the standard bench press.

3474 Board #162 June 1 8:00 AM - 9:30 AM
Effect of Vibration Intervention on Balance, Core Stability and Muscle Strength in Martial Arts Athletes
 kun wang, junzhi sun. *Chengdu Sport Institute, Chengdu, China.*
 Email: 464535162@qq.com
(No relevant relationships reported)

Objective: To compare the effects of vibration training(V)and control training(C)on balance, core stability and muscle strength in young martial arts athletes. **Methods:** Fourteen athletes were recruited and randomly assigned to two groups:vibration group(V, n=7)and control group(C, n=7). Before and after the 12 weeks training, The SMART Balance Master system was used to measure scores in the limits of stability(LS): reaction time(RT), movement velocity(MVL), end point excursion(EPE), maximum excursion(MXE), and directional control(DCL). The core stability is evaluated by the performance of grade 8 abdominal bridge. Core muscle strength are indirectly evaluated by integrating electromyography (iEMG). Student t-tests were used for data analysis. **Results :** MVL(1.37 deg/sec, P < 0.01),EPE(10.86%,P < 0.01),MXE(7.00%,P < 0.05),DCL(2.86%, P < 0.05)in group V were significantly higher after the Vibration Intervention . EPE (8.86%,P < 0.01),MXE(4.43%,P < 0.01)in group C were higher after the control training . The percentage range was higher in group V(8.29%)than C(4.50%). No significant differences were found in LS between the groups at 12 weeks of follow up. The full score of grade 8 abdominal bridge was obtained in the vibration group, and the overall Range was higher in group C than group V(P < 0.01). The scoring of core stability also revealed no differences between the groups. In group V left rectus abdominis iEMG value(nearly 100% mV·s ,P < 0.01), left rectus femoris(0.71 mV·s,P<0.05) , left tibialis anterior (0.39 mV·s, P<0.05)were higher after 12 weeks training .In group C left rectus femoris (0.42 mV·s, P < 0.01), left tibialis anterior (0.12 mV·s ,P < 0.05) were higher after 12 weeks training . After 12 weeks training, the iEMG value of left tibialis anterior(0.63 mV·s ,P < 0.01),right rectus abdominis (0.34 mV·s ,P < 0.05) in group V were higher than C. There were no significant differences in the right erector spinae, left Rectus abdominis, left rectus femoris, left erector spinae and left gluteus maximus between group V and C. **Conclusion:** Vibration training improved balance, core stability and muscle strength of movements in young martial arts athletes.

3475 Board #163 June 1 8:00 AM - 9:30 AM
Quantifying Training Loads During High-Intensity Functional Training: Session-RPE Method
 Justin DeBlauw. *Kansas State University, Manhattan, KS.*
 Email: jdeblauw@ksu.edu
(No relevant relationships reported)

High intensity functional training (HIFT), due to its constant variance and multi-modal approach presents a unique challenge in quantifying external loads. The session rate of perceived exertion (sRPE) method has been shown valid in determining training loads (TL) in a variety of sports. However, sRPE has yet to be psychometrically evaluated within HIFT. **PURPOSE:** To estimate the psychometric properties of the sRPE method within HIFT. **METHODS:** Twenty-five healthy, recreationally active men (n=13; age = 22.6 ± 3.5 years; body mass = 86.1 ± 13.9 kg; height = 182.8 ± 8.1 cm) and women (n=12; age = 21.0 ± 1.5 years; body mass = 70.5 ± 11.3 kg; height = 165.6 ± 5.7 cm) participated in six weeks (5 d·week⁻¹) of HIFT. Heart rate was continuously monitored throughout each training session and rate of perceived exertion was recorded immediately following daily workouts completion. Daily TL was quantified using sRPE and compared to two heart rate-based criterion methods (i.e., Edwards' TL and Banister's TRIMP). **RESULTS:** In training block 1 (i.e., weeks 1-3), sRPE significantly predicted both Edwards' TL (n = 271, r = 0.81, p < 0.001; R² = 0.67, 95% CI = 0.60–0.73) and TRIMP (n = 260, r = 0.43, p < 0.001; R² = 0.18, 95% CI = 0.10–0.27). In training block 2 (weeks 4-6), these associations remained significant but also improved in their predictive capability for both Edwards' TL (n = 268, r = 0.88, p < 0.001; R² = 0.78, 95% CI = 0.73–0.82) and TRIMP (n = 258, r = 0.57, p < 0.001; R² = 0.33, 95% CI = 0.23–0.42). However, reliability estimates (n = 554, ICC = 0.58, 95% CI = 0.52–0.63, p < 0.001; CoA = 52%) between perceived exertion and HR were generally poor. **CONCLUSION:** We observed the sRPE method was a valid tool across individual, group, and sex levels when compared to criterion heart rate-based measures. However, the utility of this strategy within HIFT is limited due to poor reliability in participants' abilities to correctly match their perceived exertion with the relative level of physiological effort (i.e., percentile of maximum heart rate). Over time, however, these participants demonstrated the ability to improve agreement between perceived and actual effort. Future investigations should continue to explore the potential utility of this monitoring strategy with HIFT interventions.

3476 Board #164 June 1 8:00 AM - 9:30 AM
Training Intensity Distribution In A Chinese Top-level Women's Single Sculls Rower Preparing For 2008 Olympic Games Season
 Hongjun Yu¹, Xiaoping Chen², Wei Zi³. ¹*Tsinghua University, Beijing, China.* ²*China Institute of Sport Science, Beijing, China.* ³*He Nan University, Kai Feng, China.* (Sponsor: Carl Foster, FACSM)
 Email: yuhj12@mail.tsinghua.edu.cn
(No relevant relationships reported)

Purpose: This study was to report seasonal training intensity distribution characteristics in a Chinese top-level Women's Single rower during 2007-2008, while season preparing for 2008 Olympic Games. **Methods:** A Chinese top-level (33 y, height 177 cm, weight 71 kg) World Rowing Cup champion Women's Single Sculls rower participated in this case study. The season's training load included overall duration (calculated in hours and km), frequency (calculated by overall sessions), and training intensity (measured by blood lactate and estimated by heart rate), Her performances at World Cup and Olympic competitions during the seasons, and 2000m ergometer test were also collected and analyzed. **Results:** A training program of 46 weeks (33 weeks of pre-season and 13 weeks of in-season) was analyzed. 193 training days was performed during the season. Total training hours were 737 hours. Total training time consisted of 48.9% on-water rowing (362 hours), 9.18% ergometer rowing (68 hours), 15.2% condition training (112 hours), and 18.4% warm-up and recovery programs (136 hours). All training sessions were quantified using continuous heart rate monitoring, a subset of 117 training sessions was quantified using blood lactate measurements. Intensity distribution across rowing and ergometer training hours (n=489 hours) based on heart rate analysis and blood lactate analysis was 91.12% in zone 1 (74.5% ≤2.0 mM blood lactate, 16.8% between 2.1 and 3.5 mM blood lactate), and 4.13% in zone 2 (>3.5 and 5 mM blood lactate) and 4.75% in zone 3 (over 5mM blood lactate). 2000m ergometer trials performed in weeks 2, 12 and 24 was in times 6 minutes 57 seconds, 6 minutes 55 seconds and 6 minutes 46 seconds, respectively. Maximal power test was 309 W, 313 W and 334 W, respectively. Rowing performance improved 1.29% and 6.27% during the period. She finished the season in 3rd place in the World Cup and fourth place in the 2008 Olympic Games. **Conclusion:** Training-intensity distribution with an emphasis on low-intensity polarized training model led to the success in top Chinese top-level Women's Single Sculls rower in the 2007-08 season. Possible mechanisms underlying the association between intensity distribution and performance success require further investigation.

3477 Board #165 June 1 8:00 AM - 9:30 AM
Impact of Workload on Time-Loss Incidence Rates in Elite Rugby Union Players.
 Ben E.W. Cousins¹, John G. Morris¹, Caroline Sunderland¹, Mary E. Nevill¹, Anthony M. Bennett², Simon B. Cooper¹.
¹*Nottingham Trent University, Nottingham, United Kingdom.*
²*Swansea University, Swansea, United Kingdom.*
(No relevant relationships reported)

Rugby Union has one of the highest reported time-loss incidence rates of all professional team sports. However, the relationship between workload and time-loss incidence rate has not been well studied. **PURPOSE:** To investigate the impact of workload on time-loss incidence rates in elite Rugby Union players and compare different methods of workload quantification. **METHODS:** Sixty elite Rugby Union players were followed over one season (46 weeks) of competition. Workload was measured for all training and matches using subjective (RPE load; RPE x session duration) and objective (GPS; total distance and high-speed running (HSR) distance) methods and quantified using both the acute:chronic workload ratio (ACWR) and exponentially weighted moving average (EWMA). Chi-square analysis was used to examine the influence of workload on time-loss incidence rate. **RESULTS:** Of the 240 time-loss incidences that occurred across the season, 125 were contact injuries (106 during matches and 19 during training), 76 were non-contact injuries (25 during matches and 51 during training) and 39 were illnesses. Chi-square analysis showed that time-loss incidence rates were affected by ACWR RPE load (X²₍₅₎ = 12.3, p = 0.031), EWMA RPE load (X²₍₅₎ = 30.8, p < 0.01), EWMA total distance (X²₍₅₎ = 23.9, p < 0.01) and EWMA HSR distance (X²₍₇₎ = 18.0, p = 0.012), yet were unaffected by ACWR total distance (p = 0.067) and ACWR HSR distance (p = 0.894). EWMA RPE load and EWMA total distance exhibited an optimum range of 0.8-1.2 where actual time-loss incidence rate was lower than expected. Whereas for EWMA HSR distance values <1.0 led to a lower than expected time-loss incidence rate. ACWR RPE load had an optimum range of 0.6-1.2, whilst ACWR total distance and ACWR HSR distance did not affect time-loss incidence rates. **CONCLUSION:** This is the first study to compare different methods of workload quantification in elite Rugby Union and demonstrate that the EWMA method is better at explaining the variance in time-loss incidence risk compared to the ACWR method. When using the EWMA approach, an optimum range of 0.8-1.2 for RPE load and total distance and <1.0 for HSR distance demonstrated

a reduced time-loss incidence rate. These findings suggest that the EWMA of each individual player should be monitored to minimise time-loss incidence risk in elite Rugby Union.

- 3478** Board #166 June 1 8:00 AM - 9:30 AM
The Influence Of Combine Preparation Training Duration On NFL Combine Or Pro Day Performance
 Megan D. Jones¹, Jeremy Townsend¹, Jordan Luallen², William Vantrease¹, Ian Hunter¹, Ann Toy¹, Kent Johnson, FACSM¹.
¹Lipscomb University, Nashville, TN. ²Ignition Athletic Performance Group, Nashville, TN. (Sponsor: Dr. Kent Johnson, FACSM)
 Email: mdjones1@mail.lipscomb.edu
 (No relevant relationships reported)

For collegiate football players, an outstanding performance at the NFL scouting combine or an athlete's college pro-day may increase the likelihood of being drafted or signed to an NFL team. In recent years, it has become common for players to decline playing in bowl games to allow for additional preparation for combine and pro-day performance. **PURPOSE:** To determine if the duration of combine preparation training influences NFL Combine or Pro Day performance. **METHODS:** 23 college football players (22.6±0.51 y, 108.8±18.2 kg 1.88±0.07 m) completed a preparation training program leading up to the 2018 NFL combine and college pro-days. Prior to training, all players were assessed in the 40yd dash, 225 bench press test, 3-cone drill, pro-agility test, broad jump and vertical jump. Post-training values were obtained from the players combine or pro-day performances and athlete data were then allocated to two groups: (1) athletes who completed 9-10 weeks of training (n=11) and (2) athletes who completed 6-8 weeks of the same training program (n=12). Combine training consisted of 4 resistance training sessions per week with position and test specific training occurring 6 days a week for the duration of the program. An analysis of variance with repeated measures was used to assess differences in training outcomes for each variable. **RESULTS:** Significant ($p < 0.05$) main effects for time were observed for improvements in 40-yard dash times ($p = 0.046$), 3-cone drill time ($p = 0.002$), along with 225 bench press repetitions, vertical jump height, broad jump distance, and pro-agility drill time ($p < 0.001$). There were no significant group by time interactions for any of the physical performance tests. Out of the 23 participants, 3 players were drafted and were on active rosters for the 2018 NFL season, one participant was drafted and signed a practice squad contract, while 5 other participants signed undrafted free agent contracts with various NFL teams. **CONCLUSION:** It appears that length of combine preparation did not produce significant differences in pro day performance between the two groups. Therefore, NFL hopefuls can improve their combine performance even with a short duration combine training program.

- 3479** Board #167 June 1 8:00 AM - 9:30 AM
Table Tennis Training Results with Robot: Spin Rate and Hitting Speed in Forehand Loop-Drives
 Istvan Kovacs, Austin McClinton, Catherine Rauenzahn, Wenhao Liu, FACSM. Slippery Rock University, Slippery Rock, PA. (Sponsor: Wenhao Liu, FACSM)
 Email: istvan.kovacs@sru.edu
 (No relevant relationships reported)

PURPOSE: Limited studies have addressed spin rate (SR) and hitting speed (HS) in forehand loop-drive (FLD) among recreational table tennis players. This study examined how the use of a table tennis robot would improve SR and HS of the FLD among recreational table tennis players during a self-regulated training program. **METHODS:** Thirteen middle-aged (46.2 ± 18.3 yr., 8 males) players with 4.8 ± 4.1 yr. of recreational table tennis experience participated in an eight-week table tennis program that met twice a week with the purpose of increasing SR and HS in FLD. A pretest and posttest were conducted to assess average SR and HS from five consecutive FLDs performed by each participant against consistent backspin balls served by a table tennis robot. SR was assessed with high-speed video recordings at 480fs⁻¹, and HS was assessed at 60 fs⁻¹. Each training session included a 20-min practice of FLD against balls served by the robot. The ball, after its bounce on the table, arrived to the participants at the speed of approximately 2.9 ms⁻¹ with a SR of approximately 21 rs⁻¹, the same condition as that in the pretest/posttest. In training sessions, participants also studied written and visual instructional materials, and utilized self-regulated feedback (feedback from coaches was available only when requested). In addition, progress results of SR and HS were assessed and provided to each participant every two weeks. Differences in SR and HS between pretest and posttest were examined with paired-samples t test. **RESULTS:** Participants showed significant improvements during the training program in both SR and HS measurements ($p < .05$). SR demonstrated an 45.9% improvement from 41.6 ± 30.5 rs⁻¹ to 60.7 ± 31.6 rs⁻¹, and HS resulted in a 13.3% improvement from 8.57 ± 0.98 ms⁻¹ to 9.71 ± 1.22 ms⁻¹. **CONCLUSION:** The eight-week training with a robot significantly improved SR and HS in FLD for recreational table tennis players. The use of the robot and the biomechanical feedback for self-regulated training seem to be successful tools in developing SR and HS in

recreational table tennis setting, where working with a personal coach is often limited. The effective use of technology helps the middle-aged population to meet ACSM's recommendation for neuromotor exercise training.

- 3480** Board #168 June 1 8:00 AM - 9:30 AM
The Effects of Suspension Training in Lower Body Strength and Balance in Sedentary
 aksel celik¹, murat tutar². ¹indiana university bloomington, bloomington, IN. ²nisantasi university, istanbul, Turkey.
 Email: aksel.celik@deu.edu.tr
 (No relevant relationships reported)

ABSTRACT

Purpose: The aim of the study was to investigate the effects of suspension training in lower body muscle strength and balance in sedentary.

Methods: A total of 60 healthy, sedentary volunteer aged 30-45 years participated in this study. Participants were randomly divided into two groups that were suspension strength group (40,67±3 yrs) (SSG), and traditional strength group (TSG) (39,10±3,3 yrs). In SSG were applied suspension exercises 8 weeks, twice in a week, 40-45 min. In TSG were applied traditional strength exercises 8 weeks, twice in a week, 40-45 min. In both groups volunteers' anthropometric, hand grip strength, push-up, static squat, crunch, plank and balance performances were measured before and after 8 weeks training programs.

Results: As a result of the findings in this research which was made to determine the effects of suspension exercises on muscle strength development in sedentary individuals, suspension strength training studies differ from traditional strength training. At the end of eight-week strength training; all parameters in the suspension strength group and only squat (54,27±22,67 vs. 61,60±22,39, $p < 0.05$), crunches (21,00±4,01 vs. 24,23±6,05 $p < 0.05$), plank (54,73±19,47 vs. 58,53±23,76 $p < 0.05$), flexibility (25,10±9,38 vs. 27,33±9,11 $p < 0.05$) and balance (5,13±1,90 vs. 3,33±1,44 $p < 0.05$) parameters were found significantly in traditional strength group.

Conclusion: As a result, strength training (push-up, squat, crunches and plank) applied on unstable surfaces showed more improvement than traditional strength training. It is also thought that the suspension strength exercise method may be an alternative to force exercises and may be more useful for strength development.

Key words: Traditional Strength, Fitness, TRX

- 3481** Board #169 June 1 8:00 AM - 9:30 AM
Effects of Suspension Training and Unstable Surface on the Lower Limb
 Joan Aguilera-Castells¹, Bernat Buscà¹, Javier Peña², Mònica Solana-Tramunt¹, José Morales¹, Azahara Fort-Vanmeerhaeghe¹, Ainhoa Nieto¹. ¹FPCEE Blanquerna, Ramon Llull University, Barcelona, Spain. ²University of Vic-Central University of Catalonia, Vic, Spain.
 Email: joanae1@blanquerna.url.edu
 (No relevant relationships reported)

Unstable surfaces have been used to enhance the muscle activity (MA) in different strength and conditioning exercises. Some evidence supports that the unstable surface increases the motor unit recruitment and improves the neuromuscular coordination in order to maintain balance. Thus, an emerging trend is the utilization of suspension devices to increase the amount of instability.

Purpose: To examine the MA of the lower limb when perform a Bulgarian squat, suspended lunge and suspended lunge-Bosu.

Methods: Seventeen physically active university students (age = 24±3.31y, height = 1.78±0.06 m, weight= 74.99±9.39 kg) were recruited to perform a Bulgarian squat, suspended lunge and a suspended lunge-Bosu. The MA was assessed using sEMG on the front leg (FL) to measure the rectus femoris_FL (RF_FL), biceps femoris (BF), gluteus medius (Gmed), vastus medialis (VM), vastus lateralis (VL) and the RF of the rear leg (RF_RL). The activity of all analyzed muscle was expressed as percentage of maximum voluntary isometric contraction (% MVIC). A one-way repeated-measures ANOVA was carried out to determine the effect of exercise condition on MA.

Results: A main effect was found for exercise condition on muscle activation for RF_FL [$F_{(2,32)} = 7.678$ $p = 0.002$], BF [$F_{(2,32)} = 4.076$ $p = 0.026$], Gmed [$F_{(2,32)} = 33.878$ $p = 0.000$], VL [$F_{(2,32)} = 3.508$ $p = 0.042$] and RF_RL [$F_{(2,32)} = 5.704$ $p = 0.008$], except for VM [$F_{(2,32)} = 2.346$ $p = 0.112$]. The suspended lunge-Bosu showed a higher activation for RF_FL, Gmed, and VL (44.25%±4.78; 66.56%±4.84; 75.58%±4.48, respectively) respect Bulgarian squat (RF_FL: 33.13%±3.87 $p = 0.024$; Gmed: 47.97%±4.41 $p = 0.000$) and suspended lunge (RF_FL: 33.86%±3.82 $p = 0.006$; Gmed: 47.89%±3.21 $p = 0.000$; VL: 63.87%±4.69 $p = 0.041$). However, the suspended lunge-Bosu reached a lower activity for RF_RL (25.98%±2.60) in comparison with Bulgarian squat (RF_RL: 35.69%±4.19 $p = 0.025$).

Conclusions: These findings suggested that leaning the RL on the suspension device did not provoke the sufficient stimuli to increase the muscle demands of the FL, but adding the unstable device on the FL in a suspended lunge could be a challenge to

increase the MA. Funding for this project was provided by Secretaria d'Universitats i Recerca del Departament d'Empresa i Coneixement de la Generalitat de Catalunya i als Fons Socials Europeus.

3482 Board #170 June 1 8:00 AM - 9:30 AM
Developing Muscular Power vs. Muscular Endurance: Results from Two Different Push-ups Training Programs

Austin McClinton, Istvan Kovacs, Wenhao Liu, FACSM.
Slippery Rock University, Slippery Rock, PA. (Sponsor: Wenhao Liu, FACSM)
 (No relevant relationships reported)

PURPOSE: While development of muscular power (MP) vs. muscular strength (MS) requires the use of different repetitions, weights, and movement velocity, push-ups involve overcoming constant resistance (body) weight and might be able to develop both MP and ME, especially among beginning trainees. This study examined whether two different push-ups training programs, one focusing on MP and the other on ME, would influence the development of MP and ME of the upper body differently among novice trainees.

METHODS: A six-week push-ups training with three sessions each week was administered to 46 college students (mean age: 21.36±1.67). Participants had limited experience in resistance training, and were randomly assigned to the MP group (MPG) or the ME group (MEG), with each group having 14 males and 9 females. In each training session, the MPG performed six sets of ballistic plyometric push-ups with low (4-6 for females, 4-8 for males) repetitions at maximum velocity, and the MEG did six sets of regular push-ups with high (10-20 for females, 15-25 for males) repetitions. Two push-ups tests were administered before (pretest) and after (posttest) the six-week training: (a) four consecutive ballistic push-ups for average flight height (T1), calculated from the flight time provided by a contact mat, and (b) regular push-ups for maximum repetitions (T2). The test results were compared within and between groups. **RESULTS:** Paired-samples t-tests indicated significant within-group improvements in both push-ups tests ($p < 0.05$) in both groups. The MPG improved in T1 from 6.53±1.76 to 7.59±1.74 in., and in T2 from 26.63±13.31 to 30.08±8.93 reps. The MEG improved in T1 from 6.64±3.63 to 7.33±2.86 in. and in T2 from 23.4±13.31 to 26.9±11.10 reps. As for between-group comparisons, MANCOVA showed no significant differences ($p > 0.05$) in adjusted means in either push-ups test after controlling for pre-test differences: MP 7.48±1.74 vs. ME 7.06 in±2.86 in. (T1), and 29.01±8.93 vs. 27.39±11.10 reps. (T2).

CONCLUSION: While the two push-ups training programs each has a different focus (MP or ME), they have roughly the same results in developing both MP and ME. This may be related to the constant resistance (bodyweight) in push-ups, as well as the transfer effect between MP and ME in early stage of resistance training among novice trainees.

3483 Board #171 June 1 8:00 AM - 9:30 AM
Actinin 3 Genotypes and Altitude Training

Orville Byfield, Rachael Irving. *University of the West Indies, Kingston, Jamaica.* (Sponsor: Melanie Poudevigne, FACSM)
 Email: oabyfield@gmail.com
 (No relevant relationships reported)

Certain genotypes determine adaptation to certain exercise and can be used to monitor adaptability to training. **PURPOSE:** To gauge cardiovascular response by using oxygen saturation and heart rate change to determine adaptation to altitude training in athletes with 577RR/577RX and the 577XX genotypes. **METHODS:** Athletes who were previously genotyped for the actinin 3 genes were recruited for the study. Forty athletes consented to participate and were divided in two groups. One group participated primarily in running events of distance > 1000m (group M, n=5) and the other participated in running events ≤ 400m (Group S, n=35). Each group was subjected to running up a steep slope of 5000M twice weekly for 12 weeks. Oxygen saturation was recorded using a pulse oximeter for each participant before the start of 12 weeks and each four weeks up to 12 weeks. Blood pressure and heart rate were recorded before the start of the 12 week trail and each 4 weeks up to 12 weeks. **RESULTS:** Thirty five athletes had the 577RR or the weaker 577RX variant of the actinin 3 gene. Five had the 577XX genotype. Those with the 577RR and 577RX genotypes had no significant increase in their SpO₂ values over 12 weeks ($P=0.1$). Their heart rate and blood pressure did not significantly decrease over 12 weeks ($p>0.5$). Group M athletes had significant increase in Spo₂ values, heart rate and pulse rate also significantly decreased over 12 weeks ($p<0.001$). **CONCLUSION:** Those with the 577XX genotype adapted better to altitude training than those with the 577RR and 577RX genotypes

3484 Board #172 June 1 8:00 AM - 9:30 AM

Effect of Progressive Unilateral Eccentric versus Concentric Training on Muscle Damage of the Contralateral Limb

Trevor C. Chen¹, Jian-Han Lai¹, Kuo-Wei Tseng², Wei-Chin Tseng², Tai-Ying Chou¹, Kazunori Nosaka³. ¹National Taiwan Normal University, Taipei City, Taiwan. ²University of Taipei, Taipei City, Taiwan. ³Edith Cowan University, Joondalup, Australia.
 Email: tcchen@ntnu.edu.tw
 (No relevant relationships reported)

Muscle damage of the elbow flexors (EF) induced by maximal eccentric exercise (100%EC) is significantly less following the second bout of the same exercise performed at 1-28 days after the first bout by not only the ipsilateral EF but also the contralateral EF (contralateral repeated bout effect: CL-RBE; Chen et al. *MSSE* 2016). However, it is not known whether the magnitude of the CL-RBE of the opposite limb would be differently conferred if one limb received progressive unilateral eccentric training (PET) compared with progressive unilateral concentric training (PCT). **PURPOSE:** This study tested the hypothesis that a greater CL-RBE would be conferred upon the EF by PET than by PCT. **METHODS:** Untrained young men were placed into PET, PCT and control (CON) groups (n=8/group). Both the PET and PCT groups performed 5 sets of 6 contractions of the EF of one arm once a week for 5 weeks, in which the load was increased from 10 to 30, 50, 80 and 100% of maximal voluntary isometric contraction (MVC), followed 1 week later by 5 sets of 6 100%EC of the opposite EF. The CON group performed 100%EC with one EF, and repeated the 100%EC with the opposite EF 1 week later. MVC, range of motion, upper arm circumference, muscle soreness (SOR) and plasma creatine kinase activity were measured before to 3 days after each PET and PCT, as well as before and for 5 days after 100%EC. Changes in these variables after 100%EC were compared between groups by a mixed-design two-way ANOVA. **RESULTS:** The magnitude of increases in MVC for the trained (22%) and untrained arms (10%) after PET was greater ($P<0.05$) than after PCT (11%, 5%). Changes in all variables after 100%EC were smaller ($P<0.05$) for the PET group (e.g. MVC: -9% at 4 days post) compared with 100%EC for the PCT group (-23%) and the first 100%EC of the CON group (-27%), without significant difference between the PCT and CON groups. Changes for the PET group (e.g. peak SOR: 12 mm) were smaller ($P<0.05$) than those after 100%EC for the PCT group (34 mm) and after the second 100%EC for the CON group (25 mm), and changes in all variables after the second 100%EC for the CON group were smaller ($P<0.05$) than for the PCT group. **CONCLUSIONS:** These results supported the hypothesis and showed that the CL-RBE conferred after PET would be greater than that conferred after PCT. Supported by MOST, TAIWAN (MOST105-2410-H-003-052-MY3).

3485 Board #173 June 1 8:00 AM - 9:30 AM

Comparison of Eccentric Utilization Ratio and Reactive Strength Index between Football Linemen and Backs

Taylor J. Manes¹, Eric G. Yakle¹, Jacob D. Morris¹, Jerry L. Mayhew¹, Bryan Mann². ¹Truman State University, Kirksville, MO. ²Miami University, Miami, FL.
 Email: jmayhew@truman.edu
 (No relevant relationships reported)

Explosive generation of force is a fundamental component of many sports. Various jumping indices have become major indicators of player potential or for judging training improvement. However, there is limited information concerning these indices for college football players. **PURPOSE:** To compare two forms of reactive strength index (RSI) between college football linemen and backs. **METHODS:** Linemen (n = 12) and backs (n = 16) were tested for static jump (SJ) and drop vertical jump (DVJ) on a force plate to determine flight time (Ft), ground contact time (GCT), and peak takeoff force (PTF). Peak landing force (PLF) was determined during DVJ. Each player performed 2 trials of each jump with a 1-min rest between. RSI was calculated as a ratio of DVJ to GCT (RSI-1) and Ft/GCT (RSI-2). A modified elastic utilization ratio (EURmod) was calculated as DVJ/SJ. **RESULTS:** Linemen were significantly heavier (127.9 ± 7.8 kg) than backs (92.0 ± 7.8 cm) but the two were not statistically different in age (20.2 ± 1.3 vs 19.8 ± 1.6 yrs, respectively) or height (186.5 ± 6.0 vs 183.6 ± 6.0 cm, respectively). Reliabilities for GCT (ICC = 0.870), SJ Ft (ICC = 0.952), DVJ Ft (ICC = 0.959), DVJ (ICC = 0.958), and SJ (ICC = 0.949) were high. GCT was not significantly different between backs (0.275 ± 0.055 s) and Linemen (0.288 ± 0.039 s). RSI-1 and RSI-2 were greater in backs (1.26 ± 0.37 and 1.95 ± 0.42, respectively) than in linemen (0.77 ± 0.18 and 1.47 ± 0.23, respectively) with large effect sizes (ES = 2.78 and 2.11, respectively). RSI-1 (1.05 ± 0.38) was statically greater than RSI-2 (1.74 ± 0.42), although they were highly correlated ($r = 0.95$). EURmod was significantly higher in backs (0.91 ± 0.13) than in linemen (0.75 ± 0.14) with a large ES = 1.69). PLF/kg was not significantly different between linemen (47.2 ± 7.5 N/kg) and backs (49.5 ± 8.3 N/kg) but PTF/kg was significantly greater in backs

(40.8 ± 6.4 N/kg) than in linemen (34.7 ± 3.5 N/kg). Discriminant analysis indicated that JH/kg could correctly classify 94% of backs and 100% of linemen to the correct position.

CONCLUSIONS: Various ratios indicating the ability of players to handle their body weight during explosive movements may be useful in classifying playing position and evaluating training improvement.

3486 Board #174 June 1 8:00 AM - 9:30 AM
Minimalist Style Military Boot Does Not Improve Walking Economy Under Load In Trained Males

Dylan W. Sharp¹, Montia T. Pace¹, Jonathan C. Swain¹, Ryan T. Albino¹, James M. Green¹, Lauren G. Killen¹, Harish Chander², Jeff D. Simpson³, Eric K. O'Neal¹. ¹University of North Alabama, Florence, AL. ²Mississippi State University, Mississippi State, MS. ³University of West Florida, Pensacola, FL. (Sponsor: Dr. James Green, FACSM)
 Email: dsharp@una.edu

(No relevant relationships reported)

MINIMALIST STYLE MILITARY BOOT DOES NOT IMPROVE WALKING ECONOMY UNDER LOAD IN TRAINED MALES

D.W. Sharp¹, M.T. Pace¹, J.C. Swain¹, R.T. Albino¹, J.M. Green¹, L.G. Killen¹, H. Chander², J.D. Simpson³, E.K. O'Neal¹. University of North Alabama, Florence, AL¹, Mississippi State University, Mississippi State, MS², University of West Florida, Pensacola, FL³.

Footwear may be a simple external factor to improve rucking economy (RE) for soldiers that must carry heavy external loads, but it is also possible that with no flight phase, RE may not be enhanced by footwear style. This study compared RE with an ~500 g minimalist style boot (MIN) versus an ~800 g traditional style boot (TRD) while wearing a 16 kg external load consisting of a 7.5 kg weighted compression vest and ruck sack with 8.5 kg of weight. Male participants (n = 14) completed two testing sessions for this study. In session 1 participants completed a VO₂ peak test (46.6 ± 7.3 ml/kg/min) under load while wearing their normal athletic shoes. The second session consisted of two 5-min walking treadmill sessions under load. Treadmill speed was based on the highest speed stage that allowed the participant to walk for the full stage during the VO₂ peak test. RE was evaluated using indirect calorimetry (TrueOne2400, Parvo Medics Inc. Provo, Utah) and calculated by averaging the 60-s average values of minutes 3-4 and 4-5. Steady state was confirmed by a difference < 0.1 L/min between minutes 4 and 5. MIN and TRD were worn in a counter-balanced crossover order. There was a 10-min rest period between rucking bouts. RER did not differ between treatments (MIN = 0.86 ± 0.48; TRD = 0.86 ± 0.51; p = 0.96). A two-tailed t-test with an was ran for all data (α = 0.05). Although MIN (1.79 ± 0.23 L/min) tended (p = 0.13) to improve RE versus TRD (1.85 ± 0.30 L/min), breathing RPE was the only measure that reached significance (p = 0.045) between MIN (2.0 ± 0.9) versus TRD (2.4 ± 1.2). Altering boot type does not improve RE.

3487 Board #175 June 1 8:00 AM - 9:30 AM
Cortisol and Testosterone Awakening Response During Training in Elite Military Men

Jake R. Bernards, Andrew E. Jensen, Laura J. Arrington, Brenda A. Niederberger, Jason T. Jameson, Karen R. Kelly. *Naval Health Research Center, San Diego, CA.*

(No relevant relationships reported)

Elite military training is highly stressful on the body and challenges the individual operator to maintain allostasis (i.e., the ability to adapt and recover from repetitive stressors). It is well understood that increased allostatic load, above that of allostasis, may lead to hormonal imbalances in the hypothalamic-pituitary adrenal (HPA) and gonadal (HPG) axes. However, it is not well understood if elite military training elevates allostatic load enough to disrupt the HPA and HPG axes. **PURPOSE:** To determine the cortisol awakening response (CAR)—an outcome metric of the HPA axis—and the testosterone awakening response (TAR)—an outcome metric of the HPG axis—over the course of a 9-month unit level training (ULT) cycle. **METHODS:** Active duty, elite, male operators (n = 37; age: 28.6 ± 3.8 yrs; height: 178.0 ± 5.3 cm; weight: 87.0 ± 8.6 kg) participated in this study. Operators were stratified into 3 groups based on age (20-26, 27-29, and 30-41 yrs). Daily self-administered saliva samples were completed by each operator at the time of Wake, Wake + 30 min, and Wake + 60 min, pre- and post-ULT cycle. All CAR and TAR data were calculated as area under the curve from the ground (AUC_G). Differences and interactions between age groups and days were examined using a 3 (age) × 2 (day) mixed effects model. **RESULTS:** There was a significant interaction between age groups and days for CAR (p < .0001) and TAR (p < .0001) AUC_G. Simple effects comparing differences in the CAR AUC_G from operators aged 27-29 yrs exhibited a 22.8% decrease in CAR following ULT (AUC_G = 17.5 ± 8.3 vs. 13.6 ± 7.5, p = .01). Examination of the individual main effects revealed significant differences comparing age groups in TAR (p = .006). Adjusted contrast analysis revealed operators aged 20-26 yrs had a heightened TAR during both pre- and post-ULT time points when compared with those aged 27-29

yrs (AUC_G; pre = 12059.8 ± 3819.0 vs. 8439.4 ± 3801.5; post = 11834.1 ± 5588.5 vs. 7754.2 ± 2606.3, p < .0001) and 30-41 yrs (AUC_G; pre = 12059.8 ± 3819.0 vs. 8298.1 ± 3440.0; post = 11834.1 ± 5588.4 vs. 8640.4 ± 5087.7, p < .0001). **CONCLUSION:** Results indicate the middle-aged group (27-29 yrs) has a decrease in CAR over the 9-month ULT cycle compared with the younger and older age groups. Additionally, the youngest operators, aged 20-26 yrs, have the highest TAR, regardless of time point.

3488 Board #176 June 1 8:00 AM - 9:30 AM
The Effectiveness Of Neuromuscular Training Versus Traditional Training On Dynamic Balance In Athletes: A Meta-analysis

Meiqi Zhang, John LIU. *Springfield College, Springfield, MA.*
 Email: mzhang2@springfieldcollege.edu

(No relevant relationships reported)

Neuromuscular training has been viewed as an effective approach to improving dynamic balance through enhancement of unconscious motor responses in athletes. However, it is still unclear whether neuromuscular training is better than traditional training to improve the dynamic balance ability. **Purpose** The primary purpose of the present paper was to determine whether or not neuromuscular training is better than traditional training in improving dynamic balance through a systematic review and meta-analysis of the available research articles. **Methods** The meta-analysis was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Relevant articles were searched independently by two researchers through PubMed, web of science, Google scholar, CNKI, which was completed before September 2018. The randomized controlled trials involving the effects of neuromuscular training and traditional training on athletes' dynamic balance were included. **Results** 6 RCT studies with 162 athletes met inclusion criteria for this review and were included. On average sessions went for 45 ± 20mins; 3 ± 2 times a week for 6 ± 2 weeks. Compared with traditional training, there was a significantly improve in Star excursion balance test (SEBT), the anterior (MD = 6.92 cm, 95%CI: 3.22 to 10.63), anteromedial (MD = 3.64 cm, 95%CI: 0.86 to 6.43), lateral (MD = 6.3 cm, 95%CI: 3.21 to 9.48), posterior (MD = 10.19 cm, 95%CI: 7.29 to 13.10, posteromedial (MD = 9.69 cm, 95%CI: 7.2 to 12.19) and posterolateral (MD = 5.75 cm, 95%CI: 1.81 to 9.69) scores of SEBT, respectively. No significantly differences in anterolateral (MD = 11.68, 95%CI: -0.03 to 23.38), medial (MD = -0.51 cm, 95%CI: -7.20 to 6.17) of SEBT between neuromuscular training and traditional training were found in the available research articles. **Conclusions** Neuromuscular training could be an effective training method for improving the dynamic balance of athletes in different sports and could be applied to athletes' training programs. More attention is needed in future research on validating the effectiveness of neuromuscular training between different sports programs through large randomized controlled trials and exploring the underlying physiological mechanisms.

3489 Board #177 June 1 8:00 AM - 9:30 AM
The Impact of Isometric Handgrip Training on Cardiovascular Stress Reactivity: Does Baseline Psychological Stress Matter?

Ellen C. McGarity-Shiple, Morgan Silvester, Kaitlyn Liu, Sarah Bailey, Kyra E. Pyke. *Queen's University, Kingston, ON, Canada.*

Email: 0sem3@queensu.ca

(No relevant relationships reported)

Cardiovascular stress reactivity (CSR) is associated with cardiovascular risk factors such as hypertension and carotid intima media thickness. It may also be influenced by baseline perceived psychological stress. Isometric handgrip training (IHGT) has been shown to reduce CSR in hypertensive adults, however, the impact of IHGT on CSR in normotensive adults is unknown.

PURPOSE: To examine the effect of IHGT on CSR in young, healthy males and to assess the potential influence of variability in baseline perceived stress across the intervention.

METHODS: Young, healthy male subjects were randomly assigned to a control (n=11, 22±4 yrs) or IHGT group (n=11, 23±4 yrs). The Perceived Stress Scale (PSS) was administered and mean arterial pressure (MAP) was assessed during the Trier Social Stress Task. CSR was calculated as the difference in MAP from baseline to peak during stress. A single training session consisted of 4 alternating right and left 2 min isometric handgrip contractions (30% maximal voluntary contraction) and this was performed 5 days/week for 5 weeks. All measurements were performed before and after the intervention.

RESULTS: There was a significant reduction in CSR post-intervention (19±10 vs. 23±11 mmHg, p<0.02) however, this was not significantly different between groups (p=0.45). PSS score did not change with the intervention (14±7 vs. 13±6 p=0.56) or differ between groups (p=0.7). Overall, CSR did not correlate with PSS scores (r²= -0.03, p>0.2) and addition of the PSS score to CSR analysis did not alter the findings. However, there was a significant negative correlation between CSR and PSS scores of

less than 15 ($r^2 = -0.3, p < 0.001$). Addition of PSS score to CSR analysis in only these participants did not show a training reduction of CSR compared to the control group (28 ± 3 vs. 19 ± 3 mmHg; 20 ± 3 vs. 18 ± 3 mmHg, $p = 0.172$).

CONCLUSION: In contrast to some findings with aerobic training, IHGT did not lower CSR in young, healthy males. Lower responses overall post intervention suggest that some habituation to the TSST occurred. Although considering PSS score did not alter current findings, CSR decreased with increasing reported stress up to a moderate reported stress level (PSS score of 15). This suggests that considering baseline levels of stress may be helpful in interpreting CSR changes with exercise interventions.

3490 Board #178 June 1 8:00 AM - 9:30 AM

Pushing A Sled: Assessing Its Impact On Gait Temporospatial Parameters In Young Healthy Adults

Martin G. Rosario¹, Aneesah Hyder², Monica Mathis¹, Stephanie Timon¹, Heather Taylor¹, Chad Swank¹. ¹Texas Woman's University, Dallas, TX. ²Texas Woman's University, Denton, TX. (Sponsor: Alexis Ortiz, FACSM)

Email: mrosario1@twu.edu

(No relevant relationships reported)

Resistance exercise (RE) has been demonstrated as a superior modality for increasing muscle strength, muscle endurance, power, and motor performance. The sled used in this study is a novel device that provides a proportional increase in resistance with increased speed.

PURPOSE: To examine the impact of resistance on gait temporospatial parameters using a sled in healthy young adults while walking and running.

METHODS: Fifteen young adults (ages 21-35) were recruited to participate in this study. Mobility Lab sensors (accelerometers and gyroscopes) were placed on each subject at the chest, waist, and both wrists and ankles. Each participant performed three trials of 40 feet for the following conditions: self-paced walking (W), self-paced walking while pushing the sled (WP), and maximal speed running while pushing the sled (RP).

RESULTS: A repeated measures MANOVA was conducted to compare gait temporospatial parameters across conditions. Results indicate significant differences ($p < 0.005$) between all conditions for stride length, cadence, double support time, swing %, and stance %. Stride length decreased across all three conditions: W (85 ± 3.0), WP (68 ± 4.1), and RP (56 ± 7.0). Cadence decreased while WP (92 ± 10.1), yet increased during RP (169 ± 14.9), compared to W (109 ± 6.7). During resistance conditions (WP and RP) participants demonstrated greater gait cycle percentage in stance phase [(WP, stance phase: 66 ± 1.6 , swing phase: 34 ± 1.6) and (RP, stance phase: 57 ± 2.7 , swing phase: 42 ± 2.7)] when compared to W (stance phase: 37 ± 2.1 , swing phase: 37 ± 2.2).

CONCLUSIONS: Longer stance phase with a proportional increase in resistance could be utilized as a combined resistance and gait training tool as supposed to only gait training. This resistance as an intervention might be a viable option to improve the push off of patients with limitations such as neurological disorders. Future studies should focus on neuromuscular activation of the lower extremity, specifically the muscles involved in the gait cycle stance phase when walking or running with resistance.

3491 Board #179 June 1 8:00 AM - 9:30 AM

The Specificity of Muscular Coordination between Front Crawl Swimming and Dry-land Resistance Training Exercises.

Emmet Crowley. University of Limerick, Limerick, Ireland. (Sponsor: Dr Giles Warrington, FACSM)

Email: emmet.crowley@ul.ie

(No relevant relationships reported)

PURPOSE

Specificity is an integral component in understanding the mechanism of transfer of dry-land resistance training exercises (RT) to front crawl swimming (FC). The specificity of intra and inter muscular coordination is deemed to be important, with neuromuscular adaptations at the forefront namely motor unit recruitment, synchronisation and co-contraction. Limited research has investigated the muscular coordination between FC and RT. Therefore, the aim of this investigation is to explore the muscular coordination between RT and FC.

METHODS

Fourteen male international and national level swimmers were recruited. EMG and 2D kinematic data were collected whilst FC, bench press (BP) and pull-up (PU) were performed. A standardised warm up was conducted followed by 3 x 35 m FC bouts, 1 x 70 % and 2 x 100 % of maximal exertion, with 5 minutes' recovery between bouts. The BP and PU were performed using the same protocol, with participants performing 3 x 5 RM. EMG data were filtered using a 4th order Butterworth filter and normalised to peak EMG. The EMG data were presented using a 50 % threshold of peak EMG and

demonstrated temporal overlaps (TO) for each muscle. 2D data were collected during the propulsive (PRO) phase of FC and eccentric (ECC) and concentric (CONC) phase of BP and PU.

RESULTS

The individual results show little TO between FC and BP and FC and PU. Furthermore, FC and BP had significantly ($P < 0.05$) greater TO compared to FC and PU. The ratio of the ECC and CONC phase during the SRM, BP and PU, show significant ($P < 0.001$) differences compared to the recovery (REC) and PRO phase of FC. Additionally, duration of time under tension during the CONC phase, of BP ($P < 0.01$) and PU ($P < 0.001$), was significantly higher than during the PRO phase of FC.

CONCLUSION

The EMG data shows different individual responses and little specificity between FC and BP and FC and PU. The targeted prime movers show little TO between FC and RT. These findings may question the validity of this method for assessing specificity, as it does not account for their dynamic nature. The lack of specificity between RT and FC shows further differences as the ratio and duration of time under tension of the RT compared to FC show significant differences. Velocity based training may be a viable method to target specific movement velocities and increase specificity.

3492 Board #180 June 1 8:00 AM - 9:30 AM

Effects Of Lower-leg Kinesio Taping On Ankle Strength, Foot Pressure And Balance

Young-Bae Eum¹, Ah-Ram Kim², Jong-Hak Lee¹, Ho-Seong Lee¹. ¹Dankook University, Cheonan-si, Korea, Republic of. ²Yonsei University, Cheonan-si, Korea, Republic of.

Email: hoseh28@dankook.ac.kr

(No relevant relationships reported)

The use of kinesio tape among health care professional has grown recently in efforts to efficiently prevent and treat joint injuries. However, limited evidence exists regarding the efficacy of this technique in enhancing joint stability and neuromuscular control.

PURPOSE: To compare of the effect of lower-leg kinesio taping and traditional taping method on ankle strength, foot pressure and static and dynamic balance.

METHODS: In a double-blinded, randomized, crossover trial, and twenty healthy adults were applied lower-leg kinesio taping and traditional taping method for 1-week. The two taping methods were separated by a 2-week. All subjects were evaluated for isokinetic strength (plantar flexion, dorsiflexion, inversion and eversion of 30°/sec and 60°/sec), foot pressure during gait and static and dynamic balance.

RESULTS: Results showed that backward, leftward and rightward of dynamic balance were significantly increased in lower-leg kinesio-taping compared to CON ($p < 0.05$, respectively). Leftward and rightward of dynamic balance were significantly increased in traditional taping compared to CON ($p < 0.05$, respectively). However, no significant difference in the ankle strength, foot pressure and static balance were observed between the taping methods.

CONCLUSIONS: Both taping methods applications are recommended for increasing dynamic balance ability. Further research might investigate how this affects participants with a history of injury.

3493 Board #181 June 1 8:00 AM - 9:30 AM

Effects Of Whole-body Electrostimulation On Concurrent Training Related To Explosive Strength, Anaerobic Power And VO₂max.

Ismael Martínez Guardado¹, Manuel Del Viejo Gragera¹, Jeffrey M. Mjaanes, FACSM², Aldo Vásquez Bonilla¹, Rafael Timón Andradá¹, Guillermo Olcina Camacho¹. ¹Sport Sciences Faculty, University of Extremadura, Cáceres, Spain. ²Northwestern University, Evanston, IL. (Sponsor: Jeffrey M. Mjaanes, FACSM)

Email: imartinezg@unex.es

(No relevant relationships reported)

Training programs typically involve the concurrent use of strength and endurance training sessions. Moreover, whole-body electrostimulation has also been used by athletes in the context of training programs to develop strength and physical performance. We postulate that the addition of whole-body electrostimulation (WB-ES) to concurrent training may improve explosive strength, anaerobic power and aerobic performance.

