RESULTS: Skeletal muscle CS maximal activity increased ($P<0.05$) from 25.5±3.1 to 30.0±3.1 μmol g$^{-1}$ min$^{-1}$ in HIT only, with larger ($P<0.05$) improvement compared to MIT. Muscle HAD maximal activity increased ($P<0.05$) in HIT 15.3±1.9 to 18.5±4.0 μmol g$^{-1}$ min$^{-1}$ and in MIT (15.7±2.8 to 19.5±3.0 μmol g$^{-1}$ min$^{-1}$) with no between-group difference. YYIR2 score was improved ($P<0.05$) ~39 % more in HIT compared to MIT post-intervention (323 ± 125 vs. 222 ± 113 m).

CONCLUSIONS: Additional high-intensity and moderate-intensity training augmented skeletal muscle oxidative capacity and high-intensity exercise performance in trained athletes with an overall higher effect of high-intensity training.

PURPOSE: We examined the hypothesis that failing to maintain energy availability (EA, calculated as energy intake (EI) - exercise energy expenditure (ExEE)) during intensified training (IT) would predispose athletes to a state of overreaching (OR, high perceived fatigue and prolonged performance impairment).

METHODS: After 4 weeks of baseline training, 16 female runners (28 ± 5 yrs) performed 4 weeks of IT (130% of baseline volume), followed by a 2 week recovery, (REC, 50% of baseline). Over the last 7 days of each phase, ExEE was measured with chest-worn activity monitors (Actiheart) and EI was recorded using my Fitness Pal phone application. Running performance (distance covered during a graded treadmill test) and perceived fatigue (REST-Q) were assessed at the end of each phase to classify athletes as OR or acutely fatigued (AF, increased fatigue but no decrease in performance). VO$\text{max}$, heart rate (HR), systolic blood pressure (SBP), plasma epinephrine and norepinephrine and blood lactate concentrations were measured at 75, 65 and 85% of VO$\text{max}$ and immediately after maximal exercise.

RESULTS: 7 runners became OR and 9 were AF (Aperformance= +92% vs +4±2 %). Performance was still suppressed in OR after REC ( +6 ± 5%). A significant decrease in EA was found in OR (~178±104 kcal/d), who failed to increase EI with IT. By contrast, AF increased EI (184±48 kcal/d) and maintained EA. AEA correlated with Aperformance and ΔVO$\text{max}$ (R = 0.61 and 0.66, p < 0.05). VO$\text{max}$ and peak lactate, epinephrine and norepinephrine, HR and SBP were suppressed in OR, but were maintained in AF after IT. At submaximal intensities at the same speed after IT, AF showed reduced HR, and lactate and norepinephrine responses, while OR showed no change in these variables but did have increased ratings of perceived exertion.

CONCLUSIONS: Failure to maintain EA during IT was associated with a state of non-functional OR in female runners. High perceived fatigue and impaired performance in OR was accompanied by blunted physiological responses at maximal exercise and a lack of any desirable cardiovascular or endocrine-metabolic adaptation to submaximal intensities. In contrast, AF runners that increased EI to match ExEE with IT showed improved performance and lower HR, blood lactate and plasma norepinephrine at the same submaximal speeds after IT.

PURPOSE: College years are a time of learning and adopting positive healthy habits into one’s lifestyle, so it seems prudent to measure any changes in cardiovascular profiles (i.e. blood pressure) Thus, the purpose of this study was to determine blood pressure (BP) responses in college-aged students enrolled in a 16-week Indoor Cycling or Resistance-Training course. METHODS: Thirty-eight students (N =38) volunteered for this study during The Fall 2015 Semester and signed a Human Subjects consent form. Inclusion criteria included the following: healthy males and females, normotensive, and non-smokers. Students were between the ages of 18-21 years of age. Exclusion criteria included those who were symptomatic, on contraband medications, or habitual smokers. Students’ resting systolic and diastolic BP was assessed pre-, mid-, and post- semester. RESULTS: Means and standard deviations (SD) were determined for age (21 ± 3.36 years), height (69 ± 4.07 in.), and weight (156 ± 34.88 lbs.) A Paired Sample T-Test was utilized to compare blood pressure responses between classes. Statistical significance was set a priori at $p<0.05$. Statistical analyses revealed significant findings for mid-to-post- BP between aerobic (mid-121.24 ±

In sedentary persons, high-intensity training (HIT) induces a larger up-regulation of skeletal muscle oxidative capacity than moderate-intensity training (MOD). However, it is unknown if HIT compared to MOD also induces larger muscular oxidative adaptations in trained athletes. PURPOSE: To investigate the hypothesis that HIT induces larger changes in skeletal muscle oxidative capacity and high-intensity exercise performance than MOD in trained soccer players.

METHODS: In a randomized controlled trial, 31 competitive soccer players (mean±SD, age, 22±2 years, height, 183±8 cm, weight, 76±6 kg) were assigned to either HIT (n=16) or a MOD (n=15). HIT performed 6-10 x 30 all-out exercise bouts separated by 3 min recovery (high speed running distance of 238±51 m, peak blood lactate 13.7±3.4 mM), while MIT performed small-sided games (6v6 x 2 x 7 min with 2 min recovery; high speed running distance of 14±14 m, peak blood lactate 4.8±2.3 mM). The training-intervention was conducted three times per wk in 4 wks in addition to the normal team-training. A muscle biopsy was obtained pre and post-intervention from m. vastus lateralis for analysis of 3-hydroxyacyl-CoA-dehydrogenase (HAD) and citrate synthase (CS) maximal enzyme activity. In addition, the Yo-Yo Intermittent Recovery test level 2 (YYIR2) was completed.

In the current study, subjects performed 8 weeks of supervised resistance exercise involving the knee extensors muscles. Each of the subject’s legs were randomized to complete the training program using either a flywheel (FW) device emphasizing eccentric-overload, or a traditional weight stack machine (WS). Maximal mitochondrial oxidative phosphorylation (OXPHOS) from permeabilized skeletal muscle bundles was assessed using high resolution respirometry before and after the training intervention. Citrate synthase activity was assessed using spectrophotometric techniques. After training, OXPHOS decreased ($P<0.05$) in both FW (23%) and WS (29%) with no difference across medical treatments. Although OXPHOS decreased in both legs, the change was greater (interaction P = 0.015) in WS (32% P = 0.015) than in FW (19%; P = 0.078). Citrate synthase (CS) did not change after the intervention. The increase in quadriceps muscle volume was not significantly correlated with the change in OXPHOS (R = 0.15). These results suggest that 1) eight weeks of resistance training reduces mitochondrial function but not mitochondrial content, 2) The decreased mitochondrial function with resistance exercise was not affected by ibuprofen consumption, 3) flywheel resistance training, emphasizing eccentric overload, rescues some of the reduction in mitochondrial function seen with conventional resistance training.
14.79; post-116.38 ± 12.76) and resistance training (mid-124.53 ± 14.03; post-122.76 ± 16.64) classes. CONCLUSIONS: Both classes experienced statistically, positive changes in BP from mid- to post-semester. Supported by Just-in-Time Teaching & Technology Grant (CTE: SMU)

**RESULTS:**

Following eccentric cycling training was effective in improving walking economy. To the best of our knowledge, this is the first report of a significant improvement in ambulatory function following chronic eccentric training. Improvement in ambulatory function would be beneficial for both healthy and aging populations.

<table>
<thead>
<tr>
<th>Walking Speed (m/s)</th>
<th>Cw (J/kg/m)</th>
<th>P</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>2.1±0.44</td>
<td>1.9±0.42²</td>
<td>0.63</td>
</tr>
<tr>
<td>1.11</td>
<td>2.3±0.38</td>
<td>2.0±0.27</td>
<td>0.56</td>
</tr>
<tr>
<td>1.39</td>
<td>2.3±0.43</td>
<td>2.1±0.24</td>
<td>0.06</td>
</tr>
<tr>
<td>1.67</td>
<td>2.7±0.42</td>
<td>2.5±0.27</td>
<td>0.09</td>
</tr>
<tr>
<td>1.9</td>
<td>3.3±0.57</td>
<td>3.0±0.90</td>
<td>0.09</td>
</tr>
</tbody>
</table>

**Table 1.** Pre versus post-training Cw values following eccentric training. Data presented as mean±SD

Acetaminophen (ACT) has analgesic properties and reduces fever. It blocks cyclooxygenase (COX) action and attenuates the production of prostaglandins (PG). It has been shown that ACT administration relieves pain by elevating the pain threshold. Therefore, ACT may improve performance by enabling participants to exercise closer to a true physiological limit. **Purpose:** The aim of this study was to establish whether acetaminophen improves performance of self-paced exercise through the reduction of perceived pain. **Method:** Twenty recreationally active runners performed an incremental test to determine VO2max. Participants completed a familiarisation test of a 3 km time-trial (TT) treadmill run. On separate days the participants completed two experimental self-paced 3 km TT on a treadmill beginning their effort at 90% of VO2max. During the experimental trials participants ingested either 1.5 g acetaminophen or placebo in a double blind, active running performed an incremental test to determine VO2max. Participants completed a familiarisation test of a 3 km time-trial (TT) treadmill run. On separate days the participants completed two experimental self-paced 3 km TT on a treadmill beginning their effort at 90%VO2max. During the experimental trials participants ingested either 1.5 g acetaminophen or placebo in a double blind, randomized, crossover design. Mean and maximum heart rate were recorded every 30 s during each 3 km TT. Time (pace) per kilometer was also recorded. At the end of each TT, a category-ratio scale was used to assess perceived pain. Blood lactate concentration was measured 3-5 min after completion of each TT. **Results:** Mean 3 km performance time was lower (p<0.05) after ACT (733.7 ± 92.86 s) compared with PLA (747.8 ± 95.9 s). ACT administration induced mean 2% improvement in 3 km running performance. Rate of perceived exertion was slightly higher in PLA condition (PLA 18.3 ± 1.04 vs ACT 18.3 ± 1.00). Subjects also during TT ran the 24 km (PLA 250.43 ± 32.02 vs ACT 245.61 ± 32.60 s) and 35 km (PLA 248.18 ± 34.18 vs ACT 239.91 ± 33 s) faster (p<0.05). Blood lactate and maximum heart rate were not different between experimental TT. **Conclusions:** ACT administration improved running endurance performance through increased pain tolerance, allowing the runners to exercise at a greater intensity for the same level of perceived pain and exertion.

**Board #8**

**June 1 8:00 AM - 10:00 AM
Effect Of Acute Acetaminophen Ingestion On Running Endurance Performance**


Email: 14.03@live.com

(No relationships reported)

Acetaminophen (ACT) has analgesic properties and reduces fever. It blocks cyclooxygenase (COX) action and attenuates the production of prostaglandins (PG). It has been shown that ACT administration relieves pain by elevating the pain threshold. Therefore, ACT may improve performance by enabling participants to exercise closer to a true physiological limit. **Purpose:** The aim of this study was to establish whether acetaminophen improves performance of self-paced exercise through the reduction of perceived pain. **Method:** Twenty recreationally active runners performed an incremental test to determine VO2max. Participants completed a familiarisation test of a 3 km time-trial (TT) treadmill run. On separate days the participants completed two experimental self-paced 3 km TT on a treadmill beginning their effort at 90%VO2max. During the experimental trials participants ingested either 1.5 g acetaminophen or placebo in a double blind, randomized, crossover design. Mean and maximum heart rate were recorded every 30 s during each 3 km TT. Time (pace) per kilometer was also recorded. At the end of each TT, a category-ratio scale was used to assess perceived pain. Blood lactate concentration was measured 3-5 min after completion of each TT. **Results:** Mean 3 km performance time was lower (p<0.05) after ACT (733.7 ± 92.86 s) compared with PLA (747.8 ± 95.9 s). ACT administration induced mean 2% improvement in 3 km running performance. Rate of perceived exertion was slightly higher in PLA condition (PLA 18.3 ± 1.04 vs ACT 18.3 ± 1.00). Subjects also during TT ran the 24 km (PLA 250.43 ± 32.02 vs ACT 245.61 ± 32.60 s) and 35 km (PLA 248.18 ± 34.18 vs ACT 239.91 ± 33 s) faster (p<0.05). Blood lactate and maximum heart rate were not different between experimental TT. **Conclusions:** ACT administration improved running endurance performance through increased pain tolerance, allowing the runners to exercise at a greater intensity for the same level of perceived pain and exertion.

**Board #9**

**June 1 8:00 AM - 10:00 AM
MVPA, Peak 1, And Peak 30 MinCadence Relationship With Cardiovascular Health**

Christopher Arboleda1, Jessica G. Redmond2, Tiago Barreira3

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Email: carboled@syr.edu

(No relationships reported)
RESULTS: A total of 87 participants were included in the analysis. There was a statistically significant and moderate relationship between VO2max and all three measures of physical activity, 55 with MVPA, 49 with P1, and 45 with P30. P1 and P30 were significant correlated with waist circumference (r = .36 and -.26 respectively), glucose (r = -.25 and -.22 respectively), HDL (r = .33 and .25 respectively), and BMI (r = -.32 and -.29 respectively). P1 was also significantly related to diastolic blood pressure (r = -.27). MVPA was only significantly correlated one other time with diastolic pressure (r = -.29).

CONCLUSION: P1 and P30 were significantly correlated with a larger number of cardiovascular health variables than MVPA. Both those measures should be investigated further as an alternative measure of physical activity.

1235 Board #8 June 1 8:00 AM - 10:00 AM
Haematological Responses to Detraining Following the Boston Marathon
Charles R. Pedlar1, John M. Higgins2, Marcel Brown1, Robert Shave1, Jennifer Maicha-Finch1, James Otto2, Anwesha Chaudhury1, Richard Burden1, Brian Moore3, Carlo Brugnara4, Aaron L. Baggish, FACSM5
1Massachusetts General Hospital, Boston, MA. 2Harvard Medical School, Boston, MA. 3Cardiff Metropolitan University, Cardiff, United Kingdom. 4University College London, London, United Kingdom. 5St Mary’s University, London, United Kingdom. 6Sligo Institute of Technology, Sligo, Ireland.
Email: charles.pedlar@stmarys.ac.uk

Purpose: While vigorous exercise is well known to stimulate erythropoiesis, the hematological response to exercise detraining remains incompletely understood. We sought to characterize red blood cell (RBC) mediated determinants of oxygen carry capacity, including RBC population dynamics, during a period of detraining. Methods: Recreational marathon runners participated in a structured 18-week training program (~7-8 h/w) then completed the 2016 Boston Marathon. Participants then reduced total exercise exposure to <2 h/w (no single session >1 h) for 8 weeks. Exercise testing, carbon monoxide rebreathing tests and venous blood draws were performed 10-14 days before, and at 4 and 8 weeks after the marathon. Mixed linear modeling adjusting for age and marathon finish time was used to compare data across time points. Results: Twenty-two runners (age = 34.5 ± 7.5 y, 50% men) completed the study protocol. Detraining was confirmed by serial reductions in time to exhaustion during treadmill testing (p<0.01, Figure 1). Plasma volume significantly declined by 4 weeks. In contrast, total hemoglobin mass (tHbmass) and serum ferritin remained stable. By 4 weeks, glycated hemoglobin was significantly elevated while RBC mean corpuscular volume was significantly reduced, indicating an increase in mean RBC age. By 8 weeks, there was a significant decrease in the RBC clearance threshold (Vc). Conclusion: tHbmass, a primary determinant of oxygen carrying capacity, appears to be stable during 8 weeks of exercise detraining. We speculate that this phenomenon is mediated by a subtle decrease in RBC production rate, and that an extended Vc after 8 weeks occurs to defend tHbmass in the absence of a sufficient erythropoietic stimulus.

Figure 1. Changes in exercise capacity and hematologic parameters in response to 8 weeks of exercise detraining following completion of the Boston Marathon.

1236 Chair: Laura Q. Rogers, FACSM, University of Alabama at Birmingham, Birmingham, AL.

Stroke Volume and Cardiac Output Response to Maximal Exercise is Attenuated in Anthracycline Treated Cancer Survivors
Ashley M. Larson1, Peter H. Brubaker, FACSM2, Jennifer Jordan1, Gregory Hundleby1, Wake Forest University, Winston Salem, NC. 2Wake Forest Baptist Medical Center, Winston Salem, NC.
Email: larsam15@wfub.edu

PURPOSE: Cancer survivors often experience exercise intolerance well after the completion of adjuvant chemotherapy. Although cardiotoxicity is a known consequence of anthracycline-based chemotherapy, its relationship to exercise intolerance has not been elucidated. Consequently, the objective of this study was to compare cardiovascular responses, at rest andpeak exercise, in anthracycline treated cancer survivors (ATS) and age-matched healthy controls (CON) to examine the mechanisms of exercise intolerance. METHODS: Four ATS, three males and one female, that were >12 months post- anthracycline-treatment or are currently receiving treatment, were assessed. Four age and gender matched CON participants were recruited as a comparison group. Each participant had a resting cardiac MRI (CMR) and then performed a maximal exercise test on a treadmill to obtain peak oxygen consumption (peak VO2) and heart rate (HR). Immediately (<30 sec) following the exercise test, the participant was redirected into the scanner for repeat CMR measures. CMR measures obtained both at rest and peak exercise included cardiac output (Q), stroke volume (SV), and ejection fraction (EF). Cardiac volumes were indexed for body surface area. Appropriate statistical analyses will be performed when the sample size of the study increases.

RESULTS: VO2 peak was greater in CON versus ATS (37.3 ± 10.8 ml/kg/min vs. 20.8 ± 4.0 ml/kg/min). Additionally, the change in Q from rest to peak exercise was highly correlated with VO2 peak (r = -.92) in these eight participants.

<table>
<thead>
<tr>
<th>Δ (Peak - Rest)</th>
<th>ATS</th>
<th>CON</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (bpm)</td>
<td>82.75 ± 9.55</td>
<td>90.25 ± 19.70</td>
</tr>
<tr>
<td>SV (mL/m2)</td>
<td>2.28 ± 1.27</td>
<td>5.34 ± 9.99</td>
</tr>
<tr>
<td>Q (L/m)</td>
<td>2.11 ± 0.89</td>
<td>4.31 ± 2.31</td>
</tr>
<tr>
<td>EF (%)</td>
<td>14.5 ± 0.82</td>
<td>17.75 ± 3.58</td>
</tr>
</tbody>
</table>

CONCLUSION: Both groups had a normal EF% at rest and a similar increase with exercise. Despite negligible differences in peak HR, CON had a two-fold greater increase in Q from rest to peak exercise compared to ATS, mainly due to a reduced SV response in ATS. The results of this small study suggests that anthracycline treatment may cause long-term impairments to cardiovascular system that contribute to the exercise intolerance observed in ATS.

1237 Board #1 June 1 8:00 AM - 10:00 AM
Exercise Programming Considerations Among Head And Neck Cancer Survivors In Socially Deprived Area Of England
Adrian W. Midgley1, Derek Lowe1, Andrew R. Levy2, Vishal Meapani1, Simon N. Rogers3, Edge Hill University, Ormskirk, United Kingdom. 1Astraglobe Limited, Cheshire, United Kingdom. 2Northampton General Hospital, Northampton, United Kingdom. 3University Hospital Aintree, Liverpool, United Kingdom.
Email: adrian.midgley@edgehill.ac.uk

PURPOSE: Establish whether HNC survivors in one of the most socially deprived areas of England would be interested in participating in an exercise-based cancer rehabilitation program, and obtain data to inform evidence-based programming.

METHODS: Patients treated for primary squamous cell carcinoma of the head and neck between 2010 and 2014 were identified from the University Hospital Aintree

Head and neck cancers (HNCs) and their treatment result in considerable prolonged debilitation and unique symptoms likely needing consideration for effective exercise programming.

Abstracts were prepared by the authors and printed as submitted.
database and sent a postal questionnaire pack to establish perceived exercise benefits, preferences, and barriers, and quality of life. Non-responders were sent a postal reminder 4 weeks later.

**RESULTS:** The survey comprised 1021 eligible patients of which 437 (43%) responded. The only bias observed between responders and non-responders was a lower response for those under 55 years (29%) and over 85 years (36%). Median (interquartile range) age of responders at survey was 66 (60–73) years and 74% of responders were white. 30% of responders never would be interested in participating in an exercise rehabilitation program and 34% said ‘Maybe’. Greater interest was associated with lower social-emotional aspects of quality of life and greater perceived exercise benefits (p < 0.05). The most commonly cited exercise barriers were dry mouth or throat (40%), fatigue (37%), shortness of breath (30%), muscle weakness (28%) difficulty swallowing (25%), and shoulder weakness and pain (24%). Exercise preferences were diverse; however, the most common were a frequency of three times per week, moderate-intensity, and 15-29 minutes per bout. The most preferred types of exercise for regular participation were walking (68%), flexibility exercises (35%), swimming (33%), and cycling (31%). Home (55%), outdoors (46%) and health club/gym (35%) were the main choices for where to regularly exercise.

**CONCLUSIONS:** These findings provide exercise preferences to guide exercise programming for HNC survivors. Exercise barriers specific to HNC were commonly cited and need addressing to promote exercise uptake and adherence. The need for education on potential benefits of exercise to promote greater interest and engagement in exercise also was apparent.

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**Exercise Improves Vo2max And Body Composition In Adt-treated Prostate Cancer Patients**

Brad Wall1, Daniel Galvao2, Naeem Fatheci2, Dennis Taaffe, FACSM2, Nigel Spyre2, David Joseph1, Jeffrey Hebert1, Robert Newton1, 1Murdock University, Murdoch, Australia. 2Edith Cowan University, Joondalup, Australia. (Sponsor: Dennis Taaffe, FACSM) Email: b.wall@murdock.edu.au

(No relationships reported)

Prostate cancer is the most common cancer in men and patients treated with androgen deprivation therapy (ADT) experience unfavourable changes in body composition and associated metabolic complications, which can increase the risk of cardiovascular disease. **Purpose:** To examine the effect of a 6-month program of aerobic and resistance exercise aimed at improving body composition and cardiorespiratory health in this patient population. **Methods:** Ninety-seven men (43–90 years) with localised prostate cancer receiving ADT were randomized to either exercise (EX, n=50) or usual care (CON, n=47). Supervised exercise was undertaken twice-weekly at moderate-to-high intensity. Measures of cardiorespiratory capacity (VO2max), resting metabolic rate, central blood pressure, hemodynamic variables, blood markers, and body composition were assessed. **Results:** There was a significant group by time interaction for VO2max (p=0.033) with a treatment effect for EX of 0.11 (95% CI, 0.04-0.19) L.min⁻¹ and fat oxidation (p=0.037) of 12.0 (95% CI, 2.3-21.7) mg.min⁻¹. Similarly, there was a significant improvement in glucose (p<0.001) for EX of -0.5 (95% CI, -0.8 to -0.3) mmol/L, with no change in PSA or testosterone as a result of exercise. Body composition was enhanced for EX with adjusted mean differences in lean mass (p<0.001) of 0.8 (95% CI, 0.3-1.3) kg, total fat mass (p=0.020) of -1.1 (95% CI, -1.8 to -0.5) kg, and trunk fat mass of -1.0 (95% CI, -1.4 to -0.6) kg. **Conclusion:** We conclude that a 6-month combined aerobic and resistance exercise program has a significant favourable impact on cardiorespiratory capacity, resting fat oxidation, glucose and body composition despite the adverse effects of hormone suppression. Combined aerobic and resistance training should be considered a key adjuvant component in men undergoing ADT for the treatment of prostate cancer.
of CVR risk factors (e.g., LDL cholesterol, blood pressure). A cardiopulmonary exercise test (CPET), using a TrueOne 2400 metabolic cart (Parvo Medics Inc, Sandy, UT), is then administered by an exercise physiology technologist (EPT) in concert with the cardiologist to assess CRF (Vo2peak). For the current results, we included only women with a history of early stage breast cancer examined between January 2016 and September 2016. Results: A total of 47 women with a history of early stage breast cancer had a mean age of 60.8± years and a mean BMI of 27.6± 6.5 kg/m2. The mean Vo2peak was 20.9± 4.1 mL·min⁻¹, the equivalent of 29.6% below healthy, sedentary women. Mean time from breast cancer diagnosis to Healthy Heart consult was 8± 6 years. Conclusion: There is a significant and sustained loss of CRF in early breast cancer patients presenting to the MD Healthy Heart Program. Given these findings, a personalized exercise prescription developed by the EPT as part of the Healthy Heart Program is provided to increase exercise adherence. Ultimately, the goal of the program is to utilize exercise as a non-pharmacologic strategy to mitigate cardiac insult and promote improvement in CRF to maintain healthy hearts throughout the cancer continuum.

Breast cancer treatment can result in significant and long-lasting reductions in aerobic fitness and strength. Reduced aerobic fitness among breast cancer survivors is associated with lower quality of life and an increased risk of future comorbidities and all-cause mortality. Supervised exercise training withadjacent breast cancer therapy is a promising strategy to improve health outcomes. Purpose: To describe changes in aerobic fitness and strength among women with breast cancer engaging in exercise training as supportive care during and post adjuvant treatment. Methods: Women with stage I-III breast cancer were enrolled into the Nutrition and Exercise during Adjunct Treatment (NextX) study within the first half of chemotherapy. Supervised aerobic and resistance exercise was performed for 60-80 min 3x/wk during adjunct treatment and 1-2x/wk for 20 weeks after treatment. Submaximal aerobic exercise and leg press (LP) testing were performed at: 1) baseline; 2) end of treatment; 3) end of intervention; and 4) 1-year follow-up. Maximal aerobic capacity (VO2peak) and LP 1RM were estimated using regression equations. Linear mixed models (time as fixed factor, participant as random factor, and BMI as covariate) and pairwise Bonferroni-corrected contrasts were used to detect differences between time points. Results: 68 women (age=51±11, started adjuvant treatment range 0-6 months) had VO2peak 26.8±8.0mL/min/kg (range 10.2-45.8mL/min/kg) and LP 1RM were 26.8±8.0mL/min/kg and 186.5±6.6lbs, respectively. VO2peak was not significantly different from baseline to end of treatment (+1.0mL/min/kg, p=0.1), increased from baseline to end of treatment (+2.2±0.6mL/min/kg, p=0.003), and this improvement was maintained at the 1-year follow-up (+0.5mL/min/kg, p=1.0). LP 1RM increased from baseline to end of treatment (+37.2±6.0lbs, p<0.001) and from end of treatment to end of intervention (+30.5±4.4lbs, p=0.001), but decreased at the 1-year follow-up relative to end of intervention (-25.6±6.8lbs, p=0.003) and remained higher than baseline (+42.1±8.5lbs, p<0.001). Conclusions: Breast cancer patients engaging in supervised exercise training during and after adjuvant treatment experienced significant improvements in aerobic fitness and strength. While strength had declined at the 1-year follow-up, improvements in aerobic fitness were maintained.

Purpose: After a cancer diagnosis, one of the most commonly reported symptoms is cancer related fatigue (CRF). The use of physical exercise to improve cardiorespiratory fitness, body composition, and symptoms for patients with cancer during therapy is an emerging area of research. This in-clinic trial compared the effects of high intensity concurrent aerobic and resistance training (CART) and aerobic training (AT) to usual care (UC) on multiple parameters of physical function in patients with breast cancer during chemotherapy.

Methods: Women with breast cancer stage I-IIa receiving chemotherapy were randomly allocated to 16 weeks of CART (2-3 sets of 8-12 repetitions at 70-80% of estimated 1 repetition maximum strength, followed by 3x3 min bouts of high intensity intermittent aerobic exercise), AT (20 min moderate intensity continuous aerobic exercise, followed by 3x3 min bouts of high intensity intermittent aerobic exercise), or UC (control group). Physical CRF, cardiorespiratory fitness, muscle strength, and BMI were measured at baseline and after 16 weeks. Clinically important changes were estimated as standardized effect sizes.

Results: A significant difference in fatigue was found between CART and UC post-intervention (p=0.015, ES=-0.48), with CART maintaining baseline levels and UC demonstrating a significant deterioration of CRF. Significant differences in estimated VO2peak were found favoring CART (p=0.001, ES=-0.44) and AT (p=0.001, ES=-0.57) compared to UC. Women in the CART group demonstrated significant differences in muscle strength superior to both AT and UC for right hand grasp (CART vs. AT: p=0.009, ES=0.29; CART vs. UC: p=0.001, ES=0.41) and lower limb muscle strength (CART vs. AT: p=0.007, ES=0.24; CART vs. UC: p=0.001, ES=0.65). Increases in BMI were significantly smaller in both CART (p=0.013, ES=-0.14) and AT (p=0.005, ES=0.10) compared to UC.

Conclusions: A 16-week high intensity CART intervention appears to be more effective than AT alone in counteracting physical CRF and improving muscle strength, and was equally as efficient as AT in maintaining cardiorespiratory fitness. Concurrent high intensity aerobic and resistance training is an effective and feasible training intervention, and can be prescribed to patients with breast cancer during chemotherapy.