PURPOSE: To identify which of two concurrent training protocols-consecutive (weightlifting + HIIT) or simultaneous (WB-ES + HIIT)-is more effective in enhancing explosive strength, anaerobic power and aerobic performance in recreationally trained subjects. **METHODS:** Twenty-two recreationally trained subjects (Age 20.08 ± 2.08 yr, Weight 72.49 ± 5.20 kg, BMI 22.23 ± 2.47 kg/m²) were randomized into 3 groups: Concurrent Consecutive (CC), Concurrent Simultaneous (CS) or Control Group (CG), who carried out 5 weeks of training, 2 days per week. The CC group performed a circuit strength training of 4 exercises (bench press, front pull down, back squat and femoral curl); 4 x 8 reps 60-65% 1RM, followed by HIIT (4 x 4 min 90-95% maximal aerobic power with 3 min of recovery) on a cycle ergometer. Conversely, the CS group

completed the same HIIT training combined with a strength program with WB-ES (WiemsPro, USA). Participants were evaluated in three moments; PRE, POST, and after a detraining (DET). Testing included Wingate test for anaerobic power, CMJ for explosive strength and an incremental maximal test for VO_2max . Analysis was performed using two-way ANOVA with repeated measures. **RESULTS:** CS and CG increased mean power in Wingate test between all measurements (CC 471 ± 87 W vs 562 ± 77 W vs 553 ± 70 W; CS 457 ± 74 W vs 566 ± 112 W vs 563 ± 105 W $p < 0.01$). CMJ increased in CC in POST (29.75 ± 3.87 cm vs 33.42 ± 4.11 cm $p < 0.001$) and DES (29.75 ± 3.87 cm vs 33.68 ± 4.48 cm $p < 0.05$). However, CS group only improve CMJ after DET with respect to PRE measurement (28.40 ± 3.78 cm vs 30.94 ± 3.82 cm $p < 0.05$). No differences were found in VO_2max . **CONCLUSIONS:** Concurrent consecutive training is more effective at improving lower-limb explosive strength, however both concurrent training protocols are effective at improving anaerobic power even though concurrent simultaneous protocols take half the time to complete. Supported by CTS036 GR18

3494 Board #182 June 1 8:00 AM - 9:30 AM
Improving Shoulder Internal Rotation Motion of In-season Throwing Athletes: A Randomized Controlled Trial

David Roskin¹, Kimberly Keyser¹, Christina Alperi², Heather Myers¹. ¹Duke University Health System, Durham, NC. ²North Carolina School of Science and Mathematics, Durham, NC.
 (No relevant relationships reported)

PURPOSE: Throwing athletes commonly experience loss of shoulder internal rotation (IR). This adaptation, when combined with compromised resting posture, has the potential to increase risk of rotator cuff and biceps tendinopathy, labral tears, and elbow injuries. This study investigated the effectiveness of two methods prescribed to restore IR: the Sleeper Stretch (SS), which aims to stretch the capsule, and the Ballroom Blow (BB) which aims to optimize breathing, posture, and scapular stability. Because the BB is less stressful to the shoulder joint, it may be a superior alternative. We hypothesized that when using the BB, IR would be increased either as effectively, or more so, than the SS.

METHODS: Healthy in-season baseball and softball players were randomly assigned an intervention (BB or SS) to the dominant arm 2x/day for 5 consecutive days. After a 2-week period of no intervention, both groups crossed over and performed the alternate intervention. IR was passively measured in supine at baseline, immediately after a throwing session on day 1, after intervention on day 1, and prior to practice on days 2-5. On the last day of the study, each subject was asked if he/she had a preference for either exercise. Statistical analysis for comparisons of differences in IR among intervention type (SS and BB) were performed using an analysis of covariance (ANCOVA) for the 6 instances as listed above. Statistical significance was set *a priori* at $\alpha \leq 0.05$.

RESULTS: 13 softball players (17.49 ± 0.63 yrs.; BMI 28.4 ± 5.6) and 10 baseball players (17.07 ± 0.56 yrs.; BMI 24.6 ± 4.7) participated in the study. Both interventions increased IR over the course of the 5 days, but there was no significant difference ($p = 0.66$) between SS and BB. When performing SS, the mean IR was 45.7 ± 11.38 degrees immediately after the throwing session and incrementally improved to 53.06 ± 10.95 degrees on day 5. When performing BB, the similar incremental increase was from 47.39 ± 12.15 degrees to 53.56 ± 8.61 degrees. There was no statistically significant difference in preference between the SS (51.1%) and the BB (48.9%).

CONCLUSIONS: The BB and the SS were both observed to be effective at increasing IR ROM in healthy in-season baseball and softball players over 5 days, yet neither proved to be superior with regard to degree of improvement nor speed of attaining increased IR.

3495 Board #183 June 1 8:00 AM - 9:30 AM
The Influence Of Previous Training Intensity On The Rating Of Perceived Exertion

Jos J. de Koning, FACSM¹, Jos de Haan¹, Carl Foster, FACSM². ¹Vrije Universiteit, Amsterdam, Netherlands. ²University of Wisconsin - La Crosse, La Crosse, WI.
 Email: j.j.de.koning@vu.nl
 (No relevant relationships reported)

A discrepancy between coach' intended session-intensity, and the intensity as experienced by the athlete has been found in many sport settings. To avoid deconditioning as well as non-functional overreaching, it is important that athletes execute and perceive the training as prescribed by the coach. **PURPOSE:** The aim of this study is to find an explanation for the difference between intended and perceived RPE (dRPE). **METHOD:** Thirteen athletes completed 1392 training sessions. Athletes and coach rated each session on BORG-CR10 scale (RPE). dRPE was calculated as athlete's RPE minus coach' RPE. Linear regression was used to analyze the relation between dRPE and the average RPE from, respectively, the previous 1, 2, 3, and 7 days. **RESULTS:** A weak correlation was found between the coach intended RPE and athlete executed RPE ($r = 0.302$; $P < 0.01$). Mean dRPE was 0.51 (sd = 2.07). Easy

sessions (RPE < 4.8) were underestimated by the coach, and harder sessions (RPE > 4.8) were overestimated by the coach. A significant linear regression was found between dRPE and all 4 predictor variables. **CONCLUSION:** This study demonstrates evidence for dRPE to be influenced by the intensity of training sessions during the previous days. Intended intensity has shown to be overestimated when previous days were of low intensity and underestimated when previous days had a severe intensity. This information might help the coach to adjust the program and avoid these problems in advance.

3496 Board #184 June 1 8:00 AM - 9:30 AM
The Effects of 12-week Yoga Practice on Flexibility and Dynamic Balance of Female College Students

Siu Kuen NG. *The Chinese University of Hong Kong, Hong Kong, China.*
 Email: sarobert1218@gmail.com
 (No relevant relationships reported)

The effects of 12-week yoga practice on flexibility and dynamic balance of female college students

INTRODUCTION: In recent years the practice of yoga has gained popularity as a means to improve health, sports performance and psychological wellbeing.

PURPOSE: The aim of this study was to evaluate the effects of a 12-week yoga intervention on flexibility and dynamic balance of female college students.

METHODS: A one-group pretest-posttest design was employed. Seventy females (20.8 ± 1.9 years; 1.62 ± 0.15 m; 54.2 ± 9.64 kg; BMI 21.2 ± 3.18 kg·m⁻²) attended yoga practice for a total of 12 weeks, consisting of one 90-min session per week. All participants have no previous experience on the Star Excursion Balance Test (SEBT) and yoga practice. Lumbar and hamstring flexibility and dynamic balance were assessed using the sit and reach test and SEBT before and after 12-week intervention. Participants performed the anterior (ANT), posterolateral (PL), and posteromedial (PM) reach directions of both legs in the SEBT.

RESULTS: A statistically significant increase in post-intervention normalized reach distances from 4.5% to 9.9% was seen in all directions of both legs. Results of paired sample t-test also displayed a significant normalized reach distance difference before and after the intervention. Left leg: (ANT: $76.8 \pm 9.5\%$ versus $67.0 \pm 13.1\%$; $t(69)=5.78$, $P < 0.01$; PL: $88.0 \pm 11.8\%$ versus $81.4 \pm 17.3\%$; $t(69)=3.29$, $P < 0.05$; PM: $91.2 \pm 10.9\%$ versus $86.7 \pm 17.0\%$ $t(69)=2.23$, $P < 0.01$); Right leg: (ANT: $75.2 \pm 10.8\%$ versus $68.0 \pm 16.6\%$; $t(69)=3.25$, $P < 0.01$; PL: $88.6 \pm 10.5\%$ versus $83.7 \pm 17.4\%$; $t(69)=3.17$, $P < 0.01$; PM: $92.3 \pm 11.1\%$ versus $85.9 \pm 17.2\%$; $t(69)=2.54$, $P < 0.05$). The increase in flexibility was observed after the intervention (39.3 ± 5.8 cm versus 37.8 ± 6.5 cm; $t(69)=4.64$, $P < 0.01$).

CONCLUSIONS: The dynamic balance ability and flexibility of the female college students were significantly enhanced after 12-week yoga intervention.

3497 Board #185 June 1 8:00 AM - 9:30 AM
Original Mat Pilates in Classic Ballet: A Case Study

Vicente P. Lima¹, Bruna A. Souza², Luanda L. Pasquini², Bruno L. P. Lima¹, Rodrigo G. S. Vale¹, Juliana B. P. Castro¹. ¹Rio de Janeiro State University, Rio de Janeiro, Brazil. ²Castelo Branco University, Rio de Janeiro, Brazil.
 Email: professorvicentelima@gmail.com
 (No relevant relationships reported)

Abstract

Dance is an art form in which it is necessary to develop various physical abilities because for a ballet dancer to achieve high performance it is necessary to acquire technical, athletic and aesthetic capacities so that the movements flow in a controlled way and without apparent effort. To generate positive effects on the performance, it is necessary to complement the training program with a method that maintains the technical ballet characteristics and principles. One type of training is the Mat Pilates method.

PURPOSE: To verify the effect of a training periodization with the original Mat Pilates on the performance of muscle strength and flexibility in a ballerina.

METHODS: A female ballet dancer (age: 19 yrs; height: 1.54 m; body mass: 56 kg; BMI: 23.6 kg/m²), without lesions, were submitted to the Mat Pilates method during 8 weeks, with a duration of 1 hour per training session, performed 2 times a week with a 48-hour interval between the sessions. The pre- and post-intervention tests were: strength and resistance abdominal test, isometric test of the column extensor, sit and reach, My Jump, and hip flexion with extended knee.

RESULTS: The highest post-intervention response value was for the abdominal resistance test, possibly because the exercises of the Mat Pilates contemplate this musculature. However, the jump test showed a negative post-intervention response (Table 1).

Table 1. Results of the pre- and post-intervention tests.

	Pré-test	Post-test	% Post-test	Result (%)	Absolute Difference
Seat and Reach	30	40	133.3	33.3	10
Abdominal	20	30	150.0	50.0	10
Lumbar hyperextension	4	5	125.0	25.0	1
hip flexion (right)	90	110	122.2	22.2	20
hip flexion (left)	100	130	130.0	30.0	30
Jump height (cm)	17.12	19.0	110.9	10.9	1.9
Flight time (ms)	351.33	393.0	111.9	11.9	41.7
Velocity (m/s)	0.86	1.0	111.6	11.6	0.1
Force (N)	1527.30	1345.4	88.1	-11.9	-181.93
Power (W)	1322.60	1298.7	98.2	-1.8	-23.86

CONCLUSIONS: The original Mat Pilates Method applied in the present study potentiated the increase in the flexibility, abdominal and lumbar resistance and strength levels, but did not influence the performance of the vertical jump. New studies are suggested with a greater number of participants, with Pilates exercises in machines, in both sexes, in different age groups and with subjects of other sports and artistic modalities.

3498 Board #186 June 1 8:00 AM - 9:30 AM
Relationship Between Cumulative Training Loads and Treatments of Division II Swimmers

Cristopher Lara, Candace Juhala, James Mouat, IV, Jose Alvarez, Bianca Lagamon, Angel Quintero, Adam Murphy, Cameron LeBato, Shruti Bali, Vivy Hua, Derrick Gardner, Nicole Kuhar, Arianna Mazzarini, Marcela Fernandes-Alvez, Vanessa Yingling, FACSM. *CSU East Bay, Hayward, CA.* (Sponsor: Vanessa Yingling, FACSM)
 Email: clara27@horizon.csueastbay.edu
(No relevant relationships reported)

Coaches are responsible for designing training sessions to optimize athlete progression while decreasing the incidence of treatments and fatigue by monitoring training loads. Training loads (TL) consist of the external load (work done by the athlete) and internal load (athlete's perceived intensity of that work). Multiple methods are used to monitor both external and internal TL's such as the utilization of heart rate, lactate concentration, rate of perceived exertion (RPE) and session duration (Gabbett et al, 2004). Among NCAA Division II athletics, monitoring team training loads necessitates a cost-effective method, like that of RPE and session duration. Purpose: To determine the relationship between cumulative training load, and number of visits to the Athletic Trainer for treatments, in a Division II women's swimming team. Methods: For one season, twenty-four collegiate female swimmers (mean ± SD, age 20.2 ± 1.23 years; height 169.03 ± 6.18 cm; mass 68.7 ± 8.87 kg) were surveyed after each practice and competition, and asked to report the date, the duration of training in minutes and the RPE for that session. TL was calculated as the product of the RPE and training session duration and reported as arbitrary units (au). All treatments (visits to the athletic trainer) were recorded by the athletic trainer, ranging from a cosmetic treatment (ice pack) to a soft tissue injury. TL's were averaged daily across the whole team, and a weekly cumulative TL was compared to total treatments for that week. The relationship between TL's and number of treatments was examined using a Pearson correlation. Results: On average the athletes recorded weekly a cumulative TL < 4000 au. A weak negative correlation was found between TL's and treatments, possibly contributing to TL's decreasing as athletes underwent more treatments (r = -.229). Over the course of 14 weeks the swimmers had a total of 152 treatments, 91 of which occurred following a 3 week period where TL's were consistently high (>4000 au). A 72.5% increase in number of treatments occurred after a 3 week period of high TL's. Conclusion: A latent increase in treatments after consecutive high TL's (>4000 au) is expected based on the cumulative load theory and may explain the negative correlation between TL and treatments over the entire season.

3499 Board #187 June 1 8:00 AM - 9:30 AM

The Effect Of Core Strength Training On Dynamic Balance And Agility In Collegiate Korfball Players

Lei Yao¹, Hao Guo², Lingjie Zheng³, Jindong Chang⁴.
¹Southwest University, Chongqing, China. ²Chongqing College of Humanities, Science & Technology, Chongqing, China. ³High School Affiliated to Southwest University, Chongqing, China. ⁴The Branch of the Collaborative Innovation Center of Assessment toward Basic Education Quality at Southwest University, Chongqing, China.
 Email: yaoleisouthwest@163.com
(No relevant relationships reported)

PURPOSE: The purpose of this study was to investigate the effect of core strength training (CST) on core endurance, dynamic balance and agility in collegiate korfball players.

METHODS: Twenty-two college students (age = 20.9 ± 1.4 years; height = 179.8 ± 8.9 cm, weight = 72.4 ± 12.2 kg) korfball players were randomly divided into two groups as training group (TG, N=11) and control group (CG, N=11). The TG completed CST twice a week, for 8 weeks. The CG trained according to the original plan. Star Excursion Balance Test (SEBT), Illinois Agility Test, and the core endurance tests were used to evaluate all subjects. Paired sample T-test and factor analysis were used as data analysis.

RESULTS: There were significant increases in core endurance tests (t=-7.5, p<0.05) and directions of SEBT (t=-3.1, p<0.05) after the experiment in the TG. However, no significant change was observed for agility (t=0.9, p>0.05). In addition, there were significant increases in core endurance tests (t=-4.7, p<0.05), no changes in the directions of SEBT (t=0.8, p>0.05) and agility (t=1.3, p>0.05)

CONCLUSIONS: The core strength training could improve core endurance and directions of the SEBT in collegiate korfball players, but not in agility. Consequently, if the goal of training is to enhance agility, then CST has limited. (This study was supported by Fundamental Research Funds for the Central Universities at SWU Grant 1309232)

3500 Board #188 June 1 8:00 AM - 9:30 AM

Studies On The Effect Of Single Scull Training On The Skill Improvement In Sweep Rowers

Chunmei Cao¹, Congming Chen¹, Keying Zhang¹, Yu Liu¹, Weimo Zhu, FACSM². ¹Division of Sports Science and Physical Education, Beijing, China. ²University of Illinois at Urbana-Champaign, Urbana, IL. (Sponsor: Weimo Zhu, FACSM)
 Email: caocm@tsinghua.edu.cn
(No relevant relationships reported)

In recent years some sweep rowers use single scull boat to train their rowing skill, especially during winter times. However, there is no report about the scull training efficiency in improving the sweep skill. **PURPOSE:** To evaluate the effect of single scull training on the skill training efficiency of sweep rowers.

METHODS: Thirty-five national level male sweep rowers (22.31±2.42 yr., height: 196.33±3.76 cm, mass: 96.05±4.77 kg) volunteered attending the test, who were randomly divided into experimental group (n = 18) and control group (n = 17). All subjects performed rowing skill training 5 times a week, 90 minutes each, for 4 weeks.

Two groups trained same except that the subjects in experimental group used single scull boat and the subjects in control group used sweep boat. The key parameters of rowing skill were measured before and after 4 weeks training by bio-row system including catch, release, total angle, catch slip, release slip, maximal fore, average force, leg speed and power. Separate two-way ANOVA with repeated measures was performed to compare groups (experimental, control) and times (before, after) for each of the parameters. Tukey's HSD tests were conducted for post-hoc comparisons. The alpha level was set at <0.05.

RESULTS: 1. There were significant group by time interactions for release (F_(1,32) = 6.23, p<.05), catch slip (F_(1,32) = 33.18, p<.001) and leg speed (F_(1,32) = 7.95, p<.005). 2. The main effect for time was significant for catch slip (F_(1,33) = 53.86, p<.001), average force (F_(1,33) = 37.64, p<.001), leg speed (F_(1,33) = 22.63, p<.001) and power (F_(1,33) = 9.25, p<.01). The main effect for group was significant for catch (F_(1,33) = 3.50, p<.05), release (F_(1,33) = 4.61, p<.05), release slip (F_(1,33) = 8.15, p<.01). 3. The release of experimental group significantly increased larger than that of control group (8.25 ± 2.06 vs. 1.28 ± 2.10), so that with release slip (7.88 ± 2.51 vs. 1.39 ± 2.67).

CONCLUSIONS: Single scull training dose have effect in improving release and release slip skill for sweep rowers.

3501 Board #189 June 1 8:00 AM - 9:30 AM
Results of a Six Week Training Protocol for Dancers to Achieve Pointe (Toe Shoe) Readiness
 Marijeanne Liederbach¹, Kristen Stevens¹, Emily Sandow¹, Karl Orishimo², Ian J. Kremenic². ¹*NYU Langone Orthopedic Hospital, New York, NY.* ²*Lenox Hill Hospital, New York, NY.*
 (Sponsor: Malachy P. McHugh, PhD, FACSM)
 Email: marijeanne.liederbach@nyumc.org
 (No relevant relationships reported)

PURPOSE: It is estimated that 2 million children study dance each year in USA public schools alone, and that more than 35% of all adolescent girls participate in some form of dance training. Their most common injury is ankle sprain, with recurrence as high as 80%. This study aimed to test the efficacy of a six-week, pre-pointe (toe shoe) progressive training program that, if effective, would subsequently be put into a 3-year prospective epidemiologic study examining the intervention's effect on ankle sprain rate. **METHODS:** 16 pre-pointe students, (average age 11 yrs), at a professional ballet school assented, (along with parent/guardian consent), to participate. Three motor control-based concepts were incorporated into a 50 minute progressive exercise class taught twice per week for 6-weeks. The motor control principles underlying all of the exercises were: 1.) identification and maintenance of trunk-pelvic neutral; 2.) appropriate weigh shift; 3.) dissociation of the limbs from the trunk. Tests of lower extremity and trunk strength were assessed using hand-held dynamometry and Kendall methods. Four functional tasks, (single leg eyes-closed balance; topple; airplane and sauté tests), were assessed along with one IMU-based jump task. Jump height and GRF were estimated using an inertial sensor (BTS G-Sensor 2, Brooklyn, NY). The sensor, worn in a pouch on a velcro belt wrapped around the dancer's trunk at umbilicus level, contained a triaxial accelerometer, gyroscope and magnetometer and connected wirelessly via Bluetooth® to a computer. Based on the accelerations measured by the sensor and the weight of the subject, several parameters were estimated. **RESULTS:** Paired t-tests revealed changes from the pretest to posttest assessment day: hip abduction ($p=0.009$) and trunk strength ($p=0.045$), balance ($p<0.001$), topple ($p=0.006$), airplane ($p=0.005$), all improved significantly; sauté showed a trend to improve ($p=0.084$). No G-Sensor jump parameters showed improvement. **CONCLUSIONS:** Significant improvements in strength, balance, and alignment were demonstrated by this cohort. Jump performance did not show improvement, but was an unfamiliar task to the subjects at the beginning of the training; it will be monitored intermittently as training continues.

3502 Board #190 June 1 8:00 AM - 9:30 AM
Effect Of 3d Multiple Object Tracking Training On Collegiate Ice Hockey And Lacrosse Game Performance
 Erin Manning, Jesse Hall, John Rosene. *University of New England, Biddeford, ME.*
 Email: emanning1@une.edu
 (No relevant relationships reported)

3D multiple object tracking (3D MOT) aids in improving working memory and spatial awareness by stressing foveal and peripheral vision while demanding multi-faceted attentional focus. 3D MOT also improves cognitive processing which may improve the ability to rapidly extract data from the environment thereby enhancing decision making capabilities. These attributes have the potential to enhance sports performance. **PURPOSE:** The purpose of this study was to determine if 3D MOT training increases in-game performance during a competitive season. **METHODS:** 79 athletes from four NCAA DIII collegiate athletic teams (ice hockey $n=34$; lacrosse $n=45$) participated. Athletes were assigned to either a 3D MOT ($n=38$) training intervention or control (C) group ($n=41$). Athletes completed 24 sessions of 3D MOT training, 2-4 times per week over 12 weeks during the respective competitive seasons. At the conclusion of the seasons, independent samples t-tests were used to compare performance measures (game statistics) between 3D MOT and C groups for ice hockey (men's and women's combined), men's lacrosse, and women's lacrosse. **RESULTS:** There were no significant differences in performance measures between 3D MOT and C groups for ice hockey ($p>0.05$). For men's lacrosse, faceoff winning percentage was significantly different ($p=0.000$) with the C group having a greater faceoff winning percentage versus the 3D MOT group (30% vs. 0%). For all other performance measures there were no significant differences ($p>0.05$) between groups. For women's lacrosse, there were significant differences for assists ($p=0.045$), points ($p=0.034$), shots ($p=0.035$), and free-position shots ($p=0.014$) with the 3D MOT group having lower values versus C. **CONCLUSIONS:** Athletic performance is multifactorial in uncontrolled environments such as competitive ice hockey and lacrosse, which may suggest that performance benefits of 3D MOT training may be overshadowed by the complexities of game play. The significant differences found between groups may be due to player skill differences versus a 3D MOT effect. Further research is warranted to determine the effectiveness of 3D MOT training and its impact on sport performance.

3503 Board #191 June 1 8:00 AM - 9:30 AM
Pelvic and Core Strength Training Improves Pelvic Posture, Hamstrings-to-Quadriceps Ratio, and Vertical Jump Performance
 Chee-Hoi Leong, Cassandra York, Zachary Bohling. *Central Connecticut State University, New Britain, CT.*
 Email: c.leong@ccsu.edu
 (No relevant relationships reported)

Poor pelvic posture demonstrated through anterior pelvic tilt have been known to produce musculoskeletal imbalances involving muscular weakness of the abdominal and pelvic regions. While stretching and massage techniques have been reported to be effective in alleviating anterior pelvic tilt, it remains unclear if similar improvements can be elicited by pelvic and core strength training. **PURPOSE:** To examine the effect of an 8-week pelvic and core strengthening program on anterior pelvic tilt (APT), hamstrings-to-quadriceps (H:Q) strength ratio, and vertical jump performance in healthy individuals. **METHODS:** Nine healthy males (age=27.11±12.15 years; mass=82.78±8.84 kg; height=178.76±8.07 cm) performed resistance training (2x/week; 30-40 min) involving a combination of abdominal and hip extensors strengthening exercises for 8 weeks. APT (°), vertical jump height (m), vertical jump power (W), and H:Q ratio at 60, 180, and 300 °/s were assessed prior to and following the 8-week pelvic and core strengthening program. Paired samples t-tests were used to evaluate pre- to post-training changes in APT, vertical jump height and power, and H:Q ratio. Effect sizes (*ES*) were calculated for all analyses and *ES* magnitudes of < 0.50, 0.50-1.0, and > 1.0, were interpreted as small, medium, and large effects, respectively. **RESULTS:** APT was significantly decreased, and vertical jump height and the H:Q ratio at the angular velocity of 300 °/s were significantly increased, following 8 weeks of pelvic and core strength training (all $p < 0.05$, Table 1). **CONCLUSION:** Resistance training emphasizing pelvic and core strengthening was effective in reducing APT, improve vertical jump performance and H:Q ratio. Our findings have potential implications for clinicians prescribing resistance exercises to improve pelvic posture in patient populations with musculoskeletal imbalances, and for injury prevention and maintenance of postural equilibrium in healthy individuals.

Table 1. Pre- versus post-training responses (mean±SD) following pelvic and core strength training.

	Pre-training	Post-training	%Δ	P	ES
APT (°)	14.9±3.2	8.6±3.5*	42	0.0005	1.95
Vertical jump power (kW)	4.45±8.76	4.56±1.02	2	0.18	0.12
Vertical jump height (m)	0.457±0.099	0.493±0.090*	8	0.004	0.36
H:Q ratio @ 60 °/s	0.49±0.07	0.56±0.12	14	0.06	0.92
H:Q ratio @ 180 °/s	0.50±0.15	0.57±0.12	15	0.06	0.49
H:Q ratio @ 300 °/s	0.51±0.13	0.60±0.13*	18	0.04	0.70

*Significantly different compared to pre-training ($P<0.05$).
 Supported by CCSU Faculty-Student Research Grant 2016/17.

3504 Board #192 June 1 8:00 AM - 9:30 AM
Impact of 4-week Brain Endurance Training (BET) on Cognitive and Physical Performance in Professional Football Players
 Walter Staiano¹, Michele Merlini², Chiara Gattoni², Samuele Marcora³. ¹*University of Valencia, Valencia, Spain.* ²*University of Kent, Chatham Maritime, United Kingdom.* ³*University of Bologna, Bologna, Italy.*
 (No relevant relationships reported)

PURPOSE: It has been hypothesized that acute negative effect of mental fatigue (MF) could potentially become a training stimulus for the brain (Brain endurance training [BET]) to adapt and improve its ability to better sustain or attenuate MF states during sport competitions. The aim of this study was to test the efficacy of BET to reduce fatigue during a battery of cognitive and physical tests in players from a professional football team. We hypothesized that combination of BET and standard physical training during a 4-week period would increase cognitive capacity and physical football performance by increasing resilience to fatigue, more than standard football training alone. **METHODS:** 24 professional football players were randomly assigned to 2 different training groups: BET and Control. Both groups completed 20 supervised physical training sessions. Immediately after each session BET group completed on average 400 min (20 min/session) of cognitive training. Control group, instead, was asked to listen to neutral music for the same amount of time. Endurance performance (30-15 Intermittent Fitness Test), Sprint and Decision Making (RSA Random Test), Reactive Agility alongside with cognitive performance (STROOP Task) were measured at baseline (pre-test) and after 4 weeks of training (post-test). Data were

analysed using mixed model ANOVAs. **RESULTS:** STROOP task showed reaction time in both groups decreased at post-test. However, BET decreased significantly more compared to control group ($p < 0.02$) despite no significant differences in accuracy. BET group completed the reactive agility test significantly faster than the control group ($p < 0.05$) and with lesser fouls ($p < 0.03$). During the RSA Random Test no significant differences were found between the groups for linear acceleration phase (first 10 m). However, BET group completed significantly faster ($p < 0.05$) the decisional phase (second 10 m). Distance covered during the 30-15 test showed there was no difference in the performance of the BET group. However, control group showed a significant decrease ($p < 0.05$) in performance. **CONCLUSION:** The results of this study provide evidence that the combination of BET and standard football training is more effective than standard training alone in boosting cognitive and physical performance in elite football players.

3505 Board #193 June 1 8:00 AM - 9:30 AM

Effect of Wheelchair Tai Chi Ball Exercise on Physical & Mental Health among Elderly

Jingle Xu¹, Shiqi Yu¹, Chung-Hyun Goh¹, Ting Liao², Xuanliang Neil Dong¹, Gloria Duke¹, Danita Alfred¹, Yong Tai Wang, FACSM¹. ¹The University of Texas at Tyler, Tyler, TX. ²Wuhan Sports University, Wuhan, China. (Sponsor: Yong Tai Wang, FACSM)
Email: JXu3@patriots.uttler.edu
(No relevant relationships reported)

Mind-body exercise and strength training are crucial for elderly with disability. In this project, we developed an innovative exercise of Wheelchair Tai Chi Ball 12 forms (WTCB12), which combines mind-body exercise with strength training for elderly with disability. **PURPOSE:** To examine the effect of a 3-month WTCB12 intervention on physical and mental health and functional abilities among elderly.

METHODS: Twenty-six participants from a local senior living facility participated in the WTCB12 intervention with 13 in each group. Nine completed the study in WTCB group (age: 86.55±3.39 yrs; height: 1.69±0.17 m; mass: 75.54±20.28) and ten completed in the control group (age: 81.78±14.39yrs; height: 1.64±0.07m; mass: 68.31±15.17kg). The weights of the WTCB ranged from 1 pound to 2 pounds selected by the participants based on their physical conditions. The WTCB group practiced WTCB12 twice a week, one hour each time. The control group did their daily routine without WTCB intervention. The following variables were measured: Pain Self-Efficacy Questionnaire (PSEQ), heart rate (HR), blood pressures, range of motion (ROM) and muscle strengths of the dominant arm at the shoulder, elbow and wrist joints, and SF-36v2 for physical and mental health. The Independent t test and paired t test were employed to examine the differences between and within the two groups in the pretest and posttest.

RESULTS: The results indicated that the PSEQ was significantly improved in WTCB group after WTCB intervention (Pre-test: 41.44±13.89 vs Posttest: 50.11±8.94, $p < .05$), but no significant improvement in the control group. The HR, blood pressures, ROM and SF-36v2 physical and mental health were not significantly different between two groups, however, the WTCB group had significant greater muscle strengths at the shoulder extension, abduction and adduction, elbow flexion and extension and wrist flexion and extension in the posttest than the control had since the WTCB group's joint muscle strengths maintained and the control group's muscle strengths at these joints decreased.

CONCLUSIONS: WTCB12 exercise may help with pain management, maintain upper extremity muscle strength and is a feasible exercise for elderly with disability. Supported by Paralyzed Veterans of America Education Foundation Grant #819

3506 Board #194 June 1 8:00 AM - 9:30 AM

Health And Fitness Benefits Using A Heart Rate Intensity-based Commercial Fitness Exercise Regimen

John C. Quindry, FACSM, Cassie Williamson. University of Montana, Missoula, MT.
Email: John.quindry@mso.umt.edu
(No relevant relationships reported)

PURPOSE: Inactivity leads to morbidity and mortality, while engaging fitness approaches improve health outcomes.

METHODS: The current study examined an 8-week commercial group exercise regimen for comprehensive health and fitness indices. Study duration gauged the time frame by which high intensity interval training (HIIT) elicits improved health and fitness. Aerobic fitness, body composition, resting metabolic rate, blood cholesterol and glucose, in addition to resting blood pressure were quantified. Exercise training utilized multimodal HIIT-based exercises and work intensity was gauged by real-time heart rate feedback.

RESULTS: Program adherence was 100% with 23 participants. Pre-Post analyses indicate aerobic fitness ($O_{2max} +4 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$), body composition (%fat -1.1%), resting metabolic rate (+107 Kcal), resting blood pressure (-8.1mmHg systolic, -2.5mmHg diastolic), and circulating triglycerides (-21%) were altered.

CONCLUSIONS: This study is the first study to quantify comprehensive improvements in aerobic fitness, body composition, resting metabolic rate, resting blood pressure, and triglycerides after a brief 8-week HIIT regimen. The implications of franchised group exercise with wearable technology serves as an unexplored scientific approach to understand novel exercise prescriptions on health-fitness outcomes. Future research should investigate sociological aspects of program adherence, while biological applications should be examine the adaptive stimuli of HIIT training on health and fitness improvements.

3507 Board #195 June 1 8:00 AM - 9:30 AM

Comparison of Two Training Programs for Improvement of Muscular Strength Quantified via Pull-Ups

Ciara-Lyn Lee¹, Eric C. Bredahl¹, Michael T. Lane², Jacob A. Siedlik¹. ¹Creighton University, Omaha, NE. ²Eastern Kentucky University, Richmond, KY. (Sponsor: Joan Eckerson, FACSM)
(No relevant relationships reported)

The requirement to integrate women into combat-arms military occupational specialties represents an opportunity to refocus training protocols for optimized performance in specific components of military physical and combat fitness tests. The United States Marine Corps will incorporate new standards in 2019 which include requiring more pull-ups for female Marines. The pull-up requirement is often difficult for Marine recruits to achieve and the overabundance of training protocols potentially confuses recruits and minimizes potential gains in event specific muscular strength.

PURPOSE: To quantify changes in completed pull-ups between two training protocols to determine an optimal program for improved performance in college-aged females.

METHODS: Twenty-nine female subjects volunteered to participate and were randomized to either a control group or one of two training programs (Control [n = 3]; Free Weights [n = 14]; Machines [n = 12]). The two training programs consisted of pre-programmed workouts 3 d·wk⁻¹ focused on upper body and core exercises. There was at least 1 d of recovery between workouts. Subjects were monitored for the first 2 wk of training to ensure compliance and proper technique. Maximum number of pull-ups were assessed at baseline, 3 wk, and 6 wk. Data were analyzed using a 3x3 repeated measures ANOVA. **RESULTS:** There were no significant differences in age, height, or weight between the groups (Mean ± SD; age = 20 ± 1 yr; Height = 164 ± 6 cm; Weight = 64.2 ± 9.9 kg). Over the 6 wk period a total of 5 subjects withdrew from the study (Control [n = 3]; Free Weights [n = 11]; Machines [n = 10]). No significant interaction effect was observed between programs ($p = .7$); and there was no main effect for time ($p = .1$). **CONCLUSION:** Overall the training protocols improved pull-up performance with 4 of the free weight participants and 3 of the machine-based participants improving from zero to one or more pull-ups. Results are limited due to the dropout rate of ~17% over the training period which is not unexpected given the duration of this study. Future research should focus on improved adherence, and subject monitoring, to optimize performance in the pull-up event.

3508 Board #196 June 1 8:00 AM - 9:30 AM

Effect Of Suspension Training On Functional Movement Screen (FMS) and Mobility, Activation, Posture, and Symmetry (MAPS)

Megan Jackson¹, Emily Hilliard¹, Ann T. Shields¹, Alex McDaniel¹, Ryan Swiezy¹, Rachel Willilams¹, Courtney K. Milleson¹, Andrew Ortiz¹, Brad Hollingsworth¹, Sarah Noland¹, Raechel Santee¹, Phillip Morie¹, Lauren Ackerman¹, Emma Schmid¹, Kelsey D. Bryan¹, Frances M. Livingston¹, Tiago Barreira², Wayland Tseh¹. ¹University of North Carolina Wilmington, Wilmington, NC. ²Syracuse University, Syracuse, NY. (Sponsor: Dr. Robert Boyce, FACSM)
(No relevant relationships reported)

INTRODUCTION: Although suspension training is used in various exercise routines, there has been insufficient research to determine the effect of suspension training on functional movement. **PURPOSE:** 1) to examine the effect of suspension training on functional movement, assessed via the FMS and MAPS and 2) to identify the correlation between the FMS and MAPS. **METHODS:** Twenty-seven participants (19 females; 8 males; Age = 26.0 ± 11.1 yrs; Height = 167.9 ± 9.1 cm; Body Mass = 69.6 ± 14.1 kg) completed 28 exercise sessions over a 14-week course. Throughout each 40-minute exercise session, six body positions were utilized on the suspension training straps which included push, pull, rotational, squat, and lunge movements; participants also engaged in functional training utilizing stability balls and resistance bands. Pre- and post-fitness assessments included the FMS, MAPS, body composition, muscular endurance, muscular strength, and flexibility. Dependent t-tests were used to determine if there were mean changes in functional movement status. Due to multiple comparisons, Bonferroni correction was used, therefore, alpha level was set at .007.

RESULTS: There were significant positive changes in FMS (14.6 ± 2.7 to 15.9 ± 2.1, $p < 0.001$) and MAPS (52.9 ± 10.3 to 56.3 ± 9.7, $p < 0.001$) values, as well as mean quantity of push-ups (24.9 ± 11.5 to 29.4 ± 13.9, $p = 0.004$) and handgrip dynamometer (78.0 ± 21.7 kg to 85.6 ± 24.0 kg, $p = 0.006$). There were no significant changes in

mean body mass, fat mass, lean mass, percent body fat, and sit-and-reach values. Pearson correlation was used to determine the relationship between FMS and MAPS both at pre- and post-testing. At both time points, pre- and post-testing, the correlations were significant ($r = .52$ and $.43$, respectively). **CONCLUSIONS:** Participation in suspension training produced significant improvements in overall functional movement, muscular strength, and endurance. Although there were significant positive changes in both FMS and MAPS from pre- to post-assessment, a weak correlation existed between the FMS and MAPS assessments.

3509 Board #197 June 1 8:00 AM - 9:30 AM
Biomechanical Analysis of Collegiate Baseball: Training Implications for Enhancement of Pitching Endurance

Andria C. Moitosa¹, William P. Lydon¹, J. Mark VanNess¹, Alexis C. King², Courtney D. Jensen¹. ¹University of the Pacific, Stockton, CA. ²University of Illinois at Urbana-Champaign, Champaign, IL.

(No relevant relationships reported)

Endurance is critical to a starting pitcher's success. However, the repetition of pitching stress can decrease performance and increase risk of injury in later innings. Improving arm endurance likely enhances late-game performance. **PURPOSE:** To evaluate predictors of mechanical endurance in collegiate pitchers. **METHODS:** 10 Division-1 pitchers were tested using Proteus technology (Boston Biomotion, Inc.). They completed 6 sets of 5 pitches; each set changed in resistance, ranging from ½ to 5 lbs. Endurance was a calculation of the ability to preserve power in each set on a continuous scale of 0.00 (0% preservation) to 1.00 (100% preservation). Mean endurance was the mean value of all 6 sets. Proteus also assessed biceps curls, triceps extensions, internal and external rotation, and horizontal adduction and abduction. Pitchers were tested during the 2017 season and data were compared to in-game performances. Linear regressions tested the relationships between endurance, performance on other tests, and in-game statistics. **RESULTS:** Pitchers were 72.0 ± 2.7 inches in height, had a mean fastball velocity of 84.6 ± 3.9 mph, a mean earned run average (ERA) of 5.8 ± 2.8, and a mean endurance of 97.7 ± 1.9%. Endurance was unrelated to class year ($p=0.857$) and was not related to anthropometric measurements, including height ($p=0.460$), weight ($p=0.188$), arm length ($p=0.350$), and leg length ($p=0.464$). Maximum squat strength ($p=0.917$), fastball velocity ($p=0.832$), and three-dimensional measurement of pitch range of motion ($p=0.730$) were also unrelated to pitch endurance. Biceps curl endurance ($p=0.035$) and triceps extension explosiveness ($p=0.089$) of the dominant arm correlated with pitching endurance. These relationships lost significance on non-dominant arm for curls ($p=0.241$) and extensions ($p=0.187$). Given a larger sample, other associations may be found; of interest, there may be relationships between endurance and innings per appearance ($\beta = 0.353$, $R^2=0.196$; $p=0.232$) and ERA ($\beta = -0.559$, $R^2=0.149$; $p=0.305$). Post-hoc power analyses revealed samples of 30 and 38 respectively to reach significance (power=0.80; $p=0.05$). **CONCLUSIONS:** Fatigue results from repetitive overhead throwing, elevating risk of overuse injuries. Use of Proteus may provide modes of exercise unrecognized by traditional baseball training.

3510 Board #198 June 1 8:00 AM - 9:30 AM
Automated Impact Corroboration From Game Video In Ice-hockey Using Computer Vision Approaches

Muhammad Sohaib Arif¹, Aaron Pilotti-Riley¹, Erik Bollt², Stephen J. McGregor¹, Davor Stojanov¹. ¹Eastern Michigan University, Ypsilanti, MI. ²Clarkson University, Postdam, NY. (Sponsor: Mark Peterson, FACSM)
 Email: marif@emich.edu

(No relevant relationships reported)

Purpose

Video corroboration of on ice impacts identified by wearable sensors (WS) is a time-consuming task. To automate this, we attempted a computer vision approach to recorded game video to corroborate impacts identified using WS among national ice-hockey team members.

Methods

23 U.S. National U18 Hockey team members consented to procedures approved by EMU HSRC. Impacts were previously validated from data collected at 100 Hz (Impact Processor, Zephyr MD) from 8 players with the top activity levels determined by WS in 4 games. Game video was manually synchronized, and timestamps were used to extract frames from the video that allowed for visually identifying and labeling impacts. A convolutional neural network (YOLO) was used to detect impacts in video and generate a training dataset from 1060 images from 3 game videos that included 86 impacts.

Video and timestamps were used for training instead of still frames. Denoising filters were used to account for time shift errors due to manual labeling and anomalous detections appearing and disappearing in up to half a second of video. Thus, we

removed any impacts detected by video for less than 30 or 60 continuous frames (0.5 or 1.0 second, respectively). An smaller version of the model (YOLO-tiny) was also tested on a Note 8 (Samsung) smart phone to determine applicability to real-time game setting.

Results

The trained YOLO network was applied to the 4th game video that had 32 validated sensor identified impacts. The model successfully detected all 32 impacts but generated 1000 false positives. With a 60 frame filter, the model detected 20 of the 32 events, but false positives were reduced to 211. With a 30 frame filter, the model detected all 32 impacts but false positives increased to 391. Interestingly, the mobile model and 30 frame filter detected all 32 impacts with 222 false positives, of which, 99 were classified as "Pass Bys" or players that occluded each other on the video but did not make physical contact.

Conclusion

These results demonstrate that computer vision techniques can be used to identify validated impacts with high success, but with many false positives. The high false positive rate presents a challenge, but since a large proportion of false positives were simple pass-bys, using a real-time sensor fusion approach with WS, the false positives may be reduced substantially.

3511 Board #199 June 1 8:00 AM - 9:30 AM
Relationship Between the Perceived Training Loads of Division II Swimmers and Coaches

Bianca Lagamon, Angel Quintero, Derrick Gardner, Vanessa Yingling, FACSM, James Mouat IV. *California State University, East Bay, Hayward, CA.* (Sponsor: Vanessa Yingling, FACSM)

(No relevant relationships reported)

Monitoring training loads provides coaches the opportunity to create effective programs for their athletes to prepare for competition and make adjustments to manage fatigue, reduce the risk of soft-tissue injuries and non-functional overreaching. An athlete's training load is a combination of the external load (work completed by the athlete) and internal load (physiological or psychological stress from that work). The individuality of perceived training loads is an important consideration for a coach as the athlete's perception may be different from the intended demands from the coach. The difference in perceived training loads between the coach and athlete can increase the risk of undertraining or overtraining. **PURPOSE:** To compare the perceived training loads between a coach and athletes on a Division II women's swimming team. **METHODS:** Twenty-four athletes participated (age 20.2 ± 1.2 years; height 169.03 ± 6.2 cm; mass 68.7 ± 8.9 kg). The expected training loads of the coach and perceived training loads of the athletes were monitored for one season. A survey link was sent to the coach and players to report the date, the duration of training in minutes and the rate of perceived exertion (RPE) for each practice and competition. Training load (TL) was calculated as the product of the RPE and training session duration in minutes and labeled arbitrary unit (AU). The relationship between the coach's expected training loads and the athletes' perceived training loads were examined using paired t-test and Pearson correlation. **RESULTS:** The swimmers average TL over the 54 sessions was 554.5 ± 237.1 au which showed no significant difference from the coach's average perceived TL, 555.6 ± 246.5 au ($p=0.85$). A strong correlation was found between the TL of the coach and the average TL of the 24 athletes ($r=0.87$, $CI=0.79-0.92$, $p<0.0001$). **CONCLUSION:** On average, the athletes perceived the training sessions to be harder than what the coach expected. Differences in training expectations and perception could be due to fitness levels among athletes, sleep (quantity and quality), academic stress or illness. However, the differences in TL expectation and perception could result in fatigue, injury and/or suboptimal training adaptation. Monitoring planned and perceived training load is critical to optimize performance and reduce injury.

3512 Board #200 June 1 8:00 AM - 9:30 AM
Relationships Between Isometric and Dynamic Strength in Recreationally Active Women

Stephen J. McGuire, Sam D. Blacker, Jason Lake, Stephen D. Myers. *University of Chichester, Chichester, United Kingdom.*
 (No relevant relationships reported)

Women entering training for physically demanding occupations typically perform strength orientated tasks less well than their male counterparts. However, they are not often strength-trained and appropriate training may reduce these differences. Force-time assessment of the isometric mid-thigh pull (IMTP) has been used to monitor strength adaptations in athletes as they relate to dynamic task performance. The ratio between peak countermovement jump (CMJ) concentric force and IMTP peak force (Dynamic Strength Index [DSI]) has also been used to guide prescription of maximal or ballistic strength training. **PURPOSE:** To examine the efficacy of IMTP and DSI to monitor and prescribe strength training in untrained women. **METHOD:** Following familiarization, 26 civilian women volunteers (mean ± SD, age: 24 ± 3 y, height: 1.64 ± 0.05 m, body mass: 65.4 ± 11.8 kg) completed five tests in this order: bench press one-repetition maximum (1RM); CMJ; IMTP; seated medicine ball throw (MBT); dominant handgrip strength. Force plates sampling at 1000 Hz recorded IMTP and

CMJ performance, and IRMs were predicted from submaximal load-velocity profiles. Relationships were assessed between IMTP and dynamic tests (Pearson's r), and performance compared between Low (<0.60 , $n = 8$) and High (>0.80 , $n = 10$) DSI participants (Bonferroni adjusted independent t-tests or Mann-Whitney U test), with effect sizes calculated (Hedges g). **RESULTS:** Absolute peak IMTP force (minus body weight) correlated moderately with handgrip strength ($r = 0.66$), MBT ($r = 0.70$) and IRM ($r = 0.57$), and relative IMTP peak force (per kg body mass) with CMJ height ($r = 0.48$). The IRM (Low vs High DSI: 45.0 ± 11.0 vs 31.5 ± 6.5 kg, g 1.6), absolute IMTP (1386 ± 276 vs 709 ± 166 N, g 2.9), relative IMTP (20.7 ± 2.8 vs 11.0 ± 1.9 N \cdot kg $^{-1}$, g 4.9), MBT (3.3 ± 0.3 vs 2.7 ± 0.3 m, g 2.4) and handgrip (34.5 ± 1.8 vs 26.2 ± 3.9 kg, g 3.1) were greater in Low DSI participants ($p < 0.01$), with no difference in CMJ height (0.23 ± 0.03 vs 0.19 ± 0.05 m, g 0.51). **CONCLUSION:** Moderate relationships between IMTP force and dynamic performance are consistent with current athletic literature, thus absolute and relative force are both recommended to monitor strength training adaptations in untrained women. Similar ballistic (CMJ) performance between Low and High DSI individuals support its use to prescribe training modality.

G-39 Free Communication/Poster - Anterior Cruciate Ligament

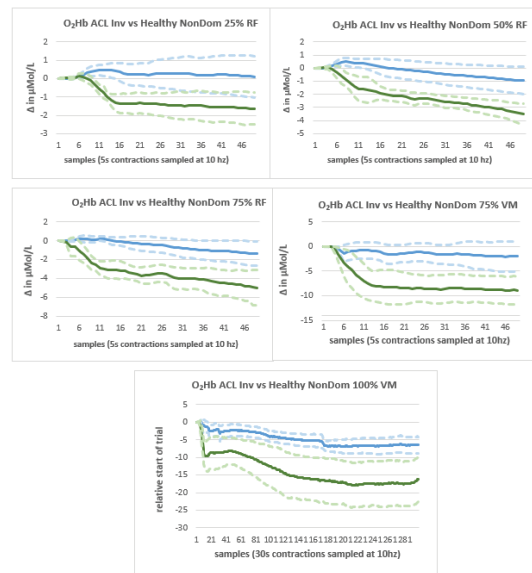
Saturday, June 1, 2019, 7:30 AM - 11:00 AM
Room: CC-Hall WA2

**3513 Board #201 June 1 9:30 AM - 11:00 AM
Quadriceps Oxygen Consumption During Exercise in Patients with ACL-Reconstruction**

Abbis Jaffri, Maggie Lynch, Susan Saliba, Joe Hart, FACSM.
University of Virginia, Charlottesville, VA.
Email: ahj8uw@virginia.edu
(No relevant relationships reported)

PURPOSE: Patients with ACL reconstructed knees (ACLR) commonly experience persistent muscle weakness. Altered oxygen consumption (OC) during voluntary rehabilitation exercises of the quadriceps may be a contributing factor. The purpose was to compare quadriceps muscle OC during knee extension exercises in patients with ACLR versus healthy controls. **METHODS:** 10 patients with primary, unilateral ACLR (7M/3F, 22.9 ± 3.5 y, 170.81 ± 7.93 cm, 73.7 ± 15.1 kg) and 10 matched controls (7M/3F, 22.9 ± 3.5 y, 170.4 ± 10.7 cm, 68.86 ± 9.51 kg) participated. Each participant completed a single data collection session consisting of 5-second isometric contractions at 25, 50 & 75% of the volitional maximum followed by a 30s maximal isometric knee extension contraction. We continuously recorded measures of oxygenated hemoglobin (O2Hb) on the reconstructed thigh (versus the non-dominant thigh of healthy controls) using three wearable, wireless near-infrared spectroscopy units placed superficial to the vastus medialis, lateralis and rectus femoris muscles. Relative changes in OC were ensemble averaged and plotted for each contraction intensity with associated 90% confidence intervals. Statistically significant differences were defined as portions of the exercise trials where confidence intervals of the O2Hb graph did not overlap. Effect sizes were calculated for statistically significance. **RESULTS:** We observed significantly lower relative change in O2Hb for ACLR compared to healthy controls in the rectus femoris at 25% ($2.1[1.5-2.7]$), 50% ($2.8[2.6-2.9]$), 75% $2.0[1.9-2.2]$ and for the vastus medialis at 75% ($1.5[1.4-1.5]$) and 100% ($2.6[2.5-2.7]$) (Figure 1). No other statistically significant differences were observed. **CONCLUSION:** Differences exist in quadriceps muscle OC between patients with ACLR during the same exercises versus healthy controls. However, not all portions of the quadriceps are affected uniformly across contraction intensities.

Figure 1: O2Hb in ACLR thighs compared to a healthy matched thighs at different exercise intensities for rectus femoris (RF) and vastus medialis (VM). Blue solid lines represent ACLR, green lines represent Healthy and dotted lines represent 90% confidence intervals over the course of knee extension isometric contraction trials. Data presented as changes relative to the start of the trial.



**3514 Board #202 June 1 9:30 AM - 11:00 AM
Comparison of Knee Functional Outcomes after Anterior Cruciate Ligament Reconstruction between Older and Younger Patients**

do kyung kim, Geon Park, WonHah Park. *Samsung Medical Center, seoul, Korea, Republic of.*
Email: hrmax1@naver.com
(No relevant relationships reported)

Anterior cruciate ligament (ACL) reconstruction is frequently performed to restore knee stability and function following ACL injury. Traditionally, ACL injury people older than 40 years received non-operative treatments because of not performing high demanding activities and possible inferior surgical outcomes. According to increasing sports activities, there are more chance to injury and surgical reconstruction in patients older than 50 years. However, a few numerous research with knee function and stability outcomes had been reported following ACL reconstruction in age over 50 years old.

PURPOSE: The aim of this study was to evaluate muscle strength, ligament stability, and functional outcomes in comparing older (>50 years) and younger (<40 years) patients at 1 year after ACL surgery. **METHODS:** A retrospective analysis of prospectively collected data was performed in 40 younger (29.0 ± 5.1 yr) and older (52.5 ± 2.1 yr) ACL reconstruction patients each. All patients were evaluated for isokinetic extensor and flexor muscle strength, laxity, and functional scores at 1 year after operation. The highest peak torque at each velocity was compared with the uninjured side by isokinetic device. The knee laxity was assessed by the KT-2000 arthrometer. The comparing injured and uninjured knee side-to-side difference was measured at anterior maximum manual tension. Knee functional score were evaluated using the validated International Knee Documentation Committee (IKDC) and Lysholm scores. **RESULTS:** There was no statistically significant difference in extensor strength deficits between older and younger groups at $60^\circ/s$ and $180^\circ/s$ ($p = 0.495$, $p = 0.419$, respectively). In addition, there was no differences in knee flexor strength deficits between the groups ($p = 0.417$, $p = 0.449$, respectively). There was also no statistically significant difference in ligamentous laxity ($p = 0.06$) and Lysholm scores ($p = 0.126$). However, IKDC scores in the younger group showed significantly greater improvement than those in the older group ($p = 0.009$). **CONCLUSION:** Older patients with ACL reconstruction surgery would have similar results for knee strength and ligament laxity. This study showed that ACL reconstruction is more effectiveness and safety for restoration of knee strength and stability in older than 50 years patient group.

3515 Board #203 June 1 9:30 AM - 11:00 AM
Associations Between Muscle Morphology Measured with Ultrasonography and Self-Reported Function Following Anterior Cruciate Ligament Reconstruction

Steven A. Garcia, Michael T. Curran, Riann Palmieri-Smith.
University of Michigan, Ann Arbor, MI.
 Email: stevenag@umich.edu
 (No relevant relationships reported)

Deficits in quadriceps function are common in patients who sustain an anterior cruciate ligament (ACL) injury and undergo subsequent ACL reconstruction (ACLR). Quadriceps atrophy is among the notable changes in muscle tissue after ACLR. The relationship between muscle morphology and self-reported function should be established so treatment options can be targeted to improve function after ACLR. **PURPOSE:** (1) To evaluate rectus femoris (RF) cross-sectional area (CSA) and intramuscular fat percent (PF) in the injured and uninjured limb from 9 weeks post ACLR to return to activity (RTA) and (2) identify associations between injured limb quadriceps CSA, PF and self-reported function. **METHODS:** 28 individuals with primary unilateral ACLR (Age=16.6±2.7; Weight=71.8±17.7; 64% female; 18 bone-patellar tendon-bone; 2 quadriceps tendon; 5 hamstring tendon) were recruited for this study. RF was imaged at 15cm proximal of superior border of the patella. Quadriceps CSA and PF of the injured and uninjured limb were used for analysis. Self-reported function was evaluated using the International Knee Documentation Committee score (IKDC). Paired-samples t-tests were used to compare inter-limb differences in CSA and PF and changes from 9 weeks to RTA. Partial correlations adjusting for sex were used to analyze the relationship between RF morphology and IKDC scores. **RESULTS:** Injured limbs had smaller RF CSA at each time point (4.5±1.6cm² vs 5.2±1.9cm², p<.01 and 5.2±1.9cm² vs 5.6±2.1 cm², respectively) compared to the uninjured limb. Injured limb CSA increased at RTA (4.5±1.6cm² vs 5.2±1.9cm², p<.01) while the uninjured limb did not (p=0.12). No differences in PF were found between limbs (p=0.18, and p=0.43, respectively) or time point (p=0.67, and p=0.92, respectively). After adjusting for sex, larger injured limb CSA was associated with higher IKDC scores at 9 weeks and trended toward significance at RTA (r=0.32, p=0.05, and r=0.26, p=0.09, respectively). Injured limb PF was negatively associated with IKDC scores at both time points (r=-0.55, p<.01, and r=-0.39, p=0.02, respectively). **CONCLUSIONS:** Inter-limb differences in RF muscle CSA are not ameliorated at RTA. RF CSA and PF are associated with self-reported function in individuals with ACLR and should be treatment targets to improve patient function following injury.

3516 Board #204 June 1 9:30 AM - 11:00 AM
Evaluating Collagen Matrix Degradation after ACL Reconstruction using Quantitative MRI

Logan K. Faux-Dugan. *Delaware State University, Dover, DE.*
 (Sponsor: Thomas Buchanan, FACSM)
 Email: lkfauxdugan15@students.desu.edu
 (No relevant relationships reported)

Logan K. Faux-Dugan¹, Jack R. Williams², Kelsey Neal², Ashutosh Khandha², PhD, Thomas S. Buchanan², PhD, FACSM. ¹Delaware State University, Dover, DE, ²University of Delaware, Newark, DE
 Forty percent of individuals who undergo anterior cruciate ligament (ACL) reconstruction develop knee osteoarthritis (OA) within eight years of the procedure. T2 magnetic resonance imaging (MRI) can be used to assess the cartilage's collagen matrix health. Higher T2 times, when compared to healthy cartilage, are indicative of cartilage matrix degradation. When the ACL is injured, a bruise develops on the central and posterior regions of the tibial plateau. It is not known if this bruising has a long-term effect on the cartilage health in this region. **PURPOSE:** To determine if T2 values at the site of initial ACL injury (central and posterior regions of tibial cartilage) are higher in the involved vs. uninvolved limb, three months post ACL reconstruction. **METHODS:** Ten participants (8 men/2 women, age = 22 ± 5 years) underwent T2 MRI testing and analysis. Menisci boundaries were used to establish regions of interest (ROI). These ROI were further divided into deep and superficial sub-layers. The average T2 value for each ROI was calculated and each was compared in the involved vs. uninvolved limb using a paired t-test ($\alpha = 0.05$). **RESULTS:** For the tibial central deep region, the inter-limb difference (involved vs. uninvolved) approached significance (36±4 SD vs. 33±6 SD; p = 0.06, (Cohen's $d = .59$)), with higher T2 values in the involved limb cartilage. No statistically significant results were found for the other ROI. **CONCLUSION:** While not statistically significant, higher T2 values within the involved limb's central tibial cartilage indicate that bone bruising may result in collagen matrix degradation three months post ACL reconstruction. Future studies should include follow-up time points and a larger sample size. Supported by NIH R25-NS095371 and NIH R01-HD087459.

3517 Board #205 June 1 9:30 AM - 11:00 AM
Skeletal Muscle Mass and Circumference Discrepancies Between Injured and Un-Injured Limbs Post-ACL Reconstruction

Kassi J. Meacham, A. Page Glave, Mary L. Williams. *Sam Houston State University, Huntsville, TX.*
 (No relevant relationships reported)

Lower extremity injuries are common in sport. Anterior cruciate ligament (ACL) injuries often result in muscle atrophy in the thigh and calf muscles of the injured leg. Evaluating muscle atrophy via circumferences to document asymmetry has been recommended and is often used clinically (1). Previous studies have shown a small loss of skeletal muscle mass (SMM) may cause a greater loss in muscular strength (1), thus investigating muscle mass and girth may be beneficial in evaluating return to play post-ACL injury.

PURPOSE: The purpose of this study was to examine SMM and circumference discrepancies between injured and uninjured limbs post- ACL reconstruction. **METHODS:** Participants (n = 7, 4 F, 3 M; 21.9 ± 4.3 y; 5.24 ± 4.74 y post injury) were tested using bioelectrical impedance analysis (BIA). Fat mass, fat-free mass, body fat percentage, and SMM (kg) for extremities and torso were obtained. Circumference measurements were taken on the injured (I) and un-injured (NI) limbs at the mid-patella, and superiorly and inferiorly of the patellar poles at 10, 15, and 20 centimeters, using a standard, non-elastic tape measure. **RESULTS:** There was no significant difference between SMM (I: 14.54 ± 3.80 kg; NI: 14.48 ± 3.48 kg; t(6) = 0.46, p = .660). Roughly half of participants had greater SMM in the injured leg versus un-injured leg. There were no significant differences in circumference measurements between the limbs. **CONCLUSIONS:** There was evidence of decreased SMM in some participants following ACL injury. It is possible that continued study with more participants may find difference in muscle mass following injury. SMM and circumferences provide useful information concerning muscular atrophy and discrepancies between limbs. SMM obtained via BIA may be utilized as a cost-effective measure indicative of knee stability and limb strength for return to play protocol (1). Future research should include measurements made pre and post injury/surgery to understand muscle mass progression following injury. 1-Ross, C. M., & Worrell, T. W. (1998). Thigh and calf girth following knee injury and surgery. *Journal of Orthopaedic & Sports Physical Therapy*, 27(1), 9-15.

3518 Board #206 June 1 9:30 AM - 11:00 AM
Patient Reported Outcomes after Anterior Cruciate Ligament Reconstruction Predict Isometric Quadriceps Torque

Alexa K. Johnson¹, Nicholas R. Heebner¹, Nicholas P. Baumann¹, Emily R. Hunt¹, Caitlin E-W Conley¹, Cale A. Jacobs¹, Darren L. Johnson¹, Mary L. Ireland, FACSM¹, Christian Lattermann², John P. Abt, FACSM¹. ¹University of Kentucky, Lexington, KY. ²Harvard Medical School, Boston, MA.
 (Sponsor: John Abt, FACSM)
 Email: johnson.alex@uky.edu
 (No relevant relationships reported)

Individuals who have undergone anterior cruciate ligament reconstruction (ACLR) have reduced muscle function that has been shown to persist for many years post-surgery. The ability to predict future levels of neuromuscular function with the use of early-on inflammatory markers may assist clinicians to better target common muscle function deficits seen after ACLR. **PURPOSE:** The purpose of this study is to determine if levels of inflammation and patient reported outcomes one month post-surgery predict muscle function at six months post-surgery. **METHODS:** Nineteen patients who underwent ACLR (82.8±20.3kgs, 1.7±0.1m, 18.4±2.8yrs, 8M, 11F) completed this study. One month post-surgery (1.1±0.3 months) individuals completed the Knee Osteoarthritis Outcomes Score (KOOS), and visual analog scale (VAS) for pain. Patients were also aspirated one month post-ACLR and commercially available ELISA kits were used to determine concentrations of interleukin-1 β (IL-1 β) in the synovial fluid. At six months (6.1±0.3months) patients completed maximal isometric contractions of the involved limb at 60 degrees of knee flexion. Rate of torque development (RTD) was calculated as the slope of the time-torque curve taken from onset of torque to peak torque. Multiple linear regressions were run to determine if levels of IL-1 β , KOOS scores, and VAS scores, while controlling for height and weight, one month post-ACLR would better predict peak torque or RTD six months post-ACLR. Models were compared and the highest adjusted R² was identified as the best model. An alpha value of 0.05 was used. **RESULTS:** Levels of IL-1 β , and patient reported outcomes one month post-surgery did not significantly contribute to the variance of RTD (86.8±68.0Nm/kg) six months post-surgery in the involved limb. Height, mass, KOOS-pain (73.3±19.2), KOOS-sport (41.9±40.2), and VAS (30.6±28.8) were included in the final model predicting 50.6% of the variance of peak isometric torque (151.3±49.1Nm; p=0.038). IL-1 β (-4.75±1.3pg/mL) did not significantly contribute to predicting the variance of peak torque. **CONCLUSION:** Although levels

of inflammation one month after surgery may not explain muscle function six months after surgery, patient reported outcomes for pain and sport performance can, suggesting early clinical use to help drive targeted rehabilitation.

3519 Board #207 June 1 9:30 AM - 11:00 AM

Differences in T1 ρ Relaxation Time in the Vastus Lateralis after an Anterior Cruciate Ligament Tear

Madalyn G. Romines, Lauren N. Erickson, Kylie A. Davis, Peter A. Hardy, Anders H. Andersen, Cale J. Jacobs, Brian Noehren, FACSM. *University of Kentucky, Lexington, KY.*

(No relevant relationships reported)

Anterior cruciate ligament (ACL) injury results in quadriceps atrophy and fibrotic changes in the extracellular matrix of the muscle that may not resolve. To date, assessments have used a muscle biopsy; however, this is an invasive procedure and impractical on a wide scale. Magnetic resonance imaging (MRI) techniques, such as T1 ρ , hold promise to measure fibrotic changes. This technique has been used to study cartilage degeneration and liver fibrosis, but has not been widely applied to muscle. Whether T1 ρ relaxation time is different between the quadriceps of the injured and non-injured limbs, as well as its relationship to quadriceps strength, is not established.

PURPOSE: To investigate the variance in T1 ρ relaxation times in the vastus lateralis (VL) between the injured and non-injured limb following an ACL tear and possible correspondence to quadriceps strength.

METHODS: 17 ACL deficient patients (8M, 9F, 21 \pm 4.52 y, BMI 25.95 \pm 3.83, days since injury 26 \pm 17.26) underwent an MRI. T1 ρ acquisition included a single 6 mm thick slice at the location of the largest cross-sectional area of the VL with 8 echoes collected within spin lock times of 0-70 ms (spin lock amplitude 300Hz, matrix 256x256, 2 excitations with 4 shots per slice). Data was fitted to a mono exponential decay curve using custom MATLAB code. Quadriceps strength was assessed via maximal voluntary isometric contractions on a dynamometer. Paired t-tests and Pearson product moment correlation coefficients were used to analyze the data.

RESULTS: T1 ρ times were significantly longer in the involved limb compared to the non-involved limb (involved: 0.0296 \pm 0.0032 s; non-involved: 0.0280 \pm 0.0031 s; 5.7% difference; p=0.04). Peak isometric torque was significantly less in the involved limb as to the non-involved limb (involved: 1.91 \pm 0.71 Nm/kg; non-involved: 2.65 \pm 0.52 Nm/kg; 27.7% difference; p<0.001); however, was not significantly correlated with longer T1 ρ time (r=0.07; p=0.70).

CONCLUSION: T1 ρ was significantly longer soon after injury, indicating that this tool is sensitive to measure early changes in muscle organization. Contrary to our hypothesis, a relationship to quadriceps strength was not found. Potentially, T1 ρ measures a different factor than peak strength and additional variables of muscle function should be evaluated.

NIH R01AR071398

G-40 Free Communication/Poster - Blood Flow Restriction

Saturday, June 1, 2019, 7:30 AM - 11:00 AM
Room: CC-Hall WA2

3520 Board #208 June 1 9:30 AM - 11:00 AM

Acute Muscular Responses to Practical vs. Traditional Blood Flow Restriction Resistance Exercise

Robert Thiebaud¹, Takashi Abe², Jeremy Loenneke², Tyler Garcia¹, Yohan Shirazi¹, Javier Fiol¹, Ross McArthur¹. ¹Texas Wesleyan University, Fort Worth, TX. ²The University of Mississippi, University, MS.

Email: rthiebaud@txwes.edu

(No relevant relationships reported)

PURPOSE: To compare the impact of blood flow restriction (BFR) resistance exercise on changes in muscular force output (MVC), muscle thickness (MTH) and total exercise volume (TEV) when using elastic knee wraps (practical) or nylon cuffs (traditional) inflated to 40 and 80% of arterial occlusion pressure (AOP).

METHODS: Participants (male=7, female=2) were 22 (4) years and had a body mass index of 25.4 (1.5) kg/m². A randomized cross-over study design used unilateral knee extension exercise (4 sets to failure) with six different conditions at three separate visits. Low-load (LL, 30% 1-RM) exercise was performed with four conditions: elastic knee wraps (Valeo®) stretched two inches from resting length (K2) and to a value that was 85% of thigh circumference (K85), and nylon cuffs inflated to 40% (BFR40) and 80% (BFR80) of AOP. LL (30% of 1-RM) and high-load (HL, 70% of 1-RM) exercise

without restriction were also performed. MVC and MTH were measured pre and post exercise. TEV was also calculated for each condition. Two-way [Condition x Time] repeated measures ANOVA and one-way repeated measures ANOVA were used to analyze the data. Data reported as mean (standard deviation). Statistical significance was set at p<0.05.

RESULTS: MVC decreased from pre to post-exercise for all conditions [Δ HL: -90 (81) N, Δ LL: -126 (57) N, Δ BFR40: -168 (89) N, Δ BFR80: -240 (134) N, Δ K2: -178 (91) N, Δ K85: -197 (57) N, p<0.05]. The changes in MVC were significantly different in K85 vs. HL (p<0.001) and K85 vs. LL (p=0.013). HL and BFR80 MVC at 15 minutes post-exercise were not different from pre-values (Δ HL: -53 (68) N, p=0.095; Δ BFR80: -67 (77) N, p=0.138) but LL, BFR40, K2 and K85 were still significantly below pre-values (p<0.05). MTH changes were similar from pre to post-exercise [Δ HL: 0.22 (0.22) cm, Δ LL: 0.26 (0.1) cm, Δ BFR40: 0.26 (0.14) cm, Δ BFR80: 0.28 (0.19) cm, Δ K2: 0.26 (0.21) cm, Δ K85: 0.25 (0.13) cm, p=0.892]. HL TEV was higher [889.6 (227.7) kg] compared to all the other conditions (p<0.05) while the LL [686.1 (173.1) kg] was higher than the BFR40 [576.8 (160.7) p=0.026], BFR80 [434.9 (142.3) kg, p<0.001] and K85 [520.2 (139.2) kg, p=0.023] conditions.

CONCLUSIONS: Exercising to fatigue with elastic knee wraps could be used to produce similar acute changes in MVC, MTH and TEV compared to known BFR pressures.

3521 Board #209 June 1 9:30 AM - 11:00 AM

Blood Flow Restriction Does Not Augment Low Force Contractions Taken to or Near Task Failure

Samuel L. Buckner¹, Matthew B. Jessee², Scott J. Dankel³, Kevin T. Mattocks⁴, James G. Mouser⁵, Zachary W. Bell³, Takashi Abe³, John P. Bentley³, Jeremy P. Loenneke³. ¹University of South Florida, Tampa, FL. ²University of Southern Mississippi, Hattiesburg, MS. ³University of Mississippi, University, MS. ⁴Lindenwood University-Belleville, Belleville, IL. ⁵Troy University, Troy, AL.

Email: slbuckner@usf.edu

(No relevant relationships reported)

Low load [30% of one repetition maximum (1RM)] exercise performed to volitional failure appears to result in similar skeletal muscle adaptations as low load exercise with the addition of blood flow restriction (BFR). However, there may be a point where the training load becomes too low (<20% 1RM) to stimulate an anabolic response without the addition of BFR. **PURPOSE:** To examine the skeletal muscle adaptations to very low load exercise with and without BFR in the upper body. **METHODS:** Changes in muscle thickness (MT), one repetition maximum strength (1RM), isometric strength, isokinetic strength and endurance were examined following 8-weeks of training with a traditional high load [70% 1RM,(70/0)], low load (15% 1RM), low load with moderate BFR (15%1RM+40%BFR), or low load with greater BFR (15% 1RM+80%BFR). Results are displayed as mean (95% CI). **RESULTS:** 40 untrained men and women completed the study. For 1RM strength, there was a condition x time interaction (p = 0.003). 1RM strength changes were greater in the 70/0 condition [2.09 (95% CI=1.35-2.83) kg] compared to all low load conditions. For isometric and isokinetic strength, there were no changes. For endurance, there was a main effect for time [mean pre to post change = 7.9 (4.3, 11.6) repetitions, p <0.001]. At the 50% MT site there was a condition x time interaction (p = 0.004). The mean change in MT in the 70/0 condition [0.16 (0.10-0.22) cm] was greater than all low load conditions. For the 60% MT site there was a condition x time interaction (p = 0.014). The mean change in MT for the 70/0 condition [0.15 (0.08-0.22) cm] was greater than all low load conditions. For the 70% MT site there was a main effect of time (p=0.001). Muscle thickness increased from pre-testing to the midpoint [mean change = 0.06 (0.01- 0.10) cm] and remained elevated above baseline at post-testing [mean change = 0.09 (0.5 - 0.14) cm]. **CONCLUSIONS:** All groups increased muscle size; however, this response was lower in all very low training conditions compared to high load training. 1RM strength increased in the 70/0 condition only, with no other changes in strength observed. These results suggest that loads as low as 15% 1RM do not provide adaptations comparable to high load resistance training. Further, BFR cannot be used to compensate for an insufficient external load regarding muscle size and strength adaptations.

3522 Board #210 June 1 9:30 AM - 11:00 AM

Nitric Oxide-dependent Myogenic Satellite Cell Activation In Human Skeletal Muscle Following Blood-flow Restricted ExerciseJakob L. Nielsen¹, Charlotte Suetta², Ulrik Frandsen¹, Lene Rordam³, Jens Bülow⁴, Robert Boushel⁵, Per Aagaard¹.¹University of Southern Denmark, Odense, Denmark.²Bispebjerg-Frederiksberg & Herlev-Genotfe Hospitals, Copenhagen, Denmark. ³Bispebjerg Hospital, Copenhagen, Denmark. ⁴Bispebjerg Hospital & Copenhagen University, Copenhagen, Denmark. ⁵University of British Columbia, Vancouver, BC, Canada.

(No relevant relationships reported)

PURPOSE: Skeletal muscle contractions performed under concurrent blood-flow restriction (BFR) have been shown to elicit myogenic satellite cell (MSC) proliferation and differentiation, however, the upstream signaling events governing MSC activation with BFR exercise remains unknown. A potential important upstream regulator of MSC activation initiated by BFR exercise may be nitric oxide (NO). Thus, the aim of the present study was to investigate the effect of endogenous nitric oxide (NO) synthesis on MSC activation in human skeletal muscle in response to BFR exercise.

METHODS: Eight male subjects (20.9 ± 2.7 (SD) years) performed five sets of low-load knee extensor exercise (20% 1RM) with concurrent BFR applied with a pressure cuff (100 mmHg) positioned at the proximal thigh. Concurrently, local arterial infusion of the NO synthase (NOS) inhibitor, NG-monomethyl-L-arginine (L-NMMA) or Placebo was applied in a within-subject cross-over design. Arterio-venous blood samples were obtained before and after exercise (30min) for assessment of leg blood-flow and oxygen extraction. Muscle biopsies were obtained at Baseline as well as 1, 3, 24 and 48h post exercise (Post1-48) for assessment of myogenic satellite cell (Pax7⁺) content using immuno-fluorescence techniques. **RESULTS:** Resting leg blood-flow decreased 37% (0.57 ± 0.14 L/min to 0.36 ± 0.12 L/min) and oxygen extraction increased 98% (26.8 ± 9.2 to 53.1 ± 7.9%) with NOS inhibition (P<0.001), while remaining unchanged in the Placebo condition. MSC counts increased (47-94%) with Placebo infusion from baseline (9.7 ± 3.3 MSC per 100 myofiber) to Post1 (15.0 ± 4.1), Post3 (15.3 ± 4.2) and Post24 (18.8 ± 7.0) and Post48 (14.2 ± 5.3) (P<0.05-0.001), while remaining unchanged with NOS inhibition.

CONCLUSIONS: This study is the first to show that inhibition of endogenous NO synthesis leads to blunted MSC activation in response to muscle contractions performed during conditions of partial blood-flow restriction in human skeletal muscle. In conclusion, the present data suggest that NO is a key signaling molecule activating MSC in human skeletal muscle in vivo.

3523 Board #211 June 1 9:30 AM - 11:00 AM

Endurance is Augmented By Greater Blood Flow Restriction Pressures: Muscle Size and Strength Are NotMatthew B. Jessee¹, Samuel Buckner², Grant Mouser³, Kevin Mattocks⁴, Scott Dankel⁵, Takashi Abe⁵, Zachary Bell⁵, John Bentley⁵, Jeremy Loenneke⁵. ¹University of Southern Mississippi, Hattiesburg, MS. ²University of South Florida, Tampa, FL. ³Troy University, Troy, AL. ⁴Lindenwood University - Belleville, Belleville, IL. ⁵University of Mississippi, University, MS.

Email: Matthew.Jessee@usm.edu

(No relevant relationships reported)

Purpose: The importance of training to failure, especially when using low-loads (i.e., 30% 1RM) is well established. However, it remains unknown if lifting 15% 1RM can disrupt muscular blood flow enough to induce failure and stimulate adaptation. This study was designed to compare muscular adaptations between training with 15% 1RM and 70% 1RM, to determine if blood flow restriction (BFR) could augment the response to 15% 1RM, and if the effect of BFR is pressure dependent [40% versus 80% arterial occlusion pressure (AOP)].

Methods: 40 untrained participants performed 4 sets of unilateral knee extension 2x/week for 8 weeks, with two conditions, one per leg. Conditions (label) were: 15% 1RM 0% AOP (15/0), 15% 1RM 40% AOP (15/40), 15% 1RM 80% AOP (15/80), 70% 1RM 0% AOP (70/0). Sets were stopped at 90 repetitions or volitional failure, as determined by an inability to maintain metronome cadence (2 s/contraction) or full repetitions. Inter-set rest was 30 s for 15/0, 15/40, 15/80 and 90 s for 70/0. A 10 cm wide nylon cuff was used for BFR.

Results: Data presented as [mean change (95% CI)]. There were condition x time interactions for 1RM (p<0.001) and endurance (p=.028). 70/0 increased 1RM [3.15 (2.04, 4.25) kg]; 15/0 [-0.06 (-1.13, 1.01), 15/40 [0.066 (-1.06, 1.20), and 15/80 [0.68 (-0.41, 1.79) did not. Increased endurance was greatest for 15/80 [6.2 (4.3, 8.0)] compared to 15/0 [4.2 (2.4, 6.0)], 15/40 [4.7 (2.8, 6.5)], and 70/0 [4.0 (2.2, 5.9)]. There were main effects of time for isometric MVC [10.51 (3.87, 17.16) Nm, p=.002] and

isokinetic MVC at 180°/s [change = 8.61 (5.54, 11.68) Nm, p<.001]. Isokinetic MVC at 60°/s did not change [2.45 (-1.84, 6.74) Nm, p=.261]. There were no condition x time interactions for muscle thickness sites (all p≥.313), which increased over time (all p<.001). There were main effects of condition for each site (70/0 was greater, all p<.001) except 30% lateral (p=.059).

Conclusion: Most muscle strength and size changes appear similar despite large discrepancies in training load and restriction pressure. While the change in 1RM with high-load may be due to motor learning or practicing, the greater endurance adaptation favoring high restriction pressures should be explored further regarding underlying mechanisms. These results are relevant to mechanistic exploration, therapeutic purposes, and program design.

3524 Board #212 June 1 9:30 AM - 11:00 AM

The Acute Muscle Swelling Response: The Influence Of Sex And Cuff SizeVickie Wong, Raksha N. Chatakondi, Takashi Abe, Zachary W. Bell, Robert W. Spitz, Scott J. Dankel, Jeremy P. Loenneke. *The University of Mississippi, University, MS.*

(No relevant relationships reported)

Muscle cell swelling is a purported mechanism for the muscle hypertrophy following blood flow restriction (BFR) training. There are numerous cuff widths used in literature in BFR. It is presently unknown if cuff width impacts the swelling response and whether this differs between sexes. **PURPOSE:** To examine whether the acute muscle swelling response differs based on cuff size and sex. **METHODS:** Forty-nine (25 men, 24 women) participants completed two conditions in a random order (one each arm). Participants completed four sets of unilateral elbow flexion exercise to failure using 30% of their one repetition maximum with BFR applied with either a narrow (5cm) or a wide (12 cm) cuff inflated to 40% of the arterial occlusion pressure. Muscle thickness and echo intensity were measured before and after each exercise bout in the supine position. A repeated measures analysis with a between subject factor of sex was used to assess changes between conditions. Default priors were used for fixed effects (r=0.5) and random effects (r=1). Bayes Factors (BF10) were used to quantify evidence for the null and alternative hypothesis. Data are presented as mean (SD) unless otherwise stated. **RESULTS:** For muscle swelling, there was evidence for an interaction. Men had greater swelling than women [Men: 0.57 (0.18) vs. Women: 0.39 (0.15) cm] with the narrow cuff [median δ (95% credible interval) .903 (.324, 1.52); BF10: 38.57]; but there was no evidence of a difference within the wide cuff [median δ (95% credible interval) .348 (-.170, .902); BF10: .690]. There was some evidence that men had greater swelling with the narrow [0.57 (0.18) cm] cuff compared to the wide [0.49 (0.14) cm] cuff [median δ (95% credible interval) .602 (.071, 1.174); BF10: 2.61]. However, there was no evidence (BF10: .439) for this in women [Narrow: 0.39 (.15) vs. Wide: 0.43 (.12) cm]. For changes in echo intensity, there was no evidence for an interaction or an effect of cuff [Narrow: 1.2 (8) vs. Wide: -.5 (7) AU, BF10: .41]. There was evidence for the null with sex (BF10: .322). **CONCLUSIONS:** Acute muscle swelling occurs in both men and women, even when using a wide cuff. There is evidence, however, that the change in swelling is greater in men, particularly with the narrow cuff. Whether these acute changes translate to differences in chronic adaptations is currently unknown.

3525 Board #213 June 1 9:30 AM - 11:00 AM

Time Course of Blood Flow Restricted Resistance Training Adaptations in Older AdultsSummer B. Cook, FACSM, Christopher J. Cleary. *University of New Hampshire, Durham, NH.*

Email: summer.cook@unh.edu

(No relevant relationships reported)

Blood flow restricted (BFR) resistance training leads to increased muscle mass and strength but the time course of adaptations may be different as they are often to a lesser magnitude than high-load (HL) training. **PURPOSE:** To evaluate the impact of resistance training loads and repetitions on older adults' muscle mass and strength following BFR or HL training. **METHODS:** Twenty-one older adults (67-90 years) were randomly assigned to HL (n=11) or BFR (n=10) training on the knee extensors and flexors twice per week for 12 weeks. Muscle strength was measured with 10-repetition maximum (10-RM) and muscle mass was assessed via magnetic resonance imaging and quantified as cross-sectional area (CSA). The measurements were performed before and after 12 weeks of training. **RESULTS:** After 12 weeks of resistance training, the HL and BFR interventions increased 10-RM knee flexion strength by 36.9±25.4% and 18.9±25.5%, respectively, but there was not a significant time x group interaction (P=.16). CSA of the knee flexors increased an average of 4.8±5.9% among the HL and BFR training interventions (time main effect P<.01) but was not different between the training groups (time x group interaction P=.89). There were similar rates of progression of knee flexion training load and repetitions (time x group interactions of each variable P>.05) as the groups combined averaged an increase of .28±.1 kg·session⁻¹ and .97±.8 repetitions·session⁻¹ of training (time main effects P<.05). Participants in the HL training group experienced greater improvements

in knee extension 10-RM strength than the BFR group (60.7±36.0% vs 35.3±25.5%; P=.03). The growth in quadriceps CSA was significant (time main effect P<.01) and to similar magnitudes (time x group interaction P=.62) following HL training (6.5±3.1%) and BFR training (7.8±8.2%). The HL group experienced a faster progression of load when compared to BFR training (.46±.30 kg·session⁻¹ vs .15±.10 kg·session⁻¹; P=.006). The BFR training group progressed at a rate of 1.8±.63 repetitions·session⁻¹ while the HL group progressed at 1.1±.21 repetitions·session⁻¹ (P=.003).

CONCLUSIONS: HL resistance training may result in better strength gains than BFR resistance training because of distinctive rates of progressive overload. Supported by NIH grant 1R15 A6040700-01A1

3526 Board #214 June 1 9:30 AM - 11:00 AM

Blood Flow Restricted Exercise and Reduced Oxygen Tension Decrease Mitochondrial ROS Emission in Human Muscle

Heather L. Petrick¹, Christopher Pignanelli¹, Tyler A. Churchward-Venne², Luc J.C van Loon³, Jamie F. Burr, FACSM¹, Gijis H. Goossens³, Graham P. Holloway¹. ¹University of Guelph, Guelph, ON, Canada. ²McGill University, Montreal, QC, Canada. ³NUTRIM School of Nutrition and Translational Research in Metabolism, Maastricht University Medical Centre+, Maastricht, Netherlands. (Sponsor: Jamie F. Burr, FACSM)

(No relevant relationships reported)

Low volume blood flow restricted (BFR) training has been proposed to induce comparable adaptations to traditional resistance training, however the underlying mechanisms remain unknown. Despite the absence of direct support, a suggested mechanism of BFR is an increase in reactive oxygen species (ROS). **PURPOSE:** We aimed to determine if the rate of mitochondrial ROS emission was altered following an acute bout of occluded (BFR) or non-occluded resistance training (RT), and to mechanistically investigate the role of skeletal muscle O₂ partial pressure (pO₂) in this response.

METHODS: Ten males (25±1yrs) performed 3 sets of single leg squats to failure at 30% 1RM, with either BFR (60-70% occlusion), or without occlusion (RT), while skeletal muscle tissue oxygenation was estimated using near-infrared spectroscopy. Muscle biopsies were obtained at rest and 2-hours post-exercise to determine mitochondrial respiration and ROS emission in permeabilized muscle fibers. In a separate cohort, muscle biopsies were obtained from six males (25±2yrs) to examine the effects of pO₂ on *in vitro* mitochondrial bioenergetics.

RESULTS: Resistance exercise, with or without BFR, did not alter maximal respiratory capacity or mitochondrial sensitivity to ADP. While maximal mitochondrial ROS emission was unchanged following RT, BFR decreased this response compared to rest (66.6 vs. 86.2 pmol min⁻¹ mg dry wt⁻¹, p<0.05). Skeletal muscle oxygenation was lower in the BFR compared to RT leg, both during (41.4% vs. 46.1% saturation respectively, p<0.01) and between (50.3% vs. 61.1% saturation respectively, p<0.01) exercise sets. Further evaluation of mitochondrial bioenergetics *in vitro* revealed that mild O₂ restriction (50µM) dramatically attenuated maximal mitochondrial ROS emission (~4-fold), and fraction electron leak to ROS (~3-fold) compared to room air (200µM). This effect was especially evident in the presence of non-saturating ADP, as submaximal ROS emission was almost completely suppressed during O₂ restriction, without a reduction in submaximal respiration.

CONCLUSIONS: These data indicate that a reduction in skeletal muscle pO₂ attenuates the propensity of mitochondria to produce ROS, a mechanism which may contribute to the acute responses to BFR training. This research is supported by NSERC funding.

3527 Board #215 June 1 9:30 AM - 11:00 AM

B.F.R. For Proximal Benefit: Blood Flow Restriction Therapy For The Shoulder?

Bradley Lambert¹, Corbin Hedt¹, Eden Epner¹, Kalyan Chaliki², Christine Wang², Joshua Lee², Aya Rossano², Michael Moreno³, Patrick McCulloch¹. ¹Houston Methodist Hospital, Houston, TX. ²Rice University, Houston, TX. ³Texas A&M University, College Station, TX.

Email: bs Lambert@houstonmethodist.org
(No relevant relationships reported)

Blood flow restriction (BFR) therapy has been observed to improve post-operative recovery in the limbs when combined with low intensity resistance exercise (LIX). Little data exists regarding use of BFR for proximal benefit of the upper limbs (shoulders). **PURPOSE:** (1) Determine if rotator cuff (RC) exercises combined with BFR (BFR-Rx) promote greater increases in strength, muscular endurance, and lean mass compared to exercise alone (NoBFR-Rx); (2) Determine if BFR applied to the arm during acute LIX increases activation of RC muscles. **METHODS:** Eighteen healthy adults (♂ 11, 32±5yr, 92.3±15.2kg | ♀ 7, 34±7yr, 81.9±6.3kg) were recruited and randomized into 2 groups (BFR-Rx, NoBFR-Rx). Each performed 8wks of LIX

(2/wk) using 4 RC exercises: cable external rotation (ER), cable internal rotation (IR), dumbbell scaption, and side-lying dumbbell ER; 20% 1RM; 1set/30reps followed by 3sets/15reps (30s rest between sets, 2min rest between exercises, ^1lb resistance each week all repetitions achieved). For the BFR-Rx group, BFR was applied to using an tourniquet system (Delfi®) that maintained 50% limb occlusion pressure during each exercise with pressure released between exercises. A group x time ANCOVA (co-varied on baseline) followed by a tukey's post hoc test was used to detect absolute & relative changes in strength (pre/post training), lean mass (pre/post training; DEXA, GE®), and achieved weekly exercise volume (sets x reps x resistance). A two-tailed paired samples t-test was used to detect differences in RC muscle activation (EMG, Delsys®) recorded during acute ER and IR fatigue tests in all subjects. Type I error was set at α=0.05.

CONCLUSIONS: Combined BFR-Rx using RC exercises may yield greater increases in shoulder/arm lean mass, strength, and muscular endurance compared to exercise alone. These findings may be partially due to a greater activation of shoulder musculature while using BFR. Data collection is ongoing and will be completed prior to conference.

		LEAN MASS				SHOULDERS				
		ARMS		Δ		%Δ		Δ		
BFR-Rx		8.15%	0.51	± 2.85*†	± 0.22 kg*†	28.10%	0.36	± 11.04*†	± 0.14 kg*	
NoBFR-Rx		-0.43%	-0.01	± 1.42	± 0.05 kg	11.23%	0.13	± 6.31*	± 0.08 kg*	
STRENGTH (%Δ From Pre-Training)										
		FLEXION	SCAPTION	ER 0°	IR 0°	ER 90°	IR 90°			
DOMINANT	BFR-Rx	4.48%*	5.25%*	7.21%*	23.25%*	2.77%	19.83%*†	± 2.54	± 8.15	
NoBFR-Rx		-2.15%	0.70%	2.97%	8.23%	-3.55%	2.11%	± 5.05	± 5.55	
NON-DOMINANT	BFR-Rx	2.69%	7.41%*	1.01%	14.50%*	6.58%	17.35%*	± 2.10	± 13.74	
NoBFR-Rx		4.59%	2.09%	7.32%	16.01%*	1.82%	21.07%*	± 4.30	± 10.37	
ACHIEVED EXERCISE VOLUME - SUM OF ALL LIFTS (%Δ From Training Week 1)										
		Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8		
BFR-Rx		9.57%*	18.37%*	25.20%*	32.97%*	35.38%*	43.51%*†	53.72%*†	± 2.60	± 5.03
NoBFR-Rx		5.62%	10.73%*	22.26%*	20.63%*	23.14%*	30.25%*	30.78%*	± 2.10	± 5.08
MEAN EMG ACTIVATION & 20% 1RM (mV Normalized To Un-occluded Control Contractions)										
		Cable ER (20 Contractions)				Cable IR (30 Contractions)				
		Infraspinatus	Teres Minor	Infraspinatus	Teres Minor	Infraspinatus	Teres Minor	Infraspinatus	Teres Minor	
With BFR		1.14	1.40	± 0.02	± 0.04†	± 0.03	± 0.03†	1.16	1.16	
Without BFR		1.16	1.19	± 0.04	± 0.02	± 0.04	± 0.10	1.03	1.05	

Data are presented as means ± SD. * = significant difference from baseline. † = significant difference between groups at the same measurement time-point. Type I error set at α=0.05.

3528 Board #216 June 1 9:30 AM - 11:00 AM

The Perceived Tightness Scale Does Not Provide Reliable Estimates Of Blood Flow Restriction Pressure

Zachary W. Bell, Scott J. Dankel, Robert W. Spitz, Raksha N. Chatakondi, Takashi Abe, Jeremy P. Loenneke. *The University of Mississippi, University, MS.*

(No relevant relationships reported)

When completing blood flow restriction, use of a perceived tightness scale is recommended as a method for setting sub-occlusive pressures. However, whether or not participants can consistently rate a similar pressure using this scale is unknown.

PURPOSE: To determine the reliability of a perceived pressure when asking participants to rate a 7 out of 10, considered a moderate pressure with no pain, during blood flow restriction. **METHODS:** Participants (12 men, 12 women) were tested over 3 visits, involving measurements for arterial occlusion and the relative pressure at which participants deemed a 7 out of 10. Participants arrived to the lab and proceeded to lie supine for a 10-minute rest period. Measurements were completed in one limb for the upper and lower body. A repeated measures analysis with a between subject factor of sex was used to compare relative arterial occlusion pressures across days and sex with a default prior of 0.5 for the fixed effects and 1 for the random effects. An independent samples t-test was used to determine if there were sex differences in %CV with a default prior of 0.707. A Bayes factor (BF₁₀) of 3 and 0.33 was considered evidence for the alternative and null hypotheses, respectively. **RESULTS:** The %CV for the measurement in the upper body was 12%, with no effect of sex (men: 12.3% vs. women 12.2%; BF₁₀: .403; median δ (95% credible interval): .016 (-.741, .752)). The %CV for relative arterial occlusion pressure in the lower body also did not differ between sexes (men: 13.7% vs. women 10.3%; BF₁₀: .509; median δ (95% credible interval): .266 (-.396, .999)). Participants rated a 7/10 pressure above the arterial occlusion pressure for the upper body and below for the lower body. At the group level, participants rated a 7 out of 10 at a higher relative pressure on day 1 compared to days 2 (BF₁₀: 4.482, median δ (95% credible interval): -.694 (-1.307, -.130)) and 3

(BF₁₀: 10.2, median δ (95% credible interval): -.838 (-1.468, -.189)) for the lower body but no differences in the upper body. There was no effect of sex. **CONCLUSIONS:** The use of a perceived tightness scale does not appear to provide a reliable method for the prescription of blood flow restriction pressure. Future work should consider alternative methods or modifications to the scale for improving reliability when setting sub-occlusive pressures.

G-41 Free Communication/Poster - Nutrition and Metabolic Health

Saturday, June 1, 2019, 7:30 AM - 11:00 AM
Room: CC-Hall WA2

3529 Board #217 June 1 9:30 AM - 11:00 AM The effect of Metabolic Syndrome on Exercise Performance in American Football Players From a Mexican University

Dulce E. Morales Elizondo, FACSM, Pedro G. Morales-Corral, FACSM, Rosalinda Sepulveda, Hector E. Pérez, Elfega Sámano-Pérez, Francisco J. Barrera-Flores, Emanuel Rizo-Belloso. *UANL, San Nicolás de los Garza, Mexico.*
Email: dulcemorales@gmail.com
(No relevant relationships reported)

PURPOSE: To demonstrate the effect that the presence of the metabolic syndrome (MetSyn) has on the physical performance on American Football Players of a college team in México

METHODS: Seventy six players were included in the study, thirteen had MetSyn (21.7±1.5 yrs) and sixty three were not diagnosed with MetSyn (21.8±1.5 yrs). In order to establish a statistical significance between the physical performance and MetSyn, the data was analyzed in two different ways: With MetSyn (WMS) or absence of MetSyn (AMS) and by groups of similarity of Body Mass and type of execution in the field **Group 1** Offensive and Linemen (OL and DL) and Tight ends (TE). **Group 2** Running Backs (RB), Linebackers (LB) and Quarterbacks (QB). **Group 3** Wide Receivers (WR), Kickers (K), Strong Safeties (SS) and Cornerbacks (CB). The physical performance tests that were measured were: Maximum strength, explosive strength, Isometric hand strength, muscular resistance, power of upper and lower body, lumbar flexibility, agility, speed and cardiovascular resistance

RESULTS: The physical performance tests between WMS revealed better performance in maximum upper body strength 293.46(56.54) against the ABS group 246(36.45), explosive strength with Snatch 165(135-205) against 155(105-205) and Jerk 228.08(31.46) against 204.29(34.70) tests, as well as muscular resistance test 9.5(1-25) against 3(0-26) repetitions. Lower athletic performance was shown in the WMS group in the speed 5.6(5.23-7.12) sec against 5.21(4.75-8.22), agility 8.84(7.1-9.79) seconds against 5.21(4.75-8.22) and cardiovascular resistance 13.32(10-18) against 11.16(9.06-17.11) min.

CONCLUSIONS: The weight and BMI and the body fat percentage were variables that presented significance difference in the WMS group, coinciding with the authors who affirm that the weight and the percentage of fat have an influence on the physical performance. The physical performance tests in the WMS group revealed better performance in maximum chest force, explosive strength with Snatch and Jerk tests, as well as muscular resistance suggesting a possible favorable relationship to presence MetSyn. We observed a lower athletic performance in the tests of speed, agility and cardiovascular resistance in the players with the presence of MetSyn negatively relating the MetSyn with these motor skills.

3530 Board #218 June 1 9:30 AM - 11:00 AM Inhibition Of miR-16 In Vitro Decreases Glucose Uptake And Insulin Signaling

Seongkyun Lim, David E. Lee, Megan E. Rosa-Caldwell, Jacob L. Brown, Tyrone A. Washington, Nicholas P. Greene. *University of Arkansas, Fayetteville, AR.* (Sponsor: Matthew S. Ganio, FACSM)

(No relevant relationships reported)

Type 2 Diabetes Mellitus (T2DM) is a fast-growing epidemic and skeletal muscle insulin resistance may be the onset point in the development of T2DM. Recent data have suggested that microRNAs (miR) may play an important role in T2DM glucose intolerance. Specifically, reduced miR-16 content in muscle has been noted in human and rodent models of T2DM. However, regulation of miR-16 and its relation to muscle insulin resistance is largely unexplored. **PURPOSE:** To investigate how miR-16 content affects insulin resistance and glucose regulation in myotubes during insulin resistant states. **METHODS:** This study was performed in three experiments. Experiment (Ex) 1: To test if miR-16 is necessary for muscle insulin sensitivity, C2C12

myoblasts were cultured to become myotubes. Cells were transfected with a plasmid to inhibit function of miR-16. Ex 2: To test if miR-16 is sufficient to improve insulin resistance, myotubes were treated with a 1-oleoyl-2-acetyl-sn-glycerol (OAG), to simulate lipid overload-induced insulin resistance, cells were transfected with plasmid to overexpress functional miR-16. Ex 3: To test if Primary-miR16 (Pri-miR16) is differently expressed in insulin resistance state, Pri-miR16 level was measured by RT-PCR in both in vivo and in vitro models of insulin resistance. In experiment 1 and 2, glucose uptake and insulin signaling were measured by uptake of 2-NBDG (a fluorescent analog of glucose), and immunoblot of phosphorylation of AKT and IRS1. Data were analyzed by ANOVA or t-test as appropriate, significance was denoted at $p < 0.05$. **RESULTS:** Ex 1: Insulin-stimulated glucose uptake was ~25% lower in myotubes following miR16 inhibition ($p=0.01$). Insulin signaling was lower in myotubes with miR16 inhibition (31%, $p=0.002$). Ex 2: OAG-induced insulin resistant myotubes exhibited lower glucose uptake ($p=0.01$; 12%). However, overexpression of miR16 did not improve OAG-induced insulin resistance ($p > 0.05$). Ex 3: Pri-miR16 level was not different between control and OAG. **CONCLUSION:** Reduction of miR-16 content seems to be necessary for glucose handling, however, miR-16 overload is not sufficient to rescue glucose regulation and synthesis of pri-miR16 was not a culprit for reduced miR16 during insulin resistance, therefore it may be due to either degradation or export of miR16 during the miRNA process.