Purpose: To describe changes in aerobic fitness and strength among women with breast cancer engaging in exercise training as supportive care during and post adjuvant treatment. Methods: Women with stage I-III breast cancer were enrolled into the Nutrition and Exercise during Adjunct Treatment (NextX) study within the first half of chemotherapy. Supervised aerobic and resistance exercise was performed for 60-80 min 3x/wk during adjunct treatment and 1-2x/wk for 20 weeks after treatment. Submaximal aerobic exercise and leg press (LP) testing were performed at: 1) baseline; 2) end of treatment; 3) end of intervention; and 4) 1-year follow-up. Maximal aerobic capacity (VO2peak) and LP 1RM were estimated using regression equations. Linear mixed models (time as fixed factor, participant as random factor, and BMI as covariate) and pairwise Bonferroni-corrected contrasts were used to detect differences between time points. Results: 68 women (age=51±11, started adjuvant treatment range 0-6 months) had VO2peak 26.8±8.0mL/min/kg (range 10.2-45.8mL/min/kg) and LP 1RM were 26.8±8.0mL/min/kg and 186.5±6.6lbs, respectively. VO2peak was not significantly different from baseline to end of treatment (+1.0mL/min/kg, p=0.1), increased from baseline to end of treatment (+2.2±0.6mL/min/kg, p=0.003), and this improvement was maintained at the 1-year follow-up (+0.5mL/min/kg, p=1.0). LP 1RM increased from baseline to end of treatment (+37.2±6.0lbs, p<0.001) and from end of treatment to end of intervention (+30.5±4.4lbs, p=0.001), but decreased at the 1-year follow-up relative to end of intervention (-25.6±6.8lbs, p=0.003) and remained higher than baseline (+42.1±8.5lbs, p<0.001). Conclusions: Breast cancer patients engaging in supervised exercise training during and after adjuvant treatment experienced significant improvements in aerobic fitness and strength. While strength had declined at the 1-year follow-up, improvements in aerobic fitness were maintained.
S252 Vol. 49 No. 5 Supplement

1247 Board #2 June 1 8:00 AM - 10:00 AM 
A Predictive Model of 12.8km Loaded March Performance for Male and Female British Army Personnel 
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(No relationships reported)

Statistical models have previously been developed to predict performance on a Loaded March (LM; 12.8 km, carrying 25 kg), which is a fitness test for British Army Infantry personnel. Because female personnel have not previously been permitted to serve in Infantry roles, existing models have not evaluated whether gender per se may influence the prediction of 12.8 km LM performance carrying 25 kg. **Purpose:** To develop a model to predict 12.8 km LM performance for male and female British Army personnel. **Methods:** 135 trained male (age; 25 ± 4 y; body mass; 78.8 ± 10.1 kg; 2.4 km run time; 09:43 ± 00:42 min:s) and female soldiers (age; 27 ± 5 y; body mass; 66.0 ± 8.2 kg; 2.4 km run time; 11:23 ± 01:05 min:s) completed four representative military tasks (RMT) tests to best effort across two sessions, separated by at least 7 days. Session 1: height and body mass were recorded, and body composition was measured from a whole body scan using dual energy X-ray absorptiometry. Participants also completed the following physical tests; single lift (SL), jerry can carry (JCC), and 2.4 km run. Session 2: participants completed a 12.8 km LM carrying 25 kg (6.4 km paced and 6.4 km individual best effort). Prediction of 12.8 km LM time was undertaken using a hierarchical forced entry ordinary least squares multiple regression. Data are presented as the means ± SD. The level of significance was set at P<0.05. Results: 8 female participants were unable to complete the LM (voluntary withdrawal) and were therefore excluded from the analysis. 2.4 km run time and body mass were strongly predictive of 12.8 km LM performance for male and female personnel when carrying 25 kg load (R²=0.71; Standard error of estimate=4.17 min; P<0.01). Including further physical characteristics (height, fat free mass) and physical performance tests scores (SL, JCC) did not significantly improve the predictive ability of the models (P>0.05). In addition, gender was not significant when included in the model. **Conclusion:** An individual’s aerobic capacity (i.e. 2.4 km run time) and body mass predict an individual’s 12.8 km LM performance irrespective of gender.

1248 Board #3 June 1 8:00 AM - 10:00 AM 
The Assessment of Training Load During British Army Phase One Training 
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(No relationships reported)

The physical demands of British Army Phase One Standard Entry (SE) training have previously been reported to be high and linked to musculoskeletal incidence in recruits. As such the SE Phase One training program was revised in 2015 to reduce these demands, primarily by decreasing running distance and including self-paced training sessions. With the advent of technologies such as global positioning systems (GPS), external training loads (distance and speed) can now be quantified and compared to measures of internal training load (heart rate [HR] and ratings of perceived exertion [RPE]). **Purpose:** To quantify the internal and external training load of the revised British Army Phase One SE training program. **Methods:** Following completion of an initial medical assessment, 26 female (21 ± 4 y, 61.8 ± 8.4 kg, 1.64 ± 0.03 m) and 24 male recruits (22 ± 4 yrs, 77.6 ± 9.7 kg, 1.78 ± 0.08 m) were fitted with a combined heart rate and GPS device (Polar Team Pro, Polar Electro, Oy, Finland). Recruits were monitored during waking hours (06:00 – 22:00 hrs) for 10 days in weeks 1 and 2 of training and reported whole-day RPE (0-10). **Results:** Recruits completed an average daily distance of 12.07 ± 27.27 km at an average speed of 0.80 ± 0.25 km·h⁻¹. The mean HR reserve (HRR) was 31 ± 7% and average RPE was 4 ± 3. Correlation analysis indicated that RPE had a significant positive relationship with 4HR (r = 0.467, P < 0.01) and daily distance (r = 0.616, P < 0.01). **Conclusion:** This is the first study to report external training loads (distance and speed) of British Army recruits during Phase One training. This provides a framework for further investigation. Distance was a key determinant of perceptual daily training stress, as measured by RPE, suggesting this is an important characteristic of training that should be managed. Future work should attempt to link the external and internal training loads with injury risk, which could be a key approach to optimise training to maximise adaptation whilst minimising risk of fatigue and injury. This research has been sponsored by the UK MOD (Army).

1249 Board #4 June 1 8:00 AM - 10:00 AM 
The Effect of Anthropometric Measures and Upper Body Strength on a Physically Demanding Soldiering Task 
Jan E. Redmond, Stephen A. Foulis, Peter N. Frykman, Bradley J. Warr, Marilyn A. Sharp. USARIEM, Natick, MA. 
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(No relationships reported)

Soldiers serving in the combat arms are required to perform tasks with high physical demands. Armor personnel perform a tank ammunition loading task (TAL) where Soldiers repeatedly lift and carry rounds. While having Soldiers perform the actual TAL is the most direct method for determining their ability to perform the TAL, the combination of height, body mass and upper body strength may provide guidance on potential for successful task performance and possible training strategies. **Purpose:** To determine the effect of height, body mass and upper body strength on a Soldier’s ability to perform the TAL task. **Methods:** While wearing a fighting load minus a weapon (approximately 32 kg), 94 men and 90 women Soldiers carried 18 tank rounds (25 kg each) 5 meters and lifted the rounds onto a platform simulating an Abrams tank hull (lift height = 1.63m). TAL performance was measured by the number of rounds moved per min (rounds·min⁻¹). Soldiers performed an isometric bicep curl (BC) for upper body strength and their height in cm (HT) and body mass in kg (BM) were measured. Stepwise multiple regression was used to develop separate equations for males and females. **Results:** For male Soldiers, average HTₚ was 177.68 ± 19.56 cm (mean ± SD); BMₚ 75.96 ± 12.18 kg, and they moved 7.69 ± 1.61 rounds·min⁻¹. The regression equation for TAL was TAL = -8.93 ± 0.025 (HTₚ) + .090 (BMₚ) (SEE = 1.36 rounds·min⁻¹). Approximately 48 percent of the variability in the prediction (i.e. R²) of TAL performance is explained by the combination of HT, BM and BC. For women Soldiers, average HTₚ was 165.80 ± 6.48 cm, BMₚ 63.46 ± 9.23 kg, and they moved 3.32 ± 1.82 rounds·min⁻¹. The regression equation for TAL was TAL = -9.83 ± 0.029 (HTₚ) + .097 (BMₚ) (SEE = 1.36 rounds·min⁻¹). Approximately 15 percent of the variability in the prediction (i.e. R²) of TAL performance is explained by the combination of HT, BM and BC. **Conclusions:** The combination of HT, BM and BC did not have a significant effect on male Soldier’s performance of the TAL, but the BC did. For women, BM and BC had the greatest effect. Training programs designed to develop a Soldier’s upper body strength may enhance TAL task performance and mitigate injury. Views expressed in this abstract are those of the authors and do not reflect official policy of the Department of Army, Department of Defense, or U.S. Government.

1250 Board #5 June 1 8:00 AM - 10:00 AM 
Does Recruitment Performance In Generic Fitness Assessments Predict Performance In Military-related Tasks? 
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(No relationships reported)

**Purpose:** To investigate the utility of existing recruit physical barrier tests in predicting performance of occupationally-relevant tasks. **Methods:** All recruits participating in the study were undertaking the Australian Army 12-week basic training course. A total of 186 male recruits were included in the study (age 21.6 ± 4.2 y, height 178.6 ± 6.8 cm, mass 77.7 ± 11.9 kg). Physical performance was assessed at weeks 1 and 11. At each time point participants were subjected to a battery of tests that comprised: generic fitness tests; maximal push-ups (2 min) and multi-stage shuttle test (MSST) and military-related tests; repetition-maximum box lift and place and 3.2-km loaded run (22 kg). The ‘generic fitness tests’ form part of the Australian Army recruit physical barrier tests. All data is reported as mean ± SD and significance was set at p<0.05. **Results:** Maximal push-up performance during week 1 of basic military training (BMT) was not correlated with box lift and place performance at week 1 or 11 (r² = 0.097 and 0.113 respectively, p>0.05). Push-up performance was moderately to strongly correlated with load carriage performance at week 1 and 11 of BMT (r² = -0.514 and -0.406 respectively, p<0.05). Maximal MSST performance during week 1 of BMT was strongly correlated with load carriage performance at both week 1 and 11 of BMT (r² = -0.676 and -0.520 respectively, p<0.05). **Conclusions:** The results showed that performance in the MSST and push-ups were moderately to strongly correlated with load carriage performance. The predictive utility of these generic fitness tests decreased over BMT. There was a weak correlation between push-up performance and occupationally-relevant muscular strength performance. Both manual handling and load carriage are enduring requirements for Army personnel. In a recent review of physically demanding tasks all Army employment categories revealed that muscular strength was the dominant physical capacity. These results indicate that the current Australian Army recruit physical barrier tests do not predict the ability of male candidates to perform key occupational tasks (i.e. manual
handling). It is therefore recommended that an additional test is incorporated into the recruit barrier test battery that assesses and/or predicts whole-body muscular strength performance.

1251 Board #6 June 1 8:00 AM - 10:00 AM
Physical Fitness Predictors Of A Warrior Task Simulation Test
Hung Chun Huang1, Takashi Nagai1, Timothy C. Self1, Mita Lovalekar2, Christopher Connaboy1, Bradley C. Nindl1, FACSM2.
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Modern warfare requires full-spectrum physical fitness to achieve combat effectiveness, resiliency, and survivability on the battlefield. Determining which physical fitness components are essential to performing well in a Warrior Task Simulation Test (WTST) can contribute toward a better understanding on how best to test and train military physical performance. Currently, there are limited studies that have examined the relationship between WTST performance and the physical fitness components. PURPOSE: To identify the underlying and modifiable components of physical fitness related to WTST performance. METHODS: Forty-three healthy and physically active men (age: 22 ± 3 yrs; height: 178 ± 8 cm; mass: 78 ± 11 kg) participated in one WTST session and one laboratory test session. The WTST was a continuous 9 sequential-event course comprised of running, jumping, crawling, climbing, obstacle negotiation, and manual handling tasks. Physical fitness measurements in the laboratory test sessions included muscular strength and endurance, postural stability, aerobic capacity, anaerobic capacity, flexibility, body composition, fat-free mass, and agility. Backward stepwise multiple linear regression analysis was performed to predict time to completion of the WTST using the physical fitness measurements. RESULTS: Average time to completion of the WTST was 238.6 ± 31.1 seconds. (a) Muscular endurance, (b) aerobic capacity, (c) body composition, (d) fat-free mass, and (e) agility significantly contributed to a model that predicted time to completion of the WTST (R² = 51.78%, p < 0.001). The regression equation was: time to completion of the WTST = 250.21 – 0.02 * (a) – 1.34 * (b) + 0.81 * (c) – 0.77 * (d) + 24.12 * (e). CONCLUSION: The WTST assesses a combination of modifiable physical fitness components consisting of muscular endurance, aerobic capacity, body composition, fat-free mass, and agility, which suggest that skill-related components of physical fitness such as agility need to be measured and tracked in addition to health-related ones in order to gain better insight to Soldiers’ ability to accomplish their mission successfully.

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C-13 Thematic Poster - Muscle Basic Science
Thursday, June 1, 2017, 8:00 AM - 10:00 AM
Room: 101

1252 Board #1 June 1 8:00 AM - 10:00 AM
Size Profile and Selective Protein Packaging of Exosomes Released From Atrophying Muscle Cells
Matthew B. Hudson1, Carina M. Pautz1, Carlos A. Barrero1, Ellen M. Kelly1, Joshua T. Selsby1, Brittany E. Wilson1. Temple University, Philadelphia, PA. Iowa State University, Ames, IA.

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Skeletal muscle atrophy occurs in a variety of conditions and can result in decreased quality of life and mortality. Previous work from our lab established that certain microRNAs in muscle cells play a role in the progression of muscle atrophy and the intracellular level of these microRNAs are altered during atrophy, at least in part, due to incorporation into small vesicles (termed exosomes) released into the extracellular environment. Currently, little information exists about muscle released exosomes. Potentially these vesicles could be taken up by other tissues and identify a mechanism for tissue repair and regeneration. Therefore, we investigated the role of exosomes during atrophy in skeletal muscle. PURPOSE: To identify if exosomes released from muscle cells during atrophy contain different internal cargo proteins than exosomes from healthy muscle cells. METHODS: C2C12 cells were treated with dexamethasone (DEX; 1μM) for 6 hours in serum free media, media was collected, and exosomes were isolated from the media. LC-MS proteomics analysis was performed on proteins isolated from exosomes, and analyzed using Ingenuity Pathway Analysis software. Nanoparticle tracking analysis revealed no change in the number of exosomes released during atrophy (6.7% ± 0.6% 7.06 ± 10⁵ vesicles/mL). However, while there was no change in the total number of exosomes the size profiles of the exosomes released during atrophy was significantly different (p<0.05). CONCLUSIONS: Skeletal muscle atrophy results in production of specific proteomes from exosomes released from muscle cells, and unique size profile of exosomes released from muscles, but does not alter the total number of exosomes released. These novel findings could have broad implications for the development of biomarkers and signaling during skeletal muscle atrophy.

1254 Board #2 June 1 8:00 AM - 10:00 AM
Ribosomal Capacity’s Relationship To Muscle Oxidative Metabolism: A Role For Exercise And Gp130 Signaling
Brittany R. Counts, Dennis K. Fix, Justin P. Hardee, James A. Carson, FACSM. University of South Carolina, Columbia, SC.

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Skeletal muscle’s capacity for oxidative metabolism parallels the basal rate of protein synthesis and ribosomal capacity. Muscle metabolic activity and protein synthesis are regulated by both muscle contraction and cytokine signaling. While endurance exercise induces oxidative metabolism, a role for ribosomal capacity in these changes is not well understood. The interleukin-6 (IL-6) cytokine family through the glycoprotein receptor gp130 induces cellular signaling that regulate muscle metabolism and remodeling. While muscle oxidative metabolism is inducible (exercise), the regulatory role of ribosomal capacity and the IL-6 cytokine family for this induction is not known.

PURPOSE: To examine the relationship between muscle oxidative metabolism and ribosomal capacity in basal and trained muscle, and determine the potential regulation by gp130 signaling.

METHODS: Male C57BL/6 (B6; N=18) and skeletal muscle specific gp130 knockout (KO; N=17) mice were randomly selected to either cage control or treadmill exercise. Treadmill training (6 day/wk., 1 h/d) was initiated at 6 weeks of age and mice were sacrificed at 12 wks. of age. Quadriceps muscle cytochrome c oxidase (COX) enzyme activity, and total RNA and protein were examined.

RESULTS: At baseline B6 COX activity was positively correlated with total RNA content (R=0.63, p<0.01), but not in KO muscle (R=0.2, p=0.65). Exercise increased B6 and KO COX activity (p<0.0001), and ablated the relationship between COX activity and total RNA content in B6 muscle (R=0.01, p=0.90).

CONCLUSIONS: These data demonstrate that basal COX enzyme activity is positively associated with ribosomal capacity, but increased ribosomal capacity is not required for the exercise induction of COX activity. Additionally, the relationship between basal muscle oxidative metabolism and ribosomal capacity requires muscle gp130 signaling.

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1255 Board #3 June 1 8:00 AM - 10:00 AM
The Relationship Between Serum Testosterone And Skeletal Muscle Wnt Signaling Markers In 3-24-month Old Rats
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PURPOSE: We sought to determine if canonical Wnt signaling markers are related to serum testosterone concentrations and muscle weights in rodents. METHODS: Male Fischer 344 rats (300-600g) were aged 3, 6, 12, 18 and 24 months, euthanized, and gastrocnemius muscle was extracted and wet skeletal muscle weights were obtained. Muscle tissue was then processed for analysis via western blotting. Additionally, serum was obtained and assays were performed for total and free testosterone (TST). RESULTS: Relative (body mass-adjusted) gastrocnemius masses revealed significant between-group differences (p<0.001) and were greater at 3 and 6 versus 12, 18 and 24 months (p<0.05). Serum free TST was 102% greater at 6 versus 3 (p<0.05), 165% greater at 6 versus 12 (p<0.05), 101% greater at 6 versus 18 (p<0.05), and 95% greater at 6 versus 24 months (p<0.05). Total TST was 305% greater at 6 versus 12 (p<0.05), 273% greater at 6 versus 18 (p<0.05), and 185% greater at 6 versus 24 months.
Transcriptional Signatures of Human Skeletal Muscle in Response to Aerobic and Resistance Exercise

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(no relationships reported)

Cryotherapy is commonly used therapeutic modality for skeletal muscle injuries in sports medicine. Despite the widespread use of this modality, there is little known about the biochemical effects of cryotherapy in human skeletal muscle tissue of humans.

PURPOSE: To determine the effects cryotherapy has on the transcriptome and metabolome of skeletal muscle. METHODS: Using a paired design, 8 healthy male subjects (mean age 24.7 years, mean BMI 22.2) received ice-cup massage or sham application, IM temperature was reduced by 29%, and by two hours remained 16% lower (p<0.05).INTRamuscular (IM) temperature 2 cm deep to the subcutaneous layer tested using paired t-tests (α=0.05).

RESULTS: Intramuscular (IM) temperature 2 cm deep to the subcutaneous layer was predicted from regression equations of skin temperature. At the end of the 15 min application, IM temperature was reduced by 29%, and by two hours remained 16% cooler than prior to administration offering cryotherapy. Microarray analysis revealed changes in some non-coding RNAs, but no differences were found for protein coding genes. Further analysis by qPCR showed no significant differences in so-called “cold-shock” genes which have been reported to be induced in animals tissues exposed to substantial cooling. Metabolomics analysis of over 60 metabolites involved in glycolysis, oxidative phosphorylation, and amino acid metabolism showed their expression is regulated differently. Irisin and Bdnf are both reported to participate in skeletal muscle regeneration via Akt-mediated pathway in addition to Fat Oxidation. Therefore, Exercise-Induced Myokines Are Regulated Precisely And Sequentially, Which In Turn Exert Different Functions At Different Time Following Exercise.

RESULTS: Was confirmed by Western Blot. To compare the difference between two groups, T-Test was employed using Spss Software and P < 0.05 was Considered Statistically Significant.

CONCLUSIONS: Although Il-6, Irisin and Bdnf Are All Exercise-Induced Myokines, Their Expression Is Regulated Differently. Irisin And Bdnf Are Both Reported To Be Involved In The Activation Of Ampk Signaling Pathway. However, We Found That The Increase Of Irisin Was In Accordance With Ampk Activation, While Bdnf Increase Is In Accordance With Akt Activation. Our Results Suggest That Bdnf May Participate In Skeletal Muscle Regeneration Via Akt-Mediated Pathway In Addition To Fat Oxidation. Therefore, Exercise-Induced Myokines Are Regulated Precisely And Sequentially, Which In Turn Exert Different Functions At Different Time Following Exercise.
young skeletal muscle following training at different frequencies, and report concurrent status of nuclei morphology. METHODS: Tibialis anterior (TA) muscles of young (3 mos) and old (30 mos) male Fischer 344xBN rats exposed to 80 SSCs for 3 or 2 days/ wk for 1 month were harvested 3 days post-training. Gene expression and methylation were quantified via RT-Profiler and Methylation Arrays. Frozen TA sections were stained for β-dystroglycan and DAPI to perform total nuclei and myonuclei morphology via total particle analysis and manual tracings, respectively. Analyses were conducted using Image J. RESULTS: Young rats adapted to 3 and 2 days/wk training and differentially (p<0.05) expressed 21 and 7 apoptotic genes, respectively. Old rats maladapted to 3 days/wk training and only expressed 1 apoptotic gene; however, old 2 days/wk expressed 8 apoptotic genes. Methylation increased in SSC trained relative to non-trained control muscles only in old 3 days/wk (0.8 ± 0.04 vs 2.2% ± 0.02, p<0.05). For old 2 days/wk there was no difference in methylation compared to non-trained (0.70 ± 0.004 vs 1.0 ± 0.01%). For nuclei, an age effect (p<0.05) was shown by a higher total count in old relative to young non-trained controls for both total nuclei (7,708 ± 181 vs 6,695 ± 171 nuclei per mm²) and myonuclei (1,943 ± 78 vs 1,483 ± 74 nuclei per mm²). A training effect (p<0.05) resulted in decreased myonuclei count in old 2x/wk relative to both old 3 days/wk and old non-trained (1,590 ± 86 vs 1,888 ± 86 vs 1,943 ± 78 nuclei per mm²). CONCLUSIONS: Reduced SSC training frequency positively influences aged muscle by decreasing methylation of apoptotic genes, thereby increasing gene expression concomitant with decreases in myonuclei count, which may influence adaptation with aging by eliminating dysfunctional myonuclei, thus aiding in improved muscle size and function.

**PURPOSE:** Apoptosis is a process of programmed cell death that occurs in different stress factors in the body. One of these stresses is exercise, exercise is a strong physiological stimulus which can influence a number of intracellular and extracellular signaling pathways. Till now, few researches shows the effect of sprint interval training and eccentric training on caspase3, bcl2 and bax gene expression changes. This study is exploring the effect of nine weeks of sprint interval training and eccentric training on caspase3, bcl2 and bax gene expression in soleus and SVL muscles. METHODS: Twenty four male Sprague Dawley rats purchased from Razi Institute were divided into three groups: control (n=8), sprint interval training (n=8) and eccentric training (n=8). Sprint interval training was included of one minute sprinting on animal treadmill with 2-4 groups: control (n=8), sprint interval training (n=8) and eccentric training (n=8). Sprint interval training was included of one minute sprinting on animal treadmill with 2-4

**RESULTS:** We sought to determine sex- differences in Six wave reflect and arterial stiffness after resistance exercise Erica M. Marshall, Alaina Glasgow, Yu Lun Thai, J. Derek Kingsley, Kent State University, Kent, OH. (Sponsor: Ellen L. Glickman, Ph.D., FACSMB) Email: emarshl1@kent.edu (No relationships reported)

Resistance exercise is recommended to improve fitness and to reduce the risk and severity of chronic diseases. Currently, no studies have evaluated sex differences in resistance-trained individuals in response to an acute bout of resistance exercise on pulse wave reflection and arterial stiffness. PURPOSE: We sought to determine sex- differences after an acute bout of free-weight resistance exercise on pulse wave reflection and arterial stiffness in resistance-trained individuals. METHODS: Resistance-trained men (n=14) and women (n=12) volunteered for the study. Aortic hemodynamics, pulse wave reflection and arterial stiffness were assessed in the supine position at rest and 10 minutes after an acute bout of free-weight exercise utilizing 3 sets of 10 repetitions at 75% 1-repetition maximum on the squat, bench press, and deadlift. Two minutes of rest was given between sets and exercises. An ANOVA was used to analyze the effects of sex across condition (acute resistance exercise or control) and time (rest and recovery). Paired t-tests were used for all post-hoc comparisons.

RESULTS: The sexes had similar values at rest and after the acute resistance exercise such that there were no significant 3-way interactions. There were also no main effects of resistance exercise on brachial or aortic blood pressure. There were significant time by condition interactions for heart rate (rest: 61±13 bpm vs 78±13 bpm, p=0.0001), augmentation index (rest: 12.1\pm7.9%; recovery: 19.9±10.5%, p=0.003), augmentation index at 75%Pulse wave reflection (rest: 5.3±7.9%; recovery: 24.5±14.3%, p=0.0001), pulse wave reflection (rest: 47.9±2.8mmHg; recovery: 8.3±6.9mmHg, p=0.004), and pulse wave velocity (rest: 5.3±0.6ms; recovery: 5.9±0.7ms, p=0.02) such that they
significantly increased after the acute exercise resistance exercise. There were also significant time by condition interactions for time of the reflected wave (rest: 150±7ms; recovery: 147±9ms, p<0.02) and the subendocardial variability ratio (rest: 147±17%; recovery: 83±24%, p<0.0001) such that there were reduced after the acute resistance exercise.

CONCLUSION: These data suggest that an acute bout of resistance exercise alters wave pulse reflection and arterial stiffness similarly between the sexes without significantly altering aortic hemodynamics.

1264 Board #3 June 1 8:00 AM - 10:00 AM
Comparing Two Low-Intensity Resistance Training Modalities on Strength and Wave Reflection in Postmenopausal Dynapenic Women
Salvador J. Jaime, Stacey Alvarez-Alvarado, Jeremiah C. Campbell, Arturo Figueroa, FACSM, Florida State University, Tallahassee, FL. (Sponsor: Arturo Figueroa, FACSM) (No relationships reported)

PURPOSE: Dynapenia, the age-related loss in muscle strength, is emerging as an important risk factor for the development of cardiovascular disease (CVD) and physical disability. Wave reflection (augmentation pressure [AP] and index [AIx]) and central pulse pressure (cPP) have shown to be sensitive markers for CVD and left ventricular afterload. Although resistance training (RT) increases mass and strength, most studies have shown no effect on AP or AIx. The purpose of this study was to investigate two modalities of low-intensity strength training on wave reflection and cPP in postmenopausal dynapenic women.

METHODS: Twenty-one non-obese (body mass index (BMI) ≤ 27 kg/m²) sedentary postmenopausal women were randomly assigned to either whole-body vibration training (WBVT) or low-intensity RT (LIRT) for 12 weeks. We measured AP, AIx, cPP adjusted at 75 bpm (AIx@75), time of reflection (Tr), and central pressures using applanation tonometry. Muscle strength was measured using a handgrip dynamometer for maximal voluntary contraction (MVC) and 1 repetition max for leg press and extension.

RESULTS: At baseline, there were no significant differences between groups in age, anthropometrics, peripheral or central pressures, and muscle strength. LIRT and WBVT similarly increased left leg press (10.6 ± 1.8%; 14.8 ± 2.6%, respectively; P<0.001) and leg extension (8.8 ± 2.8%; P<0.05; 19.2 ± 4.6%, P<0.01, respectively). There was a group-by-time interaction for the increase in MVC (12.1 ± 2.2%, P<0.01) in the LIRT group compared to no change in the WBVT group. There was a group-by-time interaction for the reduction of AP (4±1 mmHg, P<0.05), AIx (-5.0 ± 1.4%, P<0.01), AIx@75 (-5.3 ± 1.7%, P<0.05), and cPP (5±2 mmHg, P<0.05) in the WBVT group compared to no change in the LIRT group. The reductions in cPP were inversely correlated to the increases in leg extension strength (r=-.44, P<0.05).

CONCLUSIONS: While both LIRT and WBVT significantly increased leg muscle strength, WBVT also reduced markers of left ventricular afterload. Increases in leg muscle strength were related to the decreases in cPP, which may reduce risk of end-organ damage and physical disability. Our data suggest that WBVT may be a beneficial therapeutic modality for the prevention of physical disability and future cardiovascular events.

1265 Board #4 June 1 8:00 AM - 10:00 AM
Sex Differences in the Influence of Leg Strength on Arterial Stiffness.
Georgios Grigoriadis, Alexander J. Rosenberg, Sang Ouk Wee, Elizabeth C. Schroeder, Kanokwan Bunsawat, Bo Fernhall, FACSM, Tracy Baynard, FACSM. University of Illinois at Chicago, Chicago, IL. (Sponsor: Tracy Baynard, FACSM) Email: ggrigoriadis19@gmail.com (No relationships reported)

INTRODUCTION: Acute resistance exercise has been associated with increased central artery stiffness and muscle strength has been shown to be inversely associated with arterial stiffness. However, many studies have only included males with little research conducted including females. Pre-menopausal females typically have lower resting arterial stiffness, yet the relationship between strength and arterial stiffness responses is unknown for females. PURPOSE: To determine the relationship between quadriceps and hamstring strength and the acute arterial stiffness response following resistance exercise. METHODS: Eleven males (28 ± 5 yrs; 24.6 ± 2.0 kg/m²) and eight females (26 ± 4 yrs; 22.5 ± 2.3 kg/m²) completed maximal isometric knee extension and flexion (3 sets of 10 repetitions) on a force dynamometer. Central pulse wave velocity (PWV) was estimated by brachial oscillographic blood pressure waveforms at baseline and 5 min post-exercise. Bivariate correlations were performed to examine the linear relationship between leg strength and change in PWV. Relative leg strength data was adjusted for lean body mass measured by dual-energy X-ray absorptiometry. RESULTS: Only females exhibited positive correlations between changes in PWV and peak flexor torque (p<0.05), relative peak flexor power (p<0.05), and negative correlations between PWV and relative power (p<0.05). PWV did not change from rest to 5 min post-exercise in females (5.2 ± 0.2 to 5.2 ± 0.3 m/s) but did significantly increase in males (5.2 ± 0.6 to 5.4 ± 0.6 m/s). CONCLUSION: The results suggest that leg strength is positively associated with changes in arterial stiffness in females, but not males, despite the group mean for females showing no change in stiffness. Therefore, females with higher leg strength have greater changes in stiffness after a bout of resistance exercise.

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1266 Board #5 June 1 8:00 AM - 10:00 AM
Blood Flow Responses To Acute Exercise Differ By Menopausal Status
Corinna Serviente, Lauren Richardson, Sarah Witkowski. University of Massachusetts Amherst, Amherst, MA. (Sponsor: Jane A. Kent, FACSM) (No relationships reported)

Endothelial dysfunction is a subclinical marker for cardiovascular disease and is associated with higher retro- and lower ante-grade blood flow. We have shown lower endothelial function and enhanced activation following acute exercise in late post-compared to peri-menopausal women. It is unknown whether there are differences in blood flow patterns, such as retro- and ante-grade flow and oscillatory shear index (OSI) in response to acute exercise in this population. PURPOSE: To evaluate blood flow patterns before and after acute exercise in perimenopausal (PERI) and late postmenopausal (POST) women. METHODS: Healthy low-active PERI (n=7) and POST (n=8) exercised for 30min at 60-64% VO2max. Blood flow was analyzed in the brachial artery before and 30min after exercise. Retro- and anti-grade flow were calculated as the average positive and negative shear rate during 2min of baseline, 5min of forearm blood flow occlusion (200mmHg), and during the last 30sec of the 4min recovery. OSI was calculated as retrograde/ (retrograde + antegrade) flow at all time points. Data was analyzed with 2-way repeated measures ANOVA, t-tests and Mann-Whitney rank sum tests and are presented as mean±SEM. RESULTS: Before exercise, there was no difference in blood flow between groups. In response to acute exercise, PERI showed a trend for higher ante-grade flow at baseline (pre: 318.4±41.6 s⁻¹ vs. post: 368.9±47.3 s⁻¹, p=0.09), with no change in POST (pre: 280.6±35.5 s⁻¹ vs. post: 283.8±31.4 s⁻¹, p=0.91). There was a group x exercise interaction for retrograde flow at baseline (p=0.058), with no significant increase in PERI (p=0.19) and a decrease in POST (p=0.14). Despite no change in any other parameters, there was a trend for a main effect of exercise (p=0.062) and a group x exercise interaction in OSI during occlusion (p=0.075), with an increase in POST following acute exercise (pre: -1.54±0.59 vs. post: -4.17±1.87, p=0.015) and no change in PERI (p=2.02±0.45 vs. -2.33±0.73, p=0.94). CONCLUSION: Low active POST and PERI women demonstrated different vascular responses to acute exercise. The increase in OSI and lack of change in ante-grade flow following exercise in POST suggests greater stress on the vasculature and may contribute to impaired endothelial function in this population. Supported by: Research Trust Fund (Witkowski)
Menopausal hormone therapy (MHT) is used for management of menopausal symptoms; however, the long-term effects of MHT on the cardiovascular and cerebrovascular system are controversial. Previous studies have shown that pulsatility index (a measure of the variability of blood velocity in a vessel) of the middle cerebral artery (MCA) decreases during the use of MHT, but increases again within months after suspension of MHT; however, these effects have not been studied long term.

**PURPOSE:** The purpose of this study was to evaluate the long term effects of prior use of MHT on MCA pulsatility index (PI).

**METHODS:** Fifty-four postmenopausal women were evaluated 3 years after cessation of use of MHT or placebo (as part of a 4 year randomized, placebo-controlled clinical trial). Women had received either a placebo (PLA: n=19; age=59.3 ± 3; BMI=28.3 ± 5 kg/m²) or MHT (MHT: n=35; age=60.3 ± 7; BMI=27.5 ± 5 kg/m²). MCA velocity (MCAv), mean arterial pressure (MAP), and end-tidal CO₂ were continuously measured throughout the study. Baseline measurements were recorded then women underwent a stepped hypercapnic protocol inhaling 2%, 4%, then 6% CO₂ for three minutes. PI was calculated as 

\[
\text{PI} = \frac{(\text{systolic} \ MCAv - \text{diastolic} \ MCAv)}{\text{mean} \ MCAv}
\]

At each stage for three minutes. PI was calculated as (systolic MCAv-diastolic MCAv)/mean MCAv, mean arterial pressure (MAP), and end-tidal CO₂. PI was higher in the MHT group compared to the placebo group at baseline (MHT: PI=0.86±0.02 vs. PLA: PI=0.77±0.02; p<0.05), during 2%CO₂ (MHT: PI=0.85±0.02 vs. PLA: PI=0.76±0.02; p<0.05), and during 4% CO₂ (MHT: PI=0.82±0.02 vs. PLA: PI=0.73±0.02; p<0.05). PI was not different between groups during 6% CO₂ (MHT: PI=0.75±0.02; PLA: PI=0.71±0.02; p=0.28).

**CONCLUSIONS:** Cerebral PI was higher in women who had taken MHT compared to women who had not taken MHT. The differences between groups persisted until the CO₂ vasodilatory stimulus increased to 6%. Taken together, these results suggest that previous use of MHT alters regulation of the cerebral circulation that has effects at least up to three years after cessation. Supported by NIH grant AG04170, HL118154.

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Estrogen has been proposed to enhance nitric oxide synthase (NOS) expression and NO bioavailability in females. Importantly, flow-mediated dilation (FMD) is reduced post-menopause when estrogen levels decrease. Thus, FMD in females may rely on the effects of estrogen (mediated via NO) when compared to age-matched males.

**PURPOSE:** Where potentially incomplete blockade of NOS may not show a difference in functional ability (as measured via PO2 Delivery-to-Utilization Matching) between males and females, they neglect the movement quality of quickness that is key for many everyday tasks.

**METHODS:** In Sprague Dawley rats (n=5 males, 5 females), the sartorius muscle was surgically exposed and electrically stimulated (-6 V, 1 Hz) for 180 s. Prior to contractions, Oxyphor G4 was injected into the muscle to measure PₐO₂, PₐO₂ was recorded at rest and during contractions in control (CON) and following NOS blockade (intravenous (IA) infusion of L-NAME (10 mg kg⁻¹)).

**RESULTS:** NOS blockade revealed no differences in resting PₐO₂ within and between sexes (Male: CON: 20 ± 1 vs Male L-NAME: 21 ± 2 mmHg; Female CON: 17 ± 2 vs Female L-NAME: 17 ± 3 mmHg; p > 0.05). Additionally, there were no differences in kinetics (mean response time) following the onset of contractions (Male CON: 18 ± 2 vs Male L-NAME: 12 ± 4 s; Female CON: 15 ± 2 vs Female L-NAME: 15 ± 2 s; p > 0.05).

**CONCLUSION:** Contrary to our hypothesis, reducing NO bioavailability via NOS blockade did not have any different effect in females versus males with respect to resting PₐO₂ or PₐO₂ kinetics. These results suggest that estrogen via NO bioavailability does not play a significant role in resting PₐO₂ or PₐO₂ kinetics during muscle contractions in female rats.

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Slow movement is common among older adults and has been linked with negative impacts on fall prevention, independent living, and quality of life. Current exercise recommendations from the National Institutes on Aging (NIA Go4Life) include cardiovascular endurance, strength, flexibility, and balance training. While these are sensible, they neglect the movement quality of quickness that is key for many activities of daily living. A growing body of literature supports the safe use of high speed exercise in older adults to improve functional ability.

**PURPOSE:** To combine recommendations from the NIA Go4Life program with speed of movement to improve function and health perceptions in older adults.

**METHODS:** Fifteen older adults (aged 66-77) participated in two baseline tests during the control period of the exercise intervention. The group intervention included an eight week speed-based exercise program (2 days per week) that included components of endurance, strength, flexibility, and balance. **RESULTS:** No differences were observed in functional measurements between the first and second baseline tests (p > 0.05). Upon completion of the eight week program, there were improvements in the following tests: simple reaction time (F(9, 114)=7.1, p<0.01), choice reaction time (F(3, 39)=9.8, p<0.01), 10 meter walk (F(9, 39)=16.7, p<0.01), number of steps taken during the 10m walk (F(3, 39)=9.01, p<0.01), timed up and go (F(9, 39)=7.4, p<0.01), nine hole peg test (F(9, 39)=4.1, p<0.05), and SF-36 scores (F(9, 39)=2.85, p<0.05).

**CONCLUSIONS:** Results from this study support the use of speed-based exercises to improve physical and cognitive function in older adults along with perceived health.
Age-related Differences in Maximal and Rapid Hamstrings to Quadriceps Strength Capacities and Vertical Jump Power

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(Purpose and methods reported)

The balance between leg flexor and extensor strength, which is typically assessed using the hamstrings to quadriceps (H/Q) strength ratio, has been implicated as an important factor in the muscle power and functional performance abilities of aging populations. Declines in hamstrings and quadriceps maximal and rapid strength are commonly reported as a consequence of aging; however, few studies have investigated the influence of age on maximal and rapid strength H/Q ratios. PURPOSE: To examine age-related differences in maximal and rapid strength H/Q ratios between young and old females and the relationships of these characteristics with vertical jump power. METHODS: Fifteen young (age = 21 ± 2 yr) and 15 old (69 ± 7 yr) females performed three countermovement vertical jumps (CMJs) followed by three isometric maximal voluntary contractions (MVCs) of the leg extensors and flexors. Estimated peak power output (Pmax) was measured during the CMJs using a linear velocity transducer. For each MVC, participants sat in an upright position and were instructed to extend or flex the leg “as hard and fast as possible” against a load cell attached to the heel for 3-4 s. Maximal and rapid isometric H/Q strength ratios were determined by taking the quotients between leg flexor and extensor peak torque (PT H/Q) and rate of torque development at 0-200 ms (RTD200 H/Q). RESULTS: The old females exhibited lower Pmax (old = 1075.8 ± 376.7 vs. young = 3131.0 ± 1426.2 W; P = 0.001) and higher PT H/Q (old = 0.71 ± 0.24; young = 0.54 ± 0.13; P = 0.030) and RTD200 H/Q (old = 0.85 ± 0.25; young = 0.61 ± 0.22; P = 0.008) than the young females. There was a significant relationship between Pmax and RTD200 H/Q in the old females (r = -0.522; P = 0.046); however, there was no such relationship in the young females (r = -0.109; P = 0.698) nor were there any relationships between Pmax and PT H/Q for either age group (young r = 0.029; P = 0.918; old r = -0.364; P = 0.182). CONCLUSION: These findings demonstrated that maximal and rapid strength H/Q ratios increase and muscle power decreases at old age. The significant relationship observed between Pmax and RTD200 H/Q in the old females perhaps suggests that these age-related increases in rapid antagonist muscle strength ratios may play a significant role in the lower muscle power and functional performance abilities observed in older adults.

Cross-limb effects following unilateral strength training is vastly documented in young. However, since the efferent neural drive during strong muscle contractions is attenuated in old, even after lifelong strength training, it is unclear whether contralateral effects persist with age. PURPOSE: To investigate whether unilateral strength training induced contralateral strength gain in old. METHOD: We assessed the voluntary force-generating capacity along with evoked potentials recordings (V-wave and H-reflex normalized to M-wave) and voluntary activation (VA) in the plantar flexors of the opposite limb following unilateral maximal strength training (MST) with the dominant leg. Twenty-three 73.5 ± 3.4 year olds were randomly assigned to a MST group (exercising three times a week for three weeks, with an intensity of ~90% of one repetition maximum) or a control group (CG). RESULTS: MST improved maximal voluntary contraction (1076 ± 270 to 1191 ± 348 Nm) and rate of force development (1973 ± 541 to 2328 ± 777 Nm·s⁻¹) in the contralateral limb (both p = 0.05). These strength gains were associated with (r = 0.465-0.658; p < 0.05) an enhancement of the V/M-ratio of the soleus muscle (SOL) (r = 0.12-0.29 to 0.21-0.17, respectively) and increase in VA (79.5 ± 1.5 to 83.5 ± 2.9%) (both p < 0.05). In contrast, the H/M ratio remained unaltered after MST, while no changes were apparent for any of the parameters in the CG. CONCLUSION: Our results reveal that cross-limb effects persist with age, and are mediated by an efferent neural drive enhancement. Furthermore, these observations advocate the potential clinical relevance of unilateral MST as an advantageous rehabilitation strategy to improve physical function in old individuals with conditions that prevent them from exercising with both limbs.

The Functional Movement Screen (FMS™) is increasingly popular for detecting impairments and limitations in basic functional movements. However, large-sample research is scanty to investigate the degenerative changes in terms of functional symmetry, agility, and stability associated with aging. PURPOSE: To explore functional degeneration associated with aging, by using the FMS™. METHODS: One hundred mid-aged (n = 48, mean 54.75 years old, range 50-59) and older (n = 52, mean 62.42 years old, range 60-69) community adults volunteered. Their functional degeneration was assessed using the FMS™. RESULTS: (1) The mean FMS™ total score was 13.10 (±1.83) and 45% participants are in at least one of the five FMS™ testing items that include bilateral assessments; (2) Pearson’s correlation showed that there was a significant and negative relationship between age and the total FMS™ scores (r = -0.278, P = 0.005); (3) The Mann-Whitney U test showed that the scores for Hurdles and Rotary Stability were significantly worse in older participants, compared to their mid-aged counterparts (P = 0.013 and P = 0.048, respectively); (4) When a stepwise multiple regression was conducted on the FMS™ total scores, it was found that 85% of the variance in FMS™ scores could be accounted for by four variables: Push-up, Shoulder Mobility, Lunge, and Hurdle, with explained variance cumulating from 40, 56, 74 to 85% as the four variables were added into the equation. CONCLUSIONS: (1) The total FMS™ scores from this group of participants was lower than 14, suggesting increased risk of injury. Thus, specific intervention should be carried out to lower the risk; (2) When transferring from mid-aged to older stage, balance with single leg support and core stability may decrease significantly, indicating that these two factors should be taken seriously during intervention; (3) In order to improve total FMS™ score and decrease risk of injury in mid-aged and older individuals, exercises program should involve Push-up, Shoulder Mobility, Lunge, and Hurdle practice. The current study provided valuable information for better understanding of ageing process with regard to functional degeneration, and for developing specific exercise program that targets on these degenerative changes with ageing.
There are well documented positive effects of physical activity on general health and wellbeing throughout the lifespan. Next to it, beneficial effects of physical exercise interventions at improving brain health and functioning in older adults are also well reported whereas individual differences and mechanisms to gain functional capacities related to cognitive baseline level need to be investigated. PURPOSE: To investigate the influence of cognitive baseline level on gaining functional performance in older adults after 3-month of physical exercise intervention. METHODS: Thirty older adults (68±5y; 27% men) were enrolled in 3-month twice per week physical exercise program and were randomly divided into experimental (EG; N=19) or control group (CON; N=11). For further analysis we took into account EG with low cognitive (LC; Montreal Cognitive Assessment (MoCA) score <23; N=6) and high cognitive (HC; MoCA score ≥28; N=8) score. Functional performance was assessed by the means of Senior Fitness Test. RESULTS: We found a significant interaction of time/group (P=0.004). Post hoc comparison showed differences in pre to post measurements between LC and CON in Time Up To go test (TUG; P=0.002), while no differences were found between HC and CON (P=0.159) as well as for LC and HC (P=0.127). Moreover, the percent of change analysis showed pre to post improvements (P=0.05) for both, LC and HC (≥22% vs -10%), except the CON (-1%). Finally, other sub-tests from Senior Fitness Test battery presented tendencies but failed to reach significance level. CONCLUSION: Although direct comparison (pre to post change) failed to demonstrate difference between two EG, comparison of both EG with CON, confirmed our hypothesis that older adults with lower baseline cognitive function were able to achieve more functional capacity gains after 3 month of physical training intervention, as compared to those with higher baseline cognitive function.

Sedentary ages resulting in a gradual decline in fitness characterized by decreased cardiorespiratory function, increased adiposity, and loss of lean mass. Short duration exercise training augments aerobic fitness and improves body composition and hemodynamics in middle-aged adults. However, the extent to which consistent, long-term aerobic exercise training prevents age-associated decrements in body composition and cardiorespiratory fitness remains unclear. PURPOSE: We investigated the effects of a progressive two-year, high-intensity endurance exercise program on maximal oxygen uptake (VO_{2}max), fat mass (FM), fat-free mass (FFM), and blood and plasma volumes (BV and PV, respectively) in untrained adults.

METHODS: 52 sedentary, healthy middle-aged adults (24 males; 52 ± 5yrs) were recruited and randomized to one of two study groups: aerobic exercise (EX; n=28) or non-aerobic yoga control (CON; n=24). At baseline and following two years of intervention, all subjects underwent maximal exercise testing, in which VO_{2} (Douglas bags) was measured during incremental treadmill exercise. Additionally, BV and PV were assessed using a 2-min CO-rebreath protocol, and FM and FFM were determined via underwater weighing.

RESULTS: CON participants had a small decrease in VO_{2}max (29.6 ± 5.2 to 28.7 ± 5.4ml/kg/min, p=0.11) and FFM (50.8 ± 11.4 to 49.4 ± 11.6kg, p=0.13), an increase in FM (25.3 ± 6.9 to 27.5 ± 5.9kg, p=0.002), and a decrease in both absolute and relative BV (69.5 ± 8.5 to 66.0 ± 8.0ml/kg, p=0.003) and PV (44.0 ± 6.4 to 40.8 ± 5.7ml/kg, p<0.001) over two years. EX participants experienced a significant increase in VO_{2}max (28.8 ± 4.8 to 34.4 ± 6.2ml/kg/min, p<0.001) and a significant decrease in FFM (50.4 ± 11.0 to 49.5 ± 11.1kg, p=0.013). However, exercise training prevented age-associated changes in FM (24.1 ± 5.9 to 22.4 ± 6.3kg, p=0.51) and both absolute and relative BV (70.3 ± 8.4 to 71.2 ± 7.8ml/kg, p=0.54) and PV (44.9 ± 5.6 to 44.0 ± 5.6ml/kg, p=0.52).

CONCLUSION: In addition to improving cardiorespiratory fitness, two years of consistent, high-intensity aerobic training successfully preserved body composition and blood volume measures compared to controls. Thus, long-term aerobic training appears to prevent the development of many age-related health risk factors in middle age.
insulin curve (iAUC) using the trapezoid method and peak insulin concentration during the OGTT. Intervention effects were evaluated using paired t-tests and linear mixed models with the statistic package R. Data are presented as (mean±SEM). RESULTS: Participants averaged 34.8 training sessions over the 12-week intervention. Estimated VO_{2peak} increased (25.2±1.26 vs 27.7±1.36 ml/kg/min, p<0.05) and body weight decreased (75.5±5.2 vs 74.4±5.7 kg, p<0.05) following the intervention. There were significant reductions in leptin (30.8±5.0 vs 23.8±3.4 mg/ml, p<0.05), E2 (12.9±1.7 vs 10.2±1.4 pg/ml, p<0.05) and 120-minute insulin (68.8±9.1 vs 56.2±8.2 ul/ml, p<0.05) as a result of exercise training. There were no significant differences in iAUC or peak insulin, however the change in peak insulin was inversely associated with change in E2 (r = 0.57, p = 0.04). Conclusion: Exercise training lowered adipocyte-derived cancer biomarkers and postmeal (but not fasting) insulin concentrations. The use of fasting insulin alone may underestimate the impact of insulin on cancer recurrence and prognosis following exercise training in breast cancer survivors. Supported by: Rays of Hope Center for Breast Cancer Research, Springfield MA

**1281 June 1 8:30 AM - 8:45 AM**

**Chronic Inflammation, Cardiorespiratory Fitness, Physical Activity, and Dietary Inflammatory Index in Cancer Survivors**

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(No relationships reported)

Chronic inflammation has been linked to the development and progression of cancer. Age, body composition, cardiorespiratory fitness, physical activity, and dietary factors are associated with a global marker of inflammation, c-reactive protein (CRP), in healthy populations. However, few studies have explored the relationship between these variables with physically active cancer survivors. PURPOSE: To examine differences in fitness, daily activity levels, and dietary characteristics of active cancer survivors when grouped according to serum CRP (Low vs. Moderate to High).

METHODS: Cancer survivors (N = 14, mean age = 66 ± 15 years) were evaluated for body mass index (BMI), body composition, and cardiorespiratory fitness (VO_{2peak}). Physical activity was measured via an accelerometer over a 7-day span. Diet logs (3 day) were analyzed and the dietary inflammatory index (DII) for each subject was obtained. Serum CRP was evaluated with an enzyme linked immunosorbent assay (ELISA). Subjects were assigned to one of two groups based on their serum CRP concentrations: Low CRP (≤ 1 mg/L) (LO) (N = 7) or Moderate to High (CRP > 1 mg/L) (MH) (N = 7). A t-test was used to compare LO and MH groups. Data are presented as mean ± SD. RESULTS: MH had significantly higher BMI (kg/m^2) (30.5 ± 5.2 vs 24.0 ± 8.8, p < 0.02), higher body fat percentage (40.3 ± 7.7 vs 32.4 ± 5.3, p < 0.05), and lower VO_{2peak} values (ml/kg/min) (19.4 ± 5.54 vs 31.8 ± 2.70, p = 0.0002). There were no significant differences between LO and MH with respect to age, physical activity levels, caloric intake, or DII. CONCLUSION: Cancer survivors with moderate to high serum concentrations of CRP had higher BMI, more body fat and lower cardiorespiratory fitness. However, there were no differences between the groups with respect to daily physical activity, caloric intake, or DII when compared to survivors with low serum concentrations of CRP. These data suggest that interventions aimed at reducing body fat and improving cardiorespiratory fitness may be useful in controlling chronic inflammation as defined by serum CRP concentrations in cancer survivors. Supported by the Provost Fund for Faculty Scholarship and Professional Development, University of Northern Colorado.

**1282 June 1 8:45 AM - 9:00 AM**

**Eight Week Passive Heat Exposure Improves Cardiometabolic Health in Obese Women**

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(No relationships reported)

Obese individuals are at an increased risk of developing cardiovascular and metabolic disease, secondary to blood flow impairments in adipose tissue and a meta-inflammatory state. Repeated heat exposure through hot tub or sauna bathing shows great promise for improving cardiovascular and metabolic health, in part through improvements in blood flow profiles and reductions in systemic inflammation. PURPOSE: To examine changes in cardiometabolic health in obese women undergoing 8 weeks of chronic passive heat exposure (CPHE).

METHODS: Six obese women (28.8±5; BMI: 41.5±3.5 kg/m^2) underwent CPHE, consisting of 30 one-hour hot tub sessions over 8-10 weeks (3-4 per week) in 40.5°C water. Measures of cardiorespiratory health (blood pressure, pulse wave velocity, flow-mediated dilation [FMD]) and metabolic function (fasting glucose, 2-hr oral glucose tolerance test [OGTT]) were made before (0wks) and after (8wks) of CPHE. RESULTS: Following CPHE, resting mean arterial pressure was reduced (0wks: 90.2±8 vs 88.6±2 mmHg; p<0.05), with both systolic (0wks: 122±4 vs 8wks: 112±3 mmHg; p<0.05) and diastolic (0wks: 73.2±8 vs 88s: 68±2 mmHg; p<0.07) pressure tending to decrease. Arterial stiffness, measured by brachial-ankle pulse wave velocity, was lower (0wks: 780±30 vs 8wks: 797±37 mm/sec; p<0.04), and FMD trended toward increasing, albeit variably (0wks: 5.9±1.1 vs 8wks: 9.1±2.5; p<0.05). Faster clearing was also facilitated (0wks: 104.7±7 to 8wks: 92.7±5 min; p<0.04) in all subjects, and OGTT area under the curve (AUC) and glucose at the 2-hour timepoint decreased substantially in subjects who began the study with impaired glucose tolerance (2-hr glucose >140 mg/dl). In these three pre-diabetic individuals, 2-hr glucose decreased from 0wks: 181±10 to 8wks: 139:200mg d1 and OGTT area decreased from 0wks: 21,323±2,273 to 8wks: 17,695±2,890 mg d1·min. CONCLUSIONS: These preliminary data suggest a therapeutic benefit of CPHE for improving cardiometabolic health in obese women, with blood pressure and glucose parameters showing clinically significant decreases . Additionally, these data support previous work in healthy sedentary individuals showing improvements in blood pressure, arterial stiffness, and endothelial function following CPHE.

**1283 June 1 9:00 AM - 9:15 AM**

**Skeletal-muscle To Pancreatic Beta-cell Crosstalk: The Influence Of Interleukin-6**

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(No relationships reported)

Exercise improves pancreatic-beta cell (β-cell) function in type 2 diabetic patients, however mechanisms of such an improvement are currently unclear. Given the fact that interleukin-6 (IL-6) is secreted by contracting muscle, causing a spike in circulating IL-6 levels, muscle-derived IL-6 has been implicated as an important endocrine factor in skeletal-muscle to β-cell crosstalk. However, studies of IL-6 on β-cell function have been inconsistent to date making it difficult to draw conclusions on the effect of IL-6 in the β-cell. Moreover, direct effects of physiologically relevant IL-6 concentrations on β-cell insulin secretion in cells pre-exposed to diabetic conditions such as glucolipotoxicity and/or proinflammatory cytokines are sparse. Since IL-6 appears to augment the effect of interleukin-1β (IL-1β) on β-cell apoptosis, understanding the interaction between a transient IL-6 response to acute exercise and effects on β-cell function under diabetic conditions is crucial for optimizing the therapeutic benefit of exercise in T2D.

PURPOSE: To explore the extent by which an exercise-induced concentration of IL-6 influences pancreatic β-cell function under glucolipotoxic and/or proinflammatory conditions.

METHODS: Insulin-secreting INS-1 832/3β-cells exposed to BSA ± palmitate at 5, 11 or 20 mM glucose or IL-1β for 48 hours were treated with IL-6 (10 pg/ml) for 1 hour. The effects of these conditions on insulin secretion were determined. Values are means ± SEM from four experimental repeats. Statistical differences between conditions were tested for by two-way ANOVA.

RESULTS: Exposure to 20 mM glucose ± palmitate decreased glucose-stimulated insulin secretion (GSIS) by 2-fold (2.2±0.5 to 1 ±1.01 ng insulin · 10^4 cells · P < 0.05) and 2.6-fold (2.6±0.6 to 1.0 ±0.1 ng insulin · 10^4 cells · P < 0.01), respectively. Moreover, IL-1β completely blunted GSIS from 3.0±1.1 to 0±0.1 mg insulin · 10^4 cells · P < 0.05. IL-1β treatment had no effect on GSIS under normal conditions (3.4±0.7 mg insulin · 10^4 cells · P = 0.77), and did not prevent the suppression of GSIS by 20 mM glucose ± palmitate or IL-1β (all, P < 0.05).

CONCLUSIONS: Insulin secretory defects in pancreatic β-cells exposed to diabetic-like conditions are neither improved nor worsened by a direct exposure to IL-6 at an exercise-induced relevant concentration.

**1284 June 1 9:15 AM - 9:30 AM**

**Exercise Or Reduced-calorie Diet Attenuates Overnutrition-induced GLUT4 Carbohydrates In Adipose Tissue**

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(No relationships reported)

Obesity, caused in part by overnutrition and lack of physical activity, has been well-established to be a risk factor for insulin resistance. One mechanism for insulin resistance is decreased or dysfunctional glucose transporter type 4 (GLUT4), which plays a central role in skeletal muscle glucose uptake. Recently, we showed as little as 3 to 14 days of overnutrition results in oxidative damage to GLUT4 via carbonylations and subsequent insulin resistance in adipose tissue of both mice and humans. However,
it is unknown if these carbonylations of GLUT4 in adipose tissue are permanent or potentially reversible. PURPOSE: To determine if physical activity or a reduced-calorie diet can reduce GLUT4 carbonylations following overnutrition in mice. METHODS: Mice (n=8) were fed an overnutrition (60% high fat diet) for 14 days and then transferred to a 30% reduced calorie diet for 3 days or given access to a voluntary running wheel for 7 days. To determine if adipose GLUT4 carbonylations could be reversed the ‘control’ group consisted of time matched mice kept on the high fat diet with no intervention. At the end of each experimental condition mice were sacrificed and white adipose tissue (WAT) was collected. GLUT4 carbonylations were measured in WAT using a validated mass spectrometry-based multiple reaction monitoring (MRM) method via a Quantum Ultra TSQ. All experimental procedures were approved by Temple University’s IACUC. RESULTS: Following 14 days of overnutrition reducing carbolic intake by 30% for 3 days reduced WAT GLUT4 carbonylations —81% compared to time matched mice maintained on the overnutrition diet (p < .05). Further, wheel-running exercise for 7 days following overnutrition reduced WAT GLUT4 carbonylations —81% (p < .05). CONCLUSION: Overnutrition-induced GLUT4 carbonylations inmouse WAT are not permanent and can be reversed by exercise or a reduced-calorie diet. Supported by NIH GM087239

C-17 Clinical Case Slide - Knee II
Thursday, June 1, 2017, 8:00 AM - 10:00 AM
Room: 507

1287 Chair: Mark E. Lavallee, FACSM. Wellsley York Hospital, South Bend, IN.
(No relationships reported)

1288 Discussant: Wayne E. Deraman, Stellenbosch University, Cape Town, South Africa.
(No relationships reported)

1289 Discussant: Peter Gerbino, FACSM. Monterey Joint Rep and Sports Medicine, Monterey, CA.
(No relationships reported)

HISTORY: 54yo female with a history of small cell lung cancer metastatic to brain s/p Gamma Knife radiosurgery with 8 years of remission who presented with left posterior knee pain radiating to the calf. She had 5 days of severe “Charley horse” pain worse in the morning rated an 8 on a 1 to 10 scale. This pain had woke her up at night. Symptoms were worsened by flexing the knee and with weight bearing. Acetaminophen and ibuprofen were minimally helpful. No symptoms of popping, locking, or giving way. She denied trauma. No numbness, tingling, or weakness.

PHYSICAL EXAM: No obvious deformity, erythema, effusion, or ecchymosis of left knee. Normal ROM from 0-115º. Moderate tenderness to palpation of popliteal fossa, medial joint line, and along medial gastrocnemius tendon distally. No masses noted in popliteal fossa. Knee stable to varus and valgus stress at 0º & 30º. McMurray’s, patellar grind, anterior/posterior drawer, and Lachman negative. Antalgic gait on the left. 5/5 strength in all planes. Sensation intact to light touch in all five lumbar nerve distributions. Palpable pedal pulse.

DIFFERENTIAL DIAGNOSIS: Hamstring/popliteus/gastroc tendinopathy; Medial meniscal injury; Thrombosis;Neoplasm;Baker’s Cyst;Tibial stress fracture;Avascular necrosis of femur/tibia;Osteochondritis dissecans;Osteomyelitis

TESTS AND RESULTS: Left knee xray: Subtle posterolateral proximal tibial sclerosis; Labs:WBC: 6.3x10³/µl (ref 3.7-10.3); ESR: 39mm/hr (ref 0-20); CRP: 2.2mg/dl (ref 0-0.2); D Dimer: 0.35ng/ml (ref <0.5); MRI:See picture; FINAL WORKING DIAGNOSIS:Spontaneous avascular necrosis of the femur and tibia TREATMENT AND OUTCOMES:1. Quadriceps and hamstring strengthening with physical therapy; 2. NSAIDs and cane to assist with ambulation; 3. Orthopedic consult - agree with conservative management; 4. Patient reported minimal improvement in symptoms after 2 weeks of physical therapy; 5. Close follow up over 2-4 weeks to manage/symptoms and expectations

(No relationships reported)
Bilateral Knee Pain: Day #1 Of Training From Couch To 5K
Jennifer Gourdin1, Matthew Sedgley2. 1The University of Maryland, Baltimore, MD. 2MedStar, Westminster, MD. (No relationships reported)

HISTORY: A 40 year old female presents with bilateral knee pain. The pain is localized to the anteromedial side of her knees, and it started on day 1 of training for a 5K race. She is a couch to 5K runner. Her knee pain is 10/10 and worse when she rises from a seated position. She is barely able to walk and needs to use a walker. Her pain is better with sitting. OTC analgesics are ineffective. She went to urgent care where she had negative x-rays. She denies a history of swelling, bruising, and trauma to the knees. Of note, she has a history of GERD for which she has been taking dexlansoprazole 30 mg BID for several years.