3531 Board #219 June 1 9:30 AM - 11:00 AM Amelioration Of Diabetes-associated Muscle Atrophy By Transcutaneous Carbon Dioxide Exposure

Hiroyo Kondo¹, Hidemi Fujino², Tomohiro Matsumoto², Akihiko Ishihara, FACSM³. ¹Nagoya Womens University, Nagoya, Japan. ²Kobe University, Kobe, Japan. ³Kyoto University, Kyoto, Japan.
(No relevant relationships reported)

PURPOSE: Diabetes has been known to result in attenuated growth and atrophy in skeletal muscle. Recently, it has been reported the Carbon dioxide (CO₂) exposure leads to an increase of muscle mass in normal rats. Therefore, the aim of the present study was to investigate the effects of transcutaneous CO₂ exposure with the hydrogel (eCO₂GEL) on diabetic-associated muscle atrophy.

METHODS: Male Goto-Kakizaki (GK) rats were divided into control (GK) and CO₂ exposure (CO₂) groups and male Wistar rats used as a non-diabetic control. The hair on the lower limbs was shaved and the hydrogel (eCO₂GEL), which can increase the absorption of CO₂ from skin, was applied. The CO₂ adaptor was attached to the limbs and sealed, and CO₂ gas was administered into the adaptor for 30 min. The CO₂ exposure was performed everyday for 8 weeks.

RESULTS: The muscle weights of soleus and tibialis anterior in the GK group decreased compared with those of the control group. CO₂ exposure attenuated decreased muscle weights in diabetes-associated muscles ($P < 0.05$). In addition, the blood flow in skeletal muscle was increased by CO₂ exposure compared with non-CO₂ exposure condition ($P < 0.05$). Furthermore, the level of fasting blood glucose in the CO₂ exposure group was significantly decreased compared with the GK group ($P < 0.05$).

CONCLUSIONS: These results indicate that the transcutaneous CO₂ exposure may have a therapeutic potential for diabetic-associated muscle atrophy. This amelioration may associate with increased blood flow in skeletal muscle.

3532 Board #220 June 1 9:30 AM - 11:00 AM Exercise and High-Fat Diets Upregulate Endoplasmic Reticulum Membrane Protein Sensors and Muc2 in Female Mice

Paul J. Wisniewski, Natasha Malonza, Lauren A. Hall, Robert A. Dowden, Sara C. Campbell, PhD, FACSM. *Rutgers University, New Brunswick, NJ.* (Sponsor: Sara C. Campbell, PhD, FACSM, FACSM)
Email: pjwisniewski86@gmail.com

Reported Relationships: P.J. Wisniewski: Other (please describe); Supported by a Student Research Fellowship Award: Crohn's & Colitis Foundation (Ref. # 535042).

A dense dual layered mucus barrier, comprised of the muc2 mucin glycoprotein, protects the colon epithelium from luminal microbes and the external environment. The complexity and high secretory output of muc2 makes it prone to misfolding which activates the unfolded protein response (UPR) contributing to endoplasmic reticulum (ER) stress if unresolved. Interestingly, high fat diets have shown to induce colonic epithelial stress and inflammation which may be attenuated by exercise. **PURPOSE:** We aimed to examine impact of a high-fat diet (HFD) and exercise on the gene expression of factors involved in the UPR and ER stress in male and female mice colon. **METHODS:** 56 (n=7/group) 6-week old C57BL/6N Tac male and female mice were weighed and randomly assigned to one of 4 groups: (1) control-diet sedentary (CDS, 10% fat diet, Research Diets); (2) very high-fat diet sedentary (VHFS, 60% fat, Research Diets); (3) control-diet exercise (CDX); and (4) very high-fat diet exercise (VHFX) for 12 weeks. Mice had *ad libitum* access to food and water. Exercised mice

had free access to a running wheel in their cages. Food intake was monitored every other day and body weights once per week. After 12 weeks animals were sacrificed. Total RNA was extracted from colon tissue fixed in RNA_{later} and converted into cDNA using the RNeasy Mini and First Strand kits. qRT-PCR was performed using a custom RT2-profiler PCR array (Qiagen). Ct values were normalized to GAPDH and a one-way ANOVA with LSD post-tests was used to analyze group means of Δ Ct values for each sex. A difference of mean with a p value of ≤ 0.05 was considered statistically significant. mRNA expression was expressed relative to CDS groups using the $\Delta\Delta$ Ct method. **RESULTS:** For females, Atf6 and Ire1 β expression was increased in VHFX mice (0.9 and 1.1-fold times) compared to VHFS (0.6-fold times; $p = 0.001$ and $p = .008$). Muc2 expression was significantly increased in CDX mice (2.3-fold times) compared to VHFS (0.7-fold times; $p = 0.02$). In males, no significant differences in the expression of any factor was observed. **CONCLUSION:** High-fat diets coupled with exercise increase the expression of endoplasmic reticulum membrane protein sensors involved in the unfolded protein response in females. Exercise increases muc2 expression in females.

3533 Board #221 June 1 9:30 AM - 11:00 AM
Hypocaloric High Fat and High Carbohydrate Diets on Visceral Adipose Tissue and Body Composition
 Jarrett Walbolt, Yunsuk Koh. *Baylor University, Waco, TX.*
(No relevant relationships reported)

Introduction: Excess visceral adipose tissue (VAT) is strongly associated with increased cardiometabolic risks. High-fat (HF) diets are a popular method for improving body composition. **Purpose:** To determine the role of HF diets in body composition and VAT. **Methods:** In a randomized, cross-over design, 12 healthy, sedentary individuals were assigned either to a HF or HC diet trial with a 20% reduction in total caloric intake from their typical diet. Participants maintained their 1st assigned diet for 2 weeks followed by a 1-week washout period where they consumed their typical diet. After the 1-week washout period, participants began the opposite diet trial (either HF or HC) for 2 weeks. The HF diet consisted of 70% fat and 30% carbohydrate and protein, with a limit of 50 grams of carbohydrate. The HC diet consisted of 70% carbohydrate and 30% fat and protein. Body composition including VAT in mass and volume were determined using dual-energy x-ray absorptiometry. **Results:** Total body mass decreased up to 1.5 kg from the pre-intervention (78.07 \pm 17.36 kg) following either the HF (76.63 \pm 15.99 kg) or HC (76.24 \pm 15.71 kg) trial, yet it was not statistically significant. VAT in mass and volume decreased following either the HF or HC diet from the pre-intervention (429.57 \pm 225.43g and 464.42 \pm 244.02cm³). However, the magnitude of change in VATmass and VATvolume was greater in the HF diet (374 \pm 159.59g and 404.14 \pm 172.54cm³) than the HC diet (388.71 \pm 184.73g and 420.42 \pm 199.93cm³) although it was not statistically significant. Notably, percent body fat decreased only following the HF diet (pre-intervention: 29.70 \pm 9.75, HF: 27.65 \pm 10.55, and HC: 29.15 \pm 11.43%). **Conclusion:** Although a short-term hypocaloric diet with either HF or HC did not yield a significant change in body composition, there was a strong trend showing that hypocaloric diets, whether HF or HC, can lower total body weight. HF diets though may be more effective than HC at decreasing body fat percentage and VAT. Our study only looked at changes after two-week dietary interventions in healthy sedentary individuals. Thus, future studies examining long term effects of HF diets in a variety of subject populations, including obese people, may provide more accurate information regarding a role of HF diets in body composition and visceral adipose tissue.

3534 Board #222 June 1 9:30 AM - 11:00 AM
Exploring The Utility Of Muac In Classifying Adult Metabolic Syndrome Risk Using Nhanes 2015-2016
 Hayley G. Boucher, Brian Miller, Laura Richardson, Judith A. Juvancic-Heltzel. *The University of Akron, Akron, OH.* (Sponsor: Dr. Ronald Otterstetter, FACSM)
 Email: hgb6@zips.uakron.edu
(No relevant relationships reported)

Metabolic syndrome (MetS) is a constellation of cardiometabolic risk factors (visceral adiposity, dyslipidemia, hyperglycemia, and hypertension) that, when presented in tandem, exponentially increases the risk of heart disease and insulin resistance. Finding a simple and validated screening method is critical to proactively intervene and attenuate the development of these cardiometabolic diseases, thereby improving healthcare outcomes such as quality of life and associated costs. The utility of mid-upper arm circumference as a metric of MetS risk has not been widely investigated. There is paucity in the literature exploring the relation between mid-upper arm circumference (MUAC) and MetS.

PURPOSE: This study defined and attempted to validate a risk criterion for MetS using MUAC as a valid alternative criterion for MetS classification risk. **METHODS:** The target sample was derived from National Health & Nutrition Examination Survey (NHANES) 2015-2016 data that included adults over the age of 18 ($N = 9,971$). MetS was defined using the NCEP ATP III 2005 MetS diagnosis criteria. A recursive partitioning methodology (RPM), using the Classification & Regression Tree

Algorithm, was employed to create binary MUAC criterion by sex, using 75% of the total sample. Validation of the criteria was performed with the remaining 25% of the total sample, selected at random.

RESULTS: Seventeen percent (17%) of the total sample presented with the MetS. The RPM resulted in sex specific MetS criteria with the MUAC criterion being >32 cm ($p = 0.024$) and >29 cm ($p = 0.024$) for males and females, respectively. Specifically, those presenting with the risk criteria were 9.84, for males, and 9.23, for females, times more likely to present with MetS than without the MUAC criterion. The overall classification accuracy for both the training and validation models were 83% with no statistical difference between models ($p = 0.983$). **CONCLUSIONS:** MUAC shows promise in being an effective screening method for MetS in guiding further diagnostic tests to prevent associated cardiometabolic morbidity and mortality.

3535 Board #223 June 1 9:30 AM - 11:00 AM
Patterns of Interrupting Prolonged Sitting and Postprandial Triglycerides in East-Asian Young Men with Central Obesity
 Waris Wongpipit, Jane J. Yu, Stephen H.S. Wong, FACSM. *The Chinese University of Hong Kong, Hong Kong, Hong Kong.*
 Email: waris.w@link.cuhk.edu.hk
(No relevant relationships reported)

Prolonged sitting is related to an increased risk of morbidity and mortality. In the literature, frequent interruptions to prolonged sitting, e.g., every 30 min of sitting, have been found to be beneficial for cardiometabolic health. Interrupting prolonged sitting less frequently, however, may be preferred due to practical issues.

PURPOSE: To examine the acute effect of different frequency of interrupting prolonged sitting on postprandial triglycerides (TG) in young men with central obesity compared with prolonged sitting.

METHODS: Twenty-one East-Asian men with central obesity (mean age: 23.24 \pm 3.65 years; body mass index: 29.78 \pm 3.17 kg·m⁻²; waist circumference: 98.71 \pm 7.08 cm) completed three randomized 7-h laboratory-based trials including 1) a prolonged sitting trial (SIT), 2) 3-min walking every 30 min (3-min) at 3.2 km·h⁻¹, and 3) 6-min walking every 60 min (6-min) at 3.2 km·h⁻¹ separated by 7-14 days washout period. Standardized mixed meals (50% carbohydrate, 30% Fat, and 15% Protein) were provided at 0 and 3 h. Blood samples were collected at -1, 0, 0.5, 1, 2, 3, 3.5, 4, 5, and 6 h. TG concentrations were changed to total area under the curve (tAUC) using the Trapezoidal method. One-way (trial) and two-way (trial \times time) ANOVAs with repeated measures were used to compare tAUC value and TG concentrations, respectively.

RESULTS: Regarding the tAUC, the main effect of trial ($F_{2,40} = 4.210$, $P = 0.022$, $\eta^2 = 0.174$) was significant with 6-min trial (10.58 \pm 3.62 mmol·L⁻¹ per 7 h; $P = 0.020$) being lower than SIT trial (11.83 \pm 3.52 mmol·L⁻¹ per 7 h). There were no differences on the 7-h tAUC for TG concentrations between 3-min (11.52 \pm 3.47 mmol·L⁻¹ per 7 h; $P > 0.05$) and SIT trials as well as between 3-min and 6-min trials (both P s > 0.05). Regarding TG concentrations, the main effect of trial ($F_{2,40} = 4.448$, $P = 0.018$, $\eta^2 = 0.182$) was significant with 6-min trial being lower than SIT trial ($P = 0.013$). The main effect of time was also significant ($F_{9,180} = 66.589$, $P < 0.001$, $\eta^2 = 0.769$) with the TG concentrations significantly increased from 1 h to 6 h (all P s < 0.05) compared with the baseline (the average of TG concentrations between -1 and 0 h).

CONCLUSIONS: Interrupting prolonged sitting with 6-min trial elicits a superior benefit on reducing postprandial TG than SIT trial in East-Asian young men with central obesity.

3536 Board #224 June 1 9:30 AM - 11:00 AM
The Relationship Between a High Sugar-Low Fiber Dietary Food Intake and Obesity in a Clinical Setting
 Emma R. Lucas, Nicholas V. Neuwald, Arlette C. Perry, FACSM, Wesley N. Smith. *University of Miami, Coral Gables, FL.* (Sponsor: Arlette Perry, FACSM)
 Email: ex1192@miami.edu
(No relevant relationships reported)

Diets high in simple sugars and processed foods, and low in whole, fibrous plant foods have been linked to insulin resistance and weight gain. To prevent obesity and cardiometabolic disease, it is recommended that Americans limit intake of sugary beverages, fruit juices, added sugars, and processed carbohydrates, in favor of more fibrous foods such as whole fruits and vegetables, nuts, beans, whole grains, and seeds.

PURPOSE: To examine the relationship between frequency of foods consumed high in sugar and low in fiber (HSLF) with BMI. We hypothesized that a HSLF diet would be significantly higher among obese individuals (BMI ≥ 30) than non-obese (BMI < 30). **METHODS:** A total of 2,703 adults (1,521 females and 1,182 males) from a HealthSnap wellness assessment used in physicians' offices across the country were evaluated for anthropometric measurements and nutritional behaviors. HSLF consumption was evaluated from patients' self-reported intake of soda, juices, energy drinks, and other high sugar foods versus selection of whole grains, whole plant foods, nuts, beans, and seeds. To identify the association between HSLF and obesity, a

Chi-squared analysis (χ^2) was performed using quintiles of HSLF for obese and non-obese subjects. A relative risk (RR) was evaluated across data quintiles. **RESULTS:** A significant association between obesity and HSLF was observed (χ^2 [12, n = 2703] = 178.73, $p < 0.001$). Patients with HSLF in the highest 20%, Q5, had a 242% higher RR of obesity than those in the lowest 20%, Q1 (RR: 2.42, 95% CI: 1.95-3.03, $p < 0.001$). **CONCLUSION:** A diet encompassing foods high in sugar and low in fiber is associated with obesity. This supports the promotion of whole foods, high in fiber while limiting intake of foods high in sugar, as a simple recommendation to protect against obesity in a clinical setting.

3537 Board #225 June 1 9:30 AM - 11:00 AM
Acute Exercise Intervention Combined with Metformin's Influences on Glucose Homeostasis in T2D Mice

Wenqing Shen, Yi Zhang, Qiang Zhang, Zhengtang Qi, Yi Sun, Shuzhe Ding, East China Normal University, Shanghai, China.
 Email: GraceShen07@163.com
 (No relevant relationships reported)

Purpose: The aim of our investigation was to determine the effects of different ways of acute exercise intervention combined with high dose of metformin on glucose homeostasis and its relative molecular mechanisms in type 2 diabetic mice.
Methods: 4-week high fat diet (HFD) and one-time Streptozocin (100mg/kg) intraperitoneal injection were used for building T2D mice. 24 mice were divided into normal control (NC), normal acute resistance training (NCR) and normal acute endurance training (NCE) group, all n=8, fed in normal chow. Finally 48 mice were developing T2D and divided into diabetic control (DC), diabetic acute resistance training (DCR), diabetic acute endurance training (DCE), high dose of metformin (200mg/kg) control (HMC), metformin combined with acute resistance training (HMR) and metformin combined with acute endurance continuous training (HME) group, all n=8.
Results: The two ways also enhanced blood glucose and lipid metabolism in T2D mice. Compared to HMC group, hepatic G6Pase mRNA expression in HMR and HME group was significantly escalated and hepatic FBP1 mRNA expression of both groups were significantly declined. Compared to HMC group, hepatic GLUT2 and Gck mRNA expression in HMR and HME group showed opposite trends, one was down and the other was up. Compared to HMC group, hepatic PEPCK mRNA expression in HMR group mice was notably raised and hepatic AMPK α , PGC-1 α and CREB mRNA expression in HMR and HME group mice were notably increased and only hepatic AMPK α mRNA expression in HMR group was significantly increased.
Conclusions: Acute resistance training (ART) and acute endurance training (AET) combined with metformin can effectively improve glucose homeostasis in T2D mice. And the two ways can improve blood glucose and lipid metabolism in T2D mice. ART combined with metformin was better to improve glucose homeostasis and inhibit hepatic gluconeogenesis relative mRNA expression in T2D mice probably via the signaling pathway of AMPK α -PGC-1 α -CREB.

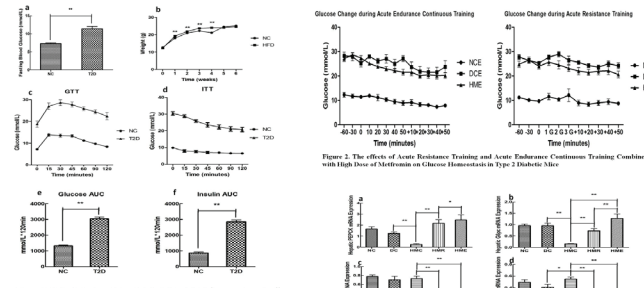


Figure 1 Relative Indicators of Type 2 Diabetic Mice Model. * represents $p < 0.05$, ** represents $p < 0.01$.

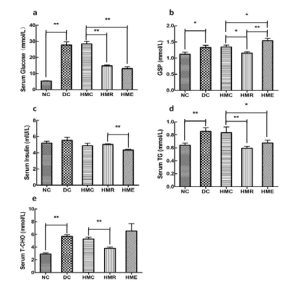


Figure 3 The Effects of Acute RT and ET combined with HM on Serum Glucose and Lipid Metabolism in T2D Mice. * represents $p < 0.05$, ** represents $p < 0.01$.

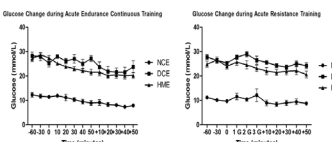


Figure 2 The effects of Acute Resistance Training and Acute Endurance Continuous Training Combined with High Dose of Metformin on Glucose Homeostasis in Type 2 Diabetic Mice

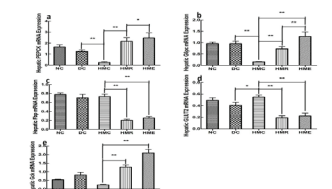


Figure 4 The Effects of Acute RT and ET combined with HM on the Relative mRNA Expression of Gluconeogenesis and Hepatic Regulating Blood Glucose in T2D Mice. * represents $p < 0.05$, ** represents $p < 0.01$.

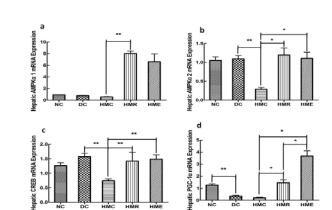


Figure 5 The Effects of Acute RT and ET combined with HM on the Relative mRNA Expression of Regulate Hepatic Glucose Homeostasis in T2D Mice. * represents $p < 0.05$, ** represents $p < 0.01$.

3538 Board #226 June 1 9:30 AM - 11:00 AM
Effect Of Combined Training On Metabolic Control In Type 2 Diabetes Overweight Patients.

Menaka N. Kalupahana¹, Katya Vargas-Ortiz¹, Claudia Luevano Contreras¹, Lorena Ibarra Reynoso¹, Arturo Figueroa, FACSM², Efraín Orozco Nieto³, Antonio E. Rivera⁴, Maciste H. Macias Cervantes⁵. ¹Universidad De Guanajuato, Leon, Mexico. ²Texas Tech University, Lubbock, TX. ³Clinica MIRA, Leon, Mexico. ⁴COMUDE, Leon, Mexico. ⁵Instituto de Investigaciones MÀ@dicas UG, LeÀ³n, Mexico. (Sponsor: Arturo Figueroa, FACSM)
 Email: macistehabacuc@yahoo.com.mx
 (No relevant relationships reported)

PURPOSE: Aerobic exercise is accepted as therapy for control of glucose levels and body fat in type 2 diabetes (T2D). High-intensity interval training (HIIT) is new aerobic training method with benefits for T2D patients. There are few documented studies of traditional exercise plus HIIT effect on resting energy expenditure (REE) in T2D. The purpose was to compare the effect of traditional training (aerobic constant intensity+resistance) with new training (HITT + aerobic constant intensity + resistance) on REE and metabolic control in patients with T2D.
METHODS: Forty two sedentary people (Age = 50.7 ± 6.1 years) with T2D were randomized to one of three groups for 16-week training program with dietary recommendation: new training (NT; n = 14) (85-100% HRmax 10 intervals of 1 minute; resistance: 12 repetition maximum (12RM); dietary recommendation), traditional (TT; n = 14) (65% -75% HRmax, resistance: 12RM, dietary recommendation) and control (C; n = 14 dietary recommendation). Body composition was measured by bio-electrical impedance (INBODY S10), REE was evaluated by indirect calorimetry (COSMED, FITMATE model). Maximum oxygen uptake (VO₂max), HRmax and Power (Watts/Kg body weight) were recorded during incremental exercise test (Monark 828 e). Glycosylated hemoglobin (HbA1c) and lipid profile were measures in fasting blood (12 hrs). Measurements were evaluated at baseline and 16 weeks.
RESULTS: The decrease in HbA1c was greater in NT compared to C (-23.1% ± 10.2 vs -8.6% ± 10.2; $p = 0.005$). BMI decreased in the NT compared to C group (-3.1% ± 2.4 vs -0.1 ± 3.0; $p = 0.03$) and power increased in NT compared to C (27.9% ± 25.3 vs 6.3% ± 20.5; $p = 0.05$). VO₂peak was increased in NT compared to C (19.8% ± 18.1 vs 2.8% ± 13.3; $p = 0.02$).
CONCLUSIONS: Our results indicate that NT improves aerobic fitness, BMI, and glucose control in patients with T2D compared to C, despite no changes in the REE among groups.

3539 Board #227 June 1 9:30 AM - 11:00 AM
Lactate Response During Graded Exercise Test In Individuals With Prediabetes After Aerobic Exercise Training

Salvador Saenz-Herrera¹, Victoriano Pérez-Vazquez¹, Maciste H. Macias-Cervantes¹, Arturo Figueroa, FACSM², Inigo SanMillan³, Rodolfo Guardado-Mendoza⁴, Talitha G. Vallejo¹, Katya Vargas-Ortiz¹. ¹Universidad de Guanajuato, León, Mexico. ²Texas Tech University, Texas, TX. ³Colorado University, Denver, CO. (Sponsor: Arturo Figueroa, FACSM)
 Email: darksalvador_1988@hotmail.com
 (No relevant relationships reported)

PURPOSE: Prediabetes (PD) is a metabolic disorder that precedes type 2 diabetes. The lactate concentration at rest, the response of lactate during graded exercise test, and the effect of aerobic training (AT) on lactate adaptation in subjects with prediabetes is little know. **The aim** of this study was to measure the lactate response adaptation to AT in individuals with prediabetes.
METHODS: Twenty-one subjects participated (age 39 ± 6 y; BMI 29 ± 5.4 kg/m²); after a glucose tolerance test, they were classified as normoglycemic (NG, n=11) and PD (n=10) group according to the criteria of the American Diabetes Association. All participants performed a graded exercise test in cycloergometer (MONARK 828), capillary lactate was measured every 5 min as well as the power output at a lactate concentration of 4mmol/l. The maximal heart rate (HR max) and peak oxygen consumption (VO₂peak) were also determined. Blood biomarkers, anthropometric measurements, and physical capacity were evaluated before and after AT.
RESULTS: Participants in both groups showed no change in blood glucose and lipid profile. VO₂peak increased similarly ($p < 0.01$) in both groups (NG: 33.5 ± 5.3 vs 37.9 ± 6.5 ml/kg/min; PD: 33.5 ± 4.1 vs 36.8 ± 3.8 ml/kg/min). The lactate at rest was similar in both groups before intervention and did not change significantly after AT (NG: 1.39 ± 0.5 vs 1.17 ± 0.4 mmol/L; PD: 1.76 ± 1.8 vs 1.59 ± 0.8 mmol/L). However, after AT, it was observed that the workload needed to reach the lactate threshold (4 mmol/L) increased significantly in each group (NG: 89.9 ± 16 vs 120 ± 22 W, $p < 0.05$; PD: 87.6 ± 16 vs 101 ± 15 W, $p < 0.01$), without a difference between groups.

CONCLUSIONS: Nine weeks of AT resulted in increased exercise capacity in both NG and PD, which indicates that patients with PD manage to respond and adapt to an exercise program and increase their aerobic capacity.

3540 Board #228 June 1 9:30 AM - 11:00 AM

Effect Of Exercise Intervention On Expression And Translocation Of FAT/CD36 In Aging Mice

Jingyu Sun, Yajuan Su, Lili Qin, Yunhe Zhou, Jingmei Dong, Jingmei Dong. *Tongji University, Shanghai, China.*

Email: jysun@tongji.edu.cn

(No relevant relationships reported)

The international trend of rehabilitation medicine is leaning towards the prevention of metabolic disease these years. Especially in the prevention of insulin resistance, exercise therapy has become an effective means of rehabilitation. In view of the close association of fatty acid metabolism with insulin resistance, the potential role of Fatty Acids Translocase/CD36 (FAT/CD36) in treatment of aging-induced insulin resistance has been attracted more attentions. However, the regulative role of FAT/CD36 in exercise improving insulin sensitivity remains unclear. **PURPOSE:** To determine the regulative role of FAT/CD36 in exercise improving aging-induced muscle insulin resistance.

METHODS: Male C57BL/6J mice (8-week old) were randomly divided into two groups: (1) control group (CON; n = 6) and (2) endurance exercise group (EX; n = 6). The treatment was administered for one year. The mRNA levels of FAT/CD36 and other fatty acid transporters were determined by semi-quantitative reverse-transcription polymerase chain reaction (RT-PCR). The protein levels of FAT/CD36 and insulin signaling pathway related molecules were examined by western blot analysis. The localization of FAT/CD36 were detected by immunofluorescence. The differences in means were analyzed by t test. **RESULTS:** Compared with the aging CON group, the mRNA levels of FAT/CD36 (1.000 ± 0.156 vs. 0.543 ± 0.051 , $P < 0.05$) and CPT-1 β (1.033 ± 0.167 vs. 0.528 ± 0.055 , $P < 0.05$) in the EX group were significantly decreased, while other fatty acid transporters were not significantly changed (FATP4: 1.000 ± 0.153 vs. 0.832 ± 0.036 , $P > 0.05$) and (FABPpm: 1.000 ± 0.048 vs. 0.718 ± 0.095 , $P > 0.05$). When compared to the aging CON group, the protein levels of FAT/CD36 were also significantly decreased in the EX group (0.415 ± 0.053 vs. 0.337 ± 0.021 , $P < 0.05$), as well as the phosphorylation levels of AKT (0.177 ± 0.012 vs. 0.290 ± 0.034 , $P < 0.05$) and ERK (0.098 ± 0.014 vs. 0.322 ± 0.088 , $P < 0.05$) were significantly increased. The immunofluorescent pictures showed that FAT/CD36 were localized to the caveolae of plasma membrane, but not the mitochondrial membrane.

CONCLUSIONS: Exercise intervention protects against aging-induced insulin resistance by regulating FAT/CD36 expression and translocation.

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3541 Board #229 June 1 9:30 AM - 11:00 AM

An Attempt To Reverse Diabetic Cardiomyopathy By Aerobic Interval Training In High-fat Diet And Streptozotocin Induced Type 2 Diabetes Rat Models

Huan Cai, Yuxiu He, Xun Li. *Hebei Normal University, Shijiazhuang, China.*

Email: sherrycaik@126.com

(No relevant relationships reported)

Purpose: Diabetes mellitus (DM) is an important risk factors of cardiovascular disease. Long-term hyperglycemia, hyperlipemia and insulin resistance may lead to diabetic cardiomyopathy (DCM). No rodent models fully captured the whole process of cardiac morphology and function changes during the course of DCM. Aerobic interval training (AIT) has been advised as a non-pharmacological strategy against DM patients. However, little is known whether impose AIT intervention at the onset of DM will reverse the process of DCM. In this study, we sought to evaluate the cardiac function during the development of DCM and explore whether AIT will reverse the process of DCM. **Methods:** 60 Wistar male rats were randomly divided into control group (CON), DCM group (DCM) and AIT intervention group (AIT). Rats in DCM group and AIT group used high fat diet and STZ to induce diabetes models. Rats in AIT group were subjected to 8 weeks AIT intervention Fasting blood glucose (FBG), lipid profiles, insulin resistance (IR) and GLP-1 levels was measured. HE staining and echocardiography were used to identify cardiac morphology and function. α -MHC and β -MHC gene expression were detected by RT-PCR. GLP-1 and GLP-1R expression were detected by western blotting.

Results: Compared with CON, the heart function of DCM gradually changes from impaired diastolic function to impaired systolic function, with heart developed hypertrophy at onset and gradually cardiac walls became thinner with large LV volume. The FBG, TG and LDL-c levels in AIT was 16.8%, 45.6% and 74.7% lower than that in DCM ($P < 0.01$). AIT increased HDL-c level up to 60% than DCM ($P < 0.01$). AIT significantly decreased IR for 37.3% ($P < 0.01$). Histological analysis and echocardiography results revealed that AIT prevent the thinners of cardiac wall and improve systolic and diastolic function. There is a 81% increase of α -MHC mRNA expression and a 67% decrease of β -MHC mRNA expression in AIT group than in

DCM ($P < 0.01$), which represented that AIT prevent the heart transformation to embryo type. AIT protect DCM heart through improving serum GLP-1 level (80%, $P < 0.05$), heart GLP-1 expression (144%, $P < 0.01$) and GLP-1R expression (219%, $P < 0.01$).

Conclusions: AIT intervention may reverse the process of DCM by activating of GLP-1/GLP-1R signaling.

3542 Board #230 June 1 9:30 AM - 11:00 AM

Predictors of Clinical Measures of Insulin Resistance

Vincent M. Smith, Gabrielle A. Volk, Elizabeth A. Sohns, Callan R. Conroy, Rebecca E. Bartram, Casey R. Heindl, Kyle T. Timmerman, FACSM. *Miami University, Oxford, OH.*

(No relevant relationships reported)

Approximately 30.3 million adults in the United States have diabetes. Diabetic complications include stroke, myocardial infarction, nerve damage, and renal failure, among others. In addition to being the seventh leading cause of death in the country, the medical costs due to diabetes is over \$325 billion annually. Clinical evaluation for type II diabetes can be assessed in a variety of ways: fasting blood glucose (FBG), hemoglobin A1c (HbA1c) percentage, and the homeostatic model assessment of insulin resistance (HOMA-IR). The **PURPOSE** of this study was to evaluate the relationships between these clinical indicators and body composition, physical activity level, and glucose response to mixed nutrient challenge in older adults.

METHODS: In 38 subjects (7 m /31 f) body composition (bioelectrical impedance); blood glucose (glucometer); insulin (enzyme-linked immunosorbent assay); and HbA1c (HbA1c Analyzer) were assessed. In a subset of 30 subjects, physical activity was assessed via accelerometry (Actical). Further, in a subset of 16 subjects, glucose area under the curve (gAUC) was calculated following mixed nutrient challenge (0.5 g dextrose/kg lean mass + 0.3 g protein/kg lean mass). Partial correlations (controlling for age and sex) were utilized to examine associations. Significance was set as $p < 0.05$. **RESULTS:** Subject characteristics included: age = 67.9 ± 6.6 y, BMI = 29.3 ± 7.5 kg/m², FBG = 104.0 ± 19.0 mg/dL, HOMA-IR = 2.61 ± 1.95 , and HbA1c = $5.42 \pm 0.25\%$. FBG was significantly correlated with body mass ($r = 0.62$), body fat percentage ($r = 0.33$); and gAUC ($r = 0.59$). HOMA-IR was significantly correlated with body mass ($r = 0.64$) and body fat percentage ($r = 0.51$). HbA1c was significantly correlated with gAUC ($r = 0.83$). There was a trend for a correlation between HbA1c and habitual, daily moderate-to-vigorous intensity physical activity ($r = -0.36$, $p = 0.06$). **CONCLUSION:** These preliminary data support previous findings that clinical indices of insulin sensitivity are associated with body composition. Interestingly, our data show blood glucose response to mixed nutrient intake, but not FBG, is predictive of HbA1c.

3543 Board #231 June 1 9:30 AM - 11:00 AM

A Family History Of Type 2 Diabetes Does Not Limit Exercise Induced Improvement In Aerobic Fitness And Mitochondrial Function In Normoglycemic Sedentary Men

Jasmin Jenkins¹, Conrad P. Earnest, FACSM², Kevin Conley³, Steven R. Smith⁴, Sudip Bajpeyi¹. ¹University of Texas at El Paso, El Paso, TX. ²Texas A&M University, College Station, TX. ³University of Washington Medical Center, Seattle, WA. ⁴Sanford Burnham Presbys Medical Discovery Institute, Orlando, FL.

(No relevant relationships reported)

A family history of type 2 diabetes (FH+) is considered a risk factor for the development of type 2 diabetes (T2D). However, it is unclear whether exercise induced improvements in insulin sensitivity (IS), maximal aerobic fitness (VO_{2max}), and mitochondrial maximum ATP synthesis rate (ATP_{max}), are impacted by a FH+.

PURPOSE: The purpose of this study was to 1) determine if normoglycemic, sedentary healthy individuals with FH+ have a lower IS, VO_{2max} , and ATP_{max} compared to those without a family history of T2D (FH-) and 2) if exercise induced changes in IS, VO_{2max} , and ATP_{max} is impeded in those with a FH+.

METHODS: Fourteen normoglycemic sedentary males with (n=6; age = 27.33 ± 2.65 years; BMI = 26.48 ± 1.25 kg/m²) or without (n=8; age = 26.63 ± 1.44 years, BMI = 26.46 ± 0.57 kg/m²) FH were trained on a stationary bicycle for 30-55 minutes/session on alternate days of continuous and interval training for 13 days over 3 weeks. Non-exercising control (n=8; age = 25.75 ± 1.85 years; BMI = 24.38 ± 1.31 kg/m²) without a FH completed the same testing procedures at baseline and after 3 weeks. IS was assessed by hyperinsulinemic euglycemic clamp. ATP_{max} was measured by magnetic resonance spectroscopy, and VO_{2max} was measured by a standardized graded exercise test.

RESULTS: There were no differences in IS, ATP_{max} and VO_{2max} between groups at baseline (one-way ANOVA all $p > 0.05$). Three weeks of exercise increased VO_{2max} only in FH- (Mean \pm SEM; Control 33.25 ± 1.68 to 32.66 ± 1.92 mL/kg/min, $p = 0.73$; FH- 33.47 ± 1.85 to 35.24 ± 1.60 mL/kg/min, $p = 0.03$; FH+ 29.96 ± 2.09 to 31.49 ± 2.07 mL/kg/min, $p = 0.14$), increased ATP_{max} only in FH+ (Control 0.68 ± 0.04 to 0.69 ± 0.04 mM ATP/s, $p = 0.98$; FH- 0.70 ± 0.05 to 0.73 ± 0.03 mM ATP/s, $p = 0.81$; FH+ 0.61

± 0.04 to 0.74 ± 0.05 mM ATP/s, $p=0.02$) but did not change IS in any group (Control 8.24 ± 0.93 to 7.00 ± 0.92 mg/kg/min, $p=0.38$; FH- 7.84 ± 0.82 to 8.42 ± 1.11 mg/kg/min, $p=0.87$; FH+ 5.39 ± 0.48 to 6.62 ± 0.83 mg/kg/min, $p=0.51$).

CONCLUSION: Three weeks of combined endurance and interval exercise training improved ATP_{max} and VO_{2max} overall, but did not change IS in normoglycemic sedentary individuals. FH+ does not seem to be a limiting factor for achieving exercise stimulated improvement in whole body aerobic fitness and mitochondrial function in a normoglycemic healthy sedentary population.

3544 Board #232 June 1 9:30 AM - 11:00 AM
Hyperbaric Treatment With Normal Air Prevents The Progression Of Hyperglycemia In Type 2 Diabetes

Goto Natsuki¹, Naoto Fujita¹, Wataru Nino¹, Kazuyoshi Hisatsune¹, Ryosuke Ochi¹, Hisao Nishijo², Susumu Urakawa¹.
¹Graduate School of Biomedical & Sciences, Hiroshima University, Hiroshima, Japan. ²Graduate School of Medical & Pharmaceutical Science, University of Toyama, Toyama, Japan.
 Email: natsu.g0731@gmail.com
 (No relevant relationships reported)

Previous study reported that hyperbaric treatment with 36% oxygen decreases glucose and insulin level in type 2 diabetes rats, and the improvement could be due to increased oxygen saturation and blood flow during hyperbaric treatment. However, the effects of simple hyperbaric treatment without high oxygen remain unknown. **PURPOSE:** To investigate the effects of hyperbaric treatment with normal air on hyperglycemia in type 2 diabetes, focusing on skeletal muscle hemodynamics.

METHODS: 24-week-old male Otsuka Long-Evans Tokushima fatty (OLETF) rats and Long-Evans Tokushima Otsuka (LETO) rats were used as diabetes model and non-diabetes model, respectively. All rats were assigned to hyperbaric treatment or non-treatment groups. The rats in the hyperbaric treatment group were exposed to hyperbaric chamber at 1.3 ATA with normal air for 8 hours a day for 16 weeks. The oxygen saturation and total-hemoglobin (Hb) changes in the calf muscle during hyperbaric treatment was measured by near-infrared spectroscopy. Oral glucose tolerance test was performed at 40-week-old.

RESULTS: Oxygen saturation and total-Hb were significantly increased during hyperbaric treatment from 73.3 to 76.7% and 25.0 to $26.3 \times 10^9/\text{mm}^3$ in OLETF rats, 71.1 to 74.8% and 20.1 to $22.5 \times 10^9/\text{mm}^3$ in LETO rats ($p < 0.05$). The glucose and insulin levels were significantly higher in OLETF rats than LETO rats at both fasting and after glucose administration ($p < 0.05$). Among OLETF rats, the glucose levels at 30, 60, 120 min after glucose administration were significantly lower in the hyperbaric treatment group than the non-treatment group (30 min: 325 ± 71 vs. 385 ± 48 , 60 min: 332 ± 67 vs. 421 ± 111 , 120 min: 216 ± 45 vs. 230 ± 20 mg/dL, $p < 0.05$). Additionally, the fasting insulin level and the levels at 120 min after glucose administration were significantly lower in the hyperbaric treatment group than the non-treatment group (Fasting: 3.6 ± 1.1 vs. 4.3 ± 2.7 , 120 min: 4.4 ± 1.6 vs. 5.2 ± 3.9 ng/mL, $p < 0.05$).

CONCLUSIONS: The present study demonstrated that hyperbaric treatment with normal air also prevents the progression of hyperglycemia in OLETF rats, and the treatment without high oxygen increases oxygen saturation and blood flow in the skeletal muscle.

3545 Board #233 June 1 9:30 AM - 11:00 AM

Hit Increases Substrate Oxidation In Obese Adolescents With And Without Insulin Resistance

Juliana M Lino Aparecido¹, Hellyelson Lopes de Omena Couto¹, Alison Fabiano Cunha Cruz¹, Thais Miriã¹, Marcelo Santin Cascapera², Cristiane Kochi², Vera Lúcia Santos Alves², Antonio H. Lancha Jr³, Marcelo Luis Marquenzi¹.
¹Universidade Cidade de São Paulo, São Paulo, Brazil. ²Faculdade de Ciências Médicas da Santa Casa de Misericórdia de São Paulo, São Paulo, Brazil. ³Universidade de São Paulo, São Paulo, Brazil.
 Email: jmonique_@hotmail.com
 (No relevant relationships reported)

PURPOSE: To verify the effect of HIT on cardiorespiratory performance and substrate oxidation in obese adolescents with and without insulin resistance. **METHODS:** Clinical trial with 25 obese adolescents, allocated to two groups: with insulin resistance (IR, $n=12$, HOMA ≥ 3.16) and no insulin resistance (nIR, $n=13$), submitted before and after six sessions of HIT to cardiopulmonary test for determination of oxygen consumption (VO_2), heart rate (HR), and velocity (V) at peak intensities and the first ventilatory anaerobic threshold (LAV1), more indirect calorimetry protocol for determination of lipid oxidation rate (LIPox) and carbohydrate oxidation rate (CHOox). The training protocol included six HIT sessions with 48h intervals, consisting of six series at 100% of Vpeak and active recovery at 50% of Vpeak. Data were treated by Student t or Mann-Whitney tests (comparisons between groups) and Student t or Wilcoxon tests (pre and post-training comparisons); the influence of HIT was tested by Cohen's d. The level of significance was 5%. **RESULTS:** Significant increases in Vpeak, VO_2 , V and HR at LAV1 were observed in post-training in both

groups ($p < 0.05$; $d < 0.02$). As a consequence, the groups presented alterations in oxidation substrates patterns, with increases of 56.13% and 20.21% of CHOox for nIR ($p=0.03$) and IR ($p=0.06$), respectively. **CONCLUSION:** Six HIT sessions were sufficient to alter parameters of cardiorespiratory and CHOox performance in obese adolescents resistant or not to insulin, suggesting its use in potential implications for the regulation of physical fitness and glycemia in these populations.

3546 Board #234 June 1 9:30 AM - 11:00 AM

Weight Loss Combined with Increased Water Consumption Improves Cognitive Performance in Overweight Older Adults

Kayla J. Airaghi, Brenda M. Davy, FACSM, Elaina L. Marinik, Kevin P. Davy, FACSM, Tina Savla, Benjamin Katz. Virginia Tech, Blacksburg, VA.
 Email: kairaghi@vt.edu
 (No relevant relationships reported)

Existing research has established links between cognition and hydration in athletes and young adults, and a higher BMI has been linked to deficits in inhibitory control and attention. We recently reported that hydration status was associated with cognitive performance in overweight older adults. However, there is little work exploring the influence of weight loss interventions that also increase water intake on cognition. **PURPOSE:** This study investigated the impact of a short-term weight loss intervention with and without increasing water intake on attention and inhibition in older overweight adults. **METHODS:** Older adults aged 50-69 ($n=23$, 67% female, BMI = 32 ± 4) were randomly assigned to one of two groups for 4 weeks: 1) hypocaloric diet + 16 fl. oz. of pre-meal water 3 times/d ($n=13$; "water"), 2) hypocaloric diet with no additional water ($n=10$; "nonwater"). Assessments at baseline and week 4 included weight, hydration (urinary specific gravity; USG), and the AX-Continuous Performance Task (CPT), a measure of inhibitory control and attention. Univariate ANCOVAs with experimental condition as a fixed factor, pre-test as a covariate, and post-test performance as the dependent variable were used to examine the outcome of the intervention on cognition.

RESULTS: Weight loss was 4.7% (± 0.7) and 4.3% (± 0.2) of baseline bodyweight for water and non-water groups, respectively, with no group difference. Intervention compliance evaluated at week two demonstrated lower USG in the water group (1.009 ± 0.002) than the nonwater group (1.015 ± 0.002), ($p=0.067$). Furthermore, at week 4, the nonwater group was 7% faster ($p=0.046$) and 4% less accurate ($p=0.076$) than the water group on the final block of the CPT after controlling for baseline performance. These results suggest a speed-accuracy tradeoff, such that individuals who were randomized to drink additional water while consuming a hypocaloric diet performed more slowly but more accurately on the later stages of the attention task. **CONCLUSIONS:** Among older, overweight adults undergoing weight loss, increasing water consumption may reduce cognitive fatigue during an attention task such that more hydrated individuals may favor accuracy over speed, relative to less hydrated individuals.

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3547 Board #235 June 1 9:30 AM - 11:00 AM

Effectiveness Of 12-week Exercise Training On Body Composition And Lipid Metabolism Of Non-alcoholic Fatty Liver Disease

Zhu Lin¹, Jing-xin Liu². ¹Guangzhou Sport University, Guangzhou, China. ²Shanghai University of Sport, Shanghai, China.
 Email: 40848567@qq.com
 (No relevant relationships reported)

Exercise training is often prescribed to treat non-alcoholic fatty liver disease (NAFLD). However, body-weight training, as a simple and convenient exercise method, the effectiveness on NAFLD is still unclear.

PURPOSE: To determine the effects of 12-week individualized body-weight training combined with aerobic training on body composition, blood lipid and liver function of NAFLD. **METHODS:** Thirty participants (male: 10, female: 10, age 45.82 ± 7.55 years) who were clinically diagnosed as NAFLD were randomized allocated to the experimental group (EG) with a trained program that 3 times per week over 12 weeks (30 min body-weight training, 30 min walking exercise at 40 - 60% heart rate reserve) or a control group (CG) with health education. Body composition, blood lipid and liver function were measured at baseline and after intervention.

RESULTS: At 12th weeks there were significant changes within group in body weight (-4.61 ± 1.87 kg, $p < 0.01$), body mass index (-1.57 ± 0.78 kg/cm², $p < 0.01$), waist circumference (-5.20 ± 2.81 cm, $p < 0.01$), hip circumference (-5.07 ± 2.28 cm, $p < 0.01$), body fat percent ($-1.86 \pm 1.62\%$, $p < 0.01$), body fat mass (-1.69 ± 0.87 kg, $p < 0.01$) and visceral fat (-1 ± 0.78 kg, $p < 0.01$) in EG. There was no significant change in body composition of CG ($p > 0.05$), all these changes were significant different between EG and CG ($p < 0.05$). EG resulted in a significant increase in triglyceride (-0.56 ± 0.91 mmol/L, $p < 0.05$), low-density lipoprotein cholesterol (-0.33 ± 0.53

mmol/L, $p < 0.05$), while total cholesterol and high-density lipoprotein cholesterol did not change significantly after exercise. Exercise training decreased Alanine aminotransferase (43.87 ± 31.34 to 23.53 ± 12.78 u/L, $p < 0.0001$) and Aspartate aminotransferase (33.87 ± 15.67 to 22.40 ± 6.32 u/L, $p < 0.0001$), which were significantly different from CG. **CONCLUSIONS:** Participates in regular combination exercise of body-weight exercise and aerobic exercise have marked beneficial effects on body composition, blood lipid and liver function on NAFLD.

3548 Board #236 June 1 9:30 AM - 11:00 AM

Post-Meal Walking Vs. Pre-Meal Vinegar Ingestion: Strategies to Reduce Postprandial Hyperglycemia

Brady J. Holmer¹, Sarah J. Taylor², Cory M. Scheadler³, Matthew J. Garver⁴. ¹University of Florida, Gainesville, FL. ²Abilene Christian University, Abilene, TX. ³Northern Kentucky University, Highland Heights, KY. ⁴University of Central Missouri, Warrensburg, MO.
Email: holmerb1@ufl.edu

(No relevant relationships reported)

Postprandial hyperglycemia is a risk factor for future CVD events. Lifestyle interventions to blunt postprandial glucose are needed to reduce diabetic and CVD risk. Apple cider vinegar, a "functional food", has been shown to attenuate the rise in glucose following a meal. Aerobic exercise may also reduce blood glucose (BG) levels when performed before or following a high-glycemic meal. **Purpose:** This study aimed to compare the effectiveness of post-meal vinegar ingestion and pre-meal walking in reducing postprandial hyperglycemia in elderly individuals. We also investigated whether this population will self-select walking speeds sufficient to reduce postprandial glucose spikes. **Methods:** Participants ($n=12$) reported for testing following a 3 hour fast. Baseline BG was measured upon arrival, after which participants completed one of three conditions in a randomized, crossover order: (1) Consumption of standard meal followed by 2 hours of sitting, (2) Consumption of standard meal with apple cider vinegar (.3g/kg BW) or (3) Consumption of a standard meal followed by 15 minutes of self-paced walking. BG was measured by finger stick at 30, 60, 90, and 120 minutes following meal consumption. The meal was designed to be high glycemic-index (GI) and included a bagel, butter, and orange juice. Total energy content of the meal was 470kcal (79g CHO [28g sugar], 12g FAT, 1g PRO). **Results:** The control trial confirmed BG rose significantly following the meal at 30 (167.8 ± 6.1 mg/dl vs. 91.8 ± 2.4 mg/dl; $p < .005$) and 60 minutes (172.8 ± 11.8 mg/dl vs. 91.8 ± 2.4 mg/dl; $p = .024$). There was no difference in BG area under the curve (AUC) at any time point following vinegar or walking interventions vs. control. However, following vinegar and walking, the absolute increase in BG at 30 minutes following the meal was significantly reduced vs. control ($\Delta 30BG$ in control 76.1 ± 7.0 mg/dl vs. vinegar 46.8 ± 9.2 mg/dl vs. walking 44.3 ± 7.5 mg/dl; $p < .05$). Speed was found to be correlated with BG AUC, such that an increase in walking speed was associated with a greater reduction in 2-hour glucose AUC ($R = .590$). **Conclusions:** Lifestyle interventions such as walking and vinegar ingestion may effectively lower postprandial glucose spikes. For elderly individuals these represent alternative therapies to aid in glucose management and improve metabolic health.

3549 Board #237 June 1 9:30 AM - 11:00 AM

Effects Of Different Exercise On Autophagy & Inflammation In Visceral Adipose Tissue Of Obese

Yongjun Zhao¹, Yuxiu He². ¹Ly liang University, Ivliang, China. ²Hebei Normal University, Shijiazhuang, Hebei, China, China.
Email: zhaoyun@126.com

(No relevant relationships reported)

PURPOSE: to examine the impact of exercise on autophagy and inflammation response in visceral adipose tissue in obesity in order to explore the relationship between them in adipose tissue after exercise. **METHODS:** 42 obese mice were randomly divided into four groups as follows: high fat diet (HC, $n=9$), normal diet (NC, $n=9$), normal diet combined with endurance exercise intervention (NE, $n=12$), and normal diet combined with resistance exercise intervention (NR, $n=12$). NE and NR conducted treadmill and ladder climbing exercise respectively for 8 weeks. Then to detect the gene and protein expression of autophagy, inflammation, ER stress and antioxidant markers using RT-PCR and WB, in addition, TEM and IHC were used to observe the autophagosome in visceral adipose tissue. **RESULTS:** BW, Lee's index and BFI were significantly decreased in all three intervention groups, and there is a great decreasing in the two exercise group, but no difference between them. Atg5, Becn1 expression and LC3II/I were decreased significantly in NE and NR group compared with HC, meanwhile p62 expression were significantly increased. When compared with NC group, p62 expression were significantly increased in NE and not happened in NR group. Becn1 mRNA expression increased and p62 protein expression decreased significantly in NR group when compared with NE group. IL-1 β was decreased significantly in NC, NE and NR group compared with HC. In addition, IL-6 and IL-10 protein expression increased significantly both in NE and NR group. When compared with NC group, IL-6 and

IL-10 protein expression increased and IL-1 β was decreased significantly both in NE and NR group except IL-6 protein expression in NR group. IL-6 increased and IL-10 decreased significantly in NR group when compared with NE group. Finally we found that IL-10 showed a negative correlation with almost every autophagy markers used in this study.

CONCLUSIONS: The effectiveness of 8wks different exercise intervention had no difference in fat reduction. The autophagic activity of visceral adipose tissue was inhibited after exercise, especially after aerobic exercise. Autophagy and inflammation enjoy the same trend before and after exercise in visceral adipose tissue in obesity, and the IL-10 is the most sensitive factor in reflecting the relationship between autophagy and inflammation.

3550 Board #238 June 1 9:30 AM - 11:00 AM

"Living High-training Low" Improves Hepatic Steatosis In Obese Mice

Wang Ru. Shanghai University of Sport, Shanghai, China.
Email: wangru0612@163.com

(No relevant relationships reported)

"Living high-training low" (LHTL) is effective for weight loss in nutritional obese individuals. But whether the LHTL improves hepatic steatosis is unknown.

PURPOSE: To explore the effect of LHTL on serum lipids and hepatic steatosis in obese mice.

METHODS: High-fat diet induced obese mice (male C57BL/6J) were randomly divided into obesity (OB, $n=9$) and "Living high-training low" group (LHTL, $n=9$), both of which were fed a high-fat diet that fat provides 60% calories (Research Diets). Mice in OB group were kept quiet, while mice in LHTL group conducted hypoxia exposure (Mixing nitrogen and air, PO₂ 14.7%, from 08:30 to 16:30, 8 h/d, 6 d/w) and exercise training (starting at 20:00, treadmill slope is zero, 14 m/min, 840 m/d, 6 d/w) intervention for 4 weeks. Animals were euthanized after the intervention. Body weight (BW), fat mass (FM), body fat percentage (BFP), liver index, serum High/low density lipoprotein cholesterol (HDL/LDL-C), Triglyceride (TG), Alanine aminotransferase (ALT), Free fatty acids (FFA), liver FFA and Histological staining (HE & Oil red O) were measured.

RESULTS: LHTL 1) reduced BW (38.41 ± 0.74 vs. 44.21 ± 0.74 g, $p < 0.01$), FM (2.06 ± 0.09 vs. 2.45 ± 0.14 g, $p < 0.05$) significantly, while BFP (5.76 ± 0.30 vs. $6.49 \pm 0.29\%$, $p > 0.05$), serum HDL-C (0.72 ± 0.01 vs. 0.72 ± 0.01 $\mu\text{g}/\mu\text{l}$, $p > 0.05$), LDL-C (0.66 ± 0.02 vs. 0.68 ± 0.01 $\mu\text{g}/\mu\text{l}$, $p > 0.05$), TG (0.20 ± 0.02 vs. 0.20 ± 0.03 pmol/L, $p > 0.05$) and FFA (722.59 ± 40.74 vs. 606.06 ± 15.97 $\mu\text{mol}/\text{L}$, $p > 0.05$) levels showed no significant difference between the two groups; 2) reduced liver index (3.58 ± 0.12 vs. $4.45 \pm 0.19\%$, $p < 0.01$), serum ALT (5.06 ± 0.12 vs. 6.28 ± 0.31 U/L, $p < 0.01$) and liver fat content significantly while liver FFA (0.11 ± 0.01 vs. 0.13 ± 0.01 $\mu\text{mol}/\text{L}$, $p = 0.131$) only showed a downward trend.

CONCLUSIONS: "Living high-training low" is effective for weight loss and improves hepatic steatosis without attenuating circulating dyslipidemia. Supported by NSFC (Grant No. 81472148; 31671242).

No potential conflicts of interest relevant to this abstract were reported.

Corresponding author: Ru Wang (wangru0612@163.com)

3551 Board #239 June 1 9:30 AM - 11:00 AM

Effects Of Nutritional Status On Arterial Stiffness In The Subjects With Pre-sarcopenia

Keqin Huang, Shizue Itano, Kanako Hamaguchi, Toshiyuki Kurihara, Natsuki Hasegawa, Motoyuki Iemitsu, Kiyoshi Sanada. Ritsumeikan University, Shiga, Japan.
Email: gr0361xx@ed.ritsumei.ac.jp

(No relevant relationships reported)

Sarcopenia associated with arterial stiffness and poor nutrition intake. However, it is unclear whether the effects of nutritional status on arterial stiffness in the subjects with pre-sarcopenia. **PURPOSE:** The purpose of this study was to investigate whether the effects of nutritional status on arterial stiffness in the subjects with pre-sarcopenia in Japanese men and women. **METHODS:** The participants included 56 Japanese adults (44-77 years). Men ($n=15$) and women ($n=41$) in whom skeletal muscle index (SMI; appendicular muscle mass/height²) was measured by dual-energy X-ray absorptiometry. Pre-sarcopenia was defined as the cut-off value of SMI based on Asian Working Group for Sarcopenia. We assessed nutritional status by Brief-type self-administered Diet History Questionnaire, and the subjects divided into high- and low-nutritional status based on the mean values of this study independent of gender.

RESULTS: Two-way ANCOVA with adjustment for age, gender and physical activity as a covariate indicated that total energy intake and sarcopenia interacted to produce a significant effect on the brachial-ankle pulse wave velocity (baPWV) in Japanese adults ($P < 0.05$). The baPWV was significantly higher in the subject with coexisting sarcopenia and low-energy intake than that with non-sarcopenia regardless of total energy intake. **CONCLUSION:** Low-energy intake effects on arterial stiffness in the subjects with pre-sarcopenia even adjustment of age and physical activity involved. Future prospective studies are needed to assess the effects of nutritional status on

arterial stiffness in sarcopenia. Supported by Grant-in-Aid for Scientific Research from the Ministry of Education, Culture, Sports, Science and Technology of Japan (#24300239).

3552 Board #240 June 1 9:30 AM - 11:00 AM
Effects of Novel Compression Exercise Technology on Glycohemoglobin Levels and Weight in Type II Diabetics

Cristian Torres¹, Richard Henderson², Chloe Wernecke¹. ¹*Vaspar Systems, Moffett Field, CA.* ²*Covenant Medical, Lubbock, TX.*
 Reported Relationships: C. Torres: Salary; Vaspar Systems.

The most potent lifestyle intervention for treatment of Type II Diabetes (T2D) is consistent exercise. However, for many patients with the condition, other comorbidities such as osteoarthritis, hypertension, and high body mass indexes prevent them from being able to exercise intensively and consistently enough to experience optimal metabolic benefits. Recent research has supported the use of compression exercise in physically limited populations and demonstrated physiologic responses at lower intensities (10-20% one repetition maximum vs. 70% for hypertrophic response in conventional resistance exercise). The combination of compression technology with core cooling further lowers the exertional requirements and has been used in cardiopulmonary rehabilitation populations to provide a safe and reliable exercise intervention. Compression exercise has also been shown to significantly increase muscle hypertrophy, with a greater growth in type II fibers (higher expressers of GLUT4). Therefore, this technology could directly address basal metabolism through increasing muscle protein turnover, increasing glucose storage in skeletal muscle mass, and improving glycemic control. This capacity to attenuate the insulin response combined with the accessibility of the platform suggests a clinical implication for diabetes management.

PURPOSE: To establish safe use of cooled compressive exercise in Type II Diabetics and to examine the effect of 6 months of training on biometabolic markers, especially Glycohemoglobin levels and weight.

METHODS: Thirty Type II Diabetics agreed to 3 training sessions a week for 6 months. Biometabolic markers via blood draw were analyzed at 0, 3, and 6 months.

RESULTS: Midpoint data from 16 participants at 0 and 3 months were analyzed with a two-tailed T-test, revealing significant differences in Glycohemoglobin and weight. There was an 8% average decrease in Glycohemoglobin levels (8.5±2.2 vs. 7.8±1.8 mg/dl, $p = 0.002$) and an average weight loss of 3.6 lbs (211±50 vs. 208±48 lbs, $p = 0.032$).

CONCLUSION: The preliminary results of this study suggest exercise with compression and cooling contributes to a reduction in biometabolic markers of diabetes. This intervention has promise in contributing to effective management of T2D with a low physical burden.

3553 Board #241 June 1 9:30 AM - 11:00 AM
High-fat Diet-induced Obesity Induces Peripheral Neuropathy During Impaired Cutaneous Wound Healing

Emma C. Moore, Adam Johnston. *University of Prince Edward Island, Charlottetown, PE, Canada.*
 Email: ecmoore@upe.ca
 (No relevant relationships reported)

Type-II diabetes is a societal epidemic that is associated with obesity and metabolic disease often resulting from poor diet and reduced physical activity. Two major complications associated with type-II diabetes are peripheral neuropathy which leads to a loss of sensation and chronic pain as well as poor wound healing, which can progress to ulceration and ultimately amputation. Since clinical trials for the treatment of these chronic conditions have only fostered limited success we examined the possibility that the nervous system and wound repair are linked. The **PURPOSE** of this study was to investigate the potential that the peripheral nervous system is a necessary regulator for normal wound repair and that diabetes-induced neuropathy is in part, causative of impaired wound healing. **METHODS:** We administered a 6 mm skin punch biopsy wound to high-fat diet (HFD, 10 weeks of feeding with 60% of energy from fat content, $n=9$) and control (10% of energy via fat content, $n=9$) fed mice. **RESULTS:** A diabetic phenotype was confirmed in HFD mice as evidenced by elevated body weight (Control mean weight=32.4g, HFD mean weight=40.7g) and impaired glucose tolerance ($p < 0.05$) in response to an intraperitoneal glucose tolerance test. Following skin injury, HFD mice demonstrated an impaired wound healing rate as evidenced by a larger wound diameter and area ($p < 0.05$) at days 2-9 while hematoxylin, and eosin staining of tissue-cross sections revealed larger wound widths and a poorly formed dermis in HFD mice in comparison to controls at day 9. Immunohistochemical analysis demonstrated that poor wound healing was coincident with a reduction of S100β+ cutaneous Schwann cells within and around the healing dermis. Ongoing analysis includes the examination of additional markers of cutaneous neuropathy using immunohistochemistry to quantify total nerve axons (UCHL-1+ cells), growing/regenerating axons (Gap43+ cells) and markers of activated/

dedifferentiated Schwann cells (p75NTR+Sox2+ cells) as well as testing the efficacy of Schwann cell transplantation to rescue HDF-induced neuropathy and wound healing deficits. **CONCLUSION:** Collectively, these experiments will give insight into the mechanisms underpinning two major complications associated with type-II diabetes that could be further explored to develop novel therapeutics.

3554 Board #242 June 1 9:30 AM - 11:00 AM
Home Cooked Meals With Whole, Plant Foods and the Protection Against Central Adiposity

Nicholas V. Neuwald, Arlette C. Perry, FACSM, Wesley N. Smith. *University of Miami, Coral Gables, FL.* (Sponsor: Arlette Perry, FACSM)
 Email: nneuwald@gmail.com
 (No relevant relationships reported)

It is well-established that central adiposity (CA) is associated with the risk of chronic disease. Diets high in processed foods and low in whole, fibrous plant foods, are often cited as risk factors for the development of CA and its adverse metabolic sequelae. Much of the processed foods consumed consist of pre-prepared foods and foods eaten outside of the home.

PURPOSE: To examine whether the consumption of processed, ready-to-eat (PRE) or restaurant meals that lack whole, plant-based foods was positively associated with CA in male and female adults. **METHODS:** A total of 2,703 adults (1,521 females and 1,182 males), from a HealthSnap wellness assessment platform used in physicians' offices across the country, self-reported their frequency of consuming PRE foods or restaurant meals versus whole, plant foods. CA was based upon a waist-to-hip ratio of ≥ 0.95 and ≥ 0.85 for males and females, respectively. To identify the association between PRE and CA, a chi-squared analysis (χ^2) was performed across quintiles of PRE by CA, and a relative risk (RR) was calculated. **RESULTS:** A significant association between PRE and CA ($\chi^2 [4, n = 2703] = 48.27, p < 0.001$) was observed. These associations remained significant regardless of gender. The RR for CA among patients in the top 20%, Q5, was compared to the lowest 20%, Q1, for PRE. The RR of a patient having CA in Q5 for PRE was 225% greater than Q1 (RR: 2.25, 95% CI: 1.69-2.99, $p < 0.001$). **CONCLUSION:** A strong positive association exists between dietary consumption of PRE and CA. This supports the consumption of more home-cooked meals with whole, plant foods over PRE in the clinical setting to protect against CA and its adverse health consequences.

3555 Board #243 June 1 9:30 AM - 11:00 AM
Role Of Aerobic Exercise On Cardiac Autonomic Modulation And Adipokines In Polycystic Ovary Syndrome

Stella V. Philbois, Tábara P. Facioli, Hugo C. Souza. *University Of Sao Paulo, Ribeirão Preto, Brazil.*
 Email: hugocds@fmrp.usp.br
 (No relevant relationships reported)

Women with Polycystic Ovary Syndrome (PCOS) present substantial weight gain that may increase the risk of developing cardiovascular diseases. Hormonal, metabolic and cardiac autonomic changes also occur and increase the risk of these diseases. However, despite advances, the effects of aerobic exercises on the different aspects of this syndrome are still unknown, especially when the body fat percentage is considered. **PURPOSE:** To investigate the effects of aerobic exercise on hormonal and metabolic aspects and cardiac autonomic modulation in women with PCOS with different percentages of body fat. **METHODS:** Women with PCOS ($N=60$) and without PCOS (control, $N=60$), between the ages of 18 and 39 years, were divided into three groups, according to their body fat percentage (22-27%, 27-32% and 32-37%). The participants were submitted to assessment of the following parameters before and after the aerobic physical training (16 weeks); body composition, fasting glucose and insulin, androgens, leptin, adiponectin, tumor necrosis factor- α (TNF- α), interleukin-6 (IL-6), and the analysis of heart rate variability (HRV). **RESULTS:** Women with PCOS had increased serum levels of androgens, insulin (insulin resistance), leptin, TNF- α and IL-6 associated with reduced serum levels of adiponectin. Autonomic assessment revealed that these women also exhibited an impaired autonomic modulation characterized by reduced HRV, but mainly in high-frequency oscillations (HF=0.2-0.5Hz), corresponding to vagal modulation. These findings were directly associated with the body fat percentage; however, according to some parameters evaluated (insulin, TNF- α , IL-6 and HRV), PCOS seems to play a key role. In turn, the aerobic physical training was effective in improving almost all the parameters evaluated, except the serum levels of androgens and TNF- α . **CONCLUSIONS:** The results showed that PCOS has been found to be associated with significant endocrine/metabolic disturbances and cardiovascular autonomic dysfunction, which are exacerbated by overweight. Aerobic physical training proved to be an effective treatment for most parameters evaluated and should be prescribed as an adjunct treatment for PCOS, the same way it has been used to treat chronic degenerative diseases.

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3556 Board #244 June 1 9:30 AM - 11:00 AM

Aerobic Exercise Reduced Body Weight through Midbrain-striatal Dopaminergic Plasticity in Obese MiceWei Chen, Juan Li, Yuxiu He, Yakai Niu. *Hebei Normal University, Shijiazhuang, China.**(No relevant relationships reported)*

PURPOSE: Previous research indicates that midbrain-striatal dopaminergic disruption is associated with obesity and involved in feeding behavior and voluntary physical activity. Since the action of exercise on midbrain-striatal dopamine, it may be an effective strategy to improve physical inactivity and overeating induced by food reward dysfunction in obesity. We therefore explored the mechanisms.

METHODS: Male C57BL/6 mice were randomly divided into control group (C, n=12), exercise group (CE, n=12) fed a normal diet (13% fat), and an additional group (H, n=40) fed a high fat diet (51% fat). Obese mice in H were further divided into obesity group (O, n=12) and obesity + exercise group (OE, n=12). The CE and OE mice underwent treadmill exercise (5-13 m/min, about 58%-75% VO₂max, 50 min/d, 5 d/wk for 8 wks). The food preference test and open-field test were used to assess food reward, and voluntary physical activity. Tyrosine hydroxylase (TH)⁺ neurons were detected by immunohistochemistry, and the expression of TH protein in midbrain-striatum were measured by western blot.

RESULTS: Body weight of OE was 15.2% lower than that of O ($P < 0.01$). Sucrose preference, physical activity level and time were decreased by 25.8%, 46.77% and 37.56% in O compare to C ($P < 0.05$, $P < 0.01$, $P < 0.01$), but were 18.2%, 37.28% and 26.35% higher, respectively, in OE than O ($P < 0.05$). TH⁺ cells in substantia nigra pars compacta (SNc) and ventral tegmental area (VTA) decreased by 15.41% and 18.45%, respectively, in O compare to C ($P < 0.05$), but increased by 12.62% and 15.53% in OE compare to O ($P < 0.05$). TH⁺ fibers in dorsal striatum nucleus accumbens were 16.36% and 17.48% lower in O than C ($P < 0.05$), but was 12.54% and 14.13% higher in OE vs. O ($P < 0.05$). In addition, the expression of TH protein in midbrain and striatum decreased by 18.46% ($P < 0.05$) and 16.35% ($P < 0.05$) in O compared with C, but increased by 12.23% and 11.58% in OE compare to O ($P < 0.05$).

CONCLUSIONS: The aerobic exercise inhibits body weight gain, improves food reward and voluntary physical activity in obese mice. The exercise-induced midbrain-striatal dopaminergic plasticity may be one of the important mechanisms for this adaptation.

3557 Board #245 June 1 9:30 AM - 11:00 AM

Effect Of Physical Training In Leptin-deficient Ob/ob Mice: Oxidative Stress Evaluation In Prefrontal CortexMatheus Santos de Sousa Fernandes, Sr.¹, Lucas Lucena¹, Diorginis José S. Ferreira², Anderson Pedroza³, Severina Andrade-Silva³, Glauber Braz³, José Stefano Tadeu, PhD¹, Fabiana Sant'anna Evangelista, PhD¹, Claudia Pinto Marques Souza de Oliveira, PhD, MD¹, Claudia J. Lagranha³. ¹University of São Paulo, São Paulo, Brazil. ²Federal University of São Francisco Valley, Petrolina, Brazil. ³Federal University of Pernambuco, Vitória de Santo Antão, Brazil.

Email: theusfernandes10@hotmail.com

(No relevant relationships reported)

PURPOSE: The overweight/obesity affects brain function from cellular to structural levels, and due to the mitochondria importance, several studies have focused upon its involvement in the obesity and brain function. On rodents, previous data have already identified impairments of the prefrontal cortex triggered by obesity and its association with the oxidative stress. As the effect of moderate exercise training in the amelioration of the oxidative balance on prefrontal cortex was not examined in leptin-deficient ob/ob mice, this study assesses the effect of moderate physical exercise on oxidative stress parameters in the prefrontal cortex of leptin-deficient ob/ob mice. **METHODS:** Male ob/ob mice (Jackson Laboratories, Bar Harbor, ME, USA) with nine-weeks-old (32 g) were assigned into groups sedentary (S) and trained (T), housed in temperature and humidity controlled rooms, and kept on a 12 h light/dark cycle with food and water ad libitum. The physical training was performed at 60% of the maximal running capacity, 5 times/week, for 8 weeks. Forty-eight hours after last training, the animals were sacrificed and the prefrontal cortex quickly collected for oxidative balance analysis.

RESULTS: We did not observe differences in the lipid ($p=0.3285$) and protein oxidation ($p=0.3208$) in leptin-deficient ob/ob exercised mice, with concomitant unchanging in the superoxide dismutase activity ($p=0.2366$) and catalase ($p=0.7068$). However, we observed that the physical training significantly increased glutathione-S-transferase activity (S: 0.93 ± 0.3 vs. T: 3.63 ± 0.8 U/mg prot; $p=0.04$). Moreover, the physical training increased the non-enzymatic antioxidant defense (GSH= S: 5.1 ± 0.3 vs. T: 6.4 ± 0.6 μ M/mg prot, $p=0.04$; -SH levels= S: 0.016 ± 0.003 vs. T: 0.031 ± 0.001 mM/mg prot, $p=0.02$). Additionally, we evaluated the AMPK and PGC1 α gene expression, and we observed that AMPK wasn't modified after 8 weeks of physical training ($p=0.86$), however, PGC1 α expression increased significantly (S: 1.00 ± 0.2 vs. T: 1.98 ± 0.20 ddCt; $p=0.013$). **CONCLUSIONS:** We suggest that physical

exercise can minimize the detrimental effect of the obesity-induced oxidative stress in prefrontal cortex by activates an important transcription factor and possibly stimulates mitochondrial biogenesis.

G-42 Free Communication/Poster - Cancer

Saturday, June 1, 2019, 7:30 AM - 11:00 AM

Room: CC-Hall WA2

3558 Board #246 June 1 9:30 AM - 11:00 AM

Severity of Fatigue is Associated with Cardiorespiratory Fitness in Cancer SurvivorsRosie Twomey¹, Mary E. Medysky², John Temesi³, S. Nicole Culos-Reed¹, Guillaume Y. Millet⁴. ¹University of Calgary, Calgary, AB, Canada. ²Oregon Health & Science University, Portland, OR. ³Northumbria University, Newcastle upon Tyne, United Kingdom. ⁴Univ Lyon, UJM-Saint Etienne, Saint-Etienne, France.

Email: Rosemary.Twomey@ucalgary.ca

(No relevant relationships reported)

Cancer-related fatigue (CRF) is defined as a distressing, persistent, subjective sense of physical, emotional, and/or cognitive tiredness or exhaustion related to cancer or cancer treatment that is not proportional to recent activity and interferes with usual functioning. It has previously been suggested that CRF is associated with cardiorespiratory deconditioning. However, there is a lack of data to support this hypothesis. **PURPOSE:** To investigate: (i) peak oxygen uptake ($\dot{V}O_{2peak}$) in fatigued vs. non-fatigued cancer survivors; and (ii) the relationship between $\dot{V}O_{2peak}$ and CRF severity. **METHODS:** Participants ($n=86$) were recruited via a cancer-registry mail-out and from local cancer centres. Participants were allocated into two groups using the Functional Assessment of Chronic Illness Therapy-Fatigue (FACIT-F) scale and a previously established cut-off (score of ≤ 34 and > 34 for fatigued and non-fatigued, respectively). Participants categorized as fatigued ($n=48$ [25 female]; mean \pm SD age 55 \pm 9 years; FACIT-F 27 \pm 6) and non-fatigued ($n=38$ [21 female]; age 57 \pm 11 years; FACIT-F 44 \pm 5) performed an incremental exercise test to volitional exhaustion on a cycle ergometer. Data were compared to reference standards based on sex and age. Differences between groups were compared using an independent samples t -test. The association between FACIT-F score and $\dot{V}O_{2peak}$ was examined using linear regression. **RESULTS:** In comparison to reference standards, 23% of the fatigued group and 5% of the non-fatigued group were below the 50th percentile for $\dot{V}O_{2peak}$. $\dot{V}O_{2peak}$ was significantly lower in the fatigued vs. non-fatigued group (25.7 \pm 6.0 vs. 30.4 \pm 5.9 mL \cdot kg⁻¹ \cdot min⁻¹; $t_{(84)}=3.9$; $p<0.001$; $d=0.8$). There was a significant association between FACIT-F score and $\dot{V}O_{2peak}$ ($r=0.36$; $p=0.001$). The variance in $\dot{V}O_{2peak}$ explained 13% of the variance in FACIT-F score. **CONCLUSIONS:** Cardiorespiratory fitness was associated with the severity of CRF. In cancer survivors with CRF of a clinically-relevant severity, $\dot{V}O_{2peak}$ was lower in comparison to cancer survivors categorised as non-fatigued. Although CRF is complex and multifactorial, an improvement in cardiorespiratory fitness may explain some of the improvement in CRF severity with aerobic exercise interventions.

3559 Board #247 June 1 9:30 AM - 11:00 AM

Comparing Modified Treadmill Protocols for Cancer Survivors: A Pilot StudyDaniel Y.K. Shackelford, Jessica M. Brown, Edwin R. Rodriguez, Richard K. Thomas, Jessica J. Ruffert, Anne E. Smith, Kieran J. DeGroot. *Carroll University, Waukesha, WI.*

Email: dshackel@carrollu.edu

(No relevant relationships reported)

INTRO: The University of Northern Colorado Cancer Rehabilitation Institute (UNCCRI) treadmill protocol has been validated to accurately predict peak oxygen consumption (VO_{2peak}) in the cancer population. It is unknown if the Modified Bruce and Balke-Ware treadmill protocols are an accurate means to assess VO_{2peak} in cancer survivors. **PURPOSE:** Determine whether the Modified Bruce and Balke-Ware treadmill protocols yield similar VO_{2peak} values and are as feasible as the UNCCRI protocol in the cancer population. **METHODS:** Eight cancer survivors participated in the study, one of which dropped out. All participants performed three VO_{2peak} treadmill tests using the following protocols: UNCCRI, Modified Bruce, and Balke-Ware. One protocol was performed per week in a randomized order. VO_{2peak} values were obtained via gas analysis using a research-grade CosMed metabolic cart. A Kruskal-Wallis test was used to determine differences in VO_{2peak} between all three protocols. **RESULTS:** VO_{2peak} values (mL \cdot kg⁻¹ \cdot min⁻¹) did not significantly differ between the UNCCRI (27.1 \pm 5.8), Modified Bruce (27.3 \pm 5.5), or Balke-Ware treadmill protocols (28.8 \pm 5.8) ($p = 0.42$). **CONCLUSION:** The findings from this limited data set suggest that the Modified Bruce and Balke-Ware may be suitable in

determining VO₂peak in cancer survivors. However, these are not cancer-specific protocols and may be difficult to perform in patients suffering from severe muscular impairments, cachexia, balance issues, peripheral neuropathy, and/or cancer-related fatigue. The Modified Bruce has large and abrupt single-stage increases in speed and grade and the Balke-Ware has a faster, consistent speed of 3.5 mph. Attempting either of these two protocols with the aforementioned side effects may cause early test termination due to non-cardiovascular reasons, be a barrier to testing, and result in an inaccurate VO₂peak. The UNCCRI protocol accounts for cancer side effects by using a more gradual increase in speed and grade, resulting in validated and accurate values. Nevertheless, valid VO₂peaks may be achieved from the Modified Bruce and Balke-Ware if the participant is not suffering from any severe side effects and is fully able to exert themselves during testing, as occurred in this pilot study. Further data collection is needed to expand upon these findings.

3560 Board #248 June 1 9:30 AM - 11:00 AM
Exercise as Supportive Care Has Selective Benefits for Chemotherapy Tolerance and Weight Gain

Amy A. Kirkham¹, Kelcey A. Bland², Karen A. Gelmon³, Donald C. McKenzie⁴, Kristin L. Campbell, FACSM⁴.
¹University of Alberta, Edmonton, AB, Canada. ²Australian Catholic University, Melbourne, Australia. ³British Columbia Cancer Agency, Vancouver, BC, Canada. ⁴University of British Columbia, Vancouver, BC, Canada. (Sponsor: Kristin Campbell, FACSM)
 Email: amy.kirkham@ualberta.ca
 (No relevant relationships reported)

PURPOSE: To determine whether chemotherapy tolerance and side effects differ among women with breast cancer who do and do not participate in an exercise program.

METHODS: Women with early stage breast cancer who were offered supervised exercise programming as supportive care during adjuvant chemotherapy (n=73) were compared to a randomly selected, retrospective, usual care group (n=87). Exercise programming included supervised moderate-intensity aerobic and whole-body resistance training 3x/week plus home-based aerobic training 2x/week. Clinical data were extracted from medical records in a standardized manner for both groups. Weight gain was defined as ≥0.5 kg increase in body weight from chemotherapy records. Complete blood counts were extracted to determine prevalence of anemia and neutropenia.

RESULTS: The groups were matched on age, body mass index, medical history, diagnosis, and treatment characteristics. The relative dose intensity and risk of a dose reduction of any chemotherapy type did not differ between groups. Neuropathy was the most common reason for a dose reduction and the prevalence did not differ between groups. Dose reductions due to neutropenia or fatigue were significantly less common, while dose reductions due to mucositis were more common in the exercise group (all p<0.04). The severity, frequency, and risk of experiencing neutropenia and anemia did not differ between groups. Most (95%) patients experienced anemia, while one-third experienced neutropenia for at least 1 treatment cycle. There were some agent-specific effects of exercise including 1) a relative risk reduction of a doxorubicin dose reduction (relative risk, RR=0.40, 95% CI=0.17-0.94, p=0.04), but not for docetaxel or paclitaxel; and 2) risk reduction of weight gain with receipt of docetaxel and cyclophosphamide (RR=0.61, 95% CI = 0.37-1.00, p=0.05) but not with receipt of doxorubicin and cyclophosphamide.

CONCLUSIONS: Women who participated in a supportive care exercise program did not experience greater overall tolerance for chemotherapy treatment. However, exercise may have some selective effects on tolerance for doxorubicin chemotherapy, weight gain with docetaxel chemotherapy, and dose reductions due to neutropenia and fatigue.

3561 Board #249 June 1 9:30 AM - 11:00 AM
Adherence And Attendance During Versus After Chemotherapy In Exercise Influence On Taxane Side Effects

Kendra Zadravec¹, Kelcey A. Bland², Amy A. Kirkham³, Josh Bovard¹, Tamara Shenkier⁴, David Zucker⁵, Margot K. Davis¹, Donald C. McKenzie¹, Karen A. Gelmon⁴, Kristin L. Campbell¹. ¹University of British Columbia, Vancouver, BC, Canada. ²Australian Catholic University, Melbourne, Australia. ³University of Alberta, Edmonton, AB, Canada. ⁴British Columbia Cancer Agency, Vancouver, BC, Canada. ⁵Swedish Cancer Institute, Seattle, WA.
 Email: kendra.zadravec@ubc.ca
 (No relevant relationships reported)

Exercise throughout cancer treatment can positively affect clinical and patient-reported outcomes. However, adverse side effects (e.g. fatigue) may reduce exercise adherence

during chemotherapy. To potentially further improve patient prognosis, developing strategies to maximize exercise participation across the cancer treatment trajectory is warranted. **Purpose:** To compare adherence and attendance to a supervised multimodal exercise intervention completed during chemotherapy for breast cancer to the same intervention completed after chemotherapy. **Methods:** Women with stage I-III breast cancer were randomized to: 1) immediate exercise during chemotherapy (IE); or 2) delayed exercise after chemotherapy (DE). The exercise intervention matched the length of each participant's chemotherapy regime (8-12 wks) and included 3x/wk supervised aerobic (50-75% HRR, 30-35 min), resistance (1-2 sets, 10-12 reps, 50-65% estimated 1-RM), and balance training. Mean attendance and adherence to aerobic (i.e. intensity/duration) and resistance (i.e. sets/reps) exercise were calculated. Exercise trainers recorded reasons for missed sessions. **Results:** 26 women enrolled and attended ≥1 session (IE: n=12, DE: n=14). Attendance did not differ between groups (IE=79±24%, DE=81±21%, p=0.82). No group differences were found for adherence to aerobic duration (IE=94±12%, DE=98±2%, p=0.28) or intensity (IE=78±30%, DE=82±17%, p=0.64), or resistance training (IE=73±35%, DE=90±9%, p=0.13). Among IE participants, top reasons for missed sessions were treatment-related symptoms (38%) (i.e. fatigue) and non-treatment related illness (17%) (i.e. cold/flu). Missed sessions for the DE group were most often due to non-treatment-related injury (43%) and travel (23%). **Conclusion:** Adherence to an identical supervised exercise intervention did not vary based on whether it was completed during or after chemotherapy. Barriers to attendance differed by group, thus strategies to maximize exercise participation during chemotherapy should be unique to the time of intervention delivery. Although feasibility does not appear to vary by timing relative to treatment, further analysis is required to determine if the timepoint of exercise delivery has differing effects on physical and psychological benefits.

3562 Board #250 June 1 9:30 AM - 11:00 AM
Changes of Total and Tumor Specific Cell Free Dna During an Exhaustive Cycling Exercise Test

Tobias Ehlert, Suzan Botzenhardt, Perikles Simon. Johannes Gutenberg University, Mainz, Germany.
 Email: ehlertt@uni-mainz.de
 (No relevant relationships reported)

PURPOSE: Circulating, cell free DNA (cfDNA) is known to directly accumulate in a load-dependent fashion in various aerobic and anaerobic exercise sessions within minutes. Furthermore, increases of cfDNA at baseline have been reported for different patient groups with cancer to depend on malignancy and tumor progression. Typically, such analysis did not differentiate between cfDNA and circulating tumor derived levels of DNA (ctDNA). Here we investigated for the first time, whether exercise to voluntary exhaustion induces increases in cfDNA and ctDNA in patients with advanced stage cancer.

METHODS: In a pilot study, individuals with solid tumors of diverse entities and an age matched control group (n = 5) were subjected to a step-wise incremental cycling spiroergometry until exhaustion. Blood samples were taken before, directly after, and 90 minutes after the end of the test. Total cfDNA was quantified directly from the blood plasma using a qPCR targeting repetitive Line-1 elements and ctDNA was measured following silica-based total DNA purification and enrichment from plasma and subsequent specific quantification using a nested qPCR assay targeting the seven most frequent oncogenic KRAS sequences in comparison to wild-type sequence. Additionally, DNase activity reduction was measured with a commercial ELISA kit.

RESULTS: We quantified total cfDNA in all blood samples and detected and quantified ctDNA concentrations in all three samples of one cancer patient with metastatic colon cancer. Total cfDNA concentrations increased 1.7-fold (95% CI 1.28-2.22-fold; p<0.01) in all tumor patients during exercise, but to a significantly lesser extent (p=0.003) than in the healthy control group (3.7-fold; CI 2.23-6.15-fold, p<0.01). The decrease of cfDNA concentrations during the recovery period was significantly lower in tumor patients than in the healthy control (1.8-fold vs 5.5-fold decrease, p=0.001), independent of the DNase activity. Tumor DNA increased only slightly, causing a relative decrease in the ctDNA during exercise.

CONCLUSIONS: cfDNA kinetics seem to be less dynamic in tumor patients, especially the depletion of cfDNA from the plasma seems to be impaired. This effect does not seem to be a result of circulating DNA originating from the Tumor.

3563 Board #251 June 1 9:30 AM - 11:00 AM

Cardiac Rehabilitation Improves Fitness In Patients With Subclinical Markers Of Cardiotoxicity While Receiving Chemotherapy

Dennis J. Kerrigan, FACSM, Madhulata Reddy, Eleanor Walker, Bernard Cook, Randa Loufif, James McCord, Jodi Baxter, Steven J. Keteyian, FACSM. *Henry Ford Heart and Vascular Institute, Detroit, MI.*

Email: dkerrig1@hfhs.org

(No relevant relationships reported)

Cardiotoxicity is the leading non-cancer related cause of morbidity and mortality in cancer survivors. Cardiac rehabilitation (CR) improves function and reduces morbidity and mortality in patients with heart failure, but little is known about its ability to ameliorate or attenuate the known cardiotoxic effects of chemotherapy agents. **PURPOSE:** Determine if participation in CR improves fitness and quality of life (QOL) in patients undergoing treatment with either Doxorubicin or Trastuzumab who exhibit markers of subclinical cardiotoxicity. **METHODS:** 20 female patients with breast cancer and evidence of subclinical cardiotoxicity (i.e. >10% decrease in global longitudinal strain (GLS) or a cardiac troponin > 20 ng·L⁻¹) were randomized to 10 weeks of CR or usual care (UC). Exercise training was performed at a cardiac rehabilitation facility and included 2-3 days per week of interval training on a treadmill or cycle at 70-90% of heart rate reserve for 40 minutes. **RESULTS:** Cardiorespiratory fitness, as measured by peak oxygen uptake (VO₂), significantly improved with CR and decreased in the UC group (between group change, 0.009; Table). No changes were observed between or within groups with respect to QOL or high sensitivity troponin. GLS, improved overtime in both groups, but no differences were observed between groups. **CONCLUSIONS:** This pilot study suggests the use of CR may be a viable option to attenuate the reduction in fitness that occurs in patients undergoing cardiotoxic chemotherapy. While trends were observed for improvements in both predictors of cardiotoxicity (GLS and troponin) with CR, these changes were not significant when compared to UC. The long-term effects of exercise on these predictors and left ventricular function warrants further investigation.

	Exercise Baseline	Exercise post test	Control baseline	Control post test	P value
Peak VO ₂ (mL* kg ⁻¹ * min ⁻¹)	17.5 ± 4.8	19.2 ± 5.9*	16.7 ± 1.5	15.7 ± 1.4	0.009
High sensitivity troponin (ng*L ⁻¹)	24.9 ± 43.8	13.9 ± 14.9	15.6 ± 25.3	27.1 ± 60.8	0.211
FACT-G score	82.6 ± 11.6	86.2 ± 14.4	72.4 ± 11.7	79.6 ± 13.6	0.556
Relative global longitudinal strain (%)	-14.7 ± 13.7	3.3 ± 9.0*	-20.7 ± 6.0	12.3 ± 10.7*	0.091
Myoglobin (ng*mL ⁻¹)	17.9 ± 5.7	21.5 ± 5.7	21.9 ± 11.4	31.2 ± 14.1*	0.134

3564 Board #252 June 1 9:30 AM - 11:00 AM

Exercise Prescription Based on a Six Minute Walk Test in Childhood Acute Lymphoblastic Leukemia Survivors

Gabrielle E. Duhamel¹, Maxime Caru¹, Valérie Lemay¹, Simon Drouin², Nathalie Alos², Laurence Bertout², Maja Krajcinovic², Caroline Laverdière², Marie-Josée Raboisson², Daniel Sinnett², Gregoir Andelfinger², Daniel Curnier¹. ¹University of Montreal, Montreal, QC, Canada. ²Sainte-Justine University Hospital Research Center, Montreal, QC, Canada.

Email: gabrielle.duhamel@gmail.com

(No relevant relationships reported)

PURPOSE: Advance in cancer treatment induced drastic improvements in survival rate of Acute Lymphoblastic Leukemia (ALL) for pediatric patients. These medical advancements came at the cost of cardiac dysfunction. Regular physical activity (PA) has been known to have a preventive effect on these health issues. Previous studies have shown that survivors are less active than their peers and below the recommended PA guidelines. The aim of this study is to evaluate the intensity measured from the Six Minute Walk Test (6MWT) comparatively to maximal exercise test and verified if it is compatible with standard recommendations.

METHODS: We tested 177 ALL survivors. We used a 6MWT and a cardiopulmonary exercise test (VO_{2max}). Classification of risk level factors was based on treatment dosage, age at diagnosis, sex, prognostic risk group, time from the end of the treatment (Standard Risk (SR) and High Risk (HR)). Participants were divided in two groups according to their median cardiorespiratory fitness level (<84.3% vs ≥84.3)

RESULTS: Mean survivors age was 22.27±6.30. The survivors included had 44.6% SR and 55.4% HR factors. The mean VO_{2max} measured was significantly lower than the one predicted; 85.8%±16.5. The heart rate measured at the end of the walk represents a mean of 75.8% of the maximal predicted. The mean intensity measured at the end of the walk test was 60.4%±17.9 of the VO_{2max}. There is no significant difference between low and high cardiorespiratory fitness level of relative exercise intensity during the 6MWT (p=0.609). We observe a trending difference in relative exercise intensity during the 6MWT depending on risk factors (SR=63.3%±17.0 vs HR=58.1%±18.4; p=0.051).

CONCLUSIONS: Although the physical cardiorespiratory fitness of survivors is lower, our results demonstrate that with a self-pace exercise (i.e. 6MWT) participants reached similar level as those of a healthy population. Their physical fitness level does not impact the relative intensity levels measured during the 6MWT. Criteria link to the disease (ALL risk prognostic: SR and HR) needs to be considered while prescribing PA to this population. Survivors have greater chances of overcoming their disease than in past history, but specific and increased knowledge about physical activity is needed to prevent late-effects related to the treatments.

3565 Board #253 June 1 9:30 AM - 11:00 AM

Comparison of Body Composition Quantification Methods in Prostate Cancer Patients Undergoing Androgen Deprivation Therapy

Zachary L. Chaplow¹, Brian C. Focht, FACSM¹, Alexander R. Lucas², Elizabeth Grainger¹, Christina Simpson¹, Ciaran M. Fairman³, Jennifer M. Thomas-Ahner¹, Jessica Bowman¹, Victoria R. DeScenza¹, Kathryn Dispennette¹, Marcy Haynam¹, Steven K. Clinton¹. ¹The Ohio State University, Columbus, OH. ²Virginia Commonwealth University, Richmond, VA. ³Edith Cowan University, Perth, Australia.

(No relevant relationships reported)

Androgen deprivation therapy (ADT) results in adverse effects on body composition (BC) and places prostate cancer (PCa) patients at increased risk for sarcopenic obesity. Accurate BC assessment across the treatment continuum is an important aspect of integrating successful supportive care strategies. Dual-energy x-ray absorptiometry (DEXA) and air displacement plethysmography (ADP) are valid methods and have exhibited excellent reliability in various populations. Evaluation of the relationship between methods when used to detect BC changes in PCa patients across an active treatment timeline would inform future trials of their respective clinical relevance.

PURPOSE: The purpose of the single-blind, randomized controlled Individualized Diet and Exercise Adherence-Pilot (IDEA-P) trial is to evaluate the preliminary efficacy of an exercise and dietary intervention, implementing a group-mediated cognitive behavioral approach, relative to standard of care treatment among PCa patients undergoing ADT. In the current study, we evaluated the reliability and absolute agreement of estimates of percent body fat (%BF), fat mass (FM) and fat-free mass (FFM) between DEXA and ADP in PCa patients to establish efficacy for detecting change in BC during treatment. **METHODS:** Change in BC estimates (baseline to 3-month) from a total of 30 PCa patients (M age = 66) on ADT were analyzed by DEXA and ADP. Degree of interrater reliability between methods was evaluated using mean-rating (k = 2), absolute-agreement, 2-way mixed-effects model intraclass correlation coefficients (ICC) and 95% confidence intervals. Potential bias between DEXA and ADP was examined using Bland-Altman plot analysis. **RESULTS:** A high degree of reliability and agreement was found for measurements of %BF and FM change between methods with average measure ICC = 0.865 (95% CI = 0.719, 0.936; p < .001) and 0.904 (95% CI = 0.800, 0.954; p < .001), respectively. Bland-Altman plots of change in %BF, FM and FFM revealed no evidence for proportional bias between DEXA and ADP. **CONCLUSIONS:** Findings from this study suggest DEXA and ADP measure change in BC with similar sensitivity across time. These results support the clinical application of DEXA and ADP as valid and reliable methods of BC quantification for PCa patients undergoing ADT. Supported by NIH/NCI R03 CA16296901

3566 Board #254 June 1 9:30 AM - 11:00 AM

Delivering Exercise Medicine To Pancreatic Cancer Patients: Is It Feasible, Safe And Efficacious?

Nicolas H. Hart¹, Dennis R. Taaffe, FACSM¹, Robert U. Newton¹, Nigel A. Spry², Daniel A. Galvão, FACSM¹. ¹Edith Cowan University, Perth, Western Australia, Australia. ²Genesis Care, Perth, Western Australia, Australia. (Sponsor: Dennis Taaffe, FACSM)

Email: n.hart@ecu.edu.au

(No relevant relationships reported)

Pancreatic cancer is an aggressive adenocarcinoma affecting men and women, with very poor patient prognoses. Alarmingly, the 5-year survival rate is only 8.7%, despite the provision of intensive treatment regimens involving surgery, chemotherapy, radiotherapy or combination therapy, all of which significantly impact function and

quality of life. Exercise has been shown to be feasible, safe and effective in other cancer populations to mitigate treatment-related side-effects, improve quality of life and minimise dose limitation. Exercise may therefore have clinical utility within pancreatic cancer.

Purpose: To establish the safety and feasibility of a supervised exercise program for patients with histologically confirmed adenocarcinoma of the pancreas.

Methods: This non-blinded, single cohort feasibility study provided patients with a 3-month supervised exercise program consisting of resistance and aerobic exercise two days per week. Upper and lower-body muscle strength, physical function (6MWT, 400m Walk Test), and body composition (DEXA) were obtained at baseline, 12 and 24 weeks.

Results: Thirty nine patients (M=23, F=16) were referred with approximately 56% of referrals leading to enrolments (n=22; M=11, F=11). Patients who declined to participate reported feeling too unwell (41%), unable to travel easily (23%), not interested (17%), lost to follow-up (17%), and in one case, the patient deceased during the screening period (2%). Twenty two patients aged 60.9 ± 12.8 years attended baseline testing and commenced exercise, however, a 50% withdrawal rate was observed during the intervention consisting of 8 females (73%) and 3 males (27%). Increased appendicular lean mass at baseline was significantly associated with patient completion, using gender and age as covariates ($F = 4.609$; $p = 0.046$). For those who exercised, improvements ($p < 0.05$) were observed at 12 weeks and maintained at 24 weeks for 6MWT, 400m Walk Test, 1RM Seated Row and 1RM Leg Press. Diastolic BP was also significantly reduced following training ($p = 0.012$).