PHYSICAL EXAMINATION: Vital signs: Pulse is 89 and regular, respirations 14 and regular, blood pressure 120/90; Pain 10/10

General: Well-developed, well-nourished 40 year old, white female in acute distress.

Lower extremities: No peripheral edema, bruising, or swelling. She is neurovascularly intact. There is tenderness to palpation of the tibial plateau in both knees. Straight leg raise intact. Normal range of motion with flexion and extension of the knees, but it is very painful. The patient cannot walk without assistance. Ligament and strength testing were deferred due to pain.

DIFFERENTIAL DIAGNOSIS: 1. Bilateral lower extremity stress fractures
2. Metabolic bone disease
3. Vascular pathology

TEST AND RESULTS: MRI RIGHT KNEE WITHOUT CONTRAST - Extra-articular incomplete stress fracture involving the medial tibial cortex with intense associated marrow and paraosseous edema.

MRI LEFT KNEE WITHOUT CONTRAST- Incomplete extra-articular stress fracture involving the medial tibial cortex with intense associated paraosseous edema.

DEXA SCAN:
- Lumbar Spine BMD: 0.857; T-score: -1.7; Z-SCORE: -1.7
- Left Hip (Total) BMD: 0.826; T-score: -1.0; Z-SCORE: -0.9
- Left Hip (Femoral Neck) BMD: 0.634; T-score: -1.9; Z-SCORE: -1.8

FINAL WORKING DIAGNOSIS: Bilateral lower extremity stress fractures presumed to be secondary to prolonged PPF usage.

TREATMENT AND OUTCOMES: The patient was referred to rheumatology. She used a wheelchair for 3 weeks, and progressed to crutches with toe touch weight bearing. She transitioned to full weight bearing at 7 weeks. Her knee pain flared up, and a CT scan was ordered to evaluate for non-union. The CT showed healing of the bone, and her pain improved. She later moved away and was lost to follow-up.
C-18 Clinical Case Slide - Medical Issues I
Thursday, June 1, 2017, 8:00 AM - 9:40 AM
Room: 402

1295 June 1 9:40 AM - 10:00 AM
Hypermobility Joint Injury in College Football Player
Kent P. Scheff, University of Michigan, Ann Arbor, MI.
(Sponsor: Robert Kinningham, FACSM)
Email: kscheff@med.umich.edu
(No relationships reported)

HISTORY: A 19-year-old college football player sustained a right knee hyperextension injury after taking a direct blow to the anterior knee. Mechanism concerning for a multi-ligament knee injury, though no reduction required on field. On field eval with R foot plantar, intact distal pulses and MCL/PCL laxity. He was transported to the local ED emergently by ambulance for further evaluation. In ED, noted significant pain and swelling. Motor/sensory findings in peroneal nerve distribution improved en route. However, his R DP/PT pulses were non-palpable and distant on Doppler. No coolness on palpation of RLE on initial eval in ED. ABIs and a CTA ordered for further work up.


1296 June 1 8:00 AM - 8:20 AM
Parkinson’s Disease: Eccentric Training To Reduce Symptoms
Jeffrey A. Bauer, Irena Vincent, Philip J. Buckenmeyer, Mark Sutherlin, Erik Lind, Kevin Dames, Alexander Generali, Brandon Schrom, Maura Mills, SUNY Cortland, Cortland, NY.
Email: jeff.bauer@ cortland.edu
(No relationships reported)

HISTORY: A 46 year old female, mother of two, had begun experiencing motor and sensory changes a few years earlier. These included unbalanced gait, a slight left-hand tremor with reduced and slower range of motion, a loss of smell, and excess saliva accumulation. A life-long athlete and otherwise healthy, she sought medical help as she did not attribute her difficulties to aging.

PHYSICAL EXAMINATION: Along with self-reported symptoms, a physical examination identified left-sided bradykinesia and rigidity and mask-like facial appearance. An MRI ruled out a brain tumor, and a diagnosis of Parkinson’s disease (PD) was made and subsequently confirmed by a second source.

DIFFERENTIAL DIAGNOSIS: 1. Motor/Neurological impairment 2. PD

TEST AND RESULTS: The study examined the effects of eccentric lower body exercise on PD symptoms. During exercise, the participant stood upright on a solid platform that moved in an elliptical path in the sagittal plane while she absorbed all motion with the lower extremities. She completed two training phases: Phase 1 biweekly exercise for six weeks and Phase 2 once-a-week exercise for eleven weeks at higher workload intensity. All sessions consisted of three 45-second exercise bouts at an RPE of ~13 with two minutes of standing rest. Biomechanical and physiological data were recorded pre- and post-exercise during each session, and speech data five times throughout the study. Over the course of the study gait values showed improvement: gait speed (+6.9%), step duration L (-4.1%), step duration R (-3.6%), stride length L (1.8%), and stride length R (3.1%). Heart rate and blood pressure increased from rest to exercise but did not differ as a function of exercise workload. Surprisingly, RPE was lower (-11.9%) during Phase 2 than Phase 1 despite higher workloads. Speech data revealed adequate intelligibility and articulation precision as well as steady voice free of tremor. Speech rate and voice pitch and loudness ranges were mildly reduced.

FINAL WORKING DIAGNOSIS: PD with improved gross motor function.

TREATMENT AND OUTCOMES
1. Running program with three sessions per week during three months. In the first week, the volunteer ran from two to five minutes. The volume of exercising minutes was increased by two to four minutes every week.
2. Resistance training in the first half of the program.
3. The patient increased his running time by 260% and his VO2max by 24%.
4. His sleep quality improved 31% and his anxiety, stress and depression levels decreased by 37%, 78% and 50%, respectively.
5. On the quality of life questionnaire, the subject improved his psychological and social domains by 200% and 6570%, respectively, and his general quality of life by 183%.
6. His reaction time during the cognitive test decreased 23%, and the number of correct answers increased 8% at rest and 266% during exercise.
7. His R-R interval increased by 33% and 31% both at rest and during exercise, respectively; also, parasympathetic control measured by the RMSSD increased by 132% at rest and by 145% during exercise.
8. An increase in the pre-frontal cortex oxygenation during exercise was found, being 93% to ventilatory threshold, 604% in respiratory compensation point and 76% in VO2 peak.
9. The need for therapeutic intervention decreased from severe to moderate.

10. June 1 8:40 AM - 9:00 AM
Lower Extremity Rash - Soccer
Ryan Matthiesen DO, Jennifer Mitchell MD, Jordan McDermott ATC, Texas Tech University; Lubbock, TX.
Email: ryan.matthiesen68@gmail.com

History: 19-year-old Caucasian college soccer player complained to her athletic trainer of a bilateral lower leg rash that was painful when putting on her shin guards. During the prior week, multiple 2-4cm in diameter lesions had appeared on both of her legs from her knees down to her ankles. The lesions began as a faint red color and were asymptomatic, but as time went on became a darker red and in some instances purple in color, as well as becoming slightly raised and tender to the touch. The patient denied any recent new exposures or recent travel, but did report that 2 months prior over the summer break she had experienced several weeks of pharyngitis like symptoms along with fever, fatigue, and cervical lymphadenopathy. The patient was empirically treated for presumed strep pharyngitis No laboratory evaluation was performed at the time of the original illness.

1. Erythema Nodosum secondary to recent mononucleosis and/or streptococcal pharyngitis
2. Reactive Arthritis
3. Gonococcal Pharyngitis
4. Syphilis
5. Sarcoidosis
6. Parotitis
7. Kawasaki disease
8. Henoch-Schönlein Purpura

Differential Diagnosis: Primary Biliary Sclerosis, Viral Hepatitis, Wilson’s Disease, Hemochromatosis, Medication Hepatotoxicity, Malignancy, Autoimmune Hepatitis, α1-Antitrypsin Deficiency, Porphyria, Granulomatous Liver Disease, Idiopathic Portal Fibrosis

TEST AND RESULTS: Bilirubin 24.4 (Direct 20.3), AST 650. ALT 859. Lipase, iron studies, ceruloplasmin, IgG, IgA, IgM, ANA, viral hepatitis panel, PT, INR, CBC, chem-7, alkaline phosphatase, and total protein all within normal limits. PPD negative. RUQ US: cholelithiasis without evidence of cholecystitis. CT abdomen/pelvis with contrast: hepatopancreasomegal with no masses or ascites.

TREATMENT AND OUTCOMES: 1. Cessation of diclofenac. 2. In addition to inpatient GI consultation and outpatient follow up, she also saw hepatology who agreed with diagnosis and treatment. 3. Initially followed LFT’s daily, which was spaced to bi-weekly at discharge and continued to be spaced as she improved. Her transaminases decreased and normalized within a week. Her bilirubin increased to 30.6, and then gradually decreased until normalizing 8 months later. 4. Her adhesive capsulitis gradually improved, although she continued to have decreased ROM at last follow up which continued to restrict her ability to play tennis. 5. NSAIDs are now completely contraindicated for her. 6. She has annual follow up with GI for labs.

Pancreatic Cancer - Preoperative Exercise During Neoadjuvant Treatment
Nicole L. Klochak, Rebecca A. Ruiz, Ryan J. Marker, John C. Peters, W. Thomas Purcell, Catherine M. Jankowski, University Of Colorado Anschutz Medical Campus, Aurora, CO. (Sponsor: Catherine M. Jankowski, FACSM)
Email: Nicole.klochak@ucdenver.edu

History: Neoadjuvant chemotherapy and radiation (NEO) is prescribed to patients with borderline-removable pancreatic cancer prior to tumor resection to improve postoperative outcomes. Physical fitness and muscle mass are positively associated with improved postoperative outcomes, but are decreased during NEO. Exercise during NEO may counteract these changes. The patient, a 70 year old male who engaged in regular exercise, was diagnosed with borderline-removable pancreatic adenocarcinoma. He reported an approximate 8kg weight loss and declining fitness prior to diagnosis. He received two months of NEO (four cycles of FOLFIRINOX and five treatments of stereotactic body radiation therapy) during which he participated in a supervised exercise program, prior to an open Whipple procedure.

Physical Examination: The patient performed a series of physical function tests and body composition (total, fat, and lean tissue mass) was measured with dual-energy x-ray absorptiometry. Assessments were at baseline (Base), preoperative (PreOp; 17 weeks after Base), and six weeks after hospital discharge (PostOp).

DIFFERENTIAL DIAGNOSIS: General muscle wasting and weakness associated with pancreatic cancer.

TEST AND RESULTS: 9:40 AM - 10:00 AM
Hepatotoxicity Associated With Frozen Shoulder In A 47 Year Old Tennis Player; What’s The Link?
Michael J. Murphy, Brian Keisler. Palmetto Health Richland - University of South Carolina, Columbia, SC.
(No relationships reported)

History: A 47 year-old female recreational tennis player with no past medical history presented with 4 months of increasing shoulder pain and stiffness. She was diagnosed with adhesive capsulitis and started on diclofenac sodium 75mg BID. Over the next month she started having abdominal pain and stopped taking diclofenac. Her pain continued to worsen and she developed intractable vomiting and jaundice and went to the hospital at that time.

Physical Examination: Alert and oriented. Scleral icterus and jaundice present. No spider telangiectasias or angiomata. No JVD. Lungs were clear. Heart rate and rhythm, no murmurs, rub, or gallop. Abdomen soft with minimal RUQ tenderness and no ascites. Right shoulder with full ROM and normal strength. Left shoulder had severely restricted ROM in all directions with significant pain. Her neurologic exam was normal including no asterixis.

Differential Diagnosis: Primary Biliary Sclerosis, Viral Hepatitis, Wilson’s Disease, Hemochromatosis, Medication Hepatotoxicity, Malignancy, Autoimmune Hepatitis, α1-Antitrypsin Deficiency, Porphyria, Granulomatous Liver Disease, Idiopathic Portal Fibrosis

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Final Working Diagnosis: Diclofenac induced hepatotoxicity

TREATMENT AND OUTCOMES: 1. Cessation of diclofenac. 2. In addition to inpatient GI consultation and outpatient follow up, she also saw hepatology who agreed with diagnosis and treatment. 3. Initially followed LFT’s daily, which was spaced to bi-weekly at discharge and continued to be spaced as she improved. Her transaminases decreased and normalized within a week. Her bilirubin increased to 30.6, and then gradually decreased until normalizing 8 months later. 4. Her adhesive capsulitis gradually improved, although she continued to have decreased ROM at last follow up which continued to restrict her ability to play tennis. 5. NSAIDs are now completely contraindicated for her. 6. She has annual follow up with GI for labs.

Pancreatic Cancer - Preoperative Exercise During Neoadjuvant Treatment
Nicole L. Klochak, Rebecca A. Ruiz, Ryan J. Marker, John C. Peters, W. Thomas Purcell, Catherine M. Jankowski, University Of Colorado Anschutz Medical Campus, Aurora, CO. (Sponsor: Catherine M. Jankowski, FACSM)
Email: Nicole.klochak@ucdenver.edu

(No relationships reported)

HISTORY: Neoadjuvant chemotherapy and radiation (NEO) is prescribed to patients with borderline-removable pancreatic cancer prior to tumor resection to improve postoperative outcomes. Physical fitness and muscle mass are positively associated with improved postoperative outcomes, but are decreased during NEO. Exercise during NEO may counteract these changes. The patient, a 70 year old male who engaged in regular exercise, was diagnosed with borderline-removable pancreatic adenocarcinoma. He reported an approximate 8kg weight loss and declining fitness prior to diagnosis. He received two months of NEO (four cycles of FOLFIRINOX and five treatments of stereotactic body radiation therapy) during which he participated in a supervised exercise program, prior to an open Whipple procedure.

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Hepatotoxicity Associated With Frozen Shoulder In A 47 Year Old Tennis Player; What’s The Link?
Michael J. Murphy, Brian Keisler. Palmetto Health Richland - University of South Carolina, Columbia, SC.
(No relationships reported)
function measures were improved at PreOp. The patient gained 8 kg of body mass including 7 kg of lean mass. All measures decreased from PreOp to PostOp, but most were slightly improved from Base. There were no adverse events related to exercise. Supervised, mixed modal exercise during NEO did not prevent postoperative changes in function and lean mass but was protective against further declines in these outcomes.

C-19 Clinical Case Slide - Wrist and Hand
Thursday, June 1, 2017, 8:00 AM - 9:40 AM
Room: 504

1304 Chair: Suzanne S. Hecht, FACSM. University of Minnesota, Minneapolis, MN.
(No relationships reported)

1305 Discussant: Hallie Labrador. NorthShore University HealthSystem, Chicago, IL.
(No relationships reported)

1306 Discussant: Brian A. Davis, FACSM. University of California-Davis, Sacramento, CA.
(No relationships reported)

1307 June 1 8:00 AM - 8:20 AM
Finger Injury-Flag Football
Leon M. Bathini Jr1, Inola Mello1, Jeff Paxton2, Karl Pankratz2.
1Texas Tech University Health Sciences Center, Lubbock, TX.
2Covenant Medical Center, Lubbock, TX.
Email: leonbathinijr@hotmail.com
(No relationships reported)

HISTORY: A 24 yo M law student was playing intramural flag football and sustained a finger injury. He was attempting to grab the flag of an opposing player when the patient accidentally collided with him and landed on him. Patient does not recall the specifics of the injury mechanism. After the injury, he had pain along his entire ring finger and especially over the distal phalanges. He also has swelling over his ring finger. He has not been able to flex his L ring finger normally. He iced it and was seen in clinic the next day and took Tylenol and Ibuprofen for pain.

PMH: L ring metacarpal fracture otherwise uncomplicated

PHYSICAL EXAM:
Musculoskeletal: L hand-> Mild swelling over the ring finger with more swelling over the volar proximal phalanges. No bruising. TTP over the volar aspect of the distal proximal phalanges and proximal aspect of the distal phalanges. Loss of active flexion at the DIP joint of the ring finger when making a fist. Intact passive flexion and extension at the DIP joint. Normal sensation and good perfusion

Differential Diagnosis:
- Flexor digitorum profundus rupture
- Flexor digitorum superficialis rupture
- Phalanx fracture
- Phalanx subluxation
- Volar plate disruption

TEST AND RESULTS:
X-ray L hand: Irregularity of the neck of the proximal phalanx of the ring finger along the ventral aspect. Soft tissue swelling about the finger more pronounced in the proximal phalanges.

Ultrasound of L ring finger: tear of the flexor digitorum profundus over the distal proximal phalanges (images available)

Final Working Diagnosis:
Zone 1 flexor digitorum profundus rupture of L ring finger

Treatment and Outcomes:
1. Prompt referral for hand surgery for repair to prevent retraction of the tendon, muscle contracture and permanent finger dysfunction
2. RICE treatment and splinted ring finger in slightly flexed position
3. Successful surgical retraction of flexor digitorum profundus tendons
4. Hand physical therapy starting with passive ROM and then strengthening exercises

History:
A right-handed 27 year old former boxer presented with a chronic deformity of his right 3rd finger noting that it does not straighten correctly. He has had 3 previous fractures in the right hand from boxing-related injuries. The most recent fracture was 10 years ago after hitting a TV. He denies any recent hand trauma. He presents with pain over the dorsum of the 3rd finger, worsened with gripping and extensive use of the hand. No numbness or tingling.

Physical Examination:
Examination showed an ulnar deviated 3rd finger in extension that resolved with flexion. No rotation deformity or extension deficit seen. The contour of the patient’s third knuckle is flattened in flexion. Normal range of motion and strength in all fingers. No laxity noted with medial and lateral stresses. Non-tender throughout.

Differential Diagnosis:
1. Sagittal band disruption
2. Metacarpophalangeal joint collateral ligament injury
3. Juncure tendinum disruption
4. Central slip rupture of extensor tendon
5. Previous metacarpal fracture with malunion

Tests and Results:
X-ray series right hand (3 views)
- Normal read
- MRI right hand
- Chronic sagittal band disruption at the third MCP with subluxation in the ulnar direction. Extensor tendon is grossly intact.

Final Working Diagnosis:
Traumatic sagittal band disruption (Boxer’s Knuckle)

Treatment and Outcomes:
- The patient underwent surgical reconstruction of his sagittal band and realignment of the extensor tendon. Due to attenuation of the chronic rupture a tendon graft was created from the extensor digitorum communis.
- Patient was subsequently placed in a short arm splint.
- Good functional and cosmetic improvement to date
etanercept, and prednisone, and subsequently referred to orthopedic surgery for evaluation for wrist fusion, and to physical and occupational therapy for joint range of motion and preservation.

1. Patient underwent tendon transfer using EIN to EPL and is recovering.
- Ruptured EPL tendon s/p non-displaced distal radius fracture
- Stump of tendon seen at the level of mid trapezium

Left wrist MRI (s/p thumb weakness)
- Medial dorsal epiphysis without presence of step-off
- Non-displaced fracture of the distal radius, with intraarticular extension involving the triangular fibrocartilage complex.
- Fusion of the metaphyseal-epiphyseal junction without presence of growth plate

TESTS AND RESULTS
5. Stenosing tenosynovitis
4. Radial nerve neuropraxia/posterior interosseous syndrome
3. Distal intersection tenosynovitis
2. Ulnar collateral ligament avulsion

DIFFERENTIAL DIAGNOSIS
- Cellulitis
- Fasciitis
- Myositis
- Abscess
- Septic arthritis
- Gout
- Fracture/dislocation
- Tendonitis
- Ganglion cyst

Tests and results:
- Left wrist x-ray: No acute fracture or dislocation
- Chronic deformity of ulnar styloid and persistent 5mm cyst within the lunate, unchanged from prior imaging
- Left wrist arthrocentesis per hand surgery consultation:
  - Monosodium urate crystals, no bacteria
- Other tests:
  - Complete blood count - no leukocytosis
  - Negative blood and synovial fluid cultures

Final/working diagnosis:
- Gout

Treatment and Outcomes:
- IV antibiotics and oral antibiotics for 48 hours
- Prednisone and ibuprofen for 5 days
- Pain and swelling significantly improved
- Did not initiate allipuriopin/colchicine

C-30 Free Communication/Poster - ACL Injury
Thursday, June 1, 2017, 7:30 AM - 12:30 PM
Room: Hall F

Individuals with anterior cruciate ligament reconstruction (ACLR) are at greater risk for knee osteoarthritis due to aberrant walking biomechanics, but limited data are available on running gait. PURPOSE: To compare impulsive loading characteristics during running between the injured and uninjured limb of individuals with unilateral ACLR, and to a control limb. METHODS: 22 individuals with unilateral ACLR (age=22±3.3 years; body mass index=23.8±3.4; time since ACLR=44.9±22.8 months; 16 females; 13 patellar tendon; 6 hamstring tendon; 3 allograft;) and 22 control participants without injury (age=22±3.3 years; body mass index=22.9±2.6; 16 females) participated in this study. Participants completed 5 running trials per limb in a random order at a self-selected speed while ground reaction force characteristics (peak impact force (PIF), average loading rate (ALR), and instantaneous loading rate (ILR)) were available on running gait. For knee osteoarthritis due to aberrant walking biomechanics, but limited data are available on running gait.
unjured limb also experiences greater PIF and ALR compared to control limbs. High loading rates and impact forces in individuals with ACLR may influence cartilage degradation, and should be considered a factor for knee osteoarthritis prevention.

High knee joint loading during walking gait and jump-landing (JL) may influence the development of post-traumatic osteoarthritis (PTOA) and increase the risk of a second anterior cruciate ligament (ACL) injury, respectively, following anterior cruciate ligament reconstruction (ACLR). It remains unknown if individuals who demonstrate higher lower extremity loading during walking gait also demonstrate higher loading during JL. PURPOSE: To determine associations between peak vertical ground reaction force (vGRF) and vGRF instantaneous loading rate during walking gait and JL in individuals with an ACLR. Secondarily, we sought to determine if limb symmetry indices (LSI = ACLR limb/uninvolved limb) for the kinetics variables associated between the gait and JL tasks. METHODS: Thirty-five individuals (74% female, age=21.0±3.2 years, height=1.69±0.08m, mass=65.2±13.8kg) with unilateral ACLR were recruited for this cross-sectional study. Participants performed 5-trials of self-selected walking gait (over 6m walkway) and JL (30 cm box placed 50% of height from force plates), respectively. Kinetics were extracted from the first 50% of the stance phase of walking gait and the first 100ms of landing for JL. Pearson product-moment (r) and Spearman’s Rho (ρ) analyses were used to determine associations between the same outcome measures collected during walking gait and JL. Significance was set at a priori P≤0.05. RESULTS: Greater vGRF instantaneous loading rate during gait (51.27±12.56% bodyweight per second (BW/s)) associated with greater vGRF instantaneous loading rate during JL (180.12±119.27 BW/s; r=0.39, P=0.021) in the uninvolved limb. All other associations between walking gait and JL kinetics and LSI were negligible (range p-value=0.289 to 0.299) and non-significant. CONCLUSION: No systematic associations were found between gait and JL kinetics for either limb or LSI’s in people with unilateral ACLR. Individuals who demonstrate high or low loading during dynamic activities may not be the same people that demonstrate high or low magnitude loading during gait. Therefore, individuals who may be at risk for PTOA onset, due to aberrant repetitive lower extremity loading, may not be the same people who are at risk for a second ACL injury, which is more likely to occur during a dynamic movement.

Patients with ACLR accumulate less MVPA and fewer steps/day compared to healthy matched controls. Only 25% of participants with ACLR met the 10,000 steps/day guidelines compared to 42% of controls. However, Marx activity (ACLR: 10.2±4.8; CON: 10.8±3.8; P=0.63) and Tegner activity (ACLR: 6.2±2.1; CON: 6.7±1.7; P=0.61) activity levels did not differ between groups. No relationships were observed between objectively measured physical activity and scale measures (P>0.05). CONCLUSIONS: Patients with ACLR accumulate less MVPA and fewer steps/day compared to highly matched controls despite reporting similar subjective activity levels. These findings highlight the importance of objective monitoring of physical activity level following return to activity due to the potential risk associated with reduced levels of physical activity.
The drop vertical jump (DVJ) task is used to assess functional recovery after an ACL injury which involves multiplanar forces within 100 ms of initial contact (IC). Our aim was to describe the timing and magnitude of peak knee power (PKP), as quadriceps contributes to anterior tibial translation, and rate of loading as quicker loads contribute to ACL injury due to viscoelastic properties of ligaments, in relation to high VM and high vGRF peaks. Methods: N=129 athletes aged 9-12 performed a cutting maneuver 5 times per limb. Motion data were captured with an 8 camera Qualisys system and an AMTI force plate. Using data reported previously three sub-groups were defined: high VM (≥32 Nm, N=89), high vGRF (≥1200 N, N=40), and high valgus angles (VA) (≥5°, N=129) respectively. A paired t-test was used to test if time-points represented discrete events, and a mixed models repeated measures ANOVA was used to test for interactions between kinetics and kinematics. Results: From IC, the mean time to PKP was 25 ms; to peak VM was 30 ms; to peak vGRF was 35 ms. Significant differences were found between all time-points (p<.001). Within-attempt sequence variability was seen in the time to peak indicating significant temporal overlap. Mean (SEM) PKP values were greater for VM than vGRF or VA groups (3.2 (0.25) Nm/kg vs 1.34 (0.54) Nm/kg; p<.009, and 1.79 (0.30) Nm/kg; p<.001, respectively). Rate of loading differed between the High VA group and VM (4382 N/s (7234 N/s) vs 35062 N/s (4615 N/s), p<.001) but not from the high vGRF group (39864 N/s (4615 N/s), p>.78. Conclusions: Considerable variability was seen in the timing of events. The timing of the specific risk factors investigated rarely coincided, although this did happen. Such an occurrence may reflect a possible scenario predisposing an athlete to ACL injury. Different subgroups may require tailored approaches for ACL injury prevention.

**Table 1: Kinematic variables at foot strike during 1st and 2nd landings of a drop vertical jump**

<table>
<thead>
<tr>
<th>Joint</th>
<th>Motion</th>
<th>First Landing</th>
<th>Second Landing</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACLR Knee</td>
<td>Flexion</td>
<td>-36.7±5.8°</td>
<td>-31.0±9.4°</td>
<td>.007</td>
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<tr>
<td></td>
<td>Adduction</td>
<td>3.0±4.8°</td>
<td>0.2±3.9°</td>
<td>.001</td>
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<tr>
<td></td>
<td>External Rotation</td>
<td>-11.4±9.9°</td>
<td>-8.3±3.0°</td>
<td></td>
</tr>
<tr>
<td>ACLR Hip</td>
<td>Flexion</td>
<td>45.5±12.9°</td>
<td>27.3±12.9°</td>
<td>.000</td>
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<tr>
<td></td>
<td>Adduction</td>
<td>-2.9±4.2°</td>
<td>-3.6±4.3°</td>
<td>.419</td>
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<tr>
<td></td>
<td>Internal Rotation</td>
<td>8.7±7.2°</td>
<td>4.6±6.8°</td>
<td>.002</td>
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</tbody>
</table>

**Table 2: Kinetic variables at foot strike during 1st and 2nd landings of a drop vertical jump**

<table>
<thead>
<tr>
<th>Joint</th>
<th>Motion</th>
<th>First Landing</th>
<th>Second Landing</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACLR Knee</td>
<td>Torque (Nm/kg)</td>
<td>1.34±0.54</td>
<td>1.79±0.30</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Power (N-m)</td>
<td>215±32</td>
<td>247±34</td>
<td>.001</td>
</tr>
<tr>
<td>ACLR Hip</td>
<td>Torque (Nm/kg)</td>
<td>3.0±0.54</td>
<td>3.5±0.54</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Power (N-m)</td>
<td>215±32</td>
<td>247±34</td>
<td>.001</td>
</tr>
</tbody>
</table>

**Conclusion:** The 1st and 2nd landings of a DVJ require distinct kinematics of the ACLR limb. Less knee flexion combined with greater knee abduction and internal rotation of the ACLR limb during the 2nd landing suggests that this landing better detects abnormal mechanics associated with subsequent injury risk. Thus, the 2nd landing could warrant additional study to identify patients who may be at greater risk for re-injury after ACLR.
Individuals with a history of ACLR participate in significantly less objectively measured moderate-to-vigorous physical activity (MVPA); however, it is unclear if these findings agree with common patient reported measures. **Purpose:** To quantify the relationship between patient-reported and objective measures of MVPA among those with a history of ACLR. **Methods:** 32 participants with a history of ACLR (Sex: 21F/11M, Age = 20.3 ± 1.7 years, BMI = 23.3 ± 2.8kg/m², Time since surgery = 28.2 ± 17.1mo) enrolled in this study. Participants completed the International Knee Documentation Committee subjective knee evaluation (IKDC) to form an knee related function. The International Physical Activity Questionnaire (IPAQ) was used to assess patient reported MVPA (min/week) and MET-minutes (min/week). Objective MVPA (min/day) was assessed with an ActiGraph GT3X-BT accelerometer worn on an elastic belt at the hip over a period of 7 days with a minimum of 4 days of wear with ≥10 hours per day. Wear time (min/day) was validated using recommendations of Choi et al. Freedom Adult VM3 cut points were then utilized to categorize physical activity as light, moderate, vigorous, or very vigorous based on the number of activity counts that occurred per minute during periods of wear time. Relationships between objectively measured and patient reported measures of physical activity were assessed using Pearson’s product moment correlations (r). In addition the dynamics of the relationship between patient reported and objectively measured MVPA was further investigated using Bland Altman plots to estimate the mean difference (MD) and limits of agreement (LOA) between assessment types. **Results:** There were positive relationships between IPAQ MET-minutes and both objectively measured MVPA (r = 0.496, p = 0.01) and step-count (r = 0.471, p = 0.01). Objectively measured and patient reported MVPA were not significantly related (r = -0.177, p = 0.33). Analysis of the Hald Allman plot revealed an average MD of 58.9 min/day and broad LOA (Upper LOA = 110.7 min/day, lower LOA = 7.0 min/day). **Conclusion:** The relationship between objective and patient reported measures of MVPA among participants with a history of ACLR is limited due to the potential for over-report in the volume and intensity of physical activity within this patient population.
Persisted quadriiceps weakness and knee dysfunction have been reported after ACLR reconstruction (ACLR). It is unclear if these clinical findings are related to physical inactivity among those with a history of ACLR. PURPOSE: To investigate the relationship between patient reported knee function, knee extension strength, and objectively measured physical activity in individuals with and without a history of ACLR. METHODS: 17 ACLR participants (Sex = 10F/7M, Age = 20.5 ± 1.9 yrs, BMI = 23.4 ± 3.5 kg/m², Time since surgery = 39.3 ± 18.7mos) and 17 matched controls (Sex = 10F/7M, Age = 20.5 ± 2.5 years, BMI = 23.1 ± 3.5 kg/m²) enrolled. Participants completed the International Knee Documentation Committee (IKDC) form to assess knee function. Involved limb knee extension maximal voluntary isometric contraction (MVIC) strength (Nm/kg) and isotonic knee extension strength (Nm/kg) was assessed at 60 and 180 deg/s using a multi-mode dynamometer. Moderate-to-vigorous physical activity (MVPA, min/day) was assessed with an ActiGraph GT3X-FT accelerometer worn on an elastic belt at the hip over a period of 7 days with a minimum of 4 days of wear ≥10 hours per day. Wear time (min/ day) was validated using recommendations of Choi et al and Freedson Adult VM3. Cut points were used to categorize physical activity. Relationships between MVPA, knee extension strength, and IKDC score were assessed for all participants as well as within the ACLR group using Pearson’s product moment correlations (r). RESULTS: Overall, IKDC score (mean = 93.42 ± 6.95) was positively correlated with isokinetic knee extension strength at 180 deg/s (mean = 1.30 ± 0.45Nm/kg, r = 0.41, p < 0.02). In the ACLR group, IKDC score (mean = 90.19 ± 7.21) was positively correlated with knee extension MVIC strength (mean = 2.28 ± 0.78, r = 0.48, p = 0.05) as well as isotonic knee extension strength at 180 deg/s (mean = 1.21 ± 0.55, r = 0.57, p = 0.02). There were no significant correlations between IKDC score, knee extension MVIC strength, or isotonic knee extension strength and MVPA. Conclusions: MVPA is an important clinical outcome that may not be related to traditional patient reported or functional outcome measures after ACLR. Understanding the factors contributing to physical inactivity after ACLR may guide clinical intervention strategies aimed at promoting MVPA.