Conclusion: Exercise programs are safe for pancreatic cancer patients. Appendicular skeletal muscle (ASM) appears critical to facilitate program completion. Focusing on increasing ASM could be a priority for this patient population. RCT's are required to confirm these results.

G-43 Free Communication/Poster - Clinical Exercise Physiology - Other

Saturday, June 1, 2019, 7:30 AM - 11:00 AM
Room: CC-Hall WA2

3567 Board #255 June 1 9:30 AM - 11:00 AM

The Intersection Of Cognitive Performance, Physical Function, Aging, And Multiple Sclerosis: A Cross-sectional Comparative Study

Rachel E. Bollaert¹, Brian M. Sandroff², Elizabeth Stine-Morrow³, Bradley P. Sutton³, Robert W. Motl². ¹Marquette University, Milwaukee, WI. ²University of Alabama at Birmingham, Birmingham, AL. ³University of Illinois, Urbana, IL.

Email: rachel.bollaert@marquette.edu

(No relevant relationships reported)

PURPOSE: Older adults with MS have worse physical and cognitive function than older adults without MS and young and middle-aged adults with MS. To date, there is no evidence regarding the associations, or coupling, of cognitive and physical function outcomes in older adults with MS. The purpose of this study was to examine the associations between physical (i.e., walking speed and endurance and functional mobility) and cognitive (i.e., information processing speed and verbal memory) functions in older adults with multiple sclerosis (MS) and healthy controls.

METHODS: 40 older adults with MS and 40 demographically-matched controls undertook measures of physical and cognitive function. Bivariate linear relationships were examined with Pearson correlations in the overall sample and subsamples of older adults with MS and healthy controls. Linear regression analyses were further used to examine the independent associations between demographic characteristics and physical and cognitive function variables in the subsamples.

RESULTS: Cognitive function (i.e., information processing speed) was significantly correlated with all physical function variables in the overall sample, and these correlations were driven by the subsample of older adults with MS. The linear regression analyses further indicated that information processing speed and years of education consistently explained variance in all physical function variables, beyond the influence of demographic variables, in older adults with MS.

CONCLUSIONS: Information processing speed and physical function are strongly correlated in older adults with MS. Future research should examine underlying neurobehavioral mechanisms associated with cognitive and physical function and behavioral strategies for jointly improving these functions in older adults with MS.

3568 Board #256 June 1 9:30 AM - 11:00 AM

Influence of Acute Aerobic Exercise on 24-hour Ambulatory Central Blood Pressure

Malvina Shoukri, Thomas Burke, Brandon Kistler, Bradley Fleenor, Matthew Harber, FACSM. Ball State University, Muncie, IN. (Sponsor: Matthew P. Harber, FACSM)

(No relevant relationships reported)

Ambulatory central blood pressure (cABP) assessed for 24-hours is a relatively new measurement that may be predictor of cardiovascular disease (CVD). Acute bouts of exercise lower peripheral blood pressure; however, it is currently unknown if an acute bout of vigorous exercise reduces 24-hour cABP. **PURPOSE:** To examine the response of cABP over 24 hours after an acute bout of aerobic exercise. **Methods:** Apparently healthy adults (N=10; 6 males; age 25.9 ± 1.8 years; body mass index 25.4 ± 0.6 kg/m²; VO_{2max} 46.1 ± 2.7 ml/kg/min) completed two trials in a randomized order. Trials consisted of a progressive maximal treadmill exercise test to assess VO_{2max} or a non-exercise control. During each trial, participants wore an ambulatory BP (ABP) monitor to record brachial and central BP variables over 24 hours. Hemodynamic variables between trials were analyzed as mean for 24 hours and by time of day; Daytime (0800-2200 hours), and Nighttime (2200- 0800 hours). Dependent t-test were used to compare 24-hour averages between control and exercise. A 2-way ANOVA with repeated measures was performed to examine time of day differences between trials. **Results:** Over the course of 24 hours, average brachial systolic BP (bSBP) (119.6 ± 2.2 vs. 122.0 ± 2.5 mmHg) central systolic BP (cSBP) (108.1 ± 2.2 vs. 111.2 ± 2.4 mmHg), and mean arterial pressure (MAP) (86.9 ± 1.5 vs. 89.4 ± 1.9 mmHg) were lower ($p < 0.05$) after exercise compared to control. A main effect for time ($p < 0.05$) indicated that bSBP, bDBP, brachial pulse pressure, MAP, cSBP, and cDBP, were lower during nighttime compared to day time, independent of exercise. **Conclusion:** A single, vigorous bout of aerobic exercise lowers ambulatory central hemodynamics for at least 24 hours. These novel findings provide insight into the regulatory effects of exercise on blood pressure.

3569 Board #257 June 1 9:30 AM - 11:00 AM

Leucocyte Telomere Length, Inflammation and Oxidative Stress in Master Athletes: The Interplay

Herbert G. Simões, Samuel S. Aguiar, Lysleine A. Deus, Caio V. Souza, Rodrigo VP Neves, Lucas P. Barbosa, Patrick A. Santos, Érica C c c Rosa, Rosângela V. Andrade, Thiago S. Rosa. Catholic University Of Brasilia, Brasília, Brazil.

Email: hgsimoes@gmail.com

(No relevant relationships reported)

Leucocyte telomere length, chronic inflammation and oxidative stress play a self-feeding loop that may be cause and consequence of several age-related diseases. However, the interplay of markers of biological aging, oxidative stress and inflammation were not investigated in master athletes who follow an anti-aging lifestyle. **PURPOSE:** To analyze the leucocyte telomere length (LTL), inflammatory markers and redox profile of master athletes and compare to young and age-matched untrained controls. **METHODS:** Subjects (n=45) were 23 middle-aged master athletes (MA, 51.95 ± 8.87 yrs.), 11 young controls (YC, 21.81 ± 3.97 yrs.) and 11 middle-aged untrained controls (MU, 45.40 ± 10.33 yrs.). Relative LTL was determined with qPCR analyses (T/S). Markers of inflammatory, oxidative and anti-oxidant status were assessed in plasma using commercial kits. A one-way ANOVA and Pearson's moment correlation enabled for comparisons and correlations. **RESULTS:** The LTL (T/S) of YC (1.26 ± 1.01) differ significantly from MU (0.48 ± 0.52) ($p < 0.05$) but did not differ from MA (0.99 ± 0.67). MA and YC demonstrated a higher CAT, SOD activity, CAT/TBARS and SOD/TBARS ratios than MU, and the % body fat of MA was also lower than MU ($p < 0.05$). The levels of inflammatory cytokines TNF, soluble TNF receptor (sTNF), IL6 and sIL6 were lower in the YC in comparison to MU and MA. Moreover, MA presented lower levels of sTNF, IL6 and sIL6 and higher IL10 and IL10/IL6 ratio compared to MU. Negative associations were found between body fat and antioxidant enzymes (CAT: $r = -0.448$ and SOD: $r = -0.413$) and IL10 ($r = -0.585$) and positively correlated with pro-inflammatory cytokines (TNF: $r = 0.278$; sTNF: $r = 0.709$; IL6: $r = 0.720$; sIL6: $r = 0.430$) ($p < 0.05$). Further, CAT and SOD were negatively associated with inflammatory parameters (sTNF, IL6 and sIL6), while the LTL was negatively associated with inflammatory markers and positively associated with anti-inflammatory variables ($p < 0.05$). **CONCLUSIONS:** Middle-aged master athletes presented lower markers of oxidative stress and inflammation, with improved antioxidant defense and longer LTL. Once inflammatory and oxidative status were negatively associated to adiposity and LTL, the biological aging of MA is attenuated possibly due to a low adiposity, a better redox balance and reduced inflammatory markers.

3570 Board #258 June 1 9:30 AM - 11:00 AM
Short-term Detraining Effects On Cardiorespiratory Fitness And Body Composition In Trained Older Adults

Inês R. Correia, Sofia L. Freitas, Júlia M. Lopes, João P. Magalhães, Diana A. Santos, Luís B. Sardinha. *Faculdade de Motricidade Humana, Universidade de Lisboa, Lisbon, Portugal.*

(No relevant relationships reported)

An interruption in the training routine may have deleterious effects on cardiorespiratory fitness (CRF) and body composition. Particularly the decline that can occur in the phase-angle (PhA), derived from the tangent value of the ratio of reactance versus electric resistance from bio-impedance analysis (BIA), may be of concern, as it is a predictive marker for cellular integrity, sarcopenia, muscular function, and frailty in older adults.

PURPOSE: To determine the effects of 2-week detraining period on CRF and body composition (including PhA) in older trained adults.

METHODS: A total of 11 older adults (4 females) aged ≥ 65 years were assessed at baseline and follow-up for CRF and body composition in the early morning in fasting condition. Fat-free mass (%FFM), fat mass (%FM), android fat mass (%AFM), and gynoid fat mass (%GFM) were estimated with dual-energy X-ray absorptiometry (DXA) and PhA was assessed with BIA. CRF was evaluated with a breath-by-breath gas analyser system (Quark RMR, Cosmed) with a modified Bruce protocol. During the 15-day detraining period, participants were instructed to refrain from structured and supervised exercise sessions. One - way repeated measures ANOVA were performed and all analyses were adjusted for sex.

RESULTS: The interruption of structured and supervised exercise sessions for 15-days resulted in declines in PhA (5.5%; p-value=0.037). No differences were found for weight (p=0.662), body mass index (p=0.631), %FM (p=0.953), %FFM (p=0.455), %AFM (p=0.138), %GFM (p=0.300), and CRF (p=0.618).

CONCLUSIONS: A short-term detraining period of 2-weeks resulted in detrimental changes in PhA, suggesting a decline in the integrity of body cells, but no changes in the remaining body composition outcomes or CRF. These results highlight the importance of maintaining structured exercise sessions in older adults in order to preserve body cell integrity.

3571 Board #259 June 1 9:30 AM - 11:00 AM
The Effects of Aerobic Exercise on Heart Rate Variability in People Living with HIV

Norberto Quiles¹, Alex Evangelista², Alexis Ortiz, FACSM³.
¹Queens College, Flushing, NY. ²Borough of Manhattan Community College, New York, NY. ³UT Health San Antonio, San Antonio, TX. (Sponsor: Alexis Or, FACSM)
 Email: bodyworks.pt@gmail.com

(No relevant relationships reported)

People living with HIV (PLWH) often present with lower heart rate variability (HRV) than healthy counterparts. This is problematic because lower HRV has been associated with cardiovascular morbidity and mortality. Aerobic exercise has been shown to improve HRV in the general population and in those with chronic diseases but its effectiveness in PLWH is unknown. **PURPOSE:** To evaluate the effects of 8-week aerobic exercise in PLWH on anti-retroviral therapy. **METHODS:** Twenty-six participants were randomly assigned to either a control group (no exercise) or an aerobic exercise group. Twenty-three participants completed the study. Resting HRV was measured for 5 minutes through an electrocardiogram. Measures included high frequency power (HF), low frequency/high frequency ratio (LF/HF ratio), low frequency power (LF), very low frequency power (VLF), standard deviation of normal-to-normal (NN) intervals (SDNN), and the square root of the mean squared differences of successive intervals (RMSSD). Estimated $\dot{V}O_{2peak}$ was assessed through a 6-minute walk test (6-MWT) on a treadmill. Body fat percentage (BF%) was measured through air displacement plethysmography. The training group performed aerobic exercise 3 times per week (2 lab-based sessions and 1 home-based session per week) at 65%-75% of the heart rate max. Exercise duration was 30 minutes per session during the 1st week increasing to 45 minutes for weeks 2 to 8.

RESULTS: Participants were 48.4 years old with a CD4 T-cell count of 681.9 cells/ μ L. There were no significant differences between groups in any of the HRV indices. However, SDNN (a marker of overall autonomic function) increased significantly in the exercise group (Pre: 46.97 ± 32.70 ms vs Post: 59.49 ± 37.20 ms, p=0.036). There was a moderate correlation between SDNN and $\dot{V}O_{2peak}$ ($r = .53$; p=0.01). There were no significant differences in $\dot{V}O_{2peak}$ or BF% between groups. **CONCLUSIONS:** While differences in HRV were not observed between groups, our data suggests that overall autonomic function can improve with aerobic exercise and these changes are associated with higher levels of $\dot{V}O_{2peak}$. These results advocate the importance of improvements in HRV as greater levels of HRV are associated to lower risk of CVD and mortality.

3572 Board #260 June 1 9:30 AM - 11:00 AM
Associations Between Cardiorespiratory Fitness and Brain-derived Neurotrophic Factor In Serum and Platelets-poor Plasma

Anne K. Gejl¹, Lars Bo Andersen², Jakob Tarp³, Natascha Holbæk Pedersen⁴, Niels Wedderkopp¹, Lone Pejts⁵, Anna Bugge¹. ¹University College Copenhagen, Copenhagen, Denmark. ²Western Norway University of Applied Sciences, Sogndal, Norway. ³Norwegian School of Sport Sciences, Oslo, Norway. ⁴University of Southern Denmark, Odense, Denmark. ⁵University Hospital Copenhagen, Copenhagen, Denmark.
 Email: akge@kp.dk

(No relevant relationships reported)

Emerging evidence suggest that brain-derived neurotrophic factor (BDNF) could mediate some of the beneficial effects of physical activity observed in neurodegenerative and metabolic disease. Observational studies report that cardiorespiratory fitness (CRF) is associated with circulating BDNF levels, but the direction of the association is inconsistent among studies. Accordingly, it appears that CRF is mostly positively associated with BDNF in plasma and negatively associated with BDNF in serum. **PURPOSE:** To investigate the associations between CRF and BDNF measured in serum and platelet-poor plasma, respectively.

METHODS: This cross-sectional study was conducted using data from a subgroup of 81 participants (mean age: 14.3 (1.4), 51%males) included in the 2015 follow-up of the population-based CHAMPS Study-DK. Blood samples were drawn in resting horizontal position from the antecubital vein after an overnight fast (≥ 8 hours). BDNF was analyzed in serum and platelets-poor plasma. CRF was assessed using a field-based running test (the Andersen test). Linear regressions adjusted for potential known confounders (age, sex, Tanner stage and BMI) were conducted in the total sample and stratified by sex.

RESULTS: No significant associations were found between CRF and BDNF measured in serum (std. $\beta = -.02$, CI: $-.21$; $.18$) or platelet-poor plasma (std. $\beta = -.09$, CI: $-.28$; $.09$). Likewise, when stratified by sex, no associations were observed between CRF and BDNF in males (serum, std. $\beta = -.17$, CI: $-.42$; $.08$ or plasma std. $\beta = -.10$, CI: $-.35$; $.15$) or females (serum, std. $\beta = .18$, CI: $-.21$; $.57$ or plasma, std. $\beta = -.10$, CI: $-.40$; $.19$).

CONCLUSIONS: Opposite to some studies in the field, results from this study suggest no association between CRF and BDNF measured in either serum or platelet-poor plasma or in males or females. However, the measured level of BDNF may be highly modified by several unmeasured factors such as physical activity prior to blood drawing or pre-analytical handling of the blood samples (e.g. storage time and centrifugation strategy), making it problematic to use BDNF concentrations obtained from a single blood sample as a measure of general circulating levels of BDNF. Funding: The study was funded by the Tryg Foundation (104982).

3573 Board #261 June 1 9:30 AM - 11:00 AM
Effect of Resistance Training Session on Intraocular Pressure in Patients with Primary Open Angle Glaucoma

Luis Felipe Milano Teixeira¹, Sidney Diyoo Tamura², Henrique Malaquias Possebon³, Marcelo Conte⁴. ¹Universidade de Sorocaba, Sorocaba, Brazil. ²NEPECE - HOSBOS, Sorocaba, Brazil. ³HOSBOS, Sorocaba, Brazil. ⁴Escola Superior de Educação Física de Jundiá, Jundiá, Brazil.
 Email: teixeira.luisfelipe@gmail.com

(No relevant relationships reported)

Chronically elevated intraocular pressure (IOP) scores are considered as main risk factor for the development of primary open angle glaucoma (POAG). It is known that aerobic and resistance training (RT) can promote reductions of IOP in individuals without diagnosis of the disease. However, there is still a need to understand the IOP behavior during RT in individuals with POAG. **PURPOSE:** To evaluate the IOP behavior in individuals with POAG during and after a RT session (RTS). **METHODS:** Six sedentary woman (64 \pm 8,2 y), with POAG, were submitted to RTS. After two familiarization sessions and seven days prior to RTS, participants were submitted to a maximum strength predictive test (1RM) in each of the exercises that comprised RTS (leg-press; chest press machine; leg curl machine; rowing machine; calf machine; abduction machine; adduction machine; seated crunch machine and side lateral raise). Then, they performed the RTS composed of the nine exercises tested, 3 sets until the concentric muscle failure with 60%1RM and rest interval of 60seg among sets. IPO and lactacidemia (LAC) were measured at the pre-RTS (M1), after the fourth exercise (M2), immediately after the last exercise (M3) and after 5min of the RTS end (M4). The LAC was measured by blood lactate analyzer, while the IOP was measured by an ophthalmologist by Perkins tonometer. One-way ANOVA with Bonferroni's post-hoc was utilized to compare differences among the RTS moments; pearson's correlation test was used to verify possible correlations between IOP and LAC and; Effect Size was calculated by using Cohen d. **RESULTS:** There was a significant reduction in IOP at all moments evaluated in relation to M1 (M1:13 \pm 2.1 mmHg; M2: 8.33 \pm 2.6

mmHg, ES=1.97; M3: 6.83±1.7 mmHg, ES=3.22; M4: 7.33±3.8 mmHg, ES=1.8, p <0.01). LAC showed a significant increase in all moments evaluated in relation to M1 (M1: 2.60±1.3mmol/dL; M2: 10.88±5.8mmol/dL, ES=1.9; M3: 11.25±5.1mmol/dL, ES=2.3; M4:8.45±4.3 mmol/dL, ES=1.8, p <0.01). Significant negative correlation between LAC and IOP was observed ($r=-0.79$, $p<0.05$). **CONCLUSION:** A single RTS was able to reduce IOP in POAG patients. RT protocols that promote significant increases in lactacidemia are able to promote important reductions in IOP. RT should be understood as a relevant non-pharmacological resource in the control of POAG.

3574 Board #262 June 1 9:30 AM - 11:00 AM
Hippocampal Growth Factor and Myokine Cathepsin B Response to Aerobic and Resistance Training in 3xTg-AD Mice

Gabriel Pena. *Florida Atlantic University, Boca Raton, FL.*
 (Sponsor: Michael Whitehurst, FACSM)
 (No relevant relationships reported)

Hippocampal Growth Factor and Myokine Cathepsin B Response to Aerobic and Resistance Training in 3xTg-AD Mice

Gabriel S. Pena, Hector G. Paez, Trevor K. Johnson, Jessica L. Halle, Joseph P. Carzoli, Nishant P. Visavadiya, Michael C. Zourdos, Michael A. Whitehurst FACSM, Andy V. Khamoui
 Florida Atlantic University, Boca Raton, FL
 Alzheimer's disease (AD) is a progressive neurodegenerative disease and the most prevalent form of dementia among the elderly today. Aerobic training (AT) has been shown to support brain health in AD through mechanisms involving neurotrophins including BDNF and IGF-1. Unlike AT, the role of resistance training (RT) in AD is not well-established, yet RT may modulate brain health through skeletal muscle-derived myokines. **PURPOSE:** This study examined the effects of AT and RT on hippocampal BDNF and IGF-1 signaling, β -amyloid expression, and myokine cathepsin B in the triple transgenic (3xTg-AD) model of AD. **METHODS:** 3xTg-AD mice were assigned to sedentary (Tg), aerobic-trained (Tg+AT, 9 wks treadmill running), or resistance-trained (Tg+RT, 9 wks weighted ladder climbing) (n=10/group). RotaRod latency and grip strength were assessed pre- and post-training. Hippocampus and skeletal muscle were collected after training and analyzed by high-resolution respirometry, ELISA, and immunoblotting. **RESULTS:** Tg+RT showed greater grip strength than Tg and Tg+AT at post-training (+13% vs. both groups, $p<0.01$). Only Tg+AT improved RotaRod peak latency after training (+88%, $p<0.01$). Hippocampal IGF-1 concentration was ~15% greater in Tg+AT and Tg+RT compared to Tg ($p<0.05$), however, downstream signals p-IGF-1R, p-Akt, p-MAPK, and p-GSK3 β were not altered. Myokine cathepsin B, hippocampal p-CREB and BDNF, and hippocampal mitochondrial respiration were not affected by AT or RT. β -amyloid was ~30% lower in Tg+RT compared to Tg ($p<0.05$). **CONCLUSION:** This data suggests that resistance training may ameliorate β -amyloid load in the hippocampus concurrent with increased concentrations of IGF-1. Both types of training offered distinct benefits, either by improvement of whole body physical function, or by modifying signals in the hippocampus. Therefore, inclusion of both training modalities may address central defects, as well as peripheral comorbidities in AD.

3575 Board #263 June 1 9:30 AM - 11:00 AM
Comparison of Work-induced Fatigue Responses Between One Versus Three 12-hour Shifts in Nurses

Brennan J. Thompson. *Utah State University, Logan, UT.*
 Email: brennan.thompson@usu.edu
 (No relevant relationships reported)

Fatigue-related impairments in the nursing workforce contribute to a multitude of health, safety, and economic consequences at the individual, organizational and societal levels. Long and compressed work schedules are commonly worked in the healthcare industry, but more research is needed to understand the cumulative effects of multiple work shifts on performance-based fatigue responses in nurses and aides. **PURPOSE:** To examine the effects of a single nursing work shift compared to three successive (one every 24-hours) 12-hour shifts on performance-based fatigue responses in nurses and aides. **METHODS:** Twenty-six fulltime hospital working nurses and aides (age = 36.1 ± 13.3 years) reported to the lab for testing before, immediately after a single 12 hour shift, and after working three 12-hour shifts in a 72-hour period. Outcome measures included vigilance-based reaction time and muscle function assessments (lower and upper body maximal strength, rate of torque development and vertical jump performance). **RESULTS:** All performance variables except hand grip strength showed a significant ($P < 0.05$) decline following the three work shifts. The psychomotor vigilance reaction time variable significantly declined from the end of shift one to the end of the three shifts (8% more impaired following shift 3 versus shift 1), indicating an accumulation of fatigue with increasing number of shifts worked. Muscle function variables responded early in the shift cycle, showing a significant decline following shift one ($P < 0.05$ for all but hand grip) and remained reduced but did not further decline by the end of the third shift (performance reductions ranged from 6 – 18% from baseline to post shift three). **CONCLUSION:** This study used objective measures to substantiate that

fatigue impairments occur from working a single 12-hour shift and in several instances, increases further with increased number of successive work shifts. Nurse personnel and administrators should view work schedules involving multiple successive shifts with caution. Fatigue management strategies may reduce consequences from fatigue-related mishaps, and this study reports several variables – namely lower body strength and power and psychomotor vigilance reaction time – that appear to be sensitive for identifying and tracking fatigue in a full time working nurse population.

3576 Board #264 June 1 9:30 AM - 11:00 AM
The Effectiveness Of Simulation-based Learning In Preparing Exercise Physiology Students For Emerging Clinical Practice Domains

Nathan E. Reeves. *Griffith University, Griffith University, Australia.*
 Email: n.reeves@griffith.edu.au
 (No relevant relationships reported)

PURPOSE: Given the pivotal role exercise plays in the prevention and management of chronic diseases, developing practice-ready clinical exercise physiology (EP) students to program and prescribe exercise-based interventions across these conditions is critical. In emerging clinical domains, the lack of practicum opportunities makes it challenging to provide students with the vital opportunity to translate theory into practice. This study reports on the impact a simulation-based learning experience (SBLE) had on EP student's confidence and perception of knowledge in the clinical domain of palliative care. **METHODS:** 12 EP students completed a palliative care interprofessional SBLE alongside students from Dietetics (n=50), Pharmacy (n=44) and Social Work (n=7). The SBLE comprised modules on what is palliative care, effective communication for grief, and spiritual and cultural considerations in palliative care. Experienced and accredited practitioners across the range of health disciplines facilitated the SBLE which included pre-reading, briefing, simulation using simulated patients, and debriefing components. Interprofessional simulated patient interactions included initial consultations, education and treatment planning, and a multidisciplinary case conference. A post-simulation questionnaire explored the effectiveness of the SBLE in developing palliative care graduate capabilities. **RESULTS:** 100% of students ranked their confidence in caring for people with a life-limiting illness as moderate or higher (mean 7.6/10), while 91.7% of students ranked their knowledge and preparedness as moderate or higher (mean 7.5). 75% of students reported having one or no experience, in the past twelve months, caring for a person who has died due to a life-limiting illness in either a clinical placement, employment or personal capacity. Qualitative responses supported the quantitative data with students appreciating the opportunity of being exposed to the clinical domain in a safe and supportive environment that bridged the gap between theory and a real world setting. **CONCLUSIONS:** The positive impact on student confidence and perceived knowledge highlights the influence of SBLE in palliative care, suggesting a broader utility for this mode of learning in other emerging clinical domains for EP students.

3577 Board #265 June 1 9:30 AM - 11:00 AM
Relationship Between Changes in Gait Speed & Resistance Training

William Perez, Brian Phipps, Jeffrey Beans, Leslie Katzel, Odessa Addison. *Veterans Affairs Medical Center, Baltimore, MD.*
 (No relevant relationships reported)

Self-selected gait speed (SGS) is an important indicator of current health. Maximal gait speed (MGS) is an important functional outcome to assess how people can function in their environment. With insufficient MGS individuals may lack the ability to adapt to sudden changes or dangerous situations. Muscular strength is related to both self-selected and maximal gait speed, however there is little known about the relationship between changes in lower extremity strength training and changes in both SGS and MGS. **PURPOSE:** To examine the effect of lower body strength training on changes in SGS and MGS. **METHODS:** Eleven individuals (10 male, 72±8 years, BMI 36±7) with dysmobility, (SGS below 1.0 m/s), or use of an assistive device were recruited. SGS and MGS were measured at baseline and after a 12-week multimodal exercise intervention that included walking, balance, and lower extremity resistance training. Strength progressions, defined as the resistance used in the leg press during weekly exercise sessions, were recorded. After 12 weeks participants were categorized as either responders (>100% increase in leg press) or non-responders (<100% increase in leg press). The relationship between strength change, SGS, and MGS was examined with a Pearson product correlation. An independent t-test was used to compare speed changes in responders and non-responders. Significance was set at $p<0.05$. **RESULTS:** Changes in MGS (Pre = 1.10±0.21 m/s, Post = 1.14±0.28 m/s) were significantly positively correlated with leg press change (Pre = 166±51 psi, Post = 313±121 psi, $r = 0.81$, $p < 0.01$). There was no significant relationship between SGS change (Pre = 0.89±0.19 m/s, Post = 0.98±0.15 m/s) and leg press strength change. Responders (n= 5) improved MGS by 16.5% (Pre = 1.06±0.18 m/s, Post = 1.24±0.30 m/s, $p < 0.01$) while non-responders (n = 6) showed reduced MGS by 7.6% (Pre =

1.14±0.24 m/s, Post = 1.05±0.27 m/s). Responsiveness had no effect on the change in SGS. **CONCLUSIONS:** MGS improved in those who made the largest progress in lower extremity strength. Encouraging the use of an aggressively progressed strength program may help a geriatric population to greater improve a functional outcome such as MGS.

3578 Board #266 June 1 9:30 AM - 11:00 AM
Telephone Intervention Is An Effective Follow-up To Stabilize %body Fat and Markers Of Inflammation After Primary Intervention

Kyung-Shin Park¹, Brett S. Nickerson¹, Seongkwan Cho¹, Boung Jin Kang². ¹Texas A&M International University, Laredo, TX. ²Elizabeth City State University, Elizabeth City, NC.
 Email: kpark@tamui.edu
 (No relevant relationships reported)

Reductions in %body fat and markers of obesity-related disorders have been reported following obesity treatments; however, this short-term success is regressed after the termination of treatments. **PURPOSE:** The purpose of this study was to evaluate whether telephone follow-up intervention is effective in preventing long-term regression of %body fat and inflammation after primary intervention in obese children. **METHODS:** 56 obese children (aged 10-14yrs) completed this study (19 PITI: primary intervention and telephone follow-up intervention, 18 PI: primary intervention only, and 19 CON: no intervention). Anthropometric data and blood samples were obtained before (PRE), after 8 weeks of primary intervention (POST), and 10 month telephone follow-up intervention (1YEAR) to measure levels of %body fat, tumor necrosis factor-alpha (TNF- α), C-reactive protein (CRP), and adiponectin. **RESULTS:** 8 weeks of primary intervention in PITI and PI significantly reduced %body fat (PITI: 29.2±1.1%→25.8±1.3, Mean±SE, P=.003; PI: 28.9±1.0→26.1±1.4, P=.008), TNF- α (PITI: 4.18±.40 pg/mL→3.24±.62, P=.02; PI: 4.05±.38→3.19±.56, P=.016), and CRP (PITI: 2.95±.33 mg/L→2.31±.47, P=.035; PI: 2.87±.36→2.28±.49, P=.031) and elevated levels of adiponectin (PITI: 6.68±.69 μ g/mL→8.55±.85, P=.019; PI: 6.48±.60→8.18±.85, P=.024), while CON showed an increase in %body fat (29.3±1.0%→30.7±1.1, P=.028) with no differences in inflammatory cytokines. Results of 10 month follow-up measurement (1YEAR) were reverted back to PRE for the PI (1YEAR value and P value for PRE vs. 1YEAR; %body fat: 28.3±1.2, P=.89; TNF- α : 4.14±.51, P=.60; CRP: 2.66±.55, P=.75; adiponectin: 6.98±.79, P=.47) whereas those in PITI at 1YEAR remained statistically significant to PRE (1YEAR value and P value for PRE vs. 1YEAR; %body fat: 27.1±1.3, P=.016; TNF- α : 3.68±.52, P=.035; CRP: 2.48±.47, P=.043; adiponectin: 8.03±.80, P=.038). **CONCLUSIONS:** Results of this study confirm that levels of inflammation are correlated to changes in %body fat, indicating that fat loss is effective in preventing and managing obesity-associated disorders. It is suggested that a telephone intervention is an effective follow-up tool for stabilizing reductions in %body fat, and levels of inflammation obtained from an intensive primary intervention in obese children.

3579 Board #267 June 1 9:30 AM - 11:00 AM
Sports Injury Management Program in Pima Community College Offers Study Abroad Opportunities for International Students

Akira Kondo¹, Chiaki Ishioka¹, Nobuko Hongu, FACSM². ¹Pima Community College, Tucson, AZ. ²University of Arizona, Tucson, AZ. (Sponsor: Nobuko Hongu, FACSM)
 Email: akondo@pima.edu
 (No relevant relationships reported)

PURPOSE: Sports injury management program is a growing academic discipline. Pima Community College, Tucson, Arizona offers study abroad sports science program. The program attracts the students who are interested in pursuing athletic training, personal training, exercise sciences, and sports coaching as a career. **METHODS:** Pima Community College Sports Injury Management (SIM) program offers an athletic training student internship. Students interns are expected to fulfill requirements including taking classes at the college and professional development activities in the US. Qualified student applicants were evaluated on the quality of their athletic training experiences, academic performance, and professional attitudes. To be enrolled in the program, the students went through an application process such as writing a letter of interest, resume, and references, then had a face-to-face interview experiencing a formal job-hunting process with SIM staff. **RESULTS:** All selected applicant international students were from Japan (18 years and older). They were assigned to work with SIM staff who provide athletic training services to their 16 intercollegiate athletic teams. The interns took classes on SIM (i.e., learning principles and techniques of preventing, recognizing, treating and rehabilitating sports related injuries, recognition of common sports injury, gaining skills of taping/wrapping technique, and an event preparation and risk managements). They also independently continued their academic development in health, physical education, recreations, coaching, dance, or fitness. Some students completed their prerequisite classes to transfer to four-year college/university and/or to apply for an entry level of master's

degree program for athletic training. **CONCLUSION:** Pima Community College SIM interns were not only preparing to become an athletic trainer (e.g., completion of an accredited athletic trainer degree program, hands-on experiences, etc.), but they also gained cultural awareness and valuable life-changing experiences by receiving opportunities such as volunteer work in a local community.

G-43b Free Communication/Poster - Late-Breaking Abstracts

Saturday, June 1, 2019, 7:30 AM - 11:00 AM
 Room: CC-Hall WA2

3580 Board #268 June 1 9:30 AM - 11:00 AM
A Comparison of Attitude Toward Physical Education Class, Physical Activity Level, and Aerobic Fitness between Hong Kong and Shanghai Adolescents

HU Rui, HUI Stanley Sai-Chuen, FACSM. *The Chinese University of Hong Kong, Hong Kong, Hong Kong.*
 Email: hurui@link.cuhk.edu.hk
 (No relationships reported)

Studies revealed that participation in Physical Education (PE) classes could increase the chance to be more physically active and influence aerobic fitness among youth (Chen, 2014; Fairclough & Stratton, 2004). Meanwhile, it is noted that weekly amount of PE classes in Shanghai and Hong Kong is largely different (Shanghai: 5 times per week, 40 mins per session; Hong Kong: 80-120 mins per week). Due to the difference in PE class volume, we hypothesized that attitude toward PE class, physical activity (PA) level and aerobic fitness of adolescents may be different between these two cities. **PURPOSE:** to compare the attitude toward PE class, PA and fitness between adolescents in Hong Kong and Shanghai. **METHODS:** A total of 2,059 adolescents (12-15 yrs old) randomly recruited from middle-schools of Hong Kong and Shanghai completed questionnaire surveys on attitudes toward PE (like, okay, or dislike), self-reported weekly moderate to vigorous PA (MVPA) (IPAQ), and field test on aerobic fitness (15m PACER). **RESULTS:** Chi-square test showed Hong Kong adolescents "like" PE (54.8%) more than that of Shanghai counterparts (39.5%) ($p<0.001$), whereas Hong Kong adolescents "dislike" PE (5.3%) much less than the Shanghai adolescents (21.5%) ($p<0.001$). After adjusting for age and gender, ANCOVA revealed that MVPA of Hong Kong adolescents was considerably higher (369.8±10.8) than that of Shanghai counterparts (302.0±8.4) ($p<0.001$). There was no difference ($p>0.05$) in aerobic fitness between adolescents from the two cities. **CONCLUSIONS:** The present study demonstrated that Shanghai adolescents, though receiving much higher volume of PE classes than Hong Kong adolescents, do not have better attitudes toward PE class nor higher MVPA level than the Hong Kong counterparts. Other factors other than the PE volume, such as PE curriculum and contents, teaching styles or leaderships, may be more important to affect attitude toward PE, PA and fitness levels.

3581 Board #269 Jun. 1 9:30 AM - 11:00 AM
Effects Of A Loaded Roach March On Isometric Muscle Strength Measured With A Novel HHD Fixation System

Jessica Schindler¹, Jonathan Kaplan¹, Clifford Hancock¹, Rebecca Zifchock², Erika Hussey¹, John Ramsay¹. ¹Combat Capabilities Development Command - Soldier Center, Natick, MA. ²United States Military Academy, West Point, NY.
 (No relationships reported)

PURPOSE: Understanding the effect that field exercises have on soldier muscular strength is an area of interest for the US Army. Reliably quantifying muscle strength in this context has been limited by availability of portable assessment equipment. The widely used hand-held dynamometer (HHD) presents a challenge when assessing strong muscle groups of healthy soldiers accurately. We devised a portable, field-ready HHD fixation solution to assist researchers in the evaluation of lower body and core isometric maximal muscle contractions. Reliability of the fixation system (patent pending) was assessed prior to implementation at a large-scale data collection during a military field exercise. The purpose of the current investigation was to identify strength changes in select muscle groups prior to and immediately following a loaded road march.

METHODS: 39 soldiers (36M, 3F) performed 4 maximal isometric contraction types, including lumbar extension, lumbar flexion, hip flexion, and knee extension. 3 trials of each contraction type were recorded during a pre-mission baseline, and 2 trials were recorded immediately following a 6-mi road march executed with an average load of 50% body weight. Measurements were recorded using the system developed, which provided repeatable subject stabilization, muscle group isolation, and HHD fixation.

The maximum force recorded from each muscle group during a session was used for analysis. A paired sample t-test was conducted to compare pre and post road march strength measures.

RESULTS: No significant change in lumbar extension strength was identified between the pre and post conditions. Significant decreases in strength performance were observed in the hip flexion (8.3%; $p=.003$), knee extension (7.8%; $p=.032$), and lumbar flexion (9.9%; $p=.009$) measurements between the pre and post conditions.

CONCLUSION: While lumbar extension strength did not change following the road march, the decreases identified for hip flexion, knee extension, and lumbar flexion followed the hypothesized trend. This study provides novel insight into the effects of field activities on soldier muscle strength that were not quantifiable prior to the portable HDD fixation system, and presents a range of new opportunities to understand the impact of military exercises on strength.

3582 Board #270 Jun. 1 9:30 AM - 11:00 AM
Effects of High-Intensity Interval Training on Fitness during Initial Military Training

John R. Borman. *United States Military Academy, West Point, NY.*

Email: john.borman@westpoint.edu

(No relationships reported)

Effects of High-Intensity Interval Training on Fitness during Initial Military Training

Author Block John R. Borman¹, Brittany R. Hotaling², Kevin A. Bigelman¹, Dan A. Jaffe¹, Jesse L. Germain¹, Richard B. Westrick², Nicholas H. Gist¹. ¹*United States Military Academy, West Point, NY.* ²*United States Army Research Institute of Environmental Medicine, Natick, MA.* **ABSTRACT**

High-Intensity Interval Training (HIIT) may confer rapid aerobic and anaerobic physiological adaptations. While several studies have compared HIIT and Moderate-Intensity Continuous Training (MICT), none have compared the United States Army's doctrinal interval training work-to-rest ratios to examine its effects on aerobic capacity, anaerobic power and physical performance. We hypothesize that HIIT will improve aerobic and anaerobic fitness as well as MICT.

PURPOSE: To investigate the effects of a 9-week low volume HIIT intervention on selected laboratory and field-based assessments {maximal oxygen uptake (VO_{2max}); Running Anaerobic Sprint Test (RAST) performance} compared to MICT protocol in Initial Military Training Soldiers.

METHODS: 30 college-aged males at the United States Military Academy Preparatory School participated in an 11-week (1 week of pre-testing, 9 weeks of exercise training, 1 week of post-testing) research study examining the effects of HIIT on components of aerobic and anaerobic endurance, anaerobic power and performance time.

RESULTS: After training, HIIT experienced a 4.3% increase in peak power as measured by RAST performance. MICT had a statistically significant decrease in VO_{2max} . Both groups had a non-significant increase in average power.

CONCLUSIONS: Using the United States Army's interval training work-to-rest ratios, the HIIT protocol was more effective for improving peak power and maintaining both anaerobic and aerobic endurance when compared to MICT protocol. The MICT protocol enabled the maintenance of peak power but decreased overall aerobic endurance. **DISCLAIMER:** The views expressed in this abstract are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government. Supported by the U.S. Army Medical Research and Materiel Command.

3583 Board #271 Jun. 1 9:30 AM - 11:00 AM
Individual Muscle Hypertrophy and Strength Responses to Traditional Resistance Training vs Drop Set System

Cleiton Libardi¹, Vitor Angleri¹, Carlos Ugrinowitsch². ¹*Federal University of São Carlos (UFSCar), São Carlos, Brazil.*

²*University of São Paulo (USP), São Paulo, Brazil.*

Email: c.libardi@ufscar.br

(No relationships reported)

Abstract category: Fitness Assessment, Exercise Training, and Performance of Athletes and Healthy People - 102 Exercise Training Interventions in Healthy People
 Cleiton Augusto Libardi, Vitor Angleri, Carlos Ugrinowitsch. Federal University of São Carlos, SP, Brazil; University of São Paulo, SP, Brazil. To maximize, or to prevent the stagnation of gains in muscle strength and mass, coaches have used resistance training (RT) systems. It has been showed that traditional RT (TRAD) and drop-set systems (DS) result in similar gains in muscle hypertrophy and strength. However, a large variability has been reported for muscle strength and hypertrophy outcomes even when subjects perform RT programs. **PURPOSE:** The aim of this study was to compare the individual muscle mass and strength gains to TRAD vs DS in well trained young men. **METHODS:** We used a within-subjects design in which 14 participants had one leg randomly assigned to TRAD (3-5 sets

of 6-12 repetitions at 75% 1RM) and the other to DS [3-5 sets of ~50-75% 1RM to muscle failure]). Participants had one leg fixed in the TRAD while the contralateral leg performed either DS to allow for total training volume (TTV) equalization. Muscle cross-sectional area (CSA) and one repetition maximum (1RM) were assessed at baseline and after 12-wks of RT. For group analyses, the accumulated TTV and changes in muscle CSA and 1-RM values were compared between TRAD and DS using paired *t*-tests. For individual analyses, if an individual that showed a difference in the response (for CSA or 1RM increases) from TRAD or DS (or vice-versa) within 2 typical errors (CSA typical error [TE] = 2.20%, 1RM TE = 2.62%), no difference in the response between RT schemes was considered. **RESULTS:** No significant differences in TTV ($P > 0.05$) were detected between protocols TRAD and DS. Muscle CSA and 1RM values increased significantly and similarly for TRAD and DS ($P < 0.0001$). This study highlights that some individuals showed greater muscle strength gains following TRAD (35.7% of individuals), and other show similar responses between TRAD and DS (64.3% of individuals). For muscle CSA, individuals showed similar responses to TRAD and DS. **CONCLUSION:** Despite the analysis groups show similar gains in strength and muscle hypertrophy, some individuals show greater strength gains for TRAD compared to the DS.

3584 Board #272 Jun. 1 9:30 AM - 11:00 AM
Wearable Positive End-Expiratory Pressure Valve Increases Aerobic Capacity and Performance

STEPHEN F. CROUSE, FACSM¹, Sean Boutros², William B. Benton³, Michael Moreno¹, Patrick McCulloch⁴, Bradley S. Lambert⁵. ¹*Texas A&M University, College Station, TX.* ²*HOUSTON PLASTIC AND CRANIOFACIAL SURGERY, Houston, TX.* ³*PEEP Performance, LLC, Houston, TX.* ⁴*Houston Methodist Hospital, Houston, TX.* ⁵*Methodist Research Institute, Houston, TX.*

Reported Relationships: S.F. Crouse: Other (please describe); Member, Board of Directors, PEEP Performance LLC.

PURPOSE: We report testing results of wearing a positive end-expiratory pressure (PEEP) valve mouthpiece during exercise on VO_{2max} and cycling time to exhaustion. **METHODS:** 4 women & 5 men (Age 31 ± 2 yrs, Ht 172.2 ± 3.8 cm, WT 72.1 ± 3.7 kg) were assigned at random on two separate occasions (time of day controlled, at least 48 hr between each test) to wear our PEEP mouthpiece or a Battle Oxygen Mouthguard® during cycle ergometer (Corival®) testing to maximal voluntary exhaustion (3 min unloaded warmup, then 150W for 2 min x 30W/2 min stages thereafter until exhaustion); VO_2 was measured continuously (MGC Ultima®), and heart rate (HR, bpm) and blood pressure (BP, mmHg) were recorded at the end of each stage. There followed approximately one week later a timed endurance ride to exhaustion with the assigned mouthpiece at a power (W) equivalent to each subject's ventilatory threshold (VT) measured during the VO_2 test. **RESULTS:** Table (all $p < 0.05$, paired *t*-test). Notably, time to exhaustion at VT was 13% greater with PEEP, but this did not reach statistical significance. Ratings of perceived exertion recorded during exercise did not differ between mouthpiece conditions.

Variable	VO_{2max} (ml·kg ⁻¹ ·min ⁻¹)	VO_{2max} Test Time to Exhaustion (sec)	Max Systolic Blood Pressure (mmHg)
Control	42.44 ± 2.33	495.3 ± 72.8	193 ± 6
PEEP	45.18 ± 2.41	521.8 ± 73.4	186 ± 5
Change from Control	+6.7%	+5.8%	-3.6%

CONCLUSION: The wearable PEEP-valve mouthpiece significantly improves cycling maximal aerobic capacity, reduces peak exercise systolic blood pressure, and may improve cycling performance. The PEEP mouthpiece technology appears to confer a benefit to cyclists performing high intensity exercise.

3585 Board #273 Jun. 1 9:30 AM - 11:00 AM
Muscle, Blood and Performance Responses to Ice Hockey Match-play in Elite Male Players

Jeppe F. Vigh-Larsen¹, Giorgios Ermidis², Vincenzo Rago³, Morten B. Randers², Dan Fransson⁴, Lasse G. Hybholt⁵, Frank V. de Paoli¹, Kristian Overgaard¹, Thomas B. Andersen¹, Lars Nybo⁵, Peter Krstrup², Magni Mohr². ¹*Aarhus University, Aarhus, Denmark.* ²*University of Southern Denmark, Odense M, Denmark.* ³*University of Exeter, Exeter, United Kingdom.* ⁴*University of Gothenburg, Gothenburg, Sweden.* ⁵*University of Copenhagen, Copenhagen, Denmark.*

Email: jeppef@hotmial.com

(No relationships reported)

Competitive ice hockey is a high-intensity intermittent sport with an activity pattern characterized by short fast-paced bouts of skating repeated continuously over the course of the game interspersed by passive recovery intervals. However, no previous studies have yet examined the physiological response and degree of fatigue during an elite game. **PURPOSE:** To examine muscle, blood and performance responses to match-play in elite male ice hockey players in relation to physiologically mediated

fatigue. **METHODS:** Thirty players from the Danish U20 national team participated and completed one experimental game. The game was modified so each period consisted of 8 shifts of 1 minute duration per player separated by 2 minutes of recovery resulting in a total playing time of 24 min for each participant. During the game each player was monitored continuously using heart rate monitors and a local positioning system assessing the activity pattern. Muscle biopsies were taken before and after the game ($n=7$) as well as instantly following shifts during the game ($n=6$). Blood sampling was performed before the game and at the end of each period. In addition, players performed a repeated sprint test consisting of three maximal 30 m sprints interspersed by 25 s recovery before the game and following each period. **RESULTS:** Players covered on average 6015 ± 199 m reaching peak speeds of 29 ± 2 km/h including 109 ± 14 intense accelerating or decelerating actions and 2701 ± 251 m high-intensity- and sprint skating resulting in an average and peak heart rate of 143 ± 9 and 182 ± 8 beats pr. min, respectively. Muscle lactate rose from 6.9 ± 3 before the game to 38 ± 20 and 20 ± 12 mmol/kg d.w during the first and third period, while blood lactate increased from 0.8 ± 0.3 at baseline to 4.7 ± 3 and 4.9 ± 3 mM following the first and third period ($p \leq 0.05$). Muscle glycogen decreased from 400 ± 22 to 188 ± 43 mmol/kg d. w. over the course of the game ($p \leq 0.05$). Compared to pre-game values mean sprint time declined following the first ($p \leq 0.05$) and third ($p \leq 0.01$), but not after the second period. **CONCLUSIONS:** Ice hockey is a high-intense team sport with a large anaerobic contribution resulting in significant glycogen utilization and fatigue development especially at the end of the game. The latter finding may at least partly be explained by lowered muscle glycogen levels.

3586 Board #274 Jun. 1 9:30 AM - 11:00 AM
Effect of Bicycle Crank Length on Maximal Oxygen Consumption and Ventilatory Threshold in Trained Cyclists

Stephanie A. Sullivan¹, Jordan T. Lee¹, Chad W. Wagoner¹, Brian C. Jensen², David K. Williams¹, Brian Moscicki³, Bing Yu¹, Edgar W. Shields¹, Claudio L. Battaglini, FACSM¹.
¹University of North Carolina, Chapel Hill, NC. ²University of North Carolina School of Medicine, Chapel Hill, NC. ³Indiana University, Bloomington, IN.
 (No relationships reported)

Many potential benefits of altering bicycle crank length (CL) have been proposed from reducing injury to increasing aerodynamics and consequently, performance. Submaximal cycling bouts are often used to simulate various riding efforts to determine how CL can impact race performance in various cycling disciplines. These studies either used a set wattage for all participants or an intensity relative to VO_{2max} or Ventilatory Threshold (VT) based on a Cardiopulmonary Exercise Test (CPET) performed on one CL. However, it is unknown whether CL impacts VO_{2max} and/or VT, thus altering the prescribed submaximal intensity when CL is changed. This is crucial prior to future work in the area and for interpreting previous studies. **PURPOSE:** The purpose of this study was to determine the influence of crank length on VO_{2max} and VT in trained cyclists and multisport athletes. **METHODS:** After a familiarization session, 10 subjects performed three separate trials using different crank lengths (162.5, 172.5 and 182.5 mm) in randomized, counter-balanced order. The trials consisted of a maximal CPET to determine VO_{2max} and VT, a supra-maximal effort to verify VO_{2max} , and two 10-min submaximal efforts at a low intensity (70% of VT) and a high intensity (95% of VT). Individual repeated measures analysis of variance (ANOVAs) were used to compare differences in VO_{2max} and VT across the three crank lengths. To achieve a power of 80% with a difference of 3 mL/kg/min and a standard deviation of 1.5, nine subjects were required. **RESULTS:** VO_{2max} and VO_2 at VT values were not significantly different across the three crank lengths (162.5, 172.5 and 182.5 mm) 4.35, 4.39 and 4.36 L/min, $p=0.65$ and 3.08, 3.04 and 3.08 L/min, $p=0.64$, respectively. **CONCLUSION:** Mean differences in the VO_{2max} and VT values between crank lengths were not statistically significant; however, several individual differences were of clinical relevance (5/10 subjects for VO_{2max} and 6/10 for VT differed by ~ 3 mL/kg/min or more between at least two CLs). Factors including explosive power capacity, preferred cadence, leg length, body composition, and submaximal cycling economy could influence these individual differences and warrant further evaluation.

3587 Board #275 Jun. 1 9:30 AM - 11:00 AM
The Effects of Experiential Learning on Exercise Physiology Self-Efficacy
 Miriam E. Leary, Lori A. Sherlock. West Virginia University, Morgantown, WV.
 Email: miriam.leary@hsc.wvu.edu
 (No relationships reported)

Purpose: This mixed methods, experiential learning research project incorporated multiple teaching methodologies to assess improvements in knowledge and self-efficacy in exercise physiology (EXPH) human performance testing. **Methods:** Six undergraduate EXPH students completed a pre-intervention quiz which assessed knowledge of blood lactate production and lactate threshold. Participants received

a lecture on lactate production and lactate threshold from an expert in the field of human performance and discussed peer-reviewed research readings. Supervised training and practice were held prior to conducting lactate threshold testing on the varsity women's rowing team. Following, participants met to review physiological concepts, data collection procedures, discuss research readings, and reflect on the service component of the project. At the end of the project, participants completed the same lactate threshold quiz as well as an anonymous, online, 15-question self-efficacy and satisfaction survey with answer choices on a 7-point Likert scale. A focus group discussion moderated by trained researchers captured participants' perceptions of the experiential service learning project. Data were content analyzed to identify common themes using independent data reviewers and a tiebreaker when necessary. **Results:** All participants agreed or strongly agreed that participation in this project would allow them to make a difference in [their] community, enable them to interact with relevant professionals in ways that are meaningful and effective, and apply [their] knowledge in ways that solve real-life problems. All students strongly agreed they would recommend this experience to their friends. Compared with a pre-assessment, participants scored 10% higher on the lactate knowledge quiz at the end of the experiential learning project. Students reported improved self-efficacy, knowledge, communication, and confidence in exercise physiology related content as well as professional skills. **Conclusion:** An experiential learning project incorporating multiple teaching methodologies successfully improved knowledge, self-efficacy, and professional skills in human performance testing.

3588 Board #276 Jun. 1 9:30 AM - 11:00 AM
Left Ventricular Function and Cardiac Biomarker Release -The Influence of Exercise Intensity, Duration and Mode: A Systematic Review and Meta-Analysis
 James A. Donaldson. CANTERBURY CHRIST CHURCH UNIVERSITY, Canterbury, United Kingdom.
 Email: james.donaldson@canterbury.ac.uk
 (No relationships reported)

Prolonged strenuous endurance exercise is associated with altered cardiac physiology that often manifests as both transient cardiac dysfunction and detectable cardiac troponin (cTn) in peripheral circulation. The extent of a possible relationship between cTn release and cardiac function is unclear as many studies do not report significant correlations. The influence of exercise intensity, mode and duration on EICF and cTn release is also unknown due to large methodological variation. **Purpose:** We performed a systematic review, meta-analysis and meta-regression of studies that sought to determine the relationship between cTn and left ventricular (LV) function. The second objective was to determine how study-level and exercise factors influenced the variation in the body of literature.

Methods: A systematic search of Pubmed Central, Science Direct, SPORTDISCUS, and MEDLINE databases for original research articles published between 1997-2018 involving >30 mins of continuous exercise, measuring cTn event rates, LV ejection fraction and E/A ratio. Random-effects meta-analyses and meta-regressions with four *a priori* determined covariates (age, exercise heart rate [HR], duration, mass) were performed.

Results: Pooled cTn event rates were evident in 45.6% of participants (95% CI = 33.6 – 58.2%); however, the overall effect was non-significant ($P>0.05$). There were significant ($P<0.05$) reductions in E/A ratio: -0.38 (SMD = -1.2 , 95% CI $[-1.4, -1.0]$), and LVEF: 2.02% (SMD = -0.38 , 95% CI $[-0.7, -0.1]$) pre to post-exercise. Exercise HR predicted cTn release and E/A ratio. Participant age was negatively associated with cTn release. There was a significant negative association between E/A ratio and cTn event rate ($P < 0.05$).

Conclusions: High levels of statistical heterogeneity and methodological variability exist in the majority of EICF studies. Exercise intensity and age are the most powerful determinants of cTn release. E/A ratio is influenced by exercise HR and cTn release, implying exercise bouts at high intensities are enough to elicit cTn release and reduce E/A ratio. Future EICF studies should reduce heterogeneity by use of echocardiographic techniques such as myocardial speckle tracking, maintaining participant hydration, serial follow-up measures to assess symptom progression or recovery.

3589 Board #277 Jun. 1 9:30 AM - 11:00 AM
Independent and Combined Effects of Arterial Angulations and Shear Stress on Vascular Function
 Aaron R. Caldwell, Lisa T. Jansen, Megan E. Rosa-Caldwell, Ronna C. Turner, Erin K. Howie, Kaitlin M. Gallagher, Matthew S. Ganio, FACSM. University of Arkansas, Fayetteville, AR.
 Email: ac039@email.uark.edu
 (No relationships reported)

Excessive sedentary time is a significant health risk, independent of daily physical activity or exercise. In particular, long periods of prolonged sitting is associated with an increased risk of cardiovascular disease. Prolonged sitting reduces flow-mediated

dilation (FMD), which is a key indicator of vascular health. Recent evidence suggests that the seated position strains the arteries through angulations that create turbulent blood flow, thereby reducing FMD. However, when blood flow in the arteries is slightly increased (via local heating), vascular function improves even when seated. However, the combined effects of removing arterial angulations (i.e., standing) and increasing shear stress (i.e., local heating) on reducing sitting-induced vascular dysfunction have yet to be investigated. **PURPOSE:** This project aims to determine if arterial angulations (through sitting or standing), shear stress (through local heating), or a combination of these factors affect vascular function. **METHODS:** 13 individuals (n = 4 male; n = 9 female) participated in a randomized crossover design study. Participants completed two experimental trials (one sitting and one standing). At the beginning of each experimental trial, participants laid supine for at least 20-minutes prior to baseline measurements of FMD at the superficial femoral artery (SFA). Participants then moved into a sitting or standing position. One leg was then passively heated through a water-perfused pant leg in order to increase shear rate. Participants maintained this position for 2-h. Participants then returned to a supine position and post measures of FMD were obtained. **RESULTS:** Overall, sitting led to approximately a 1.2% decline in FMD. Standing appeared to confer the greatest benefit independent of heating ($p = .025$). By the end of standing, participants FMD was 2.88% ($p = .037$) greater than after 2-h of sitting. However, there was no significant effect of local heating ($0.75\% \pm 1.90$, $p = .594$) and no interaction between heating and body position ($-0.17\% \pm 2.70$, $p = .879$). **CONCLUSION:** Standing was superior to sitting with regards to FMD while local heating had a non-significant effect. However, future studies need to examine modifiers such as biological sex.

3590 Board #278 Jun. 1 9:30 AM - 11:00 AM
Association Of Mid-pregnancy And Current Exercise With Arterial Stiffness 6 Months-3 Years After Delivery In Women

Abby J. Heinichen, Catherine A. O'Byrne, Paige Wilbanks, Nicole Hoffner, William Tucker, Abbi D. Lane-Cordova.
University of South Carolina, Columbia, SC.
 Email: lanecord@mailbox.sc.edu
 (No relationships reported)

PURPOSE: Regular exercise is associated with lower cardiovascular disease (CVD) risk. Pregnancy influences longer-term CVD risk for women, regardless of their previous prenatal risk level. Our purpose was to assess whether prenatal and/or current physical exercise levels were associated with arterial stiffness in women 6 months-3 years after a singleton delivery.

METHODS: We performed gold-standard measurement of central arterial stiffness (aortic pulse wave velocity; PWV) in 19 women (mean age=34±1 yrs; mean BMI=27.0±2 kg/m²; 15 white/3 black/1 Asian). Participants were asked to recall leisure-time exercise performed during mid-pregnancy, as well as current exercise habits, and reported both using a validated survey (Godin Leisure-time Exercise Questionnaire). We used linear regression to determine associations of mid-pregnancy and current exercise with PWV, adjusted for age.

RESULTS: Average exercise units were 39±6 (mid-pregnancy) and 43±7 (current). Mean systolic and diastolic blood pressures were 111±3 and 70±2 mmHg, respectively; mean PWV was 6.4±0.3 m/s. Mid-pregnancy exercise score ($b=-0.02\pm0.01$, $p=0.051$), but not current exercise score ($b=-0.01\pm0.01$, $p=0.24$), was associated with PWV after adjustment for age.

CONCLUSIONS: Mid-pregnancy exercise levels were significantly associated with PWV 6 months-3 years after delivery. The findings suggest that exercise during pregnancy may be important for influencing longer-term maternal vascular function.

3591 Board #279 Jun. 1 9:30 AM - 11:00 AM
The Impact of Blood Flow Restrictive Exercise on Endothelial Function

Leryn Reynolds, Robbie Pittman, Hannah Twiddy. *Old Dominion University, Norfolk, VA.*
 Email: lreynold@odu.edu
 (No relationships reported)

Research has shown low intensity resistance training done with blood flow restriction (BFR) to be an effective means at increasing skeletal muscle strength. However, research is lacking examining the effects of BFR exercise on brachial artery endothelial function, which is closely linked to coronary artery endothelial function and thus predisposition to developing atherosclerosis. Given the important role of blood flow (i.e., shear stress) on maintaining endothelial function, BFR exercise may have negative consequences on vascular health. **PURPOSE:** The purpose of this study was to examine the effects of blood flow restriction training on endothelial function in healthy men. **METHODS:** Subjects were 9 healthy males, 23.9±1.2 years, 27.7±1.2 kg/m² who regularly participated in resistance training exercises at least 2 times per week. Subjects performed 3 sets of bicep curls at 30% of their 1 repetition maximum to failure with a blood pressure cuff at 80% arterial occlusion pressure. Endothelial function was assessed by percent flow mediated dilation (%FMD) performed before,

immediately after, and one hour post an acute bout of BFR exercise. **RESULTS:** %FMD was unaltered immediately (9.57 ± 2.33) and 1 hr post (9.43 ± 3.05) BFR exercise compared to baseline (9.62 ± 1.63) ($p>0.05$). **CONCLUSION:** An acute bout of BFR exercise does not alter endothelial function in healthy males. Future studies are aimed at determining if females display a similar response when controlling for the impact of the menstrual cycle on vascular function.

3592 Board #280 Jun. 1 9:30 AM - 11:00 AM
The Effects of Simultaneous Upper and Lower Body Cycling on Cardiorespiratory Responses.

Jessica Royen, Brandi N. Guillotte, Kierstin Marshall, Kimberly Billiot, Robert R. Kraemer, FACSM. *Southeastern Louisiana University, Hammond, LA.*
 (No relationships reported)

Some forms of physical activity require greater amounts of upper body activity combined with lower body activity. Arm ergometry has been shown to elicit larger increases in blood pressure and heart rate when compared to lower body ergometry. Arm ergometry, in workloads up to 125 W, has been shown to illicit greater increases in VO₂ due to extra stabilization of the torso and mechanical efficiency. The effects of a combined lower and upper body ergometry simultaneously, with identical workloads, on the cardiorespiratory system has not yet been studied. Previous studies have evaluated cardiorespiratory responses to elliptical ergometry, which utilizes both upper and lower body extremities. However, an elliptical does not allow for precise regulation and measurement of work performed by both upper and lower body. **PURPOSE:** The aim of this study was to examine the effects graded upper body ergometry, lower body ergometry, and combined upper and lower body ergometry on oxygen consumption, heart rate, minute ventilation, respiratory exchange ratio, and blood pressure. **METHODS:** Eight males, ages 18-28y, participated in three trials over seven days. Subjects were divided into two groups. Session one included one trial of graded leg ergometry and one trial of graded arm ergometry. The two groups completed each of these trials in a counterbalanced fashion with 20min rest between trials. Session two included a trial of graded leg ergometry combined with graded arm ergometry, performed simultaneously, at identical workloads. Each trial began with a warmup at 0kp and maintained a 60rpm cadence. Workload for each trial increased by 0.5kp every 2 min peaking at 95W. **RESULTS:** Combined body ergometry produced significantly ($p < .001$) greater peak oxygen consumption (36.14 ± 4.95 ml/kg/min) compared lower body ergometry (19.41 ± 3.88 ml/kg/min) and upper body ergometry (21.58 ± 7.08 ml/kg/min). Combined elicited a significantly higher peak blood pressure ($p < .005$) and heart rate ($p < .005$), respectively ($180\text{mmHg} \pm 10$) (168 ± 16 BPM), than lower body (156 ± 13 mmHg) (126 ± 12 BPM), but not upper body. **CONCLUSIONS:** These data could be helpful in considering cardiorespiratory stress in healthy and clinical populations from manual tasks involving both upper and lower body extremities.

3593 Board #281 Jun. 1 9:30 AM - 11:00 AM
Bone Density and Cross-Sectional Area are Inversely Related in the Young Adult Distal Tibia

Nathaniel I. Smith¹, Paul M. Bartlett¹, Katelyn I. Guerriere¹, Kathryn M. Taylor¹, Mary L. Bouxsein², Stephen A. Foullis¹, Julie M. Hughes¹. ¹USARIEM, Natick, MA. ²Massachusetts General Hospital; Beth Israel Deaconess Medical Center; Harvard University, Boston, MA.
 Email: nathaniel.i.smith2.ctr@mail.mil
 (No relationships reported)

Bone is posited to develop and adapt to loads by satisfying the competing demands for achieving sufficient stiffness and minimizing mass. This compromise has been demonstrated at the midshaft of the tibia by an inverse relationship between cross-sectional area and thickness of the cortical shell. The requirement for minimizing mass is likely greater at the distal tibia where inertial properties cause bone mass to be more metabolically expensive. Whether there is a similar tradeoff between bone size and the amount of bone tissue at the distal tibia remains to be determined. **PURPOSE:** Determine whether cross-sectional area of bone is inversely related to bone density at the distal tibia. **METHODS:** Six hundred seventy-three (476M, 197F) Army trainees (20.4 ± 3.4 yrs; 1.71 ± 0.09 m; 72.5 ± 13.3 kg) underwent high resolution peripheral quantitative computed tomography (HR-pQCT, XtremeCT2, Scanco Medical AG) scans of their non-dominant distal tibia at 4% of bone length from the distal growth plate, at the start of their initial military training. Generalized linear models adjusted for sex were used to test the significance and directionality of relationships between total cross-sectional area (CSA) normalized to body mass and total volumetric bone mineral density (vBMD). **RESULTS:** Normalized CSA was significantly and inversely related to vBMD ($p < 0.001$) where a one-unit increase in normalized CSA (mm²/kg) resulted in a 5.856 mg HA/cm³ reduction in vBMD. Specifically, the lowest compared to the highest quartile of normalized CSA had 13% higher vBMD, per unit body mass. **CONCLUSION:** These findings support the hypothesis that bone in the distal tibial

metaphysis develops in a manner which balances the need to be adequately stiff against that of minimizing the mass of a metabolically costly tissue through maintaining lower bone density relative to larger bone size.

3594 Board #282 Jun. 1 9:30 AM - 11:00 AM
Dynamic Changes Of Doppler Signal During Tendon Scraping

Andrea Dockry, Michael Baria. *Ohio State University Wexner Medical Center, Columbus, OH.*
Email: andrea.dockry@osumc.edu
(No relationships reported)

Midsubstance Achilles tendinosis and patellar tendinosis are degenerative lesions that impede athletic performance and activities of daily living. Tendon scraping (TS) is a minimally invasive procedure to accelerate pain relief by disrupting neovascularity and reinnervation hypothesized as responsible for pain. The original description uses color Doppler (CD) to identify the region with increased blood flow but does not comment on how CD changes during TS. Others propose that TS is complete when Doppler flow is absent. Our observation is that CD is absent after a small volume injection of local anesthesia, before scraping is begun.

PURPOSE: This case series reports changes in CD during TS to better inform technical understanding of this procedure.

METHODS: Six patients (male=4, female=2) with 5 cases of Achilles and 1 case of patellar tendinosis presented to the Sports Medicine Clinic. Ultrasound identified diseased tendon, and all patients had increased CD prior to the procedure. A 25-gauge 1.5-inch needle was advanced from lateral to medial to the tendon-fat pad interface. Doppler was left on during anesthetic administration. Once local anesthesia was administered, a stab incision was made with an 11 blade scalpel. A 14-gauge 2-inch needle was then advanced under ultrasound guidance in identical fashion. The bevel was turned to make contact with the tendon surface. The fat pad was separated by pulling it away from the tendon in an anterior-posterior direction and then semi-circular, cranial-caudal sweeps were made to complete fat pad separation until the needle moved with unrestricted motion.

RESULTS: In all six patients, CD was absent after injecting 1-3 mL of lidocaine. Though only 1 needle pass was made, CD was completely absent throughout the length of the tendon. No complications occurred.

CONCLUSION: The most important finding of this work is that CD is absent after a small injection of local anesthetic, demonstrating that CD cannot be used to determine TS completion. CD is still a useful pre-procedure guide to identify the tendon region needing treatment, but it cannot be used as a marker of effective scraping / devascularization. A superior marker of procedure completion is freedom of needle motion demonstrating tendon separation from adjacent fat pad.

3595 Board #283 Jun. 1 9:30 AM - 11:00 AM
Mesenchymal Stem Cells Injection As A Therapy In A Rat Model Of Collagenase-induced Tendinopathy

Beatrice Deschenes St-Pierre¹, Mathieu Boudier-Reveret², Shant Der Sarkissian³, Henry Aceros³, Louis Gaboury², Carl-Elie Majdalani², Melanie Boric³, Nicolas Noiseux³, Martin Lamontagne². ¹Laval University, Quebec, QC, Canada. ²University of Montreal, Montreal, QC, Canada. ³Centre Hospitalier Universitaire de Montreal (CHUM) Research Centre, Montreal, QC, Canada.
Email: beatrice.deschenes-st-pierre.1@ulaval.ca
(No relationships reported)

Tendinopathy represents 30 to 50% of sports-related injuries. Yet, a significant proportion of patients do not respond to the first-line conservative management with progressive loading and strengthening exercises program. Recently, Mesenchymal Stem Cells (MSC) have emerged as a potential regenerative treatment in tendinopathy. **Purpose:** The aim of the present study is to determine whether the injection of MSC and/or Celastrol-conditioned MSC promote histopathological healing in a rodent Achilles tendinopathy model.

Methods: Eighteen Sprague-Dawley rats (36 Achilles tendons) were injected with collagenase type 1A (25 international units) in each Achilles tendons under echographic guidance. After one week, rats were randomly and equally assigned to receive a repeat injection, also under echographic guidance, with either: 1) 60 µL of Phosphate-Buffered Saline (PBS: vehicle); 2) 2.4M MSC derived from rat bone marrow aspirate or; 3) 2.4M MSC conditioned with celastrol, a HSP90 inhibitor and antioxidant. The outcome measurements were histopathological changes assessed after Hematoxylin Eosin Saffron, Bleu Alcian and Factor VIII staining of Achilles tendons. Each item of the semi-quantitative modified Bonar score (tenocytes morphology, cellularity, vascularity, abundance of mucin in fundamental substance and collagen organization) was assessed by a blinded experienced pathologist at 4 weeks (4 rats/8 tendons per group) and at 12 weeks (2 rats/4 tendons per group).

Results: There were no statistically significant differences between groups, both at 4 weeks and 12 weeks ($\alpha > 0.05$). However, at 12 weeks, there was a trend towards

more improvement and better Modified Bonar Scores in the tendons treated with MSC (0.48 ± 0.46) and conditioned-MSC (1.51 ± 0.81) compared to tendons injected with vehicle (2.26 ± 1.90).

Conclusion: No difference was found in Modified Bonar Scores in tendon specimens injected with PB-saline compared to MSC and celastrol-conditioned MSC at 4 weeks. The number of rats per group that was observed until 12 weeks for pathologic analysis was insufficient to draw any conclusion. Nevertheless, these results underline that we need to host rats for a longer period for pathologic analysis. We are currently expanding this experiment with a larger number of rats to be assessed at 12 weeks.

3596 Board #284 Jun. 1 9:30 AM - 11:00 AM
Modeling Elbow Valgus Torque From Throwing Distance With 54,701 Collegiate Baseball Throws

Ben Hansen, Brittany Dowling. *Motus Global, Inc., Rockville Centre, NY.*
Email: ben@motusglobal.com

Reported Relationships: B. Hansen: Salary; Motus Global. Receipt of Intellectual Property Rights/Patent Holder; Motus Global.

The scalability and usability of inertial measurement units (IMU's) allows for biomechanical research to be conducted on datasets that are orders of magnitude larger than traditional motion-capture equipment allows for. From a clinical rehabilitation perspective, there is a large need to better understand the effects of throwing distance on elbow valgus torque in a real-world setting.

PURPOSE: To develop a framework for the prediction of elbow valgus torque at specific long-toss distances in college baseball players. **METHODS:** 30 players from a NCAA baseball team were fitted with a motusTHROW sensor and sleeve (Rockville Centre, NY, USA) that measures peak elbow valgus torque. The sensor was worn during all training in 2018, resulting in a total of 238,611 anonymized throws captured. Of this, 54,701 throws were tagged with a long-toss distance (30-300 ft). A 3rd order polynomial regression and one-way ANOVA were performed to test for differences in elbow torque between throwing distances with Tukey post-hoc tests used to for p-value calculation. **RESULTS:** A strong relationship was found between the throwing distance and elbow torque from the 3rd order polynomial (torque = $1.18 \times 10^{-2}x^3 - 8.90 \times 10^{-5}x^2 + 2.41 \times 10^{-2}x + 0.55$, $p < 0.001$). The ANOVA showed all but 7 of 35 distance relationships had statistically significant differences: 80-90 ft, 210-240/270/300 ft, 240-270/300 ft, and 270-300 ft ($p < 0.001$).

CONCLUSION: There was a strong cubic relationship between throwing distance and elbow torque. The cubic regression formula allows for clinicians to estimate peak valgus torque in the throwing arm from distance alone. This relationship can be used to better design return-to-throw programs.

3597 Board #285 Jun. 1 9:30 AM - 11:00 AM
Does Sharing Wearable Physical Activity Monitor Data with Others Lead to Longer User Engagement?

Ciarán P. Friel¹, Keith M. Diaz². ¹Teachers College, Columbia University; Columbia University Medical Center, New York, NY. ²Columbia University Medical Center, New York, NY.
Email: cpf2111@cumc.columbia.edu
(No relationships reported)

The use of wearable physical activity (PA) monitors has increased rapidly over recent years and these devices are becoming more widely used in behavior change interventions. However, high rates of disengagement have been reported, with up to 70% stopping device use within 3 months. This trend is concerning, as these devices are unlikely to impact habitual PA behavior if they are not worn for a sustained length of time. Understanding which factors contribute to long-term engagement can support more effective use of this technology. **PURPOSE:** To assess whether the sharing of data from physical activity monitors (PAMs) via social media or directly with others (e.g. doctor, personal trainer/coach, friends/family) are related to sustained device engagement in a longitudinal survey study. **METHODS:** Current PAM users ($n=418$; mean age: 36.3 ± 12.6 ; 78% female) from across the United States were recruited online and completed a baseline web-based survey in 2015/2016. Participants were followed-up again in 2017. How respondents shared their device data (on social media, privately with family/friends, with their doctor, with coach/personal trainer [yes/no response items]) was queried. Sustained PAM engagement was defined as those who continued PAM use at follow-up. **RESULTS:** The median follow-up time was 15.5 (± 3.7) months. Approximately, 11.5%, 55.7%, 9.1%, and 4.3% reported sharing their data via social media, with family/friends, with a doctor, or with a coach/personal trainer, respectively. At follow-up, 72.5% of participants were still using their PAM. Sharing data from the PAM publicly on social media (e.g. Facebook, Twitter) was significantly associated with long-term PAM engagement (OR: 4.45; 95% CI: 1.51-13.15, $p=0.007$). Sharing of PAM data privately with family/friends (OR: 1.21; 95% CI: 0.76-1.92, $p=0.418$), with a doctor (OR: 1.38; 95% CI: 0.57-3.34, $p=0.477$), or with a coach/personal trainer (OR: 0.91; 95% CI: 0.28-3.00, $p=0.881$) were not significantly associated with sustained PAM use. **CONCLUSION:** Sharing PAM data on social media was associated with sustained device use of over median follow-up

of 1.3 years. The extent to which PAM users share their data should be considered when using this technology as a behavior change tool. Encouraging users to share data publicly may lead to longer device engagement.

3598 Board #286 Jun. 1 9:30 AM - 11:00 AM
Does Post-diagnosis Physical Activity Prolong the Duration of Active Surveillance in Men With Prostate Cancer?

Efthymios Papadopoulos¹, Shabbir M.H. Alibhai², George A. Tomlinson¹, Andrew G. Matthew², Michael Nesbitt², Antonio Finelli², John Trachtenberg², Daniel Santa Mina¹. ¹University of Toronto, Toronto, ON, Canada. ²University Health Network, Toronto, ON, Canada.

Email: efthymios.papadopoulos@mail.utoronto.ca

(No relationships reported)

PURPOSE: In this retrospective cohort study, we examined the effect of post-diagnosis physical activity on active surveillance (AS) termination in men with low-risk prostate cancer.

METHODS: 630 participants on AS were included in the analysis. Post-diagnosis physical activity was measured using the Godin Leisure-Time Exercise Questionnaire and expressed in metabolic equivalent-minutes per week (MET-min/wk). Four physical activity categories were created to classify participants throughout the study: inactive (<210 MET-min/wk), insufficiently active (210-500 MET-min/wk), active/meeting physical activity guidelines (500-1000 MET-min/wk), or highly active (>1000 MET-min/wk). Using Cox regression models, we evaluated the relationship between post-diagnosis physical activity and risk of terminating AS, adjusting for age, prostate-specific antigen (PSA) and number of positive cores most proximal to AS initiation. **RESULTS:** Of the 630 participants, 198 underwent active treatment and 432 were censored. The earliest and latest events of AS termination, indicated by active treatment initiation occurred at 5 and 116 months, respectively. In this cohort, post-diagnosis physical activity was not significantly associated with time to AS termination. PSA (HR, 1.11; 95% CI, 1.03 to 1.20) and the number of positive cores (HR, 1.34; 95% CI, 1.12 to 1.61) most proximal to AS initiation were associated with a significantly increased risk of initiating active treatment. **CONCLUSIONS:** The findings of this study suggest that termination of AS and initiation of active treatment is not influenced by post-diagnosis, self-reported physical activity status.

3599 Board #287 Jun. 1 9:30 AM - 11:00 AM
Assessing Safety, Ease of Use, and Productivity While Using Treadmill Desks: A Pilot and Feasibility Study

Lucy N. Berman, Sarah A. Rydell, Nathan R. Mitchell, Mark A. Pereira. University of Minnesota, Minneapolis, MN.

Email: Berma200@umn.edu

(No relationships reported)

BACKGROUND: Sedentary behavior is associated with a variety of health complications. Long bouts of sitting is becoming a recognized risk of workplace environments.

OBJECTIVE: The purpose of this study was to evaluate the safety, ease of use, and productivity associated with using treadmill desks (TD) during the work day.

METHODS: Sedentary office workers (n=14; 86% female, 40±12 yrs) took part in a within-person, 4-week randomized crossover study comparing group usage of a TD to a usual desk condition. During the TD condition, participants were asked to use the treadmill for a minimum of 30 minutes each workday. In-person study visits were conducted at baseline and during the final week of each condition, and electronic surveys were administered via an email link. Treadmill use and physical activity bouts were tracked with logs and the activPAL accelerometer worn on the thigh. **RESULTS:** During the TD period, participants spent an average of 33±25 minutes at an Active Station (Hopkins, Minn.) TD each day; the range of the walking bout durations, when the TD was used, was 15-120 minutes. All participants reported feeling safe while using the TD. 12 people reported it was 'easy' to use, with one person reporting it was 'somewhat easy'. Productivity results were mixed; 4 reported they were somewhat or much more productive, 4 were neutral, and 5 reported they were somewhat less productive. All participants endorsed a desire to continue using the treadmill desks.

CONCLUSIONS: Results suggest that, over the short term, treadmill desks are safe and easy to use and appear to have mixed effects on productivity. Further research should include full-scale long-term efficacy trials of treadmill desks that include measures of productivity, adherence, and cardiometabolic health outcomes.

3600 Board #288 Jun. 1 9:30 AM - 11:00 AM
Dearborn SHINES For Healthy Kids: Understanding Physical Activity Among Arab American Students in Physical Education and the Impact of SPARK

Erin E. Centeio¹, Jeanne Barcelona², Hayley McKown¹, Christine Pedder², Mariane Fahlman, FACSM². ¹University of Hawaii at Manoa, Honolulu, HI. ²Wayne State University, Detroit, MI.

Email: ecenteio@hawaii.edu

(No relationships reported)

Background/Purpose: Arab Americans account for almost 3.7 million people in the United States (Arab American Institute, 2014). However, limited health data is available on youth populations. Additionally, very few interventions have been designed to increase the physical activity levels of Arab American youth. Therefore, the purpose of this study is twofold: evaluate Arab American children's physical activity (PA) levels during physical education (PE) class and understand how the implementation of SPARK can influence the PA of Arab American youth in the PE context.

Methods: System for Observing Fitness Instruction Time (SOFIT) was used to assess activity levels, lesson context, and teacher involvement during PE class. A total of 66 PE classes in one urban, primarily Arab American, district, were observed in grades 3-8, involving 18 PE teachers. Data collection took place over two time points, with one professional development of the SPARK PE curriculum occurring in-between. Data were downloaded from the iSOFIT app and analyzed using SPSS (v25).

Results: MANCOVA's were run to better understand the effect grade level has on physical activity minutes, lesson context, and teacher involvement while controlling for teacher, total lesson minutes, and type of activity. In general results showed that students were not meeting suggested PA guidelines during PE class $M_{MVPA3rdgrade} = 18.6$ min, $M_{MVPA4thgrade} = 14.1$ min, $M_{MVPA5thgrade} = 13.4$ min, $M_{MVPA6thgrade} = 12.3$ min, $M_{MVPA7thgrade} = 18.7$ min, $M_{MVPA8thgrade} = 15.3$ min. Overall, grade did not have a significant effect on level of PA ($p=.08$). MVPA did not increase between T1 and T2 ($p>.05$), but there were significant changes across timepoints in lesson context ($p<.01$) and teacher involvement ($p<.01$).

Conclusions: The results show that youth were not meeting recommended amounts of daily PA during PE class at either timepoint. A one-time SPARK professional development did not significantly change student behavior as measured by MVPA, but did show improvements in teacher knowledge as measured by lesson context and teacher involvement. Implications for using SOFIT data gathered to inform the ongoing SPARK and Dearborn SHINES intervention and importance of prolonged professional development to transition from increases in knowledge to behavior change will be discussed.

3601 Board #289 Jun. 1 9:30 AM - 11:00 AM
Do Activity Monitors Correctly Classify Driving Time as Sedentary?

Rachel Barnett, Matthew Nelson, Cami Christopher, Mami Takeda, Julian Martinez, Sarah K. Keadle. California Polytechnic State University, San Luis Obispo, CA.

(No relationships reported)

PURPOSE: Driving is a common sedentary activity for many individuals. Previous studies suggest that accelerometers may misclassify driving as a more active behavior due to vehicle vibrations not related to human movement. Therefore, the purpose of this study is to examine how accurately accelerometer processing methods classify driving-specific sedentary time.

METHODS: Participants (n=26, mean age=30.5yrs, 16 female, 20 male) wore an ActiGraph wGT3X-BT (AG) on the right hip, an AG on the non-dominant wrist, and an activPAL (AP) accelerometer on the thigh. They were directly observed for two 2-hour sessions using a GoPro Hero 5 to establish the criterion measure of driving time. We used published methods to classify accelerometer data as sedentary, light, and moderate to vigorous physical activity (MVPA). For the AG-hip, we used the Sojourn-3x (S3x), Freedson, Sasaki, and Crouter methods. The AG-wrist was classified using a random forest (RF) and linear model (lm), and the AP used a proprietary algorithm. We isolated the directly observed driving time and determined whether each of the methods categorized the driving time as sedentary, light or MVPA.

RESULTS: Nine of the twenty-six participants drove during the observed time, resulting in 24 separate driving bouts with a mean bout length of 8.5 minutes, totaling 3.4 hours of sedentary driving time. For the AG-hip, the Crouter method produced the lowest classification accuracy with 26.5% correctly classified as sedentary, 68.4% classified as light and 7.0% as MVPA. In contrast, using the Sojourn-3X method, 70.2% of driving time was correctly classified as sedentary, 26.9% was classified as light and 2.9% as MVPA. For the wrist, using a random forest method resulted in 44.5% correct classification, while the accuracy of a linear model was 30.2%. The AP classified 100% of the driving time as sedentary.

CONCLUSIONS: Existing algorithms to estimate sedentary time for hip- and wrist-worn accelerometers do not accurately classify driving time, while the thigh-worn AP

is highly accurate. Since the average American spends 46 min/day in the car, there is a need to develop new methods that correctly classify driving time for hip- and wrist-worn devices.

3602 Board #290 Jun. 1 9:30 AM - 11:00 AM
Comparing Estimates Of Sedentary, Light And Moderate-vigorous Physical Activity Between Activity Monitors

Cami Christopher, Rachel Barnett, Mami Takeda, Julian Martinez, Matt Nelson, Sarah Keadle. *California Polytechnic State University, San Luis Obispo, San Luis Obispo, CA.*
 Email: cchris17@calpoly.edu
 (No relationships reported)

Accelerometers are widely used in research, but studies use different monitors, attachment sites, and/or data processing methods, making it difficult to compare results across studies.

PURPOSE: Therefore, the purpose of our study is to compare data collected at the hip, wrist, and thigh to determine if estimates of sedentary time (ST), light physical activity (LPA) and moderate-vigorous physical activity (MVPA) are comparable over a 7-day wearing period.

METHODS: Participants wore an ActiGraph (AG) on the hip and non-dominant wrist, and activPal on the thigh 24 hours/day for 7-days. Intensity was categorized using the following methods: AG-Hip 3x, Freedson, Sasaki, Matthews, and Crouter; AG-wrist random forest (RF), linear model (LM) and GGIR; and activPal software. Across the different methods, we compared mean estimates and Pearson correlations for ST, LPA and MVPA.

RESULTS: Average ST ranged from 461 min/day (Hip-Crouter) to 610 min/day (Hip-Freedson), the lowest correlation was between Hip-3x and Wrist-GGIR ($R=0.14$) and the highest was between Hip-Freedson and Hip-Sasaki ($R=0.94$). Average LPA ranged from 201 min/day (Hip-Matthews) to 338 min/day (Hip-Sasaki), the lowest correlation was between Hip-3x and Wrist-LM ($R=0.46$) and the highest was between Hip-Freedson and Hip-Matthews ($R=0.94$). Average time in MVPA ranged from 53 min/day (Hip-Freedson) to 186 min/day (Wrist-LM), the lowest correlation was between Wrist-LM and Wrist-GGIR ($R=0.30$) and the highest was between Hip-3x and Hip-Matthews ($R=0.93$).

CONCLUSIONS: Estimates of ST, LPA and MVPA are heterogeneous across different processing methods and attachment sites, particularly when comparing hip and wrist attachment sites. There is a need to identify which procedures will result in equivalent methods to facilitate data pooling and ensure coherent public health translation of prospective cohorts that are using accelerometers.

3603 Board #291 Jun. 1 9:30 AM - 11:00 AM
High-active Mice Have Elevated Clearance Rate Of Bcaas Compared To Low-active Mice

Jorge Z. Granados, Gabriella A. M. Ten Have, Ayland C. Letsinger, John J. Thaden, J. Timothy Lightfoot, FACSM, Nicolaas E. P. Deutz. *Texas A&M University, College Station, TX.*
 Email: jgranados@tamu.edu
 (No relationships reported)

Physical activity (PA) is associated with a diminished prevalence of hypokinetic related diseases and its worldwide economic burden on health care cost. For several decades, branched-chain amino acids (BCAAs; leucine [LEU], isoleucine [ILE], valine [VAL]) have been studied for muscle wasting disorders. However, little is known about the metabolic interactions between BCAAs and regulation of PA levels.

PURPOSE: To assess BCAA metabolism by measuring plasma clearance rates in mice previously classified as either low-active (LA; C3H/HeJ) or high-active (HA; C57L/J). **METHODS:** 12-week-old male LA ($n=23$) mice (body weight: 25.8 ± 1.2 g; lean body mass: 21.0 ± 1.1 g; fat mass: 2.5 ± 0.5 g) and HA ($n=20$) mice (27.5 ± 1.2 ; 22.5 ± 1.3 ; 2.5 ± 0.7) were used. Under anesthesia, a pulse of stable tracers (L-LEU[13C6], L-ILE [1-13C], and L-VAL [13C5]) was administered via the right jugular vein catheter. Subsequently, blood samples were taken (Time: 1, 3, 5, 7, 10, 15, 20, 25, 30, and 40 mins). Plasma enrichments and concentrations of LEU, ILE, and VAL were determined by LC-MS/MS. Whole-body production (WBP) was calculated from fitted area under the curve (AUC) as pulse/AUC, and clearance of stable tracers was calculated as WBP/plasma concentrations. Fitting and statistical analysis (unpaired student t-tests) were performed using GraphPad Prism 8 software. Data are expressed as mean \pm SE.

RESULTS: HA mice had significantly lower plasma concentrations for LEU (125.2 ± 4.8 vs 144.8 ± 6.4 $\mu\text{mol/l}$, $p=0.02$), ILE (48.5 ± 1.9 vs 57.7 ± 2.3 $\mu\text{mol/l}$, $p<0.01$) and VAL (156.8 ± 4.9 vs 187.9 ± 7.1 $\mu\text{mol/l}$, $p<0.01$) and significantly higher WBP values for LEU (11.6 ± 0.6 vs 8.3 ± 1.1 nmol/g lbm/m, $p=0.02$) and VAL (111.4 ± 5.4 vs 92.8 ± 2.8 nmol/g lbm/m, $p<0.01$) compared to LA mice. No significant WBP differences were observed for LEU (75.5 ± 3.3 vs 72.7 ± 3.2 nmol/g lbm/m, $p=0.56$). HA mice demonstrated higher percent clearance for LEU (40%), ILE (76%), and VAL (29%) compared to LA mice. **CONCLUSIONS:** The observed changes in plasma

concentration, WBP, and clearance of BCAAs suggest modified metabolic pathways of LEU, VAL, and ILE in HA mice, compared to LA mice. **FUNDING SOURCES:** Texas A&M Vice President of Research Office, TACSM Student Research Development Award, College of Education & Human Development Student Research Grant, and funds from the Omar Smith Endowment.

3604 Board #292 Jun. 1 9:30 AM - 11:00 AM
Ghrelin and PYY are Differentially Altered Following an Acute Bout of Aerobic vs Resistance Exercise

Tanya M. Halliday¹, Mollie H. White², Davis M. Bitton², Allison K. Hild², Jonathan R. Miller², Edward L. Melanson, FACSM², Marc-Andre Cornier². ¹University of Utah, Salt Lake City, UT. ²University of Colorado Anschutz Medical Campus, Aurora, CO.
 Email: tanya.halliday@utah.edu
 (No relationships reported)

PURPOSE: The purpose of our ongoing trial is to determine if aerobic exercise (AEx) and resistance exercise (REx) differentially influence acute energy intake and appetite regulation.

METHODS: Physically inactive adults with overweight/obesity ($n=19$, 35 ± 1.7 yrs, BMI: 28.7 ± 1.1 kg/m²) completed 2 conditions; 1) AEx (treadmill walking at 65-70% of age-predicted maximum heart rate for 45 minutes) and 2) REx (1-set to failure of 12 resistance exercises). Each condition was initiated in the post-prandial state (35 minutes post breakfast). Appetite (visual analog scale [VAS] for hunger and satiety) and hormones (ghrelin and PYY) were measured every 30 minutes for 3 hours following consumption of the standardized breakfast meal. Post exercise food cravings (following 90 min VAS and blood draw via Food Cravings Inventory [FCI] questionnaire) and ad libitum energy intake at the lunch meal were also measured.

RESULTS: There was no difference in post-exercise *ad libitum* energy intake between conditions (AEx: 932 ± 75 kcal vs. REx: 910 ± 81 kcal). There were also no differences in post exercise food cravings, nor area under the curve (AUC) for hunger, satiety, ghrelin, and PYY. However immediately following exercise (90 minutes post breakfast), ghrelin (AEx: 784 ± 66 pg/mL vs. REx: 642 ± 41 pg/mL, $p=0.08$) and PYY (AEx: 166 ± 12 pg/mL vs. REx: 124 ± 11 pg/mL, $p=0.05$) were both higher in the AEx condition. Across conditions, higher scores on the FCI ($r=0.49$, $p<0.01$), increased hunger AUC ($r=0.62$, $p<0.001$), and decreased satiety AUC ($r=-0.43$, $p=0.013$) were associated with increased *ad libitum* energy intake.

CONCLUSIONS: The data suggest that an acute bout of aerobic exercise appears to transiently increase both ghrelin and PYY, which are orexigenic and anorectic gut peptides, respectively, compared to resistance exercise. However, ad libitum energy intake was not different between conditions. Future work is needed to confirm these findings and uncover mechanisms by which exercise influences appetite indices and energy intake.

3605 Board #293 Jun. 1 9:30 AM - 11:00 AM
Can A Polyphenol Supplement Improve Sports Vision And Reaction Time? A Pilot Investigational Study

Neil E. Wolkodoff¹, Gerald M. Haase², Bethany Braunstein³. ¹Colorado Center for Health & Sport Science, Denver, CO. ²University of Colorado, Aurora, CO. ³Boulder Community Hospital, Boulder, CO.
 Email: neil@cochss.com
 (No relationships reported)

PURPOSE: Polyphenol supplements have emerged as positive influencers in lipid and metabolic regulation related to cardiovascular disease risk. Limited research has assessed their value in neurological function and sports reaction measures. A highly concentrated extract of citrus bergamot polyphenols was tested because of extensive publications demonstrating benefits in oxidative stress and dyslipidemias, and therefore might improve visual components.

METHODS: Nineteen (19) volunteers, aged 50-74 years old, were studied. Fourteen (14) subjects consumed BergaMet Sport, a high concentration polyphenol compound, and five (5) controls consumed a placebo. Subjects were randomly assigned to either the placebo or intervention groups. Weight, body composition, visually directed balance, sports vision reaction time and a seven-test sports vision battery were measured at time 0 and at 30 and 60 days.

RESULTS: The mean age for the control group was 58, + or - 9.42 yrs for the and for the intervention group, 57.1 + or = 6.42 yrs. 52% were female and 48% were male. The subjects who received the intervention improved to statistically significant levels in all sports vision and balance measures compared to the placebo group. The key measures of time to balance task (5.76 second increase Placebo (PL) vs. 15.51 second decrease/improvement Intervention (INT)), reaction time test (73.6 point improvement PL vs. 492.5 point improvement INT) and the sports vision ranking composite of seven measures as a percentile to normative (.654 point improvement in percentile ranking for PL vs. 6.33 point improvement for INT), were all significant ($P<0.05$), using paired student's t-tests.

CONCLUSIONS: In this pilot study, consumption of a high concentration polyphenol produced significant improvements in neurological function specifically related to visual components, balance and reaction time in this older age group in a relatively short time period. Further investigation in other age groups attempting to regain and maintain function in domains related to vision and reaction time is warranted in respect to polyphenol compounds.

3606 Board #294 Jun. 1 9:30 AM - 11:00 AM
Metabolic Flexibility is Impaired in Response to Acute Exercise in the Young Offspring of Mothers with Type 2 Diabetes

Cullen Vincelle, Timothy Allerton, Brian Irving, FACSM, Guillaume Spielmann, Neil Johannsen. *Louisiana State University, Baton Rouge, LA.*
 Email: cvinc19@lsu.edu
 (No relationships reported)

Metabolic Flexibility is Impaired in Response to Acute Exercise in the Young Offspring of Mothers with Type 2 Diabetes.

Cullen Vincelle¹, Timothy Allerton², Brian Irving¹, Guillaume Spielmann¹, and Neil Johannsen¹

¹Louisiana State University, Baton Rouge, LA. ²Pennington Biomedical Research Center, Baton Rouge, LA. Healthy adults with a family history (first degree relative) of T2D demonstrate impairments in metabolic flexibility (MF), which is considered to be a factor in the development of T2D. Insulin sensitivity has been shown to improve in the first 48 hours in response to exercise. Whether, a single bout of high intensity interval exercise (HIIE) improves MF in men and women with a family history of T2D remains to be resolved. **PURPOSE:** The purpose of this study was to assess MF in a group of young, seemingly healthy adults with a positive family history of maternal T2D (FH+) and those without a family history of T2D (FH-) in response to a single bout of HIIE and 1 hour (1H) and 48 hours (48H) after exercise. **METHODS:** Seventeen participants (n=9 FH+ 2M/6F) consumed a liquid mixed meal with 3-hour post-prandial resting metabolic assessments (RMR) taken at baseline (BL, no prior exercise), and at 1H and 48H after a bout of HIIE (10 x 60s @90% watt max). **RESULTS:** ΔRER AUC for FH+ vs. FH- groups differed at BL, but not significantly (p=0.08); however, at the 1H visit the ΔRER AUC for the FH+ group (4.3 ± 1.6) was lower when compared to FH- group (6.5 ± 1.9; p=0.02). The suppression of FatOx (reduction at 60 minutes post-meal) was attenuated during the 1H visit in the FH- participants (-0.018 ± 0.01 g/min), but not in FH+ participants (0.007 ± 0.01 g/min; p=0.03). ΔRER AUC was increased at 48H in FH+ participants. **DISCUSSION:** Our results suggest that young adults with a maternal family history of T2D demonstrate impaired MF in response to a mixed meal tolerance test 1H post-HIIE. However, MF was improved to the level of FH- participants at 48H.

3607 Board #295 Jun. 1 9:30 AM - 11:00 AM
Relationship Of Leptin, Body Composition And Resting Metabolic Rate In Chinese Overweight And Obese Adults

Jingjing Xue¹, Shuo Li², Xiujuan Hao³, Yue Fu³, Rou Wen⁴, Ping Hong⁵. ¹China Institute of Sport Science, Beijing, China. ²Shanghai University of Sport, Shanghai, China. ³Beijing Sport University, Beijing, China. ⁴Beijing Dance Academy, Beijing, China. ⁵Winter sports management center of the general administration of sport of China, Beijing, China.
 Email: xue_jing_jing@126.com
 (No relationships reported)

PURPOSE: Resting metabolic rate (RMR) and substrate utilization are important factors in maintaining energy balance and leptin is postulated to be involved in the regulation of body weight. However, in overweight and obese individuals, excess fat mass has a significant impact on metabolic function both directly through altered metabolic rate and substrate oxidation, and indirectly, through chronic changes in hormonal concentrations. This study determined the relationship of body composition and leptin with RMR and substrate utilization (carbohydrate, fat and protein oxidation rates) in Chinese overweight and obese adults.

METHODS: The subjects were 33 women (age = 44.0±12.1 years; BMI = 27.9±3.2 kg/m²; percent body fat (%fat) = 38.7 ± 4.0%) and 34 men (age = 30.0±9.7 years; BMI = 27.4±1.7 kg/m²; percent body fat (%fat) = 27.5 ± 4.3%). RMR and substrate utilization were measured by indirect calorimetry (Metamax 3B[®] Metabolic Measurement system, German) and body composition by the bioelectrical impedance method. Serum leptin levels were determined by radioimmunoassay.