C-31 Free Communication/Poster - Activity Trackers and Smartwatches
Thursday, June 1, 2017, 7:30 AM - 12:30 PM
Room: Hall F

Measuring children’s free-play physical activity (PA) to ensure they meet the recommended daily dose is key to slowing the childhood obesity epidemic. While activity trackers (ATs) are common in the commercial market, few have been validated for measuring children’s free-play PA. PURPOSE: To compare the cadence of children’s play, sport and locomotive PA recorded by five ATs vs. video direct observation (ViDO) and to assess the relationship among AT and ViDO cadence and PA intensity. METHODS: Healthy weight (HW) and overweight (OW) children (N=31; 15 girls) participated in 3 play/sport, 2 locomotive, and 1 stationary PA. Prior to playing, anthropometrics and resting metabolic rate (RMR) were measured using standard procedures. While playing, children wore a portable metabolic unit to measure PA energy expenditure [PAEE (METs) = energy expenditure + RMR], plus 2 research and 3 commercial ATs to record cadence (steps/min) for each activity. All activities were self-paced and played in random order. ANOVA was used to assess differences in PAEE and cadence across sex and weight status. RMANOVA was used to assess differences between AT and ViDO cadence. Regression analyses assessed the relationships among AT and ViDO cadence and PAEE. RESULTS: Overall, PAEE was higher in boys than girls (6.93 vs. 6.22 ± 0.3 METs), with no difference between HW and OW children. There was no effect of sex or weight status on AT or ViDO cadence. Four of the 5 ATs recorded significantly higher cadence for all activities combined (range: 71.5 ± 173.1 steps/min) compared to ViDO (37.4 ± 62.3 steps/min). When activities were classified by PA intensity (moderate vs. vigorous) or type (sport, play, locomotive), one AT recorded consistently higher cadence than ViDO, while three ATs AT recorded higher cadence (range: 6.5 ± 2.0 to 141.5 ± 69 steps/min) during stationary squats compared to ViDO (1.8 ± 0.7 steps/min). A weak relationship existed among cadence and PAEE (r = -0.21 to 0.31), with a stronger relationship between ViDO and AT cadence (r = -0.32 to 0.67). Conclusion: None of the ATs consistently recorded an accurate cadence of children’s play, sport, and locomotive PA. With the tendency to inflate cadence, caution should be exercised when using activity trackers to determine if children are meeting the recommended dose of daily physical activity.
baseline vs. week 3 (6801.0±4747.5 steps/day, p<0.001), and baseline vs. week 7 (9033.4±6603.3 steps/day, p<0.001) in the group users, but only baseline (7110.4±4225.9 steps/day) vs. week 7 (8587.3±4887.7 steps/day, p<0.001) in the individual users. WCs were significantly decreased in the individual users. Self-efficacy was improved in the group users (p<0.04).

CONCLUSION: WC, SBP and DBP were decreased in the individual users, and self-efficacy was increased in the group users. PA was increased at week 1, 2, 3, and 7 in the group users, but individual users showed increased PA only at week 7 from the baseline.

**Purpose:**

To investigate energy expenditure (EE) and step count (SC) measurements of the Fitbit Flex (FF) activity tracker during two walking protocols. **Methods:** 49 volunteers (male=26, female=23; age (years) 23±4.63±6.57; height (m) 1.72±0.11; mass (kg) 76.15±18.46 walked protocol one and 46 (male=24, female=22; age (years) 23±4.63±6.57; height (m) 1.72±0.11; mass (kg) 76.52±18.73 walked protocol two. 31 (male=18, female=13; age (years) 22.62±5.5; height (m) 1.71±0.10; mass (kg) 77.95±21.52 were used for reliability. Subjects walked for 3 minutes at 1.5, 2.5, and 3.5mph at 0% grade for each protocol. EE and SC values for each speed were compared to a MOXUS respiratory cart and a manual count of steps respectively. **Results:** EE: ρ=0.53, ρ<0.01; ρ=0.46; FF: 19.43±7.12 Kcal, MOXUS:11.9±3.09 Kcal, p<0.01; SC: 1.5mph (r=0.51, p<0.01; ρ=0.46; FF: 27.5±6.6; MOXUS:14.3±3.67 Kcal, p<0.01), 2.5mph (r=0.61, p<0.01; ρ=0.67; FF: 27.5±6.6; MOXUS:19.4±3.67 Kcal, p<0.01). **Conclusions:** Because of the popularity of activity trackers such as the Fitbit Flex, it is important to evaluate their accuracy and consistency. By understimating steps taken and overestimating the caloric cost associated with it, the Fitbit Flex may be hindering people from reaching the recommended levels of daily exercise that have been shown to provide minimum health benefits.

**Purpose:** To evaluate the accuracy and reliability of step counts from the Fitbit Charge™ among older adults. **Methods:** Thirteen participants with a mean age of 70.38±24.7 years volunteered to participate and completed all testing. Participants completed a 96 meter walk around a gymnasium while wearing the Fitbit Charge™ activity tracker. Step counts on the activity tracker were recorded before and after the walk to determine the step count. The walk was also video recorded to determine the actual number of steps taken during the walk. Step counts from video analysis were confirmed by two researchers. The same procedures were repeated on a second, non-consecutive day of testing to determine the reliability of the activity tracker. Accuracy of the activity tracker was determined by comparing step counts to the observed step counts from each testing session. The reliability of the activity tracker was determined by correlation analysis and comparison of step counts from the first testing session to the second testing session. **Results:** The activity tracker significantly underestimated observed steps at both testing sessions by 21.31 steps and 15.14 steps respectively (p<0.05). However, the correlation between the two sessions was only moderate, r=−0.55, p<0.05. **Conclusion:** Among older adults, the Fitbit Charge™ appears to underestimate steps taken even over a short distance. The reliability of the Fitbit Charge™ is questionable given only a moderate correlation between sessions. While preliminary, these results call into question the accuracy and reliability of daily step counts from the Fitbit Charge™. It is suggested that all new activity trackers to hit the market are given a careful study to determine their ability to accurately measure daily activity.

**Purpose:** To evaluate the accuracy and consistency of steps between the Fitbit Zip and One 0.2±2.1 0.3±0.3

**Fibit Zip and One were within one half percent of actual steps while wrist-worn Fitbits ranged from 7.0-19.7% 11 actual step counts.**

**Conclusion**

Consistent with previous research, activity trackers worn at the waist provide the most accurate step counts compared to wrist-worn models. Differences found in wrist-worn models may result in significant over- or underestimation of activity levels when worn for long periods of time.
greater than 75% of their maximum HR as a vigorous intensity activity. An estimate of children’s maximum age-related HR was obtained from the 208 - 0.7 (age) equation. Each intensity classification was compared to the intensity categorized by the MET determined by resting metabolic rate (i.e., criterion measure) to examine the measurement agreement. McNemar’s test was used to examine the measurement agreement for paired intensity frequency. RESULTS: After setting PA intensity classification with 50% and 75% of HR, the frequency determined by measured MET from the Cosmed K4B² were 1002, 80, and 120 for light, moderate, and vigorous intensity. The frequency determined by HR monitor and FHR were as follow: 1076, 394, and 58 by PFR, 1393, 127, and 9 by FHR. The values of weighted Kappa statistics from the McNemar’s test were 0.40 (95% CI: 0.36-0.44) for the intensity by PFR, 0.21 (95% CI: 0.18-0.25) for the intensity by FHR, 0.19 (95% CI: 0.16-0.23) for the intensity by FHRR. CONCLUSIONS: The agreement of PA intensity classified by the wearable activity tracker to the intensity classified the metabolic analyzer showed fair agreement.

CONCLUSION: The results demonstrate that the apple watch accurately measures steps on normal walking and running conditions compared to the manually counted steps. However, further research is needed to with more sample size and various populations.

Words: 1972/2000

Both consumers and researchers have become increasingly interested in using wearable fitness devices to monitor and measure physical activity (PA). Apple Watch was designed to track individual’s PA using a built-in exercise application, “Workout App” estimating user’s energy expenditure and exercise duration. Even though Watch was described as a useful wearable fitness technology, the validity of its PA measures is unknown. PURPOSE: The purpose of the study was to investigate the validity and reliability of the energy expenditure estimation of Apple Watch among college students. METHODS: A total of 30 college students (17 males and 13 females) from a state public university in Pennsylvania participated into the study. All participants completed two sets of three 10-minute treadmill walking and running trials while wearing three randomly positioned Watches while also being connected to indirect calorimetry. The two sets of measurement were arranged on two separate days with a randomization and 4-48 hour rest in between. The three walking trials were at speeds of 54, 80, and 107 m/min while the running trials were at speeds of 134, 161, 188 m/min. Resting Metabolic Rate was collected by the indirect calorimetry along with a familiarization trial prior to the execution of the exercise protocol. Energy expenditure comparisons was made using Two-way ANOVA with repeated measures. Reliability was analyzed by Intraclass Correlation. RESULTS: There was no significant device × speed interactions (F(1, 28) = 1.13, p = 0.05) between the indirect calorimetry (criterion) and iWatch. Bonferroni post hoc analysis revealed no significant differences between the criterion energy expenditure estimates (76.91±39.69 calories) and iWatch (81.5±36.69, p > 0.05). The reliability analysis: Overall, a moderate to high agreement among the three apple watches examined in this research, with coefficients increasing once speed surpassed the 2 MPH level. The Inter-Class Correlation (ICC) scores were 0.49 (95%CI) at 2mph, 0.66 (95%CI) at 3mph, 0.72(95%CI) at 4mph & 5mph, 0.71(95%CI) at 6mph & 7mph. CONCLUSION: iWatch demonstrated a moderate to high level of validity and reliability on measuring physical activity.

Purpose: To evaluate the validity of step counts detected by the Apple Watch (Series 1) during nineteen laboratory-based activities. METHODS: Fifteen participants (mean ± SD: age = 28.2 ± 6.2 years; BMI = 23.6 ± 3.6 kg/m²) wore the Apple Watch on the dominant wrist and performed 19 different activities for 2 to 3 minutes each. The Apple Watch was calibrated for each participant prior to commencing the experiment and the protocol included ambulatory activities on the treadmill and various simulated free-living activities that occur in day-to-day life. Start and stop times were recorded along with step counts displayed on the Apple Watch before and after each activity. Manually counted steps were obtained from video-recordings of the activities and used as the criterion for comparison. A step was defined as each instance the foot was completely raised off and put down on the floor. Paired sample t-tests (p<0.05) were conducted between the Apple Watch and the criterion variable for each activity to determine the validity of the Apple Watch in detecting steps. Results: There was statistically significant difference between mean step counts from the Apple Watch and the criterion for the following activities: sitting and talking while gesturing (0 vs. 5, 80.39 steps; p=0.025), standing and stacking books (54.5 ± 6.1 vs. 89.7 ± 7.5 steps; p=0.014), walking on the treadmill at 3 mph at a flat rate (244.5 ± 111.1 vs. 342.4 ± 24.44 steps; p=0.008), standing and folding towels (48.3 ± 42.5 vs. 11.9 ± 11 steps; p=0.007), riding the stationary bicycle at 600 kpm/min (47.7 ± 54.1 vs. 0 steps; p=0.004), and vacuuming (47.7 ± 42.6 vs. 134.8 ± 44.8 steps; p=0.000). Conclusion: It was observed that the Apple Watch was able to disregard extraneous hand movements (e.g. gesturing) and not count those as steps during light intensity activities of daily living. These activities did not involve rhythmic and exaggerated arm movements similar to that during unsupported walking. Conversely, increasing the intensity of hand movement during stacking books and folding towels while standing yielded...
Despite the popularity of consumer-based physical activity monitors (AMs), many of these AMs have little data examining their accuracy. **PURPOSE**: Our study’s purpose was to determine the validity of a popularly used wrist-worn AM to estimate Calories (kcals), steps, and heart rate (HR) during laboratory and semi-structured protocols. **METHODS**: Participants (n=32) aged 18-51 completed two protocols while wearing one AM on their non-dominant wrist. In the laboratory protocol, participants performed 11 activities including lying, sitting, standing, walking at various speeds (2.0, 3.0, 3.5-4.0 miles/hr) and elevations (0%, 5%, 10%), jogging, and cycling for 5 min each. For the semi-structured protocol, participants were taken to an indoor track to perform 3 activities (walking for 200 m, 1 jogging for 400 m). The variables measured by the AM were recorded during each activity and compared to criterion measurements (kcals assessed via metabolic analyzer, steps via hip-worn pedometer, and HR via pulse oximeter) using paired samples t-tests. Additionally, overall and activity-specific percent differences (%) were calculated between estimated kcals, steps, and HR from the AM and criterion measures. **RESULTS**: Overall % errors for steps, kcals, and HR were 9.7%, 50.2%, and 6.6%, respectively. The AM underestimated steps during most of the slow walking activities (<17.7%, p<0.05), whereas kcals were significantly overestimated (9.9%, p<0.05) during higher intensity activities (jogging, inclined walking and cycling). HR was not significantly different from the criterion for any activity except standing (underestimated by 4.1%, p<0.05). Steps and HR estimates by the AM were poorer for the semi-structured activities, underestimating both steps (≥12.1%, p<0.05) and HR (≥6.6%, p<0.05). **CONCLUSIONS**: The AM had low overall error (<10%) for estimating steps and HR in the laboratory protocol. However, accuracy was notably worse for kcals in the laboratory and in steps and HR estimates in the semi-structured protocol, and steps were less accurate during the low speed activities. This study indicates that caution should be used when making health and wellness decisions based on information from AMs since accuracy varies widely among different activities and activity variables.

There is limited information regarding the validity of consumer targeted wearable physical activity (PA) trackers, such as the Fitbit, to assess PA in free-living adults. **PURPOSE**: To compare daily minutes of sedentary time, and moderate-to-vigorous (MVPA) collected using two types of activity trackers, in a sample of overweight and obese adults (n = 12, BMI ≥37±4 kg/m², age = 48±12 yrs.) who completed a 6-mo. weight loss intervention (diet + self-directed PA) delivered using Facebook. **METHODS**: Participants were a Fitbit FlexTM on their non-dominant wrist continuously over 6 mos. They were also asked to wear an Actigraph GTX1TM on their non-dominant hip for 7 consecutive days at both baseline and 6 mos. Fitbit and Actigraph data for a minimum of one 10-hr. day at baseline and 6 mos. was required for inclusion in this analysis. Categorization of sedentary time and MVPA was derived from the Fitbit algorithm or using NHANES Actigraph cut-points (Troiano, 2008). **RESULTS**: Sedentary time was significantly lower and MVPA was significantly higher when assessed with the Fitbit compared with the Actigraph at both baseline (sedentary time: Fitbit = 427 ±168, Actigraph = 639 ±132 min/d, p<0.001; MVPA: Fitbit= 128±49, Actigraph = 18 ±19 min/d, p<0.0001) or 6 mos. (sedentary time: Fitbit = 459 ±168, Actigraph = 613 ±103 min/d, p<0.001; MVPA: Fitbit=123±53, Actigraph=14 ±10 min/d, p<0.0001). Change in both sedentary time and MVPA was not significantly different between the Fitbit (sedentary time = +63 ±46, p<0.16; MVPA = +8±13 min/d, p = 0.72) or the Actigraph (sedentary time = -49±52, p = 0.39; MVPA = -2±13 min/d, p = 0.48). **CONCLUSIONS**: The Fitbit significantly underestimated sedentary time and overestimated MVPA when compared with the Actigraph in a small sample. Changes in sedentary time and MVPA over 6 mos. were non-significant when assessed by either the Fitbit or Actigraph. These observations suggest that the Fitbit, which is relatively inexpensive when compared with the Actigraph, may be useful for assessing changes in sedentary time and MVPA in response to an intervention. However, the absolute values for sedentary time and MVPA assessed by the Fitbit are questionable, and worthy of additional investigation in larger samples of free-living adults. Funded by Kansas City Life Sciences Institute.
CONCLUSIONS: Individuals using step counting devices should be aware of sources of error in step counts. Contributing factors to error are the wear location, the algorithms used to count steps, and the activities performed.

Manufacturers of step counting devices apply filters to their step counting algorithms to prevent accumulation of steps when none are taken (i.e. false positives). However, because filters prevent steps from being recorded during short, intermittent walking bouts, it is possible that these filters may be a source of error. Since few manufacturers disclose the type of filter they use, we decided to investigate this topic. PURPOSE: To determine whether the devices used in this study have a filter, and to describe the effects of the filter on short, intermittent walking bouts with varied walk and pause durations.

METHODS: In Parts A and B, 20 participants performed intermittent walking bouts for 2 min, at a cadence of 100 steps/min. In Part A participants were instructed to walk a certain number of steps (i.e. 4, 6, 8, 10, and 12) followed by a 10-sec pause and repeat this until the trial ended. In Part B participants were instructed to walk four steps followed by pauses of variable intervals (i.e. 8, 6, 4, 2, and 1 sec) and repeat this. A researcher counted steps using a hand-tally device (criterion). "Percent of actual steps taken" was used for statistical analysis. A one-way repeated measures ANOVA was taken to evaluate the concurrent validity between the gold standard (Polar HR system) and the wearable technology (Fitbit HR). RESULTS: Peak HR measured by the Polar system (151.9 ± 15.9 beats/min) was not significantly different from the peak HR measured by the Fitbit HR (149.6 ± 18.0 beats/min; p = 0.69). Similarly, mean HR measured by the Polar system (127.9 ± 17.9 beats/min) was not significantly different from the mean HR measured by the Fitbit HR (121.0 ± 18.2 beats/min; p = 0.23). Concurrent validity between the Polar HR system and the Fitbit HR for both peak (r = 0.6) and mean HR (r = 0.66) was not significantly different (p > 0.05). CONCLUSIONS: On average, peak and mean HR was similar between the two devices. These results support the validity of wearable technology; the Fitbit HR was moderately valid in peak and mean HR compared to the Polar HR system. These results are promising for those who own wearable technology and are using it to monitor HR during physical activities such as pickleball doubles. We acknowledge our small sample size and admit that further investigation of the validity of wearable technology on physiological measures during pickleball and other racket sports is warranted.
CONCLUSIONS: The use of wearable devices with or without engagement did not have a statistically significant effect on weight or cardiorepiratory fitness after a 12-week intervention. However, some individuals improved within YMCA fitness scores post-intervention, which may have clinical significance.

1359 Board #34 June 1 9:00 AM - 10:30 AM
Increased Habit Strength and Self-Efficacy Promote PA with Wearable Fitness Monitors
Jeni Lansing, Laura Ellingson, Alison Philips, Greg Welk, FACSM. Iowa State University, Ames, IA. (Sponsor: Greg Welk, FACSM)
Email: jenil@iastate.edu
(No relationships reported)

In the US, less than 5% of adults obtain the recommended 150 minutes of physical activity (PA) per week, contributing to the onset of preventable chronic disease. Wearable fitness monitors are increasingly popular, with the goal of increasing PA levels; however, usage trends show that 75% of users stop wearing the devices after 1 month, limiting their potential benefits. Increasing self-efficacy (SE) (one’s belief in their ability to succeed at a specific task) and developing habits (automatic behaviors that occur in response to environmental cues) related to usage could improve engagement with monitors and further promote changes in PA. PURPOSE: Our purpose was to determine if change in SE and habit formation predict PA levels over a 3-month intervention using a wearable fitness monitor. METHODS: Ninety-four healthy adults (52% female; age 41.6 ± 18.4) were randomly assigned to receive a commercial fitness monitor alone or in combination with motivational interviewing and education on successful development of habits. Prior to receiving the monitors, participants completed the Self-Efficacy and Exercise Habit Survey and wore ActiGraph GT3X+ and activPAL3 accelerometers for 7 days to assess baseline physical activity levels. One week later, they were introduced to and provided with a fitness monitor to utilize at their discretion for three months. Participants returned for a follow up visit three months later, completing all baseline measures as well as the Self-Reported Habit Index (SRHI). The SRHI measured HS for wearing the monitor, checking data on the monitor and using the computer software and mobile app. A linear regression analysis was performed to assess the influence of change in SE and HS on PA levels at follow-up. Age, gender, group, and baseline PA levels were also included as predictors in this model. RESULTS: The overall model was significant (F(9, 74) = 5.681, p<0.001). Significant predictors were change in SE (β=0.278, p=0.039), HS (β=0.296, p<0.009), and age (β=0.247, p=0.018). CONCLUSION: Our results demonstrate that improving SE and HS may be key contributors to success when using fitness monitors for promoting PA. Interventions utilizing fitness monitors may benefit by including components to improve these constructs.

1360 Board #35 June 1 9:00 AM - 10:30 AM
Accuracy of Fitbit Charge 2 Worn at Different Wrist Locations During Exercise
Vanessa E. Salazar, Naomi D. Lucio, Merrill D. Funk. University of Texas Rio Grande Valley, Brownsville, TX.
Email: e.vanessa.slrz@gmail.com
(No relationships reported)

Many newly released activity monitors use heart rate measured at the wrist to estimate exercise intensity, however, where the device is placed on the wrist may affect the accuracy of the measurement.

Purpose: To determine whether the Pure Pulse technology on the Fitbit Charge 2 will show different heart rate readings when placed on the recommended exercise position compared to the all-day wear position at various exercise intensities.

Methods: Thirty five participants (MEAN ± SD; 22.0 ± 2.9yrs; 23.9 ± 2.6kg/m², 18 male) consented to participate in a single visit where two Fitbit Charge 2 devices were placed on the non-dominant wrist. Fitbit A was placed 2-3 fingers above the wrist bone. Fitbit B was placed directly above the wrist bone. The treadmill was set at 3 mph with 0% grade. Participants remained at this speed for 4 minutes. Heart rate measurements were taken at the last 10 seconds of each stage from both Fitbits and a polar heart rate monitor (chest strap). The same procedure was followed for 5 and 6 mph. Statistical analyses were performed using IBM SPSS 23.0. A Two-way (speed x location) Repeated Measures ANOVA was used to examine main effects. Pairwise comparisons with Bonferroni correction were used in post-hoc analysis. Pearson correlation and mean bias were calculated for each speed.

Results
Repeated Measures ANOVA found significant differences between speeds (p<0.01) and location (p<0.01), but not for the interaction (p=0.234). Pairwise comparisons indicated significant differences between each speed (p<0.01) and between the polar monitor and Fitbit B (p<0.05), but not between the polar monitor and Fitbit A (p=0.608). Pearson correlations indicated strong correlations between each Fitbit and the polar monitor (r= .58; 91; all p<0.01). Mean bias decreased as speed increased for Fitbit A (mean bias bpm SD; 1.1 ± 5.4; 1.9 ± 9.5; 6.4 ± 6.9; -0.3 ± 7.3 for resting, 1.5, 2.5, and 3.5 mph, respectively). Mean bias for Fitbit B increased as speed increased (-2.8 ± 8.8; -3.1 ± 11.1; -3.9 ± 14.6; -6.7 ± 14.3 for resting, 3mph, 5mph, 6mph respectively) while mean bias for Fitbit B increased as speed increased (-2.8 ± 8.8; -3.1 ± 11.1; -3.9 ± 14.6; -6.7 ± 14.3 for resting, 3mph, 5mph, 6mph respectively).

Conclusion: Wrist-worn heart rate monitors appear to provide values adequate for recreational use, however, following recommended guidelines on wear-position may impact heart rate readings.
The development of devices that measure physical activity has increased over the last decade. Research is needed to determine the accuracy of these devices at providing useful information that may affect behavior and health.

**Purpose:** To determine the accuracy and reliability of current smartphone fitness applications at measuring steps while walking on a treadmill. **Methods:** Fifty participants (18-40 years) consented to perform testing on two separate visits. On the first visit participants walked on a treadmill at 3mph for 500 steps, while using a pedometer and 5 smartphone fitness applications: Moves, Google-Fit (G-Fit), Runtastic, Accupedo, and S-Health using an android smartphone placed in the pocket. The second visit was held on a different day and followed the same procedures as the first visit. Zero and negative values were replaced with the mean value for that trial. Mean bias scores were calculated between the step count for each app and the respective tally counter for each trial. Mean Absolute Percent Error (MAPE) values were calculated for each app for both trials and mean bias scores were compared between trials for each app using Pearson correlations. Significance was set at p<0.05. **Results:** Fifty participants were included (Mean±SD; Age 22.9±4.3 yrs; BMI 24.3±7.3 kg/m^2; 22 Male). G-Fit recorded 3 zero values and 4 negative values and Moves recorded 1 zero value. Pearson correlation coefficients indicated that step bias between trials was significantly correlated for the pedometer, Runtastic, and S-Health (r=-0.42, p<0.01; r=-0.407, p<0.01; r=-0.382, p<0.01; respectively). Correlations for Moves, G-Fit, and Accupedo were not significant (r=-0.080, p=0.581; r=0.125, p=0.389; r=0.191, p=0.184; respectively). The MAPE values for trial 1 demonstrated that the apps with the smallest deviation from the tally counter were also the ones with best test-retest reliability, with S-Health being the most accurate (bias, MAPE: 2.28 steps, 1.31% followed by the pedometer and Runtastic (-3.26 steps, 2.86%; -0.02 steps, 3.70%, respectively). Moves, Accupedo, and G-Fit deviated farther from the tally counter. **Conclusion:** Some smartphone fitness applications consistently and accurately measure steps while walking at a normal pace while other apps may have more variation.

Numerous physical activity monitors exist and are used to track and improve fitness levels. Due to the increasing popularity of these devices, newer products have been developed that measure heart rate (HR) at the wrist. Little is known about how accurate these devices are at measuring HR at the wrist and how they compare to each other. **Purpose:** To determine how accurately HR was measured by three different wrist-worn physical activity monitors. **Methods:** Recreationally active men (n=9) and women (n=3) participated in this study. The average age and weight of participants was 22 ± 3 years and 73.9 ± 12 kg. TomTom Cardio (TT), Fitbit Surge (FB) and Microsoft Band (MB) physical activity monitors were used. The TT, FB, and MB were randomly assigned to the right or left wrist for each participant. The testing procedure included speeds of 2, 3, 4, 5, and 6 mph with each speed lasting three minutes. HR was measured by electrocardiography (ECG) using standard limb lead II and by the three different physical activity monitors. HR was recorded from each device every minute throughout the duration of the procedure. Pearson product moment correlations and bias between electrocardiography (ECG) and physical activity monitors with 95% limits of agreement (Bland-Altman analysis) were calculated. Statistical significance was set at p<0.05. **Results:** At 2 mph and 3 mph, only TT HR was significantly correlated with ECG heart rate (t=0.693, p=0.012 and r=0.392, p=0.043). At 4 mph and 6 mph TT was significantly correlated with ECG (t=0.911, p<0.001 and r=0.853, p<0.001). Significant correlations were calculated between FB and ECG at 4 mph (t=0.691, p=0.013) and 5 mph (r=0.953, p<0.001) and 6 mph (r=0.924, p<0.001). Only FB had a significantly different HR than the ECG at 2 mph (99 vs 85 bpm, p=0.037). The largest mean bias was found between ECG and FB at 2 mph [-13 bpm ± 24 bpm (95% limits of agreement)], while the smallest mean bias was found between TT and ECG [-2 bpm ± 12 bpm (95% limits of agreement)].

**CONCLUSIONS:** With increasing speeds, physical activity monitors more accurately measure HR but individuals should be aware that these devices may underestimate HR during slower walking speeds.

A variety of locations on the body are suggested for where a smartphone should be carried throughout the day to measure physical activity, however, there may be significant differences in daily activity levels depending on where the phone is carried. **Purpose:** To determine if smartphone location has a significant impact on the accuracy of popular smartphone pedometer applications at measuring steps while walking on a treadmill. **Methods:** Fifty-two participants (Mean±SD; 22.9±4.2 yrs; 28.4±6.4 kg/m^2; 22 Male) consented to perform testing on one visit. Participants walked on a treadmill at 3mph for 500 steps, while using a pedometer and 4 smartphones placed in commonly used locations (pocket, armband, waistband, hand). All smartphones were simultaneously running 5 applications throughout the trial: Moves, Google-Fit (G-Fit), Runtastic, Accupedo, and S-Health. Steps were verified using a hand tally counter. Zero, negative, and outlier values were replaced with the mean value for that app. A separate one-way Repeated Measures ANOVA was used for each app with the pedometer and tally counter. Significance was set at p<0.05. Pairwise comparisons with Bonferroni corrections were used for post-hoc analysis. Mean bias scores were calculated between the step count for each app and the tally counter. **Results:** Repeated Measures ANOVA showed significant differences across apps and the step counter for all apps (p<0.05 for all). Using pair-wise comparisons, Moves and G-Fit showed significant differences with the tally counter only for the hand (p=0.01), Runtastic showed significant differences with the tally counter for the arm, hand, and waist (all p<0.01), Accupedo and S-Health showed significant differences with the tally counter for the hand and waist (p<0.01). Lowest bias values for each app were as follows: FB had the lowest mean bias values for pedometer and 5 smartphone fitness applications: Moves, Google-Fit (G-Fit), Runtastic, Accupedo, and S-Health. Only FB had a significantly lower with the wristband PA monitor than pedometer (9226±188 vs. 5512±255 steps; P<0.01) as well as total steps (when combined with exercise) 13650±280 steps vs. 10005±2 steps; P<0.01) on Day 1. However, wristband PA monitor steps were significantly greater than pedometer steps during activities of daily living (7125±430 vs. 5512±255 steps; P<0.01) as well as total steps (when combined with exercise) on Day 2 (11134±397 vs. 9818±233 steps; P<0.01). **Conclusion:** Wristband physical activity monitors over-report “Steps” accumulated during activities of daily living.