RESULTS: In men and women, RMR significantly correlated with Skeletal Muscle Mass (Men: R=0.556, p=0.001; Women: R=0.493, p=0.004), but both not significantly correlated with leptin (both p>0.05). In stepwise multiple regression analysis, SMM was the main predictor of RMR, explaining 42.5% and 28.5% of the variance of RMR in men and women respectively. In women, but not men, leptin significantly correlated

with RER (R=-0.581, p=0.029) and carbohydrate, fat, and protein oxidation rates respectively (R=-0.558, 0.689, 0.690; all p<0.01). Furthermore, in stepwise multiple regression analysis, leptin explaining 33.7% of the variance of RER in women.

CONCLUSIONS: Skeletal Muscle Mass is a significant predictor of RMR in Chinese overweight and obese adults, evaluation of body composition may be an effective and efficient way to evaluate metabolic status. Serum leptin concentrations in female subjects showed a negative association with respiratory quotient and carbohydrate oxidation rate and positive association with fat and protein oxidation rates. We suggest that sex-specific evaluations are also necessary. **Acknowledgements:** This work was supported by National science and technology program of China (Grants No.2013FY114700)

3608 Board #296 Jun. 1 9:30 AM - 11:00 AM
Exercise, Estradiol, And Specific Estrogen Receptor Activation For The Prevention Of Type 2 Diabetes

Brittany Gorres-Martens¹, Janelle Shiffler¹, Teresa Binkley². ¹Augustana University, Sioux Falls, SD. ²South Dakota State University, Brookings, SD.
 Email: brittany.gorres-martens@augie.edu
 (No relationships reported)

Postmenopausal women have an increased risk for type 2 diabetes (T2D), and hormone replacement therapy (HRT) decreases this risk. However, HRT increases the risk of breast cancer and stroke, and thus, the US Preventive Services Task Force does not recommend HRT to prevent or manage T2D. Moreover, exercise is an effective means to prevent and treat T2D. **PURPOSE:** To compare exercise treatment with drug-induced estrogen receptor (ER) activation in ovariectomized (OVX) rats fed a high-fat diet (HFD). **METHODS:** OVX female rats were fed a HFD for 10 weeks. One group of rats ran on a treadmill for 25 minutes/day at 40 cm/s for 5 days/week (Ex), while the other rats were treated with estradiol (E₂: 1.4 µg/day), the specific ERα activator PPT (18 µg/day), or the specific ERβ activator DPN (18 µg/day) (n=8/group). Throughout the study, weekly food intake was determined by weighing the amount of food given and the amount of food remaining at the end of the week, and voluntary cage activity was measured using Optmo-M4 cage monitors. At the end of the study dual energy X-ray absorptiometry (DXA) determined the body composition. Normally distributed data were analyzed using a one-way ANOVA and an LSD post-hoc test. Non-normally distributed data were analyzed using Kruskal-Wallis testing. **RESULTS:** At the end of the study, the Ex and E₂ groups gained 125±5 g and 125±9 g of body weight, which was significantly less than the PPT and DPN groups (165±12 g and 160±8 g, respectively; p<0.05). Although the Ex and E₂ groups gained the same amount of total body weight, the Ex group had a significantly lower abdominal fat % compared to the E₂ group (30±1% vs. 37±2%; p<0.001), and the abdominal fat % of the E₂ group was the same as the PPT and DPN groups (39±3% and 38±2%, respectively). Although the food intake (kcal/day) did not differ between the groups, the voluntary cage activity of the E₂ group (498±27 counts/hr) was significantly greater (p<0.05) than the Ex, PPT, and DPN groups (387±34, 397±27, and 370±27 counts/hr, respectively). **CONCLUSION:** The prescribed exercise in the Ex group contributed to a lower body weight and lower % abdominal fat, and the voluntary cage activity in the estradiol group contributed to a lower body weight, but not lower % abdominal fat, which is the greatest risk factor for T2D. Supported by NIH Grant P20GM103443 and NSF Grant IIA-1355423.

3609 Board #297 Jun. 1 9:30 AM - 11:00 AM
The Effect Of Gestational Physical Activity On The Psychological Health Of Their Offspring

Jung eun Byun¹, Da-Ae Kim¹, Yong-Chul Jang², Sung-Hun Park³, Tayler S. Thurston³, Eun-Young Kim⁴, Hyun-Chul Cho⁵, Joon-Yong Cho⁶, Jung-Hoon Koo⁶. ¹Korea Incubator Laboratory of group exercise, Seoul, Korea, Republic of. ²University of West Florida, Pensacola, FL. ³University of Utah, Salt Lake City, UT. ⁴Preventive Medicine, Chungbuk, Korea, Republic of. ⁵Yongin University, Gyeonggi, Korea, Republic of. ⁶Korea National Sport University, Seoul, Korea, Republic of.
 (No relationships reported)

PURPOSE: Gestational physical activity (GPA) has been associated with improved fetal outcomes. The purpose of this study was to examine whether exercise during pregnancy contributes positively to the psychological health of their offspring.

METHODS: A survey was administered to 1509 children (ages 11-13) to identify psychological health factors such as mental stress, depression, and self-esteem using a modified Daily Hassles Questionnaire, Children's Depression Inventory, and Rosenberg's self-esteem, respectively. Mothers of the participants were retrospectively categorized into three groups based on GPA: non-exercisers (CON), low-intensity aerobic exercise (AE), and body-weight strength training (BWT).

RESULTS: After excluding questionnaires due to incomplete data sets, 855 surveys were analyzed. Our results indicated significantly lower levels of depression with concomitant increased self-esteem among children of exercising mothers compared

to CON (AE: $p < 0.05$ and $p < 0.01$; BWT: $p < 0.05$ and $p < 0.01$, respectively). However, there was no effect of exercise on offspring mental stress levels, nor were there any differences observed between AE and BWT for any psychological health factors. Mental stress was significantly correlated with depression ($r = 0.640$, $p < 0.01$) and self-esteem ($r = -0.534$, $p < 0.001$). In addition, depression was negatively correlated with self-esteem ($r = -0.689$, $p < 0.01$).

CONCLUSIONS: GPA had a positive influence on the psychological health of their offspring. Interestingly, there were no differences between types of physical activity, which should be recognized to benefit the mental health of their children regardless of modality. Therefore, implementation of GPA should be accepted as part of the healthy gestational regimen along with prenatal vitamins and a healthy balanced diet.

3610 Board #298 Jun. 1 9:30 AM - 11:00 AM
Investigation of the Association of Depression and Cardiovascular Disease Risk in Retired Professional Football Players

Eric Kessler, Jocelyn N. Simons, Genevieve E. Smith, Mark M. Cassidy, Gregory W. Stewart, FACSM. *Tulane University School of Medicine, New Orleans, LA.*

(No relationships reported)

Former professional football players have considerable cardiovascular disease risk. Studies have shown that psychosocial factors and depression are also strongly associated with CVD morbidity and mortality. **PURPOSE:** To better understand the association of cardiovascular disease and psychosocial factors such as depression in a population of retired NFL players. **METHODS:** Blood pressure, anthropometry, and laboratory blood analyses were collected from former NFL athletes ($n = 648$) between October 2016 and February 2018 during cardiovascular screenings held throughout the U.S. Questionnaires were used to collect demographic information, exercise frequency and Patient Health Questionnaire 2 (PHQ-2) scores. Means were analyzed via one-way ANOVA and associations between variables assessed using GLM. Chi-square analysis or t-test was used to assess differences between categorical variables, as appropriate. **RESULTS:** Variables of race ($p = 0.0007$), log of systolic blood pressure (SBP) ($\beta = -0.5258$, $p = 0.0404$), log of waist circumference ($\beta = -16.9366$, $p = 0.0218$), log of hip circumference ($\beta = 17.2927$, $p = 0.0196$) and waist to hip ratio ($\beta = 8.2430$, $p = 0.0171$) were significantly associated with positive screen for depression on the PHQ-2. Variables race ($p = 0.0002$), log of SBP ($\beta = -3.3818$, $p = 0.0009$), diastolic blood pressure (DBP) ($\beta = 0.0168$, $p = 0.0035$), log of waist circumference ($\beta = -46.3330$, $p = 0.0100$), log of hip circumference ($\beta = 46.5107$, $p = 0.0100$), and waist to hip ratio ($\beta = 22.3890$, $p = 0.0078$) were significantly associated with higher score on the little interest in doing things question of the PHQ-2. Variables race ($p = 0.0048$), log of SBP ($\beta = -2.2832$, $p = 0.0122$), and DBP ($\beta = 0.0141$, $p = 0.0059$) were significantly associated with higher score on the feeling depressed question of the PHQ-2. There were significant differences in prevalence between racial groups for positive screen for depression on the PHQ-2 ($p = 0.0006$). **CONCLUSIONS:** Factors reflecting body composition were found to be significantly associated with a positive screen for depression and depressive symptoms. Measures for abdominal obesity may be a better indicator for the association of body composition and depression in retired athletes. Accounting for racial differences in clinical practice may also help improve overall health outcomes.

3611 Board #299 Jun. 1 9:30 AM - 11:00 AM
Influence of Physical Stress on Interpretation of Ambiguous Social Cues

Julie A. Cantelon¹, F. Caroline Davis², Nate Ward¹, Erika Hussey², Robin B. Kanarek¹, Holly A. Taylor¹. ¹Tufts University, Medford, MA. ²U.S. Army Combat Capabilities Development Command Soldier Center, Natick, MA.

Email: julie.cantelon@tufts.edu

(No relationships reported)

Individuals with high stress jobs (e.g. law enforcement or military personnel) are often tasked with quickly interpreting ambiguous information in order to guide appropriate action. For example, certain social cues, such as (surprised) facial expressions, are ambiguous as they do not clearly signal whether an individual feels positive or negative, and could be interpreted as either safe or threatening. Previous work has demonstrated that acute emotional stress, which heightens arousal and negative affect, makes individuals more likely to interpret surprised facial expressions negatively. Likewise, exercise also influences affect and arousal, with the direction depending on exercise intensity. However, the influence of exercise intensity on valence bias, or tendency to interpret ambiguity as positive or negative, remains unexplored. **PURPOSE:** To examine shifts in valence bias of ambiguous social cues under moderate and high intensity exercise. **METHODS:** Forty-two healthy young adults (19 men, 23 women, ages 18-35) who engaged in regular exercise, completed 40 minutes of continuous steady-state cycling at moderate (65% Heart Rate Reserve, HRR) and high (85% HRR) intensities on two separate days. They completed measures of perceived exertion, affect and arousal 30 minutes into exercise, then rated a series of

ambiguous (surprised) faces as positive or negative. **RESULTS:** Heart rate, perceived exertion, negative affect and arousal were significantly higher under the high relative to moderate intensity condition (all p 's $< .05$). However, there was no significant difference in valence bias of surprised faces as a function of exercise intensity ($p > .1$). **CONCLUSIONS:** Understanding factors that influence interpretation of ambiguous social cues is important, as even slight shifts might alter if information is perceived as safe vs. threatening. This could have significant behavioral consequences for individuals operating in high-stakes environments. Results suggest that despite differences in participant's emotional state between moderate and high levels of physical stress, interpretation of ambiguous social cues remains unaffected. Supported by the U.S. Army Combat Capabilities Development Command Soldier Center (CCDC, Natick, Massachusetts, USA) under award number W911QY13C0012.

3612 Board #300 Jun. 1 9:30 AM - 11:00 AM
The Gut Microbiome Modulates Diet's Effect on the Regulation of Physical Activity

Ayland C. Letsinger, Rani Menon, Jorge Z. Granados, Brianne M. Breidenbach, Edward C. Nagel, Tatiana N. Castro, Sarah A. Little, Arul Jayaraman, J. Timothy Lightfoot, FACSM. *Texas A&M University, College Station, TX.*

Email: aylandletsinger@gmail.com

(No relationships reported)

PURPOSE: We have observed chronic overfeeding via a high fat/high sugar diet decreases wheel running and substantially alters the microbiome in C57BL/6J mice. In this study, we tested the hypothesis that gut microbiota modulates the effect of nutrient intake on physical activity.

METHODS: 40 C57BL/6J male mice (5 wks of age) were individually housed, adjusted to a standard "chow" diet (CHOW) for a week, and then divided randomly into four groups: Group 1 (control group) received an *ad libitum* CHOW diet and water while Groups 2, 3, and 4 received an *ad libitum* high fat diet and a 20% fructose drinking water solution (HFHS) for a total of 12 weeks. Each group was given a running wheel for physical activity monitoring after three days on the new diet. After 12 weeks, Groups 2 and 3 were changed to a CHOW diet. Fresh fecal pellets from Group 1 (control group) were collected, homogenized in an anaerobic solution, and then 100 ul was orally gavaged into Groups 2 and 4 one time a week for five weeks. Wheel running and body composition data were analyzed via repeated ANOVAs. The major bacterial phyla were quantified using qPCR.

RESULTS: By week 12, Groups 2, 3, and 4 (HFHS diet) ran significantly less distance, duration, and speed than Group 1 on a CHOW diet ($p < 0.05$). The HFHS animals ate significantly greater calories and had more body fat ($p < 0.05$) over the 12 weeks. With the diet alteration at week 13, Groups 1-3 (now all on CHOW) ran at a significantly higher speed than Group 4 (HFHS). Group 2 (CHOW plus transplant) had a significantly greater increase in wheel running compared to Group 3 (CHOW diet and a vehicle transplant). *Bacteroidetes* and *Firmicutes* were similar between Groups 1-3 within two weeks after the diet change regardless of the fecal transplant.

CONCLUSIONS: A HFHS diet increases body fat and decreases wheel running activity compared to a CHOW diet in C57BL/6J male mice. Recovery of wheel running and lowering body fat was accomplished within 2 weeks by switching from a HFHS diet to a CHOW diet. However, switching diets plus receiving a fecal transplant provided quicker results than diet alone. A fecal transplant without changing diet type did not recover activity levels.

3613 Board #301 Jun. 1 9:30 AM - 11:00 AM
The Association Between Player Age and Initial Helmet Contact Amongst American Football Players.

David Wang¹, Anthony Napoli², Alexander Webb¹, Priyanka Tripuraneni¹, Phillip Nelson¹, Matthew Civate¹, Eleonor Belilos¹, Brandon Stryder¹, Kevin Berardino¹, Matthew Druckenbrod¹, Harry Tsou¹, Janette Baird². ¹Georgetown University School of Medicine, Washington, DC. ²Warren Alpert Medical School of Brown University, Providence, RI.

Email: dxw2@georgetown.edu

(No relationships reported)

Recent research has demonstrated an association between repetitive head trauma and the incidence of chronic traumatic encephalopathy (CTE), particularly among professional American football players. It is believed that younger players are more susceptible to head injury yet the incidence in these younger age groups appears to be lower. We have shown that video review of game film is a reliable tool in quantifying the frequency and characteristics of head impacts in football games. **PURPOSE:** To study the association between player age and dangerous tackling techniques in all age groups of tackle football using video review of game film.

METHODS: 8 video reviewers were trained in a universal definition of a "hit" and 3 were chosen to individually review each game. Each reviewer classified each "hit" between a ball carrier and defender based on the level of helmet involvement from the two players. Initial Helmet Contact (IHC) hits were defined as hits between a

ball carrier and a defender that were initiated by at least one of the players' helmets. Regional or national championship level game-films from 2016 and later were obtained, from each age division, via open-source locations on the internet or a private subscriptions service for film review (NFHS Network, Indianapolis, IN). This study received IRB waiver of consent, an a priori power analysis was done to detect a 5% difference between age divisions, and data analyzed by assessing relative risk of each division as compared with the NFL and utilizing tests of trends.

RESULTS: A total of 37 games, 2,912 hits, were watched over 7 age groups. Nearly 1 in 6 (16% [95% CI 15-17]) hits involved IHC. 18.9% [95% CI 15.8-22.31] of hits were IHC at the NFL level. Most lower age levels demonstrated significantly lower relative risks of IHC (range 0.55-0.92) as compared with the NFL and there was a trend toward increasing risk of IHC with increasing age division of play ($p=0.09$). IHC was twice as common amongst defensive participants as offensive (RR 2.0, $p<0.01$).

CONCLUSIONS: IHC is relatively frequent amongst all levels of American tackle football. There is a higher rate amongst defensive participants and a trend toward an increased relative risk at higher age divisions. Further study is necessary to identify the relationship with quantitative forces of impact and potential cognitive sequelae.

3614 Board #302 Jun. 1 9:30 AM - 11:00 AM
Head Trauma Biomarkers in NCAA Men's Soccer Athletes Over The Course Of A Season

Andreas Kreutzer¹, Javier A. Zaragoza², Jonathan M. Oliver³, Anthony Anzalone⁴, Tori Como⁵, David Juovich⁵, James Hall⁵, Sid O'Bryant⁶, Stacie L. Urbina², Lemuel W. Taylor, IV, FACSM². ¹Texas Christian University, Fort Worth, TX. ²University of Mary Hardin-Baylor, Belton, TX. ³United States Military Academy, West Point, NY. ⁴Wake Forest School of Medicine, Winston-Salem, NC. ⁵University of North Texas Health Science Center, Fort Worth, TX.
 Email: a.kreutzer@tcu.edu
 (No relationships reported)

Repetitive subconcussive impacts to the head are commonplace in soccer. The ability to detect the extent of neurological injury due to these impacts over the course of a season is paramount. **PURPOSE:** The purpose of the current study was to examine alterations in blood biomarkers of head injury over the course of a soccer season. **METHODS:** Sixteen National Collegiate Athletic Association (NCAA) male soccer athletes (20.1±1.3 years, 178.6±8.3 cm, 77.8±11.3 kg, 15.0±6.0 %BF) participated in weekly blood sampling throughout an 18-week season. Coaches provided player statistics following the season. Headers (HEAD) were defined as any impact of the players' head with the ball. Serum samples were stored at -80°C until analysis for Tau and Neurofilament Light polypeptide (NFL). We used R statistical language and the *lme4* statistical package to perform a linear mixed effects analysis of the relationships of minutes played (MP) and HEAD with Tau and NFL. We included the intercept for subjects as a random effect, and time point (TP), MP, and HEAD (without the interaction term) as fixed effects. P-values for model comparisons were obtained by likelihood ratio tests of the full model with the effect in question against the model without the effect in question. Visual inspection of residual plots did not reveal any obvious heteroscedasticity or deviation from normality. **RESULTS:** NFL was significantly elevated in weeks 5 (7.3±2.8pg/mL; $p<0.001$), 14 (7.0±3.1pg/mL; $p=0.047$), and 15 (7.9±4.0pg/mL; $p<0.001$) compared to baseline (5.2±1.2 pg/mL). Tau did not change significantly over the course of the season. Neither adding MP ($\chi^2(1)=1.85$, $p=0.17$, $\Delta AIC=0.2$) nor adding HEAD ($\chi^2(1)=0.15$, $p=0.69$, $\Delta AIC=1.85$) as fixed effects improved the model fit for Tau, compared to the simpler model with TP. Similarly, the addition of MP did not improve model fit for NFL ($\chi^2(1)=1.50$, $p=0.22$, $\Delta AIC=0.5$). Conversely, including HEAD improved the model for NFL compared to the simpler model with TP ($\chi^2(1)=5.68$, $p=0.02$, $\Delta AIC=-3.7$). However, only a small negative effect of HEAD, -0.09 (95%CI=-0.16, -0.02), was detected. **CONCLUSION:** In our study, neither MP nor HEAD had a significant effect on Tau concentration over the course of an NCAA Men's soccer season. HEAD appeared to have a small negative effect on NFL concentrations across the season.

3615 Board #303 Jun. 1 9:30 AM - 11:00 AM
The Role of Endogenous Opioids in Cerebral Glucose Uptake Following Acute Exercise

Qudratullah Qadiri¹, Candance Longoria², Harlee York¹, Kelly A. Dougherty¹, Bryce J. Muth¹, Sara C. Campbell, FACSM², John J. Guers¹. ¹Stockton University, Galloway, NJ. ²Rutgers University, New Brunswick, NJ.
 (No relationships reported)

Exercise has been linked to several opioid mediated phenomena including exercise mediated analgesia, euphoria "runner's high" and addiction. The role of the endogenous opioid system in these events have all been verified using the opioid receptor blocker naltrexone. Despite this, a full understanding on how the endogenous opioid system influences brain activity under acute exercise conditions is lacking. **PURPOSE:** To investigate the role of the endogenous opioid system on brain

glucose uptake following an acute bout of exercise with and without administration of naltrexone. **METHODS:** To assess cerebral glucose uptake mice were fasted overnight and scanned using positron emission tomography (PET) in one of four assigned conditions: control (CON), exercise (EX), naltrexone injection (NTX) or exercise + naltrexone injection (EX+NTX). Mice were delivered a dose of 18F-fluorodeoxyglucose (FDG) 1 hour prior to scanning. Mice that underwent exercise performed 50 minutes of forced swimming (FS) following a week of familiarization, which consisted of 5-25 minutes of FS. NTX was given via intraperitoneal injection (4 mg/kg) 15 minutes prior to exercise or FDG administration. Data was imaged using VivoQuant software and analyzed using PMOD software by a technician blinded to the experimental conditions. Data was calculated as average standardized uptake values (SUV) for 19 regions of interest (ROI) and made relative to the SUV of the whole brain. **RESULTS:** Exercise increased the SUV of glucose in the cerebellum (EX=1.27 ± 0.14; $P<0.05$) relative to mice under CON (0.98 ± 0.07) or NTX (0.85 ± 0.03) conditions. The exercise mediated increase in activity in the cerebellum was abolished ($P<0.05$) with the addition of NTX (0.88 ± 0.10). The combination of EX+NTX increased the SUV of glucose in the hypothalamus region relative to all groups ($P<0.05$). **CONCLUSIONS:** The cerebellum is largely responsible for the regulation of voluntary muscular activity. Exercise appears to have a potent effect on brain activity specific to this region and may be at least partially mediated by endogenous opioids. Further, the endogenous opioid system may play a role in the attenuation of the hypothalamic-pituitary adrenal system during exercise.

3616 Board #304 Jun. 1 9:30 AM - 11:00 AM
Diminished Cardiovascular Performance That Persists Up To 3 Days After Completion Of Repeated 6-hour Hyperoxic Resting Dives At 1.35 ATA Is Associated With Reduced Oxygen Consumption

Elizabeth R. Bergeron, John P. Florian. Navy Experimental Diving Unit, Panama City Beach, FL.
 (No relationships reported)

Previous measures of cardiovascular endurance after repeated dives on air and 100% oxygen at 1.35 atmospheres absolute (ATA) have shown reductions in performance that persist up to 3 days post-dive for the hyperoxic group only. **PURPOSE:** Examine ventilatory parameters associated with changes in treadmill endurance immediately and 3 days after completing repeated air and oxygen resting dives. **METHODS:** 15 and 12 healthy male Navy divers completed 5 consecutive 6-hr dives with 18-hr surface intervals while breathing air and 100% oxygen, respectively, at 1.35 ATA (Air/Oxygen: 30±5/32±7 yrs; VO_2 max: 52±7/53±5 ml/kg/min; mean±SD). Treadmill endurance time at 80-85% of VO_2 max and associated physiological variables were tested a few days prior to the first dive (BL), 2 hours post-dive day 5 (PD) and 3-days post-dive (PD3) on day 8. Breath-by-breath (Innocor) minute ventilation (VE), end-tidal CO_2 ($F_{ET}CO_2$), oxygen consumption (VO_2), and respiratory quotient (R) were collected during the 80-85% VO_2 max run at 10% grade until exhaustion. PD and PD3 were compared to BL (BL-PD and BL-PD3) using data from the first minute, mid-run, and last minute of the run. **RESULTS:** PD cardiovascular endurance significantly decreased for Air and Oxygen phases (Air: -34%; Oxygen: -36%; $p<0.05$), yet only the Oxygen phase remained reduced PD3 (Air: -11.9%; $p>0.05$; Oxygen: -31%; $p<0.05$). VE increased significantly during the run, but was not different between Air and Oxygen phases or across testing days. Although $F_{ET}CO_2$ decreased across run times and testing days for Air and Oxygen, values for the Oxygen group remained lower than Air throughout ($p<0.05$). PD VO_2 showed decline in both groups (Air/Oxygen: PD -7%; $p<0.05$). VO_2 for Air recovered by PD3, whereas Oxygen remained reduced (Air: +1%; Oxygen: -13%; $p<0.05$). PD R increased overall for both groups, yet Air returned to baseline while Oxygen remained elevated by PD3 (Air: PD: +4%; $p<0.05$; Oxygen: PD +7%, PD3 +4%; $p<0.05$). **CONCLUSIONS:** Treadmill endurance is reduced after long-duration diving and persists longer when exposed to hyperoxic diving conditions. Reduced VO_2 and elevated R has been reported in the literature to correlate with increased lactate production and a greater reliance on anaerobic energy systems making them likely causes of this decrease in aerobic performance.

3617 Board #305 Jun. 1 9:30 AM - 11:00 AM
The Combined Impact Of Altitude And Heat On Heat Shock Protein 70 And Hypoxia-inducible Factor-1 Alpha

Roy M. Salgado, Katherine M. Mitchell, Karleigh E. Bradbury, Adam J. Luippold, Charles S. Fulco, Jermaine A. Ward, Robert W. Kenefick, FACSM. US Army Research Institute of Environmental Medicine, Natick, MA.
 Email: roy.m.salgado.civ@mail.mil
 (No relationships reported)

There are areas in the world where elevated temperatures occur at relatively high altitudes. Exposure to heat or altitude typically induces an increase in intracellular heat shock protein 70 (iHSP70) and hypoxia-inducible factor-1 α (iHIF-1 α), which

have beneficial down-stream physiological effects. However, the responses to the combination of these environments are unclear. **Purpose:** To determine the impact of combined acute exposure to heat and altitude on iHSP70 and iHIF-1 α .

Methods: Using a randomized, cross-over study design, 10 men (mean \pm SD; age: 25 \pm 7 yr; weight: 88 \pm 13 kg; height: 180 \pm 6 cm; sea level (SL) VO_{2peak}: 42 \pm 5 ml \cdot kg⁻¹ \cdot min⁻¹) were exposed to four environmental conditions separated by at least one week: (1) SL thermoneutral (SLTN; 250m, 20°C, 30-50% rh); (2) SL hot (SLH; 250m, 35°C, 30% rh); (3) altitude thermoneutral (ATN; 3000m, 20°C, 30-50% rh); and (4) altitude hot (AH; 3000m, 35°C, 30% rh). Blood samples were collected at SL (baseline, BL) prior to ~1.5 hour environmental equilibration period and again immediately Pre- and Post- 30 minute of steady state (SS) exercise (cycling, 50% of SL VO_{2peak}). iHSP70 and iHIF-1 α were measured from peripheral blood mononuclear cells. The percent change (% Δ) from BL to Pre- and PostSS was analyzed with 2 x 4 (% Δ BL to Pre- and PostSS x environment) RM ANOVA. **Results:** iHSP70: there was an effect of exercise (PreSS: 4.4 \pm 7.6% vs PostSS: 17.5 \pm 9.6%, $p < 0.05$), but no effect of environment ($p > 0.05$) or an exercise x environment interaction ($p > 0.05$). iHIF-1 α : there was no effect for exercise ($p > 0.05$), environment ($p > 0.05$), or an exercise x environment interaction ($p > 0.05$). **Conclusion:** Our results indicate that iHSP70 increased in response to SS exercise while iHIF1 α was unaltered in these testing conditions. The combination of heat and altitude did not result in an even greater protein expression when compared to exercise alone. However, it is plausible that a more severe environmental stress and/or higher exercise intensity (> 50% SL VO_{2peak}) would result in elevated cellular response compared to a single environment. Funded by USAMRMC; authors views not official US Army or DOD policy.

3618 Board #306 Jun. 1 9:30 AM - 11:00 AM
Effects Of Exercise On Stress-induced Attenuation Of Vaccination Responses In Mice

Yi Sun¹, Selena S. Wang², Christy S. Carter¹, Thomas W. Buford, FACSM¹, Jeffrey A. Woods, FACSM². ¹UNIVERSITY OF ALABAMA AT BIRMINGHAM, BIRMINGHAM, AL. ²UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN, URBANA, IL.
 Email: yisun@uabmc.edu
 (No relationships reported)

Vaccination is one of the most successful public health interventions for preventing infectious diseases, although the immunosuppressive effects of chronic stress can reduce a vaccine's efficacy. Exercise improves vaccine responses, but the role in attenuating stress-induced effects is unknown. **Purpose:** We investigated the effects of forced/acute (eccentric exercise; ECC) and voluntary/long-term (wheel running; VWR) exercise on antibody and cell-mediated immune responses to vaccination in chronically stressed mice. **Methods:** Mice were randomized into Control (CON), S (Stress)-ECC, S-VWR, and S-SED (Sedentary) groups. Chronic restraint stress occurred 6-h/day, 5-days/week for three weeks. S-VWR mice were allowed access to a wheel for the entire experiment. One week post-stress, S-ECC mice ran on a treadmill for 17m/min, -20% grade, for 45 minutes and were then injected with 100 μ g of ovalbumin (OVA) and 200 μ g of alum adjuvant (intramuscularly), along with all other groups. Anti-OVA IgM and IgG was measured via ELISA. Three weeks post-stress, mice were injected with OVA into the ear to determine delayed-type hypersensitivity (DTH) response as a measure of cell-mediated immunity. **Results:** As expected, chronic restraint stress significantly reduced body weight and caused adrenal hypertrophy. Over the course of the experiment, S-ECC, and S-VWR groups had significantly elevated anti-OVA IgG compared to S-SED which had significantly lowered levels compared to CON ($p < 0.05$). No differences were observed with anti-OVA IgM nor DTH responses. **Conclusion:** Acute ECC and VWR alleviated chronic stress-induced reductions in anti-OVA IgG vaccination responses while neither type of exercise had an impact on anti-OVA IgM or cell-mediated immune responses. Future experiments need to address the mechanism of the exercise beneficial effects on IgG.

3619 Board #307 Jun. 1 9:30 AM - 11:00 AM
Body Composition Assessment in Athletes with Spinal Cord Injury

Claudia Pérez¹, Juan Tejo², Raul Smith³, Fernando Carrasco⁴. ¹Hospital de Carabineros de Chile, Santiago, Chile. ²Centro de Alto Rendimiento de Chile, Santiago, Chile. ³Instituto Teleton, Santiago, Chile. ⁴Universidad de Chile, Santiago, Chile.
 Email: claudiaperezlmd@gmail.com
 (No relationships reported)

PURPOSE: To determine which anthropometric equation used to estimate body composition in athletes with chronic spinal cord injury (SCI) has better concordance with Dual X-ray absorptiometry. **METHODS:** Seventeen male athletes with chronic SCI AIS A or B, participated from this study. Body composition was estimated using two anthropometric equations (Kerr Ross and Durnin Womersley). The evaluation was performed with the athlete in the supine/prone position and seating in their wheel chair. The same day a DEXA scan was performed. Shapiro Wilk test was used

and results were analyzed with student T test, Pearson correlation test and Bland & Altman method. **RESULTS:** The athletes were 30,9 year old (SD: 7,1), they trained 14,5 (SD 7,7) hours a week and averaged 5,4 years of experience in sports. They had 29,5% Fat Mass (FM) (SD: 7,3) and 48,6 (SD: 5,5) kilograms of Free Fat Mass (FFM) measured with DEXA scan. There was no difference between FM and FFM results determined by DEXA scan and those estimated by Kerr Ross Method ($p < 0,001$). There was a significant difference between DEXA scan results and estimations by Durnin Womersley equation ($p > 0,05$). No difference was found when comparing anthropometric results with the athlete in the supine/prone position and seating in their wheel chair. The correlation between FM and FFM measured with DEXA scan and the estimated By anthropometric equation where superior for Kerr Ross method ($r = 0,75$ and $r = 0,86$ respectively). The average difference between DEXA scan results and Kerr Ross method estimation for FM and FFM was: 0,84% (SD= 5.04) and -0,39 kilograms (SD= 3,49) respectively. **CONCLUSIONS:** When using anthropometric evaluation to estimate body composition in athletes with SCI, Kerr Ross method is superior to Durnin Womersley equation. But this method does not have acceptable agreement with DEXA scan for clinical purposes. Anthropometric evaluations are easily performable in the field and affordable, but more research is needed to determine the best method to estimate body composition in athletes with SCI.

3620 Board #308 Jun. 1 9:30 AM - 11:00 AM
Wearable Technology To Reduce Sedentary Behavior And CVD Risk In Older Adults: A Pilot Trial

Lisa M. Roberts¹, Byron C. Jaeger¹, Liliana C. Baptista¹, Sara A. Harper¹, Elizabeth Jackson¹, Anna K. Gardner², Bhanuprasad Sandesara², Todd M. Manini², Stephen D. Anton², Thomas W. Buford¹. ¹University of Alabama at Birmingham, Birmingham, AL. ²University of Florida, Gainesville, FL.
 (No relationships reported)

Older adults account for the vast majority of healthcare expenditures and deaths attributable to cardiovascular disease (CVD). Physical activity (i.e. exercise) is associated with decreased CVD risk, but recent large-scale trials suggest that exercise alone is insufficient to reduce CVD events in high-risk populations of older adults. **PURPOSE:** This pilot randomized clinical trial evaluated the impact of combining structured exercise with an intervention designed to enhance non-exercise physical activity (EX + NEPA) compared to EX alone. **METHODS:** Participants aged ≥ 60 years ($n = 40$) with moderate to high risk of coronary heart disease (CHD) events were randomly assigned to either the EX + NEPA or EX groups and followed for 20 weeks. Both groups underwent a twice weekly, eight-week center-based exercise intervention with aerobic and resistance exercises. The EX + NEPA group also received a mobile activity tracking device along with behavioral monitoring and feedback throughout the study. Study outcomes evaluated at week 20 were: 1) physical activity patterns (steps/day and sedentary time), 2) blood pressure, and 3) circulating indices of cardiovascular risk (blood glucose and triglyceride levels). Linear mixed models estimating group differences were adjusted for age, sex, group, visit, and baseline level of the outcome. Data are presented as mean differences (EX + NEPA relative to EX) with 95% confidence intervals at week 20. **RESULTS:** Relative to EX, the change in steps/day at week 20 was 2,071 [61.07, 4081] for EX + NEPA. For sedentary time (minutes per day) the difference between groups was -31.21 [-168.18, 105.76]. The differences for systolic and diastolic blood pressure were -9.94 [-19.57, -0.31] and -1.77 [-6.89, 3.34] mm Hg, respectively. The difference was 0.70 [-15.90, 17.31] mg/dL for glucose and -5.53 [-58.63, 47.57] mg/dL for triglycerides. **CONCLUSIONS:** The addition of activity tracking technology appeared to positively influence daily activity patterns and directionally favored blood pressure and triglyceride levels. Wearable technology may impact daily habits of older adults and improve risk factors for CHD - although a fully-powered trial is needed to definitely test this hypothesis. Supported by AHA 16IRG27250237, NIA 2P30AG028740, NCMRR 1P2CHD086851, and the UAB Center for Exercise Medicine

3621 Board #309 Jun. 1 9:30 AM - 11:00 AM
Identifying Specific Elements Necessary for a Pediatric Cardiac Rehabilitation Program: An e-Delphi Study

Tracy Curran¹, Susan Duty², Naomi Gauthier¹, Rachelle Pojednic, FACSM². ¹Boston Children's Hospital, Boston, MA. ²Simmons University, Boston, MA.
 Email: tracy.curran@cardio.chboston.org
 (No relationships reported)

Encouraging children and adolescents with congenital heart disease (CHD) to participate in regular exercise is an essential component in helping them rise toward their full potential physically, socially, and emotionally. Identifying appropriate tools and resources that promote healthy and active lifestyles specifically for this population are currently lacking and must be developed. Cardiac rehabilitation programs are an effective modality with beneficial clinical outcomes for adult patients with coronary heart disease, however these programs are scarce for the CHD pediatric population and not well defined.

Purpose: The purpose of this study was to identify relevant content for the development and structure of a pediatric cardiac rehabilitation curriculum for young patients with CHD using a consensus approach.

Methods: A three-round e-Delphi study among CHD and pediatric exercise physiology (EP) experts was conducted. In the first round, experts provided opinions in a closed- and open-ended electronic questionnaire to identify specific elements necessary for inclusion in a Pediatric Cardiac Rehab Program. In the second round, experts were asked to re-rate the same items after feedback and summary data was provided from round one. In the third round, the same experts were asked to re-rate items that did not reach consensus from round two.

Results: 47 experts were contacted via e-mail to participate on the Delphi panel. 37 consented, 35 completed round one, 29 completed round two and 28 completed the final round. After the third round, consensus was reached in 55 of 60 (92%) questionnaire items. Experts identified specific elements across four domains: exercise training, education, outcome metrics and self-confidence to be included in a Pediatric Cardiac Rehab Curriculum.

Conclusion: This study established consensus toward the ideal program structure, exercise training principles, educational content, patient outcome measures and self-confidence promotion. By identifying the key components within each domain, there is potential to benchmark recommended standards and practice guidelines for the development of a Pediatric Cardiac Rehab curriculum to be used healthcare team members for optimizing the health and wellness of pediatric CHD patients.

3622 Board #310 Jun. 1 9:30 AM - 11:00 AM

Consequences Of Physical Inactivity In Older People: An Umbrella Review Of Meta-analyses

Conor Cunningham¹, Roger O' Sullivan¹, Paolo Caserotti², Mark A. Tully³. ¹Institute of Public Health in Ireland, Belfast, United Kingdom. ²University of Southern Denmark, Odense, Denmark. ³Ulster University, Belfast, United Kingdom.
Email: conor.cunningham@publichealth.ie
(No relationships reported)

Low physical activity (PA) levels are implicated in the aetiology of many non-communicable diseases. However research often fails to specifically focus on the impact of physical inactivity on the health of older adults, despite the fact that PA declines and health worsens with age.

PURPOSE: An umbrella review of the epidemiological evidence for the effects of physical inactivity on physical and mental health in older adults (≥ 60 yrs) for the 2019 Copenhagen Consensus Statement on PA and Ageing.

METHODS: Systematic database search for meta-analyses (MA) of longitudinal observational studies. Titles and abstracts were reviewed independently by two researchers. Duplicates were removed and data from included MAs extracted, including relative risk (RR) for health outcomes, characteristics and risk of bias (AMSTAR Scale) of included reviews.

RESULTS: 4,434 citations identified. 17 full text MA were included. Key findings of high quality reviews ($\geq 8/11$ on AMSTAR scale): **All-cause mortality:** 34% RR reduction with highest vs lowest level of PA (≥ 70 yrs, RR=0.66, 95% CI 0.50-0.88) (Samitz et al., 2011); **Healthy ageing** was significantly associated with PA (n=174,114, ≥ 65 yrs, ES=1.14 95% CI 1.07-1.22) (Daskalopoulou et al., 2017); **Cognitive decline:** Moderate vs lowest level of PA=RR reduction ranged from 26% (OR=0.74, 95% CI 0.60-0.90) (Guure et al., 2017) to 35% (HR=0.65, 95% CI 0.57-0.75) (Sofi et al., 2011); **Dementia:** Highest vs lowest level of PA=14% RR reduction (n=40,384, RR=0.86, 95% CI 0.76-0.97) (Blondell et al., 2014); **Alzheimer's disease:** Highest vs lowest level of PA=35% RR reduction (n=23,345, 70-80 yrs, RR=0.65, 95% CI 0.56-0.74) (Santos-Lozano et al., 2016); **Incident depression:** Highest vs lowest level of PA=17% RR reduction (adjusted OR=0.83, 95% CI 0.79-0.88) (Schuch et al., 2018); **Musculoskeletal health:** RR reduction in hip fracture=6% (n=96,966 women, RR=0.94, 95% CI 0.93-0.96) (Rong et al., 2016) and 29% RR reduction in total fractures for highest vs lowest level of PA (RR=0.71, 95% CI 0.63-0.80) (Qu, et al., 2014). Adverse risks were not reported.

CONCLUSION: PA confers contemporaneous and wide ranging health benefits in later life. These findings make a compelling case for further investment in preventive services that promote PA in older adults.

3623 Board #311 Jun. 1 9:30 AM - 11:00 AM

How Does Circadian Rhythmicity Relate to Neuropsychological and Neuroimaging Markers in Older People at Risk for Dementia?

Shantel Duffy, Jonathon Pye, Jake Palmer, Sharon L. Naismith. University of Sydney, Camperdown, Australia.
(No relationships reported)

Background: Changes in the circadian regulation of the sleep-wake cycle occur with ageing and may be linked to neurodegeneration. It is unclear the extent to which such changes are evident in mild cognitive impairment (MCI), and how they may relate to neuropsychological functioning, the integrity of key temporal lobe structures

and longitudinal decline. **Method:** 334 older individuals (mean age=66.1, sd=8.9) with subjective cognitive impairment (SCI) and MCI (mean MMSE=28.1, sd=1.4) received detailed neuropsychological assessment including Logical Memory, Rey Auditory Verbal Learning Test, Rey Figure and Boston Naming Test. They also received clinical and wrist-worn actigraphic assessment, and a subset of 60 individuals underwent neuroimaging. Circadian rhythm analysis was performed using non-parametric methods to obtain intradaily variability, interdaily stability, and activity during the least and most active 5-hours and 10-hours of the day, respectively. Cosinor methods were also used to derive amplitude, mean, and variability of the rest-activity rhythm. For the neuroimaging subset, cortical thickness of the entorhinal cortex and hippocampal volume were derived using Freesurfer. A subset of 90 individuals had 2-year longitudinal follow-up data from which memory decline scores were computed. **Results:** Compared to SCI, after controlling for age, participants with MCI showed significantly greater intradaily variability as well as lower amplitude of activity across the circadian period, and lower activity during the most active 10-hour period. Across both groups, circadian disruption was associated with poorer performance on tests of verbal memory ($p<0.05$), visuospatial memory ($p<0.001$) and confrontation naming ($p<0.001$). Lower activity amplitude was associated with reduced cortical thickness in the entorhinal cortex. For those with follow-up data, greater activity during the least active 5-hours of the day was associated with memory decline longitudinally ($p<0.05$). **Conclusion:** Disruptions to the rest-activity cycle relate to both memory and language decline cross-sectionally and memory decline longitudinally as well as to degeneration of key temporal brain regions. Alterations in this cycle may represent a preclinical or prognostic marker for dementia and may warrant intervention.

3624 Board #312 Jun. 1 9:30 AM - 11:00 AM

Exercise Intervention Reduces Circadian Clock Suppressor, CRY2, in Adults with Obesity

Melissa L. Erickson¹, Hui Zhang², John P. Kirwan, FACSM¹. ¹Pennington Biomedical Research Center, Baton Rouge, LA. ²Case Western Reserve University, Baton Rouge, LA.
Email: melissa.erickson@pbrc.edu
(No relationships reported)

PURPOSE: Exercise improves skeletal muscle insulin sensitivity, and also resets physiological circadian clocks. CRY2, a circadian clock suppressor, reduces exercise capacity in mouse models. Whether exercise impacts CRY2 in humans is unknown. Thus, we tested the effects of 12 weeks of exercise training on circulating CRY2 concentrations in adults with obesity. Secondly, we assessed whether these changes were related to improvements in insulin sensitivity. **METHODS:** Thirteen adults (Age: 64.4 ± 13.7 , BMI: 35.9 ± 5.1) participated in 12 weeks of exercise training (5 day/wk, 60 min/session, 85% HRmax) combined with a eucaloric diet. Body composition (abdominal adiposity using computed tomography), insulin sensitivity (glucose disposal rate from euglycemic-hyperinsulinemic clamp), exercise capacity (VO_{2max}), and circulating CRY2 levels measured by ELISA were assessed before and after intervention. **RESULTS:** Body composition (BMI, abdominal adiposity), insulin sensitivity, and exercise capacity all improved (all $P > 0.05$). CRY2 levels decreased after intervention (Pre: 12.2 ± 2.1 ; Post: 10.1 ± 2.3 ng/mL; $P=0.001$). Baseline CRY2 inversely correlated with baseline fat-free mass ($r=-0.56$, $P=0.046$) and baseline insulin sensitivity ($r=-0.61$, $P=0.038$). **CONCLUSION:** We show for the first time that exercise training reduces circulating levels of CRY2, a circadian clock suppressor, in adults with obesity, which was accompanied by increased insulin sensitivity and improved body composition. Direct links between exercise-induced changes in circadian clock function and parallel systemic metabolic improvements are worthy of further investigation.

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3625 Board #313 Jun. 1 9:30 AM - 11:00 AM

The Effects Of Different Resistance Training Zones With Equalized Volumes On Muscular Adaptations

Alexandre L. Evangelista¹, Roberta A.G.T. Evangelista², Tiago V. Braz³, Cauê V. La Scala Teixeira⁴, Danilo S. Bocalini⁵, Roberta L. Rica⁶, Angelica C. Alonso⁷, Julia Maria D. Greve⁸. ¹Nove de Julho University, SAO PAULO, Brazil. ²Sao Judas tadeu University, SAO PAULO, Brazil. ³Methodist University of Piracicaba, PIRACICABA, Brazil. ⁴Federal University of Sao Paulo, SANTOS, Brazil. ⁵Federal University of Espirito Santo, VITORIA, Brazil. ⁶Estacio de Sa University, Vitoria, Brazil. ⁷Sao Judas Tadeu University, SAO PAULO, Brazil. ⁸Faculty of Medicine, University of São Paulo, SAO PAULO, Brazil.
Email: contato@alexandrelevangelista.com.br
(No relationships reported)

PURPOSE: To investigate the effects of different resistance training (RT) zones with equalized volumes on muscular adaptations. **METHODS:** Thirty-one volunteers underwent 8 weeks of RT and were distributed in two groups: ten sets of three maximal

repetitions (10x3, n=14) and three sets of ten maximal repetitions (3x10, n=17). The biceps curl, squat and elbow extension exercise were performed twice a week. The maximum strength (one repetition maximum test-1RM) was tested before and after the study for these exercises. Muscle thickness (MT) was also measured (pre x post) for biceps braquii (BB), triceps braquii (TB) and vastus lateralis (VL). RESULTS: As showed in Table 1, a significant main effect (p=0.001) on time in 1RMbiceps curl, 1RMsquat and 1RMelbow extension was observed for both groups. There was no significant difference in time x group interaction for 1RMbiceps curl, 1RMsquat and 1RMelbow extension (all p>0.05). A significant main effect (p=0.001) in time was observed in MT for BB, TB and VL. There was no significant difference in time x group interaction for BB, TB and VL (all p>0.05). CONCLUSION: The present study suggests that, regardless of the number of sets and maximum repetition zone, the improvement of maximum strength in squatting, elbow flexion and extension, as well as biceps, triceps and vastus lateralis muscle thickness occurs similarly when volume of repetitions is equalized.

KEY WORDS: Resistance training; Muscular adaptations; Volume of training

Table 1. Muscle strength and muscle thickness measures after 8 weeks of training.

Parameters	Before	After	Δ%	Cohen ES	ANOVA 3x2	
					time p value	time*group p value
1RM_{biceps curl} (kg)						
3x10	29±10	38±11 ^a	30.3	0.86	0.001	0.414
10x3	29±15	38±17 ^a	33.2	0.60	0.001	
1RM_{squat} (kg)						
3x10	156±41	206±43 ^a	32.4	1.20	0.001	0.973
10x3	152±73	206±85 ^a	35.3	0.68	0.001	
1RM_{elbow extension} (kg)						
3x10	56±18	69±19 ^a	22.8	0.69	0.001	0.375
10x3	54±20	66±23 ^a	20.8	0.52	0.001	
BB (mm)						
3x10	34.6±6.9	39.3±6.8 ^a	13.7	0.69	0.001	0.226
10x3	34.9±6.5	39.4±6.7 ^a	13.0	0.69	0.001	
TB (mm)						
3x10	35.4±3.9	39.8±4.4 ^a	12.2	1.03	0.001	0.884
10x3	35.0±5.5	40.1±4.7 ^a	14.4	0.98	0.001	
VL (mm)						
3x10	40.7±5.5	45.2±6.3 ^a	11.2	0.77	0.001	0.775
10x3	40.9±4.7	45.7±4.9 ^a	11.8	1.01	0.001	

Values expressed in mean±SD of 3x10 group and 10x3 group One maximal repetition test (1RM). Muscle thickness (mm) of the biceps brachii and brachialis (BB), triceps brachii (TB) and vastus lateralis (VL). Effect size (ES). ^asignificant (p<0.05) differences to before.