Physical activity (PA) guidelines recommend accumulating 10,000 steps/day through 10 minutes of exercise and maintaining a physically active lifestyle (~6,500 steps). The advent of wristband PA monitors has made monitoring steps easier than ever, yet “steps” accumulated with wristband PA monitors may not be equal to valid pedometer devices. **Purpose:** To compare 10,000 steps accumulated during exercise and activities of daily living using a pedometer and wristband PA monitor. **Methods:** 26 healthy males (n=13) and females (n=13) were recruited for this two-day study. On Day 1 participants completed 30 minutes of exercise on a treadmill at 64-74% of their predicted HRmax wearing a pedometer and wristband PA monitor. Pedometer and wristband PA monitor steps were recorded after exercise and pedometer steps were subtracted from 10,000 to determine the remainder of steps participants needed to accumulate during daily activities. Remaining steps were accumulated by walking a treadmill at 3 mph and wristband PA monitor steps were re-recorded. Participants were then sent home with a pedometer and wristband PA monitor to assess steps during activities of daily living on Day 2. On Day 2, participants accumulated the same number of pedometer steps achieved on Day 1 (during treadmill walking) while engaging in their normal activities of daily living and wristband PA monitor steps were recorded. **Results:** Participants accumulated significantly fewer wristband PA monitor than pedometer steps during exercise (401±168 vs. 430±186 steps; P<0.01) and treadmill walking (521±126 vs. 569±186 steps; P=0.01) on Day 1. Consequently, total steps accumulated on Day 1 was significantly lower with the wristband PA monitor than pedometer (9226±188 vs. 10005±2 steps; P=0.01) on Day 1. However, wristband PA monitor steps were significantly greater than pedometer steps during activities of daily living (7125±430 vs. 5512±255 steps; P<0.01) as well as total steps (when combined with exercise) on Day 2 (11134±397 vs. 9818±233 steps; P<0.01). **Conclusion:** Wristband physical activity monitors significantly underestimate HR during slower walking speeds.
C-32 Free Communication/Poster - Biomechanics in Ball Sports

Thursday, June 1, 2017, 7:30 AM - 12:30 PM
Room: Hall F

1366 Board #41 June 1 8:00 AM - 9:30 AM
Effect of Jaw Pad Thickness on American Football Helmet Performance
Sean E. Quisenberry, Mark Jessunathadas, Scott G. Piliand, Trenton E. Gould. University of Southern Mississippi, Hattiesburg, MS.
Email: sean.quisenberry@usm.edu

1367 Board #42 June 1 8:00 AM - 9:30 AM
Can an Elbow Brace Change Elbow Valgus Acceleration During Throwing?
Takahiro Otsudo1, Hiroshi Hattori2, Yutaka Sawada2, Yu Okubo2, Kiyokazu Akasaka2. 1Saitama Medical University, Saitama, Japan. 2Saitama Medical Center Saitama Medical University, Saitama, Japan.
Email: otsudo@saitama-med.ac.jp

1368 Board #43 June 1 8:00 AM - 9:30 AM
Perceived and Actual Throwing Performance of Quarterbacks While Wearing Soft and Hard Rib Protectors

(Paper No. 1366)

Effect of Jaw Pad Thickness on American Football Helmet Performance

Equipment (NOCSAE) headform and then impacted per guidelines detailed in thePURPOSE: To investigate whether helmet fit,
PURPOSE: To determine whether throw performance (ball speed and throw error) outcomes and perceptions are affected by rib protector hardness and whether perceptions change after performing overhand football throws.
METHODS: Seven males (age: 23.25 ± 4.41 yr) with competitive quarterback experience (high school varsity to professional) participated. In a counterbalanced order, for each rib protector condition, no protector (NO RIB), soft (SOFT RIB) and hard protector (HARD RIB), the participant completed a 10 cm subjective visual analogue scale (VAS) of its perceived performance ability (10 cm perfect performance) before and after completing 10 single-step drop-back football passes as fast and accurately as possible at a target 9.1 m (10 yd) away. Performance measures of throw error (distance from target center) and ball speed (Bushnell® radar gun) among rib protectors were compared using repeated (RM) ANOVA. For VAS scores (% of 10 cm), RM ANOVA (3 Protector x 2 Time) were used. Significance for all tests was p < .05. RESULTS: HARD RIB (27.73 ± 2.83 cm) compared to NO RIB (24.68 ± 4.59) was greater; SOFT RIB throw error (26.86 ± 2.81), between NO and HARD RIB values, was nonsignificant. Speed differences up to 0.2 m/s among protectors were nonsignificant. For VAS, protector type but not time was significant. VAS of HARD RIB (78.1 ± 13.9%) was less than SOFT RIB (77.25 ± 13.06%) and NO RIB (93.39 ± 5.61%). CONCLUSION: For these athletes, hardness of the hard rib protector negatively influenced their perceived influence of rib protector on throwing performance, but only accuracy actually decreased. Throwing while wearing protectors did not change their perceptions. A non-rigid rib protector could be an acceptable compromise between getting an athlete to wear a protector and having no rib protection at all, but only if the softer protector has been proven to reduce collision forces or injury.

PURPOSE: To examine the effectiveness of jaw pad thickness on American football helmet’s ability to mitigate linear acceleration measures. Methods: The American football helmet’s thickest jaw pad in our test set-up resulted in a reduction of the advertised STAR value (peak g, STAR) of jaw pads of three different thicknesses (S = 1.65, M = 2.4, and L = 3.5cm). Helmets were fit to a medium National Operating Committee on Standards for Athletic Equipment (NOCSAE) headform and then impacted per guidelines detailed in the STANLEY rating system. Helmets were impacted twice at 4 locations (front, rear, side, top), and 5 drop heights (0.31, 0.61, 0.91, 1.22, 1.52m). Linear acceleration in the three cardinal planes was measured with a trizila accelerometer mounted in the center of gravity of the headform (sensing rate 20 kHz). A three-way (thickness x height x location) ANOVA with repeated measures was used to test for differences in vector resultant linear g accelerations (α = 0.05). RESULTS: Statistical differences in resultant linear g by location (F3,45 = 43.2, p <0.01, ƒ = 3.34), drop height (F1.76,60 = 270.83, p <0.01, f = 19.5), and location*thickness (F1.76,60 = 27.07, p <0.01, f = 23.31) were found. There were no statistical differences for thicknesses (Means ± SD, S = 75.15 ± 23.22, M = 76.75 ± 22.58, L = 78.39 ± 23.51g, p=0.068), height*thickness (p = 0.058), or location*thickness (p = 0.124). STANLEY values were calculated to be S = 0.43 (3 STAR), M = 0.47 (3 STAR), and L = 0.52 (2 STAR). CONCLUSIONS: Jaw pad thickness had no influence on linear acceleration measures. However, application of the thickest jaw pad in our test setup resulted in a reduction of the advertised STANLEY value from 3 to 2 STARS (Good, Adequate respectively).

The effectiveness of elbow brace to decrease elbow valgus acceleration during throwing is not clearly identified. PURPOSE: To measure the effect of an elbow brace on elbow valgus acceleration during throwing.METHODS: Repeated measures were taken of elbow valgus acceleration in 20 college students (16.7±0.7 yrs) with and without an elbow brace. One acceleration device was fixed to the medial epicondyle of the humerus while another to the distal forearm. All subjects threw 100 balls over a distance of 18.44m consecutively. Valgus acceleration was calculated as the sum of the acceleration of internal rotation of the humerus and posterior rotation of the forearm. Average elbow valgus acceleration(Ave-VA) was from the 5th to 9th throw (early phase) and compared with the average from the 90th to 94th throw (late phase). Additionally, ball speed (mile/h) and accuracy (percentage strike) were measured. Comparisons of ball speed, strike rate and Ave-VA were conducted using two-way ANOVA with repeated measures.RESULTS: All values are presented in time order (early and late phase). Ave-VA with a brace was 652.4±172.1 and 647.5±198.2, respectively. Ave VA without a brace was 842.0±246.7 and 816.5±195.5, respectively. These differences were significant (p<0.05). Ball speed with a brace was 63.9±5.0, while ball speed without a brace was 65.2±4.1 and 65.5±5.0, respectively which was not significantly different. Strike accuracy with a brace was 47.0±27.7 and 64.0±20.3 while with a brace was 49.0±20.9 and 50.0±27.1, respectively. There was a significant difference in strike accuracy when comparing early and late phase when wearing a brace (p<0.05).CONCLUSIONS: Ave-VA was decreased by wearing an elbow brace during throwing compared with normal throwing. Acknowledgement: Supported by a grant from the Faculty of Health and Medical Care, Saitama Medical University (2015-006).

PA monitors are a useful qualitative device to promote/maintain a physically active lifestyle. However, findings from our analysis indicate that quantitatively, wristband PA monitors may over report accumulated steps through activities of daily living.

THURSDAY, JUNE 1, 2017

Abstracts were prepared by the authors and printed as submitted.
regression model was constructed for the purpose of this study. Outcome variables were ball velocity and peak elbow varus torque. Kinematic pitch variables were the predictor variables.

RESULTS: Statistically significant predictive models were found for ball velocity ($R^2=0.30; p<0.003$) and peak elbow varus torque ($R^2=0.52; p<0.001$). Significant predictors of ball velocity included trunk forward lean ROM during the cocking phase ($β=0.22; 95\% CI [0.02, 0.43]$), ($p<0.04$) and stride length ($β=0.30; 95\% CI [0.09, 0.50]; p<0.005$). Significant predictors of peak elbow varus included trunk rotation at stride foot contact ($β=0.01; 95\% CI [-0.02, -0.01]; p<0.001$) and stride length ($β=0.05; 95\% CI [0.02, 0.07]; p<0.001$).

CONCLUSIONS: Greater stride lengths are associated with greater ball velocities and greater peak elbow varus torques in adolescent male baseball pitchers.

Handball is a court sport practiced by recreational and competitive athletes to develop speed, agility, power, muscular endurance, ambidexterity, and similar skills and components of fitness. Handball is a paragon of the principle of generality/ cross transfer; it develops skills and fitness which directly transfer to many team, individual sports and physical activities. The elemental nature of handball (no external implements) emphasizes the importance of biomechanics; only the kinetic chain influences and contributes to interactions with the ball. Despite the elemental, minimalistic mechanics of handball, research regarding biomechanics of performance is scarce.

PURPOSE: To determine transverse plane angular velocity of hip and shoulder rotation and resultant linear velocity of the ball associated with the power serve.

METHODS: Eighteen handball players competing at the B-class level or above (4 professional, 2 qualifiers, 4 open, 5 A and 3 B) provided informed consent and were videotaped in the transverse and sagittal plane while performing 10 power serves.

Vicon Motus 9.2 software was used to quantify peak hip (HAV) and shoulder (SAV) angular velocity in the transverse plane, and peak resultant linear velocity of the ball (RVB). RESULTS: HAV ranged from 3.2 to 12.3 rad/s in individual players; grand mean $= 8.13$ rad/s. RVB ranged from 10.5 to 18.4 rad/s in individual players; grand mean $= 13.98$ rad/s. RVB ranged from 25.5 to 36.7 m/s in individual players; grand mean $= 29.4$ m/s. To evaluate sequentially accumulated angular velocity within the kinetic chain, the proportion of serves in which HAV preceded SAV were tallied, and ranged from 30% to 100%; grand mean $= 72.2$%. SAV was more strongly related to peak ball velocity ($r=0.25; p>0.05$) than was HAV ($r=0.13; p>0.05$). Players in higher competitive divisions exhibited faster ball velocity and angular kinematics, and more effective timing within the kinetic chain.

CONCLUSIONS: Angular kinematics, linear ball velocity and kinetic chain sequence and timing of the handball serve were comparable to those reported for throwing sports. The experience, practice and playing time necessary to achieve higher competitive status in handball were related to faster angular kinematics and linear ball velocity, and more effective timing within the kinetic chain.

Athletes achieve high-level performances utilizing dysfunctional movement patterns that can increase an athlete’s injury risk. Little is known about how movement patterns change during a competitive season with an emphasis on dynamic performance. PURPOSE: To compare the functional movement patterns of Division III (D3) women’s (S) and volleyball (V), and how those movement patterns are affected during a single competitive season.

METHODS: 17 S (19+0.3 yo) and 14 V (19.2+ 0.4 yo) D3 players volunteered for the study. Injury history was obtained before the season and then after. FMS testing and %BF were performed at pre-season, twice in-season, and 1-wk post season. After pre-season FMS, teams were split into three age groups (age $= 16$ years, $n_3 = 26$; age $= 17$ years, $n_4 = 14$; age $= 18$ years, $n_5 = 16$). The FMS test consisted of the subjects starting at maximum speed between cones positioned in a “K” pattern at an indoor gym with hardwood flooring. The subjects started and ended running at the intersection of the “K” pattern. A contact switch for time measurement was placed on the top of each cone which subjects touched with the right or left hand. The subjects performed two trials with a 10-minute rest in between repetitions of the Agility K-test, and the time of test execution was measured in seconds. The difference among the age groups were statistically analyzed with the Kruskal-Wallis test and $p<0.05$. There was an increase in agility time from 16 to 17 years of age (19.22%).

Performance relative to age differences in a new Agility K-test (Cabella, 2015, 2016) required testing among three age groups. PURPOSE: To compare agility times in the Agility K-test among the three age groups. METHODS: Late adolescent male soccer players (n = 56) volunteered in the study and were divided into three groups (age $= 16$ years, $n_1 = 26$; age $= 17$ years, $n_2 = 14$; age $= 18$ years, $n_3 = 16$). The Agility K-test consisted of the subjects running at maximum speed between cones positioned in a “K” pattern at an indoor gym with hardwood flooring. The subjects started and ended running at the intersection of the “K” pattern. A contact switch for time measurement was placed on the top of each cone which subjects touched with the right or left hand. The subjects performed two trials with a 10-minute rest in between repetitions of the Agility K-test, and the time of test execution was measured in seconds. The difference among the age groups were statistically analyzed with the Kruskal-Wallis test and $p<0.05$. There was a significant difference among the groups, $K (2, n = 56) = 34.23, p<.001$, $\eta^2 = 0.81$. The post hoc tests showed a significant difference between 16-17 years, $Z = -3.16, p<.001$; 17-19 years, $Z = -4.66, p<.001$; 16-19 years, $Z = -2.43, p<.05$.
CONCLUSION: The results indicated significant differences in Agility K-tests among late adolescent soccer players. The results may be beneficial for strength and conditioning coaches, physical therapists, and other clinical and sports science staff in amateur soccer as a useful set of reference values for comparison with subjects of particular ages.

Trunk stability is critical for the transfer of energy from the lower extremity to upper extremity during throwing. Defining lower extremity kinematics during dynamic tasks will enable understanding of their contribution to trunk stability. PURPOSE: To examine the effects of trunk stability on lower extremity kinematics during a step-down task (SDT). METHODS: Professional baseball players (n=70; 22.6 ± 2.2 years; 91.8 ± 9.9 kg; 185.8 ± 6.6cm) volunteered. A SDT was performed on their lead leg from a 20.3cm box, lowering their contralateral heel to the ground and then returning to the starting position. Participants were filmed in the frontal and sagittal planes. Data were analyzed at heel strike using Dartfish. Trunk stability was defined as ‘poor’ when trunk motion (sum of trunk flexion and lean) was >24.9°, the median of the sample. ‘Good’ stability was defined as <24.9°. A one-way ANOVA was performed to determine if kinematics were different between participants with poor and good trunk stability. Pearson Product correlations characterized the relationship between trunk motion and lower extremity kinematics. RESULTS: See Table 1. Knee flexion (p=0.04) and hip flexion (p=0.03) were significantly greater in participants with good trunk stability. Significant negative correlations between trunk motion and knee (r=-0.323) and hip flexion (r=-0.360) were observed. CONCLUSION: Participants with poor trunk stability had significantly less knee and hip flexion during the SDT. Correlations indicate that as lower extremity motion decreases, trunk stability decreases. Deficits in knee and hip motion may have contributed to trunk instability, or they are a compensation strategy for the increased trunk motion in those classified with poor trunk stability. Research is needed to assess the impact of altered lower extremity kinematics and trunk stability on energy transfer during throwing.

Table 1. SDT data in participants with good and poor trunk stability, Mean (SD).

<table>
<thead>
<tr>
<th>Trunk Stability</th>
<th>Ankle Dorsiflexion</th>
<th>Knee Flexion</th>
<th>Hip Flexion</th>
<th>Knee Valgus</th>
<th>Pelvic Drop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>45.6 (3.8)</td>
<td>100.5 (4.5)*</td>
<td>119.9 (15.1)*</td>
<td>7.4 (8.6)</td>
<td>7.1 (3.4)</td>
</tr>
<tr>
<td>Poor</td>
<td>46.9 (3.2)</td>
<td>98.2 (4.8)*</td>
<td>112.2 (13.5)*</td>
<td>9.5 (8.0)</td>
<td>6.9 (3.0)</td>
</tr>
</tbody>
</table>

POURPOSE: To examine differences in axiomatic movement patterns and dynamic balance during golf performance between varying competition levels in golfers. METHODS: Nine participants with an average PGA handicap of 1.2 (range: 0 to 3) performed 52 drives on an outdoor driving range: 12 practice drives, 20 drives with a driver, 20 drives with a 6 iron. Half of the drives were performed while wearing directional compression core shorts (DCP). Visual analog scores (VAS, 150 mm) for low back pain (LBP), low back muscle fatigue (LBF), quadriceps fatigue (QF) and total fatigue (ToF) were measured at the beginning and end of each 26 trial condition (none, DCP). A launch monitor was used to measure carry distance. Two-way repeated measures ANOVA were computed to contrast the VAS (compression (none, DCP), time (pre, post) variables. Carry distance was measured with a launch monitor and the maximum carry distance was contrasted with a repeated measures ANOVA between conditions for each club. The coefficient of variation and Cronbach’s Alpha were computed to determine the reliability of carry distance for each club (driver, 6 iron) and condition (none, DCP). RESULTS: Significant time by compression statistical interactions were found for LBF (p=0.019), QF (p=0.046) and ToF (p=0.033). The pre-to-post change in these variables were 57%, 75%, and 57% lower during the DCP condition for LBF (none, 14.6 ± 10.9%; DCP, 6.2 ± 8.0%), QF (none, 7.9 ± 9.6%; DCP, 2.0 ± 4.8%) and ToF (none, 14.9 ± 12.0%; DCP, 6.4 ± 8.7%). Maximum carry distance was not different between conditions for the 6 iron (p=0.777; none, 268.0 ± 14.6 yards; DCP, 268.0 ± 17.1 yards) or driver (p=0.916; none, 183.0 ± 9.4 yards; DCP, 183.1 ± 9.1 yards). Reliability for the 6 iron drives were .881 and .976 for none and DCP conditions whereas the driver drives were .962 and .975, respectively. The coefficient of variation measurements were 5.6 ± 4.0% and 4.4 ± 1.5% for the 6 iron drives during the none and DCP conditions whereas the variation for the driver drives were 2.8 ± 0.9% and 2.8 ± 1.3%. CONCLUSION: Directional compression core shorts improved self-reported measures of low back, quadriceps and total body muscle fatigue but did not influence carry distance when performing golf drives with a 6 iron or driver.
CONCLUSION

had less than optimum SL, 41% had high LTF at BR, 45% had high pVGRF and 45%

RESULTS:

A large proportion of the study population were at risk of injuries (100%

statistical analysis of results was done. Forces (pVGRF) were recorded simultaneously using Force Plates. Data processing

2D video cameras (125fps). Key biomechanical variables including Delivery Stride

workload and on-field injuries. Very little such information is available with respect to

variables as predictors of injury in fast bowlers apart from other factors like bowling

demands a high level of performance from the fast bowler who obviously carries

Kraus1, Wouter Hoogkamer2, 3Specialized Bicycle Components Inc., Boulder, CO. 3University of Colorado Boulder; Boulder, CO. 4Specialized Bicycle Components Inc., Morgan Hill, CA. (Sponsor: William Byrnes, FACSMD)

Reported Relationships: T.M. Carver: Salary, Specialized Bicycle Components Inc.

Riding bicycles with rigid frames on rough roads leads to fatigue and discomfort. In response to this problem, manufacturers have begun designing road bicycles with suspension systems. However, suspension systems intrinsically dissipate mechanical energy, which may impose a metabolic penalty. Suspension losses may be greatest for riding uphill in a standing position.

Purpose: To quantify the effects of a novel front suspension system on the mechanical and metabolic power requirements during steep uphill bicycling.

Methods: 11 males (74.9kg) rode six 5-min trials at 3.35 m/s uphill (4.0°) on a large motorized treadmill in both sitting and standing positions, using their preferred gear ratio/cadence. They wore a helmet and metabolic mouthpiece (1.05kg combined) and rode the same road bicycle (9.02kg) with the suspension in rigid and compliant configurations. The suspension system comprises a spring-loaded steering tube that allows for vertical travel of the handlebars. We equipped the bicycle with a crank-based power meter and video recorded the axial displacement (ΔL) of the steering tube relative to the frame headtube. From the video measurements of ΔL (m) and knowing the stiffness (k/N/m), we calculated the mechanical power put into the suspension system: mechanical power (watts) = k ΔL Δf, where, f = cadence in rev/s. We averaged V02 and VCO2 for the last 2 min of each trial and calculated metabolic power.

Results: For the rigid and compliant conditions, mechanical power was the same (2.85 ±0.05 W/kg) while sitting (p=0.71) and not different for standing: 2.86 ±0.03 W/kg vs. 2.87 ±0.05 W/kg respectively (p=0.51). Metabolic power for sitting was 13.11 ±0.56W/kg rigid vs. 13.21 ±0.57W/kg compliant (p=0.23). For standing, metabolic power was 14.23 ±0.76W/kg and 14.15 ±0.84W/kg respectively (p=0.45). Power losses in the suspension while sitting 0.01±0.004W/kg, and standing 0.03±0.01W/kg, were < 1.05% of total mechanical power.

Conclusion: The steering tube suspension system did not require significantly more mechanical or metabolic power compared to riding with the suspension rigidly locked out. Supported by a gift from Specialized Bicycle Components Inc.

Knee Joint Angle Variability Does Not Differ Between Healthy and Knee OA Participants during Cycling

Jacob K. Gardner1, Kristyne Wiegang2, Julia Freedman Silvernail1, 1Biola University, La Mirada, CA. 2University of Nevada, Las Vegas, NV. Email: jake.gardner@biola.edu

(No relationships reported)

Stationary cycling is commonly prescribed for people with knee osteoarthritis (OA) yet anecdotal evidence suggests that for many patients, cycling tends to aggravate knee symptoms which may reduce the likelihood of cycling participation. To date, very little research has been conducted on cycling with knee OA participants and it is unclear if, and to what extent, individuals with OA cycle differently than individuals without OA. Coordination variability measures can be used to assess how an individual alters their movement from one repetition to the next, where greater variability is reflective of a healthy system. Therefore, it is possible that knee joint variability differences may exist among these populations. PURPOSE: To investigate differences in knee joint (thigh-shank) variability among healthy and knee OA participants during stationary cycling. METHODS: Thirteen participants with medial knee OA (age: 56.8 yrs., mass: 83.2 kg) and 11 healthy participants (age: 50.0 yrs., mass: 80.17 kg) cycled for 50-100% of the pedal cycle and 50-100% of the pedal cycle. A 2 x 5 (group x condition) ANOVA was used to assess differences in knee joint variability. RESULTS: No group or condition differences were found for any of the 3 planes of motion (all p-values > 0.05). Figure 1 indicates variability across all conditions, planes, and groups for the first 50% of the cycle only.

Results: COL golfers exhibited greater UQL (medial: 95.2 vs. 86.6 %LL; p<.0001; inferolateral: 94.8 vs. 88.6 %LL; p=0.0007; suprolateral: 72.1 vs. 64.5 %LL; p<.001; and LQ (anterolateral: 77.0 vs. 68.6 %LL; p<.001; posteroomedial: 117.4 vs. 104.7 %LL; p<.001; posterolateral: 116 vs. 97.2 %LL, p=.001) dynamic balance compared to SCHOL. COL athletes displayed greater proficiency in the lunge (COL: 1.81±0.11, SCHOL: 1.44±0.12; p=0.016), hurdle step (COL: 1.88±0.09, SCHOL: 1.59±0.10; p<0.0167) and active straight leg raise (COL: 2.58±0.10, SCHOL: 2.07±0.11; p=.0207), and a greater composite score (COL: 13.71±0.54; SCHOL: 12.44±0.52; p=.0293) compared to SCHOL.

Conclusions: COL level golfers had better proficiency in UQL and LQ dynamics, stability, individual movement patterns that involved unilateral stance, and overall movement ability compared to SCHOL. These data support the premise that movement quality improves with increased competitive level among golfers. These data may also help establish functional movement and dynamic stability normative values for golfers of different competition levels.
CONCLUSION: These findings suggest that OA participants do not display different knee angle variability by condition or compared to healthy participants. Thus, OA symptoms during cycling associated with individuals with knee OA are likely not a result of knee angle variability.

In cycling, increased power output at the pedal results in increased speeds (1). Pedal power output is primarily generated by the muscles spanning the trunk, hip, knee, and ankle and is a result of the summation of angular power produced from all lower extremity joints (2, 3). To our knowledge, non-sagittal kinematic variables have not been studied with respect to power production in cycling. PURPOSE: To assess the relationship between frontal plane knee, hip and trunk kinematics during maximal seated and standing cycling with average and peak power generation in trained cyclists. METHODS: Seventeen trained male cyclists (39.1 ± 7.8yrs; 1.82 ± 0.07m; 80.8 ± 9.2kg) completed a 15min warm-up followed by two, seated or standing (i.e., off the saddle), 3min cycling bouts at 80% of their maximal power output in a randomized order. Maximal power output was measured during 30s maximal cycling efforts during the warm-up. In the last 20s of the 3min cycling bouts, cyclists were asked to perform a maximum-effort sprint at 90-110rpm (4). During these efforts, knee, hip, and trunk 3D kinematics were collected using a motion capture system (240Hz, Qualisys, Sweden). Average and peak power output (W) was also collected (Vector, Garmin, USA) during these maximal efforts. All cycling testing was performed on the participants’ own bicycle fixed to a stationary trainer that allows side-to-side motion (Rock and Roll, Kurt Kinetic, USA). Pearson’s r correlation coefficients between frontal plane joint angular positions and cycling power were computed (p ≤ 0.05). RESULTS: Seated average and peak powers were 705.91 W and 875.158 W while standing average and peak powers were 728.88 W and 897.130 W, respectively. Hip abduction excursion during the down stroke of standing cycling was positively correlated with power (r = 0.53, p < 0.029). No other frontal plane kinematic variables were significantly correlated with peak or average power during seated (range r = -0.092 to 0.24) or standing (range r = 0.031 to 0.25) maximal cycling (p > 0.05). CONCLUSION: These findings suggest that hip abduction excursion may play a role in maximal standing power generation during cycling. Greater abduction excursion may indicate increased contributions of hip abductor muscles and future studies should assess muscle activation of hip abductors as a predictor of cycling power.
**Purpose**: To compare the Retül 3D motion capture system to the Vicon 3D system. A lack of significant difference between devices would support a low-cost option for clinicians working with cyclists.

**Methods**: Cycling kinematics were captured from ten competitive female cyclists using a 10-camera Vicon MX system and compared with a cycling-specific motion analysis system, Retül, while pedaling at 70% peak power output on a Velotрон cycle ergometer.

**Results**: MANOVA demonstrated no significant difference between systems for knee range of motion (ROM) (mean difference (MD) = 0.12º, p = 0.16), knee extension (MD = 0.12º, p = 0.10), knee frontal plane knee angles (MD = 2.7º, p = 0.15), ankle dorsiflexion (DF) (MD = 1.14º, p = 0.15), and plantarflexion (PF) (MD = -4.51º). However, knee flexion (MD = 1.42º, p = 0.02), hip flexion (MD = 32.83º, p < 0.001), hip ROM (MD = -3.8º, p = 0.001), ankle ROM (MD = -3.7º, p = 0.001) and measurement of the mean knee distance from bicycle centerline (MD = 11.13 mm, p < 0.001) were significantly different between systems. ICC indicated moderate agreement between systems for knee flexion (ICC = 0.52, p < 0.001). Linear regression of difference scores on mean scores demonstrated a significant relationship for knee flexion, hip ROM and ankle DF (p = 0.66, p = 0.10, p = 0.38, respectively).

**Conclusion**: In general, these data support Retül for use in comparison with Vicon for the measurement of knee extension, ankle DF and ankle PF, which are most relevant measurements for obtaining correct fit on a bicycle.

**Keywords**: Bike-fit, kinematics, agreement

**Table 1**: Lower extremity total and average joint powers

<table>
<thead>
<tr>
<th>Age</th>
<th>Total power (W)</th>
<th>Hip power (W)</th>
<th>Knee power (W)</th>
<th>Ankle power (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Older</td>
<td>107.8±16.1</td>
<td>26.0±6.7</td>
<td>37.8±9.9</td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>111.8±15.2</td>
<td>51.6±8.0</td>
<td>45.1±9.1</td>
<td></td>
</tr>
</tbody>
</table>

**ABSTRACT**

Plyometric ability was measured using the modified reactive strength index (RSI$_{m}$) and four indices using propulsion time (PTI), propulsion work (PWl), propulsion power (PP), and propulsion impulse (PII). Analysis of variance was used to test the differences in the mechanical variables and the plyometric indices across the four jump conditions. Correlations were used to assess the relationships between the plyometric indices and RSI$_{m}$. Results: RSI$_{m}$ (mean differences: 0.03 – 0.06 m; p < 0.007) and V$_{pre}$ (mean differences: 0.69 – 0.93 KN/m, p < 0.001) greater during CMJ compared to the DJ conditions. The mechanical variables during the absorption phase were greatest during the highest DJ (W$_{ABS}$, mean differences: 1.6 –
PURPOSE: To investigate how the number of jumps affects the force-velocity (Fv) characteristics derived from drop jumps (DJ) from different heights and squat jumps (SJ) performed with different loads.

METHODS: Twelve resistance-trained men (age: 21.8 ± 1.7 years; height: 1.81 ± 0.06 m; mass: 85.1 ± 8.6 kg; 1-RM squat: 162.3 ± 27.3 kg) performed SJ with loads equivalent to 0% (SJ0), 27% (SJ27), 56% (SJ56), and 85% (SJ85) 1-RM and DJ from heights of 0.40 m (DJ40), 0.60 m (DJ60), and 0.80 m (DJ80). Force plates were used to record the ground reaction force (GRF) during each jump from which the descent and ascent of the center of mass (CM) during ground contact was determined. The absorption phase during DJ was determined when the net impulse of the GRF was positive and the CM was descending while the propulsive phase during SJ was determined when the net impulse of the GRF was positive and the CM was ascending. The eccentric and concentric Fv characteristics (average vertical GRF, average vertical velocity of CM) for each subject were calculated during the absorption phase of DJ and the propulsive phase of SJ, respectively. Linear regression equations were fitted to the Fv data and the differences in the regression parameters were assessed when the number of jumps included was varied for concentric Fv (model 1: SJ, SJ, SJ, SJ, model 2: SJ, SJ, SJ, SJ; model 3: SJ, SJ, SJ, SJ) and eccentric Fv (model 1: SJ, SJ, SJ, SJ, model 2: SJ, SJ, SJ, SJ, model 3: SJ, SJ, SJ). RESULTS: Model 3 for the eccentric Fv characteristics produced a significantly greater y-intercept (mean difference: 1.2 Nm/kg, p < 0.043) and lower slope (mean difference: 1.2 Nm/kg, p < 0.020) than model 1. There were no significant differences in the y-intercept (range of differences: 1.7 - 3.7 Nm/kg, p > 0.05) or slope (range of differences: 1.5 - 2.8 Ns/m, p > 0.05) between the three models for the concentric Fv characteristics, although some of the parameters associated with model 3 were unrealistic.

CONCLUSIONS: Both DJ and loaded SJ may provide means of assessing the eccentric and concentric Fv characteristics, with the regression parameters becoming more realistic with the inclusion of a greater number of jumps.
KFC independently accounted for 11.8% (p = 0.047) of the variance in DOM vGRF. No DOM limb multiple linear regression model was significant. KFC and PKF independently accounted for 15.7% (p = 0.021) and 16.5% (p = 0.017) of the variance in NON vGRF, respectively. KFC and IKQ5 as a multiple linear regression model accounted for 18.9% (p = 0.043) of variance in NON vGRF. CONCLUSION: KFC, on DOM and NON limbs, is the best sagittal plane kinematic predictor of vGRF, in a single limb drop landing task in physically active males. Despite IKQ5 not being an independent significant predictor on either limb, it improved KFC prediction of vGRF on the NON limb. This study highlights how active males use sagittal plane knee motion and quadriceps strength to influence vGRF in a single leg landing task, as research has shown women are more likely to use hip and knee kinematic strategies. Active individuals with weak quadriceps and a stiffened knee at initial contact are likely at risk for injuries associated with increased impacts during single limb landings.

No DOM multiple linear regression model was significant. PKF and IKQ5 independently accounted for 15.7% (p = 0.021) and 16.5% (p = 0.017) of the variance in NON vGRF, respectively. PKF and IKQ5 as a multiple linear regression model accounted for 18.9% (p = 0.021) of variance in NON vGRF. CONCLUSION: PKF, on DOM and NON limbs, is the best sagittal plane kinematic predictor of vGRF, in a single limb drop landing task in physically active males. Despite IKQ5 not being an independent significant predictor on either limb, it improved PKF prediction of vGRF on the NON limb. This study highlights how active males use sagittal plane knee motion and quadriceps strength to influence vGRF in a single leg landing task, as research has shown women are more likely to use hip and knee kinematic strategies. Active individuals with weak quadriceps and a stiffened knee at initial contact are likely at risk for injuries associated with increased impacts during single limb landings.

Vertical jump is an important skill in many sports. Sports such as volleyball and basketball require its participants to perform a vertical jump in a more upright position and gain as much height as possible. Previous research has shown that when trunk motion is restricted during a vertical jump participants have decreased jump height, take-off velocity, and hip extension moment compared to a jump with non-restricted trunk motion. Findings also suggested that the knee was the greatest compensator for the difference in hip extension moment. It was interesting to note that some participants jumped higher with the UR. This shows that there might be potential to train individuals to jump higher while maintaining an upright trunk. It is important to recognize that there are sports that require task performance in less than ideal situations. It could be worthwhile repeat this study with athletes who are trained to jump with a vertical trunk i.e. volleyball players, basketball players.

The functional movement screen (FMS) has been shown to be a valid and reliable tool for assessing fundamental movement patterns. While dysfunctional movement patterns have been shown to increase an athlete’s risk for injury, it is unclear what influence they have on athletic performance.

PURPOSE: To examine the relationship between FMS testing and sport specific performance tests for Division III (D3) women’s soccer (SOC) and volleyball (VB), as well as compare performance differences between sports.

METHODS: 17 SOC (19.6 ± 0.3 yo) and 13 VB (19.2 ± 0.4 yo) players consented to the study and performed pre-season FMS, a 3-site % body fat (%BF) skinfold analysis, and performance testing. Performance testing included 1-min push-up test, Vertical Jump (VJ) test, Illinois Agility (IA) test, and 12x 20 m repeated sprint test (RST) with 20 sec recovery each sprint. 1-way ANOVA was run to compare differences between sports. Pearson correlations were run to examine the relationships between the FMS and performance measures. All data were expressed as mean ± se, and all significance levels were set at α = 0.05.

RESULTS: Players were of similar height but VB players weighed (76.5 ± 2.1 kg) significantly (p < 0.0001) more than SOC (63.0 ± 1.9 kg). %BF was significantly higher (p = 0.0022) for VB (28.6 ± 1.4% vs 22.2 ± 1.3%), which resulted 5.8 kg greater fat free mass (FM) for VB (p = 0.0001). There were no significant differences in any of the performance measures, including VJ. However, the estimated power output for the VJ was significantly higher (p < 0.0001) for VB (388.8 ± 105.8 W) than SOC (309.46 ± 92.6 W). The FMS lunge score was moderately related to both mean (r = 0.46, p = 0.0160) and best (r = 0.41, p = 0.0295) RST time (sec). The total FMS score showed a similar relationship for mean (r = 0.42, p = 0.00251) and best (r = 0.50, p = 0.0066) RST. %BF appears to negatively impact FMS scores (r = -0.36, p = 0.0447).

CONCLUSIONS: In a cohort of D3 women athletes, there appears to be no differences between athletes in common skill-related performance measures, despite significant differences in %BF and FM. The inverse relationship between %BF and lower FMS scores suggests that reducing body fat could improve performance measures. The FMS may be useful in identifying potential skill-related performance decrements in similar athletes.

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head. The NAS CMVJ began with the dominant upper limb fully raised overhead, while the non-dominant hand remained on the iliac crest during the entire CMVJ. All jumps were performed by descending to an internal knee angle of 90°, using maximal effort, and reaching for an overhead target. A three dimensional markerless motion capture system (MCS; DARI, Lenexa, KS) was used to analyze the kinematic and kinematic data. T-tests and ANOVAs (*AS vs. NAS, †eccentric [ECC] vs. concentric [CON]; p<0.05) were performed on mean values from all 3 jumps for AS and NAS for each subject. RESULTS: Results for AS and NAS CMVJs are shown in the table. The AS CMVJ produced greater vertical jump height (VJH) an average of 0.07±0.03 m (3.01±1.3 in). The hips and ankles produced greater ECC and CON torques, less hip flexion, and greater time in the concentric phase during the AS CMVJ. The knees produced greater concentric torque, however there were no differences between jump conditions. The NAS CMVJ also had greater time in the concentric phase of the jump. CONCLUSION: Compared to NAS, use of an AS produced a 13% increase in CMVJ height, and greater peak torques for the hips and ankles, even when comparing eccentric and concentric phases. The AS CMVJ also increased the duration of the concentric phase, thus permitting greater torque generation to increase CMVJ height.

Table 1. Kinetic and kinematic data during eccentric (ECC) and concentric (CON) phases of countermovement vertical jumps with arm swing (AS) and no arm swing (NAS) (X±SD).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AS</th>
<th>NAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jump Height (m)</td>
<td>0.55±0.09</td>
<td>0.48±0.07</td>
</tr>
<tr>
<td>ECC Duration (s)</td>
<td>0.62±0.15</td>
<td>0.59±0.07</td>
</tr>
<tr>
<td>COO</td>
<td>0.29±0.06</td>
<td>0.27±0.06</td>
</tr>
<tr>
<td>Hip Flexion (°)</td>
<td>102.5±15.14</td>
<td>92.05±15.48</td>
</tr>
<tr>
<td>Knee Flexion (°)</td>
<td>101.36±15.68</td>
<td>90.58±11.86</td>
</tr>
<tr>
<td>Ankle Flexion (°)</td>
<td>21.40±8.84</td>
<td>23.26±4.23</td>
</tr>
<tr>
<td>DCC Hip Peak Torque (Nm)</td>
<td>28.34±6.65</td>
<td>23.13±8.05</td>
</tr>
<tr>
<td>DCC Knee Peak Torque (Nm)</td>
<td>15.26±3.56</td>
<td>10.71±4.21</td>
</tr>
<tr>
<td>DCC Ankle Peak Torque (Nm)</td>
<td>7.60±2.27</td>
<td>8.15±1.75</td>
</tr>
<tr>
<td>CON Hip Peak Torque (Nm)</td>
<td>50.43±13.21</td>
<td>37.43±13.42</td>
</tr>
<tr>
<td>CON Knee Peak Torque (Nm)</td>
<td>17.48±3.96</td>
<td>16.50±4.60</td>
</tr>
<tr>
<td>CON Ankle Peak Torque (Nm)</td>
<td>7.78±1.23</td>
<td>5.89±2.81</td>
</tr>
</tbody>
</table>

1396 Board #71 June 1 8:00 AM - 9:30 AM
Visual Memory Influences the Effect of Soccer Ball Handling on Knee Valgus Angle while Cutting
Scott M. Monfort1, Jared J. Pradarelli1, Dustin R. Grooms2, James A. Ohat1, Ajit M.W. Chaudhari, FACSM1. The Ohio State University, Columbus, OH. 2Ohio University, Athens, OH. Email: scott.monfort@osumc.edu
(No relationships reported)

BACKGROUND: Sports injuries remain a major concern for athletes despite ongoing efforts to improve screening and prevention methods. Recent research suggests that neurocognitive may play a role in the neuromuscular control associated with injuries such as anterior cruciate ligament tears. Additionally, sport-specific tasks, such as dribbling a soccer ball, are integral to playing sports, but may also influence lower extremity mechanics. The relationship between neurocognitive ability and biomechanics during a sport specific cutting task is yet to be investigated.

PURPOSE: To determine the relationship between neurocognitive and the effect of soccer ball handling on lower extremity mechanics during a side-step task.

METHODS: Fifteen healthy male collegiate soccer players (20.8 ± 2.0 y, 1.77 ± 0.07 m; 77.0 ± 8.6 kg) participated in the study. Participants performed anticipated 45° run-to-cut trials while dribbling a soccer ball (BH) and without dribbling (NB) while 3D kinematics and kinetics were recorded. Approach speeds of NB trials were matched to those of BH trials. Peak knee valgus angle (pKValA) and moment for the plant leg were calculated. Participants also completed the ImPACT® neurocognitive assessment to evaluate visual and verbal memory, reaction time, and visual motor speed. Composite scores from the neurocognitive assessment were entered as candidate linear regression predictors for the change scores in lower extremity biomechanical parameters (i.e., BH – NB). Promising models with respect to adjusted-R² and Mallows‘ C₅ were further evaluated for significance (n=0.05) through linear regression analysis.

RESULTS: A one unit decrease in the visual memory composite score (i.e., worse visual attention, scanning, and/or visual learning) was associated with an increase in pKValA of 0.25° ± 0.07° during the BH task compared to the NB task (R² = 45.8%, p = 0.006).

CONCLUSION: The detrimental effect of soccer ball handling during a side-step cut movement on knee valgus was found to be influenced by athletes‘ visual memory ability. These results may suggest that athletes with a diminished capacity for visual memory may be less able to maintain optimal biomechanics while accommodating the demands of sport-specific tasks that require visual attention.

Muscle preactivation prior to high impact landing is a normal sensorimotor strategy to attenuate loads and place joints in stable positions. Patients with chronic ankle instability (CAI) have shown sensorimotor deficits, which can result in injury-prone joint positions. Little is known whether rehab training can improve pre-landing joint positions and muscle activation in patients with CAI.

PURPOSE: To examine the effect of a 6-week ankle and hip intervention program on sagittal ankle, knee and hip joint kinematics and medial gastrocnemius (MG), vastus lateralis (VL) and gluteus maximus (GX) activation from 150 ms pre-to initial-contact of landing.

METHODS: 15 CAI subjects in a rehab group (23±2 yrs, 178±18 cm, 76±9 kg, 83±7% FAAM ADL, 56±10% FAAM Sports, 4.7±2.0 ankle sprains) completed a series of 10 jumps per trial with each trial including a different external load (body weight (BW, kg), BW*1.1, BW*1.2, BW*1.3). Using a three-way 2 (sport) x 2 (environment) x 4 (load) ANOVA. RESULTS: There were no significant differences in any measure for the sport factor. The aquatic condition displayed significantly (p<0.001) reduced PF by 50.7%, RFD by 53.5%, Imp by 38.6% and TTS by 6.5%. On land, increasing external load did not significantly change PF or RFD, but did produce significantly (p<0.001) greater Imp (12% increase for BW vs BW*1.3). In water, increasing load had a significant effect on PF (p=0.001) increasing PF (except BW 1.1 vs BW 1.2), RFD (except for BW vs BW*1.1) and Imp (except for BW*1.2 vs BW*1.3). Despite this increase in PF, RFD and Imp with load in water, all measures were still significantly (p<0.001) lower than land. CONCLUSION: The results for lower PF, RFD and Imp in water vs land validate the potential lower risk of injury for performing countermovement jumps in water. Adding small to moderate external loads in water increased PF, RFD and Imp in most conditions, yet still apply a significantly lower orthopedic stress compared to Land. Further research should monitor injury rates between these two environments.
Sports involving frequent jumping (JUMP) and landing (LAND) and changes in direction may increase risk of Achilles tendon (AT) injury. Mechanisms of AT rupture are thought to be related to weight bearing activities such as JUMP and LAND that involve knee extension and vigorous dorsiflexion on a plantar flexed foot. Studies report less postural stability and a higher plantarflexor moment during lateral jump-landing. To our knowledge, there are no studies that have examined AT loads during JUMP and LAND in forward-backward (F/B) and medial-lateral (M/L) directions.

**Methods:**

Physically active healthy males (age 21.6 ± 1.8 years, height: 178.4 ± 6.4 cm, weight: 76.4 ± 11.2 kg) were fitted with 47 markers and performed 10 single leg F/B and M/L JUMP and LAND over a 20cm barrier. The rate of LAND and JUMP was paced with the use of a metronome set at 60 Hz (approximately 1 second per 2 steps). Kinematic and force data sampled by 15 motion analysis cameras (180 Hz) and force platforms (1800 Hz), respectively. Inverse dynamics and then static optimization were used to estimate muscle force. AT cross sectional area and mass trajectory was used for clipping data during LAND and JUMP, which occurred approximately the first and second 50% of movement, respectively. Two way repeated measures multivariate analyses of variance (n = 0.05) were used to compare peak AT force, stress, and strain between movements (JUMP and LAND) and directions (F/B and M/L).

**Results:** M/L JUMP and LAND peak AT force (p = 0.002), stress (p = 0.004) and strain (p = 0.004) were greater than A/P. JUMP peak AT force (p = 0.007), stress (p = 0.015) and strain (p = 0.015) were higher than LAND. There was no interaction between movements and directions. **Conclusion:** M/L JUMP LAND has greater AT loading demands than F/B JUMP LAND. JUMP showed higher AT loading demands than LAND. This may provide insight to both AT injuries and rehabilitation efforts.
Purpose: A single bout of cardiovascular exercise improves cognitive learning, but effects on motor learning have been scarcely researched with mixed results. Key questions remain, including the intensity of exercise required to achieve behavioral effects. The purpose of this study is to test the effect of moderate intensity exercise (ModEx) on the retention of a drop vertical jump (DVJ) landing strategy. Methods: 40 healthy females (mean age: 20.1, range: 18-22) with no history of leg injury in the past 12 months attended a 1 hour session, first performing 2 DVJs to gather baseline data. Peak vertical ground reaction forces (PVGRF) and hip flexion (HF) angles at the deepest point of landing were measured with a force plate and 2D motion capture software. Next they performed 30 DVJs with feedback for enhanced “soft” landing mechanics. Individuals were then randomized to the ModEx group (n=20), to perform 30 minutes of biking at 55-65% heart rate reserve, or the control (C) group (n=20) for 30 minutes of sham electrical stimulation. After 1 week, a retention session was performed to assess PVGRF and HF during 2 DVJs. Results: Baseline performance did not differ between groups (C: mean PVGRF=48 N/kg (SD=12), ModEx PVGRF=45 N/kg (12), p=0.84; C: HF angle=96° (23), ModEx: HF angle=94° (24), p=0.62). Both groups reduced PVGRF and HF angles after training (C:PVGRF=38.5 N/kg (11.5), 56°(14); ModEx: PVGRF= 39 N/kg (10), 62° (14), p<0.01) and at retention (C:PVGRF=42 N/kg (10), 58°(15), ModEx: PVGRF= 41 N/kg (8), 60° (15), p<0.01). There was a group by time interaction effect on relative retention (percent change from training to retention) for PVGRF (d=0.21) and HF (d=0.31), which failed to reach statistical significance (p>0.05). Conclusion: Training methods were sufficient to induce motor learning, however the effect of ModEx on retention of the skill was small, and these results fail to statistically support the hypothesis that ModEx enhances motor learning of landing strategies. Recommendations for use of ModEx to enhance motor learning cannot be made on the basis of these results. Due to substantial variability, further study with a larger sample will strengthen conclusions. Other considerations for further investigation include exercise timing and dosage, motor skill complexity, and length of the retention period.

During exercise and sport, physically active individuals often perform movements that require dynamic postural stabilization. Postural stability has been linked to ankle and knee injuries and examining factors associated with stabilization may provide insight as to how poor stability influences joint loading. Purpose: To examine mechanisms associated with postural stability during a Forward Jump Single-Leg Landing task (FJSL). Methods: Dynamic postural stability index (DPSI), a composite of the anterior-posterior, medial-lateral, and vertical ground reaction forces, kinematics, knee extension strength (KES), and knee extension rate of torque development (RTD) were collected on 23 males (Age: 23.9 ± 1.3 years, Height: 178.4 ± 7.1 cm, Mass: 84.4 ± 8.6 kg). KES and RTD were collected using an isokinetic dynamometer. DPSI, sagittal plane joint angles at initial contact (HiJp), Knees (JC), ANK (JC) and peak flexion angles (KneePKFlex, AnklePKFlex) were collected during a FJSL for the dominant (DOM) and non-dominant (NON) limb using a 3D motion capture system. Paired samples t-tests examined lower extremity asymmetries in DPSI, kinematics, KES, and RTD. Pearson correlation coefficients examined the relationships between KES, RTD, DPSI, and landing kinematics. Significance was set at p<0.05. Results: Subjects demonstrated asymmetrical DPSI (p=0.003) and asymmetrical AnklePKFlex (p=0.033) but not asymmetrical KES or RTD (p>0.05). Increased KneePKFlex and AnklePKFlex correlated with an improved DPSI (r= -0.519, p<0.016 and r= -0.466, p<0.03) on the DOM limb while KneePKFlex and HipPKFlex correlated with an improved DPSI on the NON limb (r=-0.472, p=0.031 and r=-0.520, p=0.016). Neither KES nor RTD correlated with any of the kinematic measures for their respective sides. (p>0.05). Conclusions: Biomechanical stabilization strategies utilized the knee but the DOM, which had better stabilization, incorporated more AnklePKFlex, likely distributing weight over the forefoot. Neither strategy related to KES or RTD. Incorporating movement and balance components focused on symmetrical coordination of corrective movement strategies, including ankle stability, into current training programs may be necessary for improved dynamic postural stabilization.

INTRODUCTION: Jumping is a fundamental skill for children to develop. While the vertical jump has been extensively researched in adults, such investigations have not been thoroughly extended to children. Understanding the biomechanical correlates of jump height in children could help guide future research of jump height prediction models leading to valuable information about the development of fundamental motor skills in children. Purpose: To conduct a preliminary analysis on the relationship between lower extremity joint kinetics and vertical jump height (VJH) in children. Methods: 37 children [age (yrs): 7.2 ± 1.5; height (m): 1.2 ± 0.1; mass (kg): 26 ± 7.7] participated in the study. Anthropometric measurements were obtained prior to the start of the jump protocol. The task consisted of participants performing five maximal effort vertical jumps. Segment position data were collected using a ten camera optical motion capture system, and ground reaction forces were obtained from two force platforms. To assess joint kinetics, sagittal plane moments at the hip, knee, and ankle were calculated using an inverse dynamics technique and normalized to body weight. Maximum vertical displacement of the center of mass after takeoff was calculated to determine JH. Results: Correlation analysis revealed a significant positive linear relationship between peak ankle moment (2.1 ± 0.8 Nm/kg) and JH (18.05 ± 2.40 cm) (r=51; p<0.01), peak knee moment (0.7 ± 0.4 Nm/kg) and JH (r=50; p<0.01) as well as peak hip moment (1.5 ± 0.6 Nm/kg) and JH (r=61; p<0.01). Conclusion: Peak ankle, knee, and hip moments were found to be moderate to strong correlates of JH in children. Future research investigating JH predictors in children should consider lower extremity joint kinetics as plausible predictors.
INTRODUCTION: Jumping is a fundamental motor skill that influences successful participation in various physical activities and sport. Understanding the factors associated with vertical jump performance can provide a more extensive indication of normal or deviated motor skill development in children. However, predictors of vertical jump height in children have not been extensively explored. PURPOSE: To explore potential biomechanical, anthropometric, and descriptive predictors of vertical jump height (JH) in children. METHODS: 37 children [age (yrs): 7.2 ± 1.5; height (m): 1.2 ± 0.1; mass (kg): 26.7 ± 7.7] participated in the study. Participants were asked to perform five maximal effort vertical jumps. Lower extremity position data and ground reaction forces were collected using an optical motion capture system and two force platforms respectively. Peak sagittal plane lower extremity joint moments were calculated using an inverse dynamics technique, and peak joint powers were calculated as the product of individual joint moments and angular velocities. Net peak power (NP) was calculated as the highest sum of hip, knee, and ankle power at a given instant. In addition to biomechanical variables, age, height, weight, leg length, and weekly amount of physical activity served as independent variables (IV). Stepwise multiple regression analysis was conducted to determine the accuracy of IV predicting JH. RESULTS: Regression results indicated that the model significantly predicts JH (R2 = .716, R2ad = .70, F(2,35) = 44.158, p < .001), and accounts for 71.6% of the variance in JH when net peak power (14.43 ± 3.95 W/kg) and peak hip moment (1.5 ± .06 Nm/kg) were the sole predictors. CONCLUSION: NP and peak hip moment were shown to be significant predictors of JH in children, which coincides with previous research on biomechanical JH predictors in adult populations.
Effect of Rehabilitation Intervention on Hip Mechanics during Cutting in Patients with Chronic Ankle Instability

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THURSDAY, JUNE 1, 2017

1409 Board #84  June 1 8:00 AM - 9:30 AM
Effect of Rehabilitation Intervention on Hip Mechanics during Cutting in Patients with Chronic Ankle Instability

Preston Danielson¹, S. Jun Son¹, Kim Hynsoo², Cameron Hadley¹, Dustin Breuning¹, Matthew K. Seeley¹, J. Ty Hopkins, FACSM¹. ¹Brigham Young University, Provo, UT. ²West Chester University, West Chester, PA. (Sponsor: J. Ty Hopkins, FACSM) Email: prestonddanielson@gmail.com (No relationships reported)

Hip dysfunction may be closely associated with chronic ankle instability (CAI). Ankle and hip intervention strategies in CAI patients could improve hip mechanics during functional sport movements.

PURPOSE: To examine the effect of a 6-week ankle and hip intervention program on hip landing mechanics in patients with CAI.

METHODS: 15 CAI subjects in a rehab group (23±2 yrs, 178±8 cm, 76±9 kg, 83±7% FAAM ADL, 56±10% FAAM Sports, 3.6±1.1 MAII, 4.7±2.0 ankle sprains) completed a series of 10 ankle and hip strength and proprioceptive exercises (theraband, wobble board, ankle disk, etc.) 3 times/week for 6 weeks under supervision. 14 CAI subjects participated in a control group (22±2 yrs, 177±9 cm, 75±12 kg, 81±9% FAAM ADL, 56±12% FAAM Sports, 3.4±1.2 MAII, 5.9±3.3 sprains). Subjects performed 10 jumps consisting of a max vertical jump plus a side cut. Functional analyses (α=.05) were used to detect a group x treatment interaction over time. If 95% CI did not cross the zero, significant differences existed.

RESULTS: Figure 1. The rehab intervention resulted in up to (i) 3.5 deg less hip flexion at 9-82% of stance, (ii) 0.27 Nm/kg less hip extension moment at 8-16% stance, and (iii) 0.2 Nm/kg more hip extension moment at 19-25% of stance. No changes were detected in frontal hip angle and frontal hip moment over time between groups.

CONCLUSIONS: Relative to the control group, CAI patients in the rehab group tend to land with less hip flexion angle along with less hip extension moment initially, but they increased hip extension moment in an effort to control the high impact landing. Less hip flexion angle and more hip extension moment are indicative of a stiff hip landing strategy. Data are needed to examine whether this strategy reduces the risk of ankle injury.

Six-week Rehabilitation Intervention Increases Ground Reaction Force during Cutting in Patients with Chronic Ankle Instability

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Altered ground reaction force (GRF) during cutting is associated with chronic ankle instability (CAI). Little is known whether a rehabilitation intervention alters GRF patterns during a cutting task.

PURPOSE: To examine the effect of a 6-week ankle and hip intervention program on GRF during the stance phase of cutting in patients with CAI.

METHODS: 15 CAI subjects in a rehab group (23±2 yrs, 178±8 cm, 76±9 kg, 83±7% FAAM ADL, 56±10% FAAM Sports, 3.6±1.1 MAII, 4.7±2.0 ankle sprains) completed a series of 10 ankle and hip strength and proprioceptive exercises (theraband, wobble board, ankle disk, etc.) 3 times/week for 6 weeks under supervision. 14 CAI subjects participated in a control group (22±2 yrs, 177±9 cm, 75±12 kg, 81±9% FAAM ADL, 56±12% FAAM Sports, 3.4±1.2 MAII, 5.9±3.3 sprains). Subjects performed 10 jumps consisting of a max vertical jump plus a side cut. Functional analyses (α=.05) were used to detect a group x treatment interaction over time. If 95% CI did not cross the zero, significant differences existed.

RESULTS: Figure 1. The rehab intervention resulted in up to (i) 0.16 N/kg less vertical GRF at 3-9% of stance, and 0.21 N/kg more vertical GRF at 17-23% and 39-74% of stance, (ii) 0.06 N/kg more posterior GRF at 11-22% and 38-48% of stance, and 0.03 N/kg less posterior GRF at 82-97% of stance, while no changes were detected in medial-lateral GRF.

CONCLUSION: Relative to the control group, CAI patients in the rehab group tend to land with greater vertical and posterior GRF, which results in a stiffer landing. While this may lead to a faster execution of the cutting task, greater vertical GRF could result in greater impact loads in the lower extremity, which might increase the risk of ankle injury in a CAI population.
Energetic redistribution from the distal to proximal joints may be linked to sensorimotor deficits at the ankle in patients with chronic ankle instability (CAI). It is known whether a rehab intervention improves lower extremity energetic patterns during cutting. 

**PURPOSE:** To examine the effect of a 6-week ankle and hip intervention program on ankle, knee and hip joint power during cutting in CAI patients.

**METHODS:** 15 CAI subjects in a rehab group (23±2 yrs, 178±8 cm, 76±9 kg, 83±7% FAAM ADL, 56±10% FAAM Sports, 3.6±1.1 MAII, 4.7±2.0 ankle sprains) completed a series of 10 ankle and hip strength and proprioceptive exercises (theraband, wobble board, ankle disk, etc.) 3 times/week for 6 weeks under supervision. 14 CAI subjects participated in a control group (22±2 yrs, 177±9 cm, 75±12 kg, 81±9% FAAM ADL, 56±12% FAAM Sports, 3.4±1.2 MAII, 5.9±3.3 sprains). Subjects performed 10 jumps consisting of a max vertical jump plus a side cut. Functional analyses (α=.05) were used to detect a group x treatment interaction over time. If 95% CI did not cross the zero, significant differences existed.

**RESULTS:** Figure 1. The rehab intervention resulted in up to (i) 0.8 W/kg less ankle power absorption (19-26% of stance) and 0.2 W/kg less hip power absorption at 9-14% of stance, and (ii) 1.9 W/kg less knee power generation at 25% of stance and 1.6 W/kg less hip power absorption at 9-14% of stance.

**CONCLUSIONS:** Relative to the control group, CAI patients in the rehab group tend to absorb power using the knee and hip during landing and to generate power using the ankle during push-off. Proximal joints play a key role in landing energetics in patients with CAI following the intervention.
Lower-extremity functional asymmetries (LEFA) of the bodyweight squat have been found to be related to injury risk, post-injury function, and physical performance. Due to movement complexity, several sources may cause LEFA to change throughout the exercise. PURPOSE: The goal of this investigation was to examine vertical ground reaction force (GRFv) LEFA and their relationships in multiple phases of the movement. METHODS: Twenty recreationally active adults (9 men, 11 women; age = 21 ± 2.6 years; height = 171 ± 8.8 cm; mass = 67.2 ± 1.9 kg; mean ± SD) performed five consecutive bodyweight squats while GRFv were recorded under each foot. Squats were performed in a controlled manner with hands on hips, each repetition separated by a brief pause. LEFA was calculated by subtracting the percent of the average GRFv on the preferred kicking leg (KL) from that of the non-preferred kicking leg (NLK) over the entire movement and within 6 phases: the entire down (eccentric), the entire up (concentric), and first and second half of each. Eleven subjects were reassessed at a later date for repeatability. RESULTS: LEFA in the phases were not significantly different from the 4.5 ± 2.1% LEFA over the entire movement (p = 0.415). Pearson’s correlations of LEFA levels found all phases to be significantly correlated with each other as well as the total movement (r ≥ 0.499). However, when just the 10 asymptotic subjects were examined (absolute LEFA > 4.5%) significant correlations between concentric and eccentric phases were less common (p = 0.055 in 4 of 9 comparisons). LEFA was found to be highly repeatable (Chronbach’s α ≥ 0.715 except in the second half of the up phase α = 0.548). CONCLUSION: These results suggest that in healthy subjects with low levels of LEFA the source(s) of any weight-bearing asymmetry may be expressed similarly throughout the movement. However, in those that are more asymmetric different sources may exist between phases or the mode of contraction may cause asymmetries to be expressed differently from a single source. Therefore, when screening for injury risk, it may be necessary to examine more than just the average over the entire squat movement.

**RESULTS:**

<table>
<thead>
<tr>
<th>Speed (ft/s)</th>
<th>FB in position</th>
<th>FB out position</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.04</td>
<td>4743±1/-5.5</td>
<td>4877±25.1</td>
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<tr>
<td>2.21</td>
<td>4852±20.3</td>
<td>5178±21.8</td>
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<tr>
<td>2.38</td>
<td>5001±24.2</td>
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</tr>
</tbody>
</table>

**Comparison of the Effect of Flexible Barbell Weight Position on Max Ground Reaction Force**

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(No relationships reported)

Previous research reported that force production of a flexible barbell (FB) to that of a steel Olympic barbell (SB) resulted in the FB generating greater maximum ground reaction forces (GRFmax) for experiments with a lifting machine and human subjects lifting at 1.73 ft/s as an inner position. No studies have shown that the same trend is true for other lifting speeds (LS) at various inner and outer positions of the FB.

**PURPOSE:** The purpose of this study was to compare maximum ground reaction force production (GRFmax) of the FB at various physiologically relevant LSs at an inner-most and outer-most position for the loaded weight plates. **METHODS:** Using a bar-lifting machine, FB were lifted at various speeds of 2.04 ft/s, 2.21 ft/s, and 2.38 ft/s. The weight of each bar was set to 63lbs and placed at an inner-most and outer-most position on the FB. The GRFmax of FB in and out positions were compared with independent-samples t-tests. **RESULTS:** The FB had significantly higher GRFmax for all speeds for the out position (see table below). **CONCLUSIONS:** These results may provide a physiological mechanism to recruit more type Ix muscle fibers compared to the SB under these conditions. Future studies need to be conducted to validate these results with human subjects for different types of lifts.

**Maximum Ground Reaction Forces (N) for In vs. Out Position**

**Ground Reaction Force Asymmetries in the Bodyweight Squat: An Examination of Phases**

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(No relationships reported)

The partial deadlift (PDL) is commonly used to improve maximum strength in the conventional deadlift (CDL). However, it has been proposed that a problem with the PDL may be the lifters inability to replicate the CDL body position and form in the PDL at the liftoff position. Currently, no studies have been conducted to determine the kinematic or kinetic profile of the PDL or how it compares to the CDL. **PURPOSE:** To investigate the kinematic and kinetic differences between the PDL and CDL by comparing the joint angles of the ankle, knee, hip, thorax, and joint moments of the ankle, knee, and waist. **METHODS:** A group of 10 resistance-trained healthy males (21.9 ± 2.6 yrs; height = 171 ± 8.8 cm; mass = 67.2 ± 1.9 kg; mean ± SD) performed five consecutive bodyweight squats while GRFv were recorded under each foot. Squats were performed in a controlled manner with hands on hips, each repetition separated by a brief pause. LEFA was calculated by subtracting the percent of the average GRFv on the preferred kicking leg (KL) from that of the non-preferred kicking leg (NLK) over the entire movement and within 6 phases: the entire down (eccentric), the entire up (concentric), and first and second half of each. Eleven subjects were reassessed at a later date for repeatability. **RESULTS:** LEFA in the phases were not significantly different from the 4.5 ± 4.9% NLK-KL LEFA over the entire movement (p = 0.998). Similarly, absolute levels of LEFA in the phases were not significantly different from the 4.5 ± 2.1% LEFA over the entire movement (p = 0.415). Pearson’s correlations of LEFA levels found all phases to be significantly correlated with each other as well as the total movement (r ≥ 0.499). However, when just the 10 asymptotic subjects were examined (absolute LEFA > 4.5%) significant correlations between concentric and eccentric phases were less common (p = 0.055 in 4 of 9 comparisons). LEFA was found to be highly repeatable (Chronbach’s α ≥ 0.715 except in the second half of the up phase α = 0.548). **CONCLUSION:** These results suggest that in healthy subjects with low levels of LEFA the source(s) of any weight-bearing asymmetry may be expressed similarly throughout the movement. However, in those that are more asymmetric different sources may exist between phases or the mode of contraction may cause asymmetries to be expressed differently from a single source. Therefore, when screening for injury risk, it may be necessary to examine more than just the average over the entire squat movement.

**Effects of Zero-Drop Shoes on Knee Joint Kinematics & Kinetics During the Barbell Back Squat**

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(No relationships reported)

**PURPOSE:** During the barbell back squat, increased loading promotes strength gain, but also poses potential for injury from increased exertion at lower extremity joints. Barefoot and zero-drop footwear are being studied in running and other athletic situations, but little is known about how they influence squatting. It has been shown that there is a reduction of frontal plane knee moments during squatting in barefoot and zero-drop footwear compared to standard athletic shoes. The purpose of this study was to investigate joint moment differences at the ankle and hip while performing barbell back squats in barefoot and zero-drop footwear. **METHODS:** 10 male and 5 female (n=15) recreational weight lifters performed 1 set of 10 repetitions of barbell back squats at a self-selected weight, defined as the amount of weight the participant would do with performing 4 sets of 10 repetitions. The sets were performed in unshod, non-cushioned zero-drop (0mm heel-toe drop, minimalist style), cushioned zero drop (0mm heel-toe drop, cushioned soles), and standard athletic shoe (SAC) conditions while 3D kinematics and kinetics were collected. **RESULTS:** The barefoot condition led to a reduced peak dorsiflexion angle (14.4º ± 3.6º vs. 0º ± 0.001) and sagittal plane range of motion (15.3º ± 3.6º vs. 0º ± 0.001) compared to the SAC. A reduced peak plantarflexion moment in the barefoot condition was trending towards significance (p = 0.072) compared to the SAC. Peak dorsiflexion angles were not significantly different between either zero-drop condition and SAC. The peak plantarflexion moment in the non-cushioned zero-drop condition was reduced compared to the standard condition (0.86 Nm/kg ± 0.36 Nm/kg, p = 0.008). A decrease of the peak plantarflexion moment in the non-cushioned zero-drop condition was also trending towards significance (p = 0.082). No significant differences were seen in the hip kinematic and moment variables. **CONCLUSION:** The results indicate that performing barbell back squats in either of the zero-drop conditions reduces the demands placed on the ankle joint compared to the SAC. Performing the barbell back squat barefoot provides the greatest reduction of stress to the ankle. Implication of these findings suggest that zero-drop footwear are effective to use while squatting in companion with other athletic footwear used for training.
at liftoff in the PDL may be significantly different than the CDL. Due to these differences, the PDL may not be an appropriate exercise for improving the CDL. Care should be used when selecting appropriate exercises to improve the CDL.

The Functional Movement Screen (FMS™) identifies limitations in an individual’s movement patterns. The Microsoft Kinect™ sensor is reported to be a feasible markerless system to assess joint angles during a squat and has the potential to be a quantitative tool for the FMS™. PURPOSE: To assess the inter and intra-rater reliability of the Microsoft Kinect™ sensor, integrated with bespoke software, for assessing the deep squat FMS™ sub test. METHODS: A prototype (V1) was developed to allow the Kinect™ to track flexion of the hip and knee joints, and alignment between ankle and knee joints, to score deep squat performance against FMS™ guidelines. Prototype (V2) was developed to enhance reliability by tracking 20 body joints during deep squat performance. Raw data was captured, based on a deep squat score of three, as per FMS™ guidelines, to generate teaching samples. The samples were fed into a machine learning algorithm to allow the Kinect™ to learn deep squat performance. A data model was then created to identify individual movement errors as outlined by FMS™ guidelines, to calculate a performance score. For prototype (V1), a convenience sample of 141 children (9.7±3.7 years) performed the deep squat three times. For prototype (V2), 43 adults (23.7±7.5 years) completed the deep squat three times and repeated 72 hours later in a test-retest protocol. For both validations, the Kinect™ was set four metres from each participant in the frontal plane and at one metre high. In addition, a blinded manual assessment of each performance was completed by a certified FMS™ tester, whilst the bespoke software automatically assessed performance. A Cohen’s Kappa statistic was calculated to determine inter-rater reliability between manual and the prototype (V1) and intra-rater reliability for the prototype (V2), the intraaclass correlation coefficient (ICC) was determined to assess intra-rater reliability between test re-test performances. RESULTS: Inter-rater reliability between blinded manual assessment and the bespoke software was found to be excellent for prototype (V1) (Kicc = 0.89). Intra-rater reliability was found to be high for prototype (V2) (ICC = 0.99). CONCLUSIONS: The results indicate the Kinect™ sensor, linked with bespoke software, is a more reliable tool to assess deep squat FMS™ test performance than manual assessment.

PURPOSE: To investigate the effects of two non-ballistic squat and two ballistic jump squat protocols performed over multiple sets on the total mechanical work performed and oxygen uptake. METHODS: In a counterbalanced cross-over design, 11 resistance-trained men (age: 21.9 ± 1.8 years; height: 1.79 ± 0.05 m; mass: 87.0 ± 7.4 kg) attended four testing sessions during a three week period where they performed multiple sets of squats and jump squats with a load equivalent to 30% 1-repetition maximum under one of the following conditions: 1) three sets of four non-ballistic repetitions (30N-B), 2) three sets of four non-ballistic repetitions with a 3-second pause between the eccentric and concentric phases (30NP-B), 3) three sets of four ballistic repetitions (30B), 4) three sets of four ballistic repetitions with a 3-second pause between the eccentric and concentric phases (30BP-B). Force plates and a 3D motion analysis system were used to determine the total mechanical work performed during each session while a portable gas analysis system was used to collect expired gases. RESULTS: Total mechanical work performed during each set was significantly greater during 30B compared to 30N-B (mean difference [MD]: 7.792 J, p < 0.001, effect size [ES]: 1.88) and 30NP-B (MD: 7.740 J, p < 0.001, ES: 1.89), while that during 30PB was significantly greater than that during both 30N-B (MD: 7.488 J, p < 0.001, ES: 1.89) and 30NP-B (MD: 7.445 J, p < 0.001, ES: 1.90). Energy expenditure during each set was significantly greater during the 30B condition compared to the 30N-B (MD: 13.983 J, p < 0.001, ES: 1.08) and the 30NP-B (MD: 11.326 J, p < 0.001, ES: 0.92). Energy expenditure during 30PB was significantly greater than during 30N-B (MD: 12.615 J, p < 0.001, ES: 1.04) and 30NP-B (MD: 9.958 J, p < 0.006, ES: 0.86). Furthermore, energy expenditure during set 1 was significantly greater than that during set 2 (MD: 6.840 J, p < 0.001, ES: 0.64) and set 3 (MD: 8.070 J, p < 0.001, ES: 0.75). CONCLUSION: Ballistic resistance training exercises may represent a more effective metabolic stimulus compared to traditional resistance training exercises and a pause inserted between the eccentric and concentric phases has little effect.

PURPOSE: Many lower extremity strengthening programs prescribed after injury include the squat as an integral part of rehabilitation. Little attention has been paid, however, in either research or clinical settings, to the impact of the functional differentiation on segmentation of the gluteus maximus (GM) muscle on the prescription of therapeutic exercise. The purpose of this study was to describe the activation of the two parts of the gluteus maximus muscle during a single and double leg squat.

METHODS: Ten subjects (7 females, 3 males, mean age 23.6 years) without current neuromuscular or orthopedic ailments participated in the study. Electromyographic (EMG) activity was assessed with surface electrodes, (Model EMG-55, Therapeutics Unlimited). Electrodes were placed on the right side, lateral and inferior to PSIS for upper part of GM and inferior to the greater trochanter for the lower part of GM. EMG electrodes were also placed on the vastus medialis (VMA) and adductor magnus (ADM). Subjects performed 5 trials for each bilateral and single leg squats with a maximum knee flexion angle of 100 degrees. Squat activity was time normalized and EMG amplitudes normalized to %Maximal Voluntary Contraction (MVC). Paired t-test and Pearson correlations (p-value < 0.05) were performed between the levels of muscle activation for two types of squat.

RESULTS: Mean activation was greater for the UGM (0.38 ± 0.04) compared to the LGM (0.25 ± 0.04) for the single leg squat (p < 0.01) demonstrating different recruitment. UGM activation was greater than LGM (p < 0.01) during abduction MVC testing. A stronger correlation was observed between LGM-ADM (0.76) compared to UGM-ADM (0.55) for single leg squat. LGM was highly correlated to ADM during the bilateral squat (0.95). A strong correlation was also observed between UGM-GMED (0.74) during single leg squat.

CONCLUSIONS: Differences are seen in the activation levels and patterns for the upper and lower GM. LGM compliments the role of ADM during both bilateral and single leg squats. Upper part of GM were strongly correlated with the GMED, suggesting the GM has an abductor function during a single leg squat. The results suggest that segmentation of muscles based on moment arms should be taken into consideration for muscle modeling and in developing more specific therapeutic exercises.

The use of a resistant band wrapped around the distal end of the thighs may act as a proprioceptive aid to reduce medial collapse of the knee during squats. No studies have examined this corrective technique on mechanically advanced exercises, such as the overhead barbell squat. PURPOSE: The purpose of this study was to examine the influence of a high resistance consecutive loop elastic band on lower body kinematics during an overhead barbell squat.

METHODS: 8, resistant-trained males participated in the study. 3D kinematics were assessed using motion capture and sampled at 50 Hz. Kinematics were captured using rigid bodies consisting of active, infrared markers placed bilaterally on the mid-segmental areas of the foot, Shank, thigh and torso. Participants warmed up with a single set of bodyweight squats for a self-selected number of repetitions, followed by two sets of overhead barbell squats with a load of 25% of their bodyweight with and without a consecutive loop elastic band (resistance of 6.5 Kg at 100% elongation) wrapped around the distal end of the thighs. Sets were performed for 12 repetitions, or to voluntary failure, at a controlled tempo. The order with which the band was used was randomized. Medial knee collapse was calculated using a knee width index (KWI) as a ratio of the distance between the distal thigh segments and the distal shank segments. KWI was evaluated for both concentric and eccentric phases.
RESULTS: The maximum knee flexion angle across the 12 repetitions was not different between the band and no band conditions (P = 0.18). However, the average KWI was smaller in the band condition for Tband: 0.06±0.05, no band: 1.0±0.06, P = 0.05) and eccentric phase (band: 0.97±0.06, no band: 1.0±0.05, P < 0.05). Maximum KWI was also smaller for the band condition for the concentric phase (band: 1.0±0.06; no band: 1.04±0.05, P < 0.06) and eccentric phase (band: 1.0±0.05; no band: 1.04±0.05, P < 0.05).

DISCUSSION: The overall barbell squat was significantly smaller with the use of the band. Familiarity may have played a role in this finding as none of the participants had any prior experience with band-assisted work. Because the band provides a high amount of resistance, the use of the band may have actually enhanced medial collapse rather than improve it. Sponsored by Performance Health.

C-36 Free Communication/Poster - Body Composition

Polyphenol Supplementation Attenuates Apoptotic Signaling Following Acute Resistance Exercise in Untrained Males

Jeremy R. Townsend1, Jeffrey R. Stout, FACSM2, Adam R. Jajnert1, David D. Church1, Kyle S. Beyer1, Michael B. La Monica1, Joshua J. Riffie1, Tyler W.D. Muddle2, Leonardo P. Olivariez1, Kelli A. Herrlinger1, David H. Fukuda1, Jay R. Hoffman, FACSM1. 1Lipscomb University, Nashville, TN. 2University of Central Florida, Orlando, FL. 3Kent State University, Kent, OH. 4Kemin Foods L.C., Des Moines, IA. (Sponsor: Jeffrey Stout, FACSM) (No relationships reported)

Research has demonstrated an increase in free radical production, oxidative stress, and apoptotic signaling following resistance exercise. Thus, identifying dietary strategies to prevent or attenuate exercise-induced cellular stress and apoptotic activity are of interest. PURPOSE: To examine the effects of 28-days of supplementation with an aqueous proprietary polyphenol blend (PPB) sourced from Camellia sinensis on intramuscular apoptotic signaling following an acute lower-body resistance exercise protocol and subsequent recovery. METHODS: Untrained males (n=38, 21.8 ± 2.7 y, 1.7 ± 0.1 m, 77.6 ± 14.6 kg) voluntarily participated in this study. Participants performed a 3RM maximum test followed by a set of 3 repetitions at 75% of 3RM and three sets of eight repetitions in bench press at 60% of 3RM. This task was executed in three experimental conditions: (1) without any specific instruction concerning the focus of attention (NOI), (2) with an internal focus of attention on the contraction of the pectoral muscle (INT), and (3) with an external focus of attention on the movement of the bar (EXT). The order of (2) and (3) were randomized. EMG data was recorded from 13 muscles, i.e. 7 from the upper body and 6 from the lower body. Each EMG envelope was normalized with respect to the EMG data recorded at 75% of 3RM and the average EMG amplitude was calculated. RESULTS: The average normalized EMG amplitude values were significantly higher for INT than NOI for pectoralis major (PM) 44±16 vs. 40±16%, anterior deltoidus (AD) 43±18 vs. 38±17%, triceps brachii medial head (TBM) 40±19 vs. 35±17%, latissimus dorsi (LD) 40±17 vs. 36±16%, and erector spinae (ES) 24±15 vs. 22±14% (p<0.05 for all). In other words, the EMG amplitude increased in 6 of 7 muscles of the upper body, when an external or internal focus of attention was applied as compared to a control condition. CONCLUSIONS: The present findings indicate that adopting an internal or external focus of attention significantly increases the EMG amplitude in muscles of the upper body during bench press when compared to a control condition.
Purpose

The purpose of this study was to conduct a systematic review and meta-analysis to determine the effects of acute high-carbohydrate (HC) and very low-carbohydrate (VLC) diets on body composition measures in healthy adults.

Methods

A systematic search of electronic databases (PubMed, Embase, Scopus, CINAHL, and PEDro) was conducted until September 2016. Studies were included if they directly compared the effects of HC and VLC diets on body composition measures in healthy adults aged 18-45 years. Twenty-three studies were identified, and 12 were included in the meta-analysis.

Results

There were significant differences in body weight, body mass index, and body fat percentage between HC and VLC diets. However, the results were inconsistent for other body composition measures such as lean body mass and visceral fat mass.

Conclusions

High-intensity interval training (HIIT) is as effective as moderate-intensity continuous training (MICT) for improving body composition, but HIIT requires less time commitment. More studies are required to analyze regional-specific changes in body fat, especially central adiposity and visceral fat.
Sclerostin, interleukin-6 (IL-6), and insulin-like growth factor-I (IGF-I) are three osteocytes are believed to be the primary mechanosensors of bone tissue. They signal to both osteoblasts (bone forming cells) and osteoclasts (bone resorbing cells) by releasing certain proteins. Sclerostin, interleukin-6 (IL-6), and insulin-like growth factor-I (IGF-I) are three such proteins that signal to osteoblasts to increase (via IGF-I and IL-6) or decrease (via sclerostin) osteoblast activity. PURPOSE: To determine if the osteocyte protein response to mechanical unloading is restricted to the unloaded bone or is a systemic signal. Using a hindlimb unloading (HU) rodent model, we hypothesized the unloaded hindlimb would have altered prevalence of osteocyte proteins while the weight-bearing forelimb would have no differences. METHODS: Male Sprague Dawley rats (6-9 mo old) were subjected to HU (n=7) for 28 days. Age-matched controls (CON; n=7) had normal weight-bearing activity for 28 days. The unloaded distal femur (DF) and the weight-bearing proximal humerus (PH) were compared in HU vs CON. RESULTS: Immunohistochemical staining of the cancellous region to quantify %positive osteocytes revealed 19% higher %sclerostin+ osteocytes in the DF in HU, but 30% lower %sclerostin+ at the PH. Both %IGF-I+ and %IL-6+ osteocytes were lower at the DF (49% and 28%, respectively), but higher at the PH by 94% and 48%. Staining for ostein, a marker of osteoblasts, showed 60% lower %ostex+ cancellous bone surface in HU vs the DF, however, the PH had 48% more %ostex+ surface in HU. All comparisons were statistically significant at p<0.05. CONCLUSION: After 28 days of HU, the unloaded DF had higher sclerostin osteocyte prevalence and lower IL-6 and IGF-I osteocyte prevalence as well as lower osteoblast surface as expected with unloading. Our results indicate that the osteocytes in the PH are signaling osteoblasts to increase formation, which is an unexpected finding based on the conventional notion that the forelimbs of HU animals are normally loaded and not overloaded. The opposite response of osteocyte proteins and osteoblast surface in bones within the same animal that are experiencing both unloading and loading indicates a precise, localized mechanism by which osteocytes sense mechanical strain and signal to local cells to adapt to those changes.
the effect of vitamin D status on bone density and microarchitectural health. PURPOSE: To investigate the relationship between total serum 25(OH)D and bone density, cortical bone, and bone microarchitectural parameters. METHODS: We recruited 24 rowers and 24 age and body mass (±2yrs and 5lbs) matched physically active healthy men. RESULTS: Mean 25(OH)D and age in rowers were 57.7±21.4 nmol/L and 27.4±2.8 years, respectively. In contrast, mean 25(OH)D and age in controls were 29.8±15.6 nmol/L and 26.8±4.6 years, respectively. The difference in age between groups was not statistically significant (p=0.30). Mean (±SD) values of bone density, cortical bone, and bone microarchitectural parameters in rowers and controls are shown in Table 1. Sub-endocortical Tb density (301±34 vs 294±29 mg HA/cm², p=0.056), ES = 0.22) tended to be higher in the rowers than in the controls. The rowers had greater tibiae bone area and strength compared to the controls. CONCLUSIONS: Serum 25(OH)D was negatively associated with iPTH (r=-0.271; P<0.0001), Tb density (r=0.127; P<0.05), and Tb volume to tissue volume ratio (r=-0.128; P<0.05). CONCLUSION: Total serum 25(OH)D <50 nmol/L was not associated with impaired bone density or Tb microarchitectural of the distal tibia in younger men. These findings suggest that vitamin D status is a key factor influencing bone strength. The role of vitamin D in stress fracture risk warrants further investigation. Supported by UK MoD (Army)

### Table 1. Group comparisons of mean bilateral skeletal characteristics (means(SE))

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rowers (n=24)</th>
<th>Controls (n=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hips</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-sectional moment of inertia (mm²)</td>
<td>13256±495.6*</td>
<td>11841±5409.8</td>
</tr>
<tr>
<td>38% Tibia Strength-Strain Index (mm²)</td>
<td>1887±81.61*</td>
<td>1705±14.48</td>
</tr>
<tr>
<td>38% Cortical Density (mg/cm³)</td>
<td>1153.9±14.3</td>
<td>1168±1.3*</td>
</tr>
<tr>
<td>66% Tibia Strength-Strain Index (mm²)</td>
<td>2852±51.109.4*</td>
<td>2587±37.69</td>
</tr>
<tr>
<td><strong>4% Radial Periosteal Circumference (mm)</strong></td>
<td>63.7±0.9*</td>
<td>60.8±1.1</td>
</tr>
<tr>
<td>66% Radial muscle CSA (mm²)</td>
<td>3557±0.106.3*</td>
<td>3108±88.8</td>
</tr>
</tbody>
</table>

*p < 0.05 and **p < 0.01 significant differences between groups.
years were included in this study. Three handing sixty one healthy subjects including 129 males and 232 females were living in Qinghai-Tibet Plateau (QTP) 2260m above sea level and 438 participants including 323 males and 115 females, were from Sendai of Japan (SJ)-46m above sea level. We divided all subjects into 5 groups according to their age (20-29, 30-39, 40-49, 50-59, 60-69). BC and BMD were tested by InBody720. The differences between HA and SL are analysed by independent T test. The statistical difference level was defined as α=0.05. All data were expressed as mean ± SEM. Data were analyzed by ANOVA with repeated measures. p<0.05 was considered significant.

CONCLUSION: There was a significant difference in BMD of young males aged 20-29 in different living altitude. However, in 30-40 and 40-49 age groups, male HA residents showed higher BMD than SL. In female, HA residents demonstrated significantly higher BMD than SL. There was no significantly difference in BMD of young females aged 50-59. In addition, the BMD of HA residents aged from 20-29 and 60-69 was significantly higher than that of SL residents regardless of gender. In the same age group, the BMD of HA residents was significantly higher than that of SL residents. The BMD of HA residents was significantly higher than that of SL residents regardless of gender (Males: HA 104.8±10.35 g/cm² > SL 98.9±11.06 g/cm², p<0.05). HA residents, aged from 20-29 and 60-69, had significantly greater BMD compared to SL female residents. (20-29: HA 110.9±13.15 g/cm² > SL 101.2±14.12 g/cm², p<0.01) (60-69: HA 112.5±21.41 g/cm² > SL 103.1±13.37 g/cm², p<0.01). Body fat percentage (BFP) of the HA residents was significantly higher than that of SL residents regardless of gender (Males: HA 25.6±6.65% > SL 22.2±7.01%, p<0.01). Females (HA 32.3±5.86% > SL 28.7±6.77%, p<0.01). There was significantly difference in BFP of males aged 30-39 and 50-59 age groups, who lives in HA demonstrated higher BFP than SL (30-39: HA 27.4±5.91% > SL 24.2±5.76%, p<0.005).

CONCLUSION: Inhabitants living in high altitude demonstrated higher bone density compared to the residents on sea level in the same age. Thus, living in plateau area might reduce the risk of diseases caused by insufficient bone density.

1437 Board #112 8:00 AM - 9:30 AM
Bone Quality in Weight and Non-Weight Bearing Sports in Male Collegiate Athletes
Devin Freda, Tessa Skoe, Colton Cave, Mitch Wehrli, Kristian Heumann. Colorado Mesa University, Grand Junction, CO. Email: devinfreda@gmail.com

Bone quality has been correlated with lifetime physical activity. The accrual and maintenance of bone has been shown to be related to the type of sport, length of participation, weight bearing (WB) or non-weight bearing (NWB) activity, and the multidirectional forces applied. PURPOSE: To determine if there are differences between WB and NWB activities on bone quality in male collegiate athletes. METHODS: Ten male collegiate athletes (20.8±1.2yrs), with no history of previous bone fractures, osteoarthritis, or both参加了 this study. The bone density of the dominant and non-dominant foot for sports or WB vs. NWB activities were compared using ANOVA with repeated measures. RESULTS: In refutation of our primary hypothesis, SS were not at increased risk for osteoporosis compared to CS, and their hip BMD was even larger. These findings might be attributed to longer out of water practice time that might offset the negative effects low body weight in SS. While encouraging girls and adolescent females to be physically active, precautions should be taken to avoid osteopenia in non-weight bearing disciplines such as SS & CS.

1438 Board #113 8:00 AM - 9:30 AM
Bone Mineral Density - Is It Lower In Synchronized Swimmers Compared To Competitive Swimmers?
Naama Constantini, FACSM, Shiri Weinberg- Hendel, Rakefet Arieli, Ari Zimran. Shaare Zedek Medical Center, Jerusalem, Israel. Email: naamacos@gmail.com

In female athletes bone mineral density (BMD) is typically 5-15% higher than in the non-athlete population, depending on the type and amount of impact on the bone. Other environmental factors that can affect female athletes’ BMD include nutritional habits, energy availability, calcium intake and menstrual cycle patterns. Synchronized swimming (SS) is a unique sport characterized, among other things, by many hours of non-weight bearing exercise and a requirement for leanness. PURPOSE: To compare BMD in SS with a sport that is similar in terms of mechanical stress on the bones, but does not require extreme leanness such as competitive swimming (CS). We hypothesized that SS will have lower BMD compared to CS. METHODS: 14 women ages 20-40 years with a history of at least 5 years of intensive training in SS during puberty were compared to 14 women of the same age, who were CS. Participants completed questionnaires about their medical, sports, gynecological & dietary history, and were tested for BMD (lumbar spine, left hip & total body) in a DEXA machine. BMD T-score and Z-score were compared between groups and correlated to the data obtained by the questionnaire. Results: The prevalence of osteopenia of the lumbar spine was high in both groups (43% of SS & 50% of CS). SS had higher left hip BMD than CS (0.8525 vs. 0.7485 g/cm², p=0.012). SS were significantly leaner at pubertcy than CS (BMI 18.7 ± 1.3 and 21.5 ± 2.1 kg/m², respectively, p<0.0001), but both groups had sufficient calcium intake (>1100 g/day) and only one subject in each group had disordered eating. There were no significant differences in age of menarche (SS 13.6 ± 1.1 vs. CS 13 ± 1.7 years). The prevalence of menstrual irregularities: Average training hours per week for both groups was 24, but SS spend significantly more training hours (<0.024) more time in “out of water” training compared to CS (8 ± 3.5 and 5±2.5 h·week¹, respectively). Conclusions: In refutation of our primary hypothesis, SS were not at increased risk for osteoporosis compared to CS, and their hip BMD was even larger.

1439 Board #114 8:00 AM - 9:30 AM
The Effect of Soccer Training on Tibia Bone Properties in Healthy Young Females
Henry Wang, D. Clark Dickin, Daniel Chan, Jonathan Foster, Julie Hughes. Ball State University, Muncie, IN. US Army Research Institute of Environmental Medicine, Natick, MA. Email: hwang2@bsu.edu

No relationships reported

Tibia stress fracture (TSF) is very common in military recruits. Female Soldiers experience a higher rate than their male counterparts. TSF occurs frequently in basic training due to repetitive impact loading from tasks such as load carriage. Common TSF sites are at distal and middle thirds of the tibia. To date, it is unknown whether training involved multiaxial load bearing (e.g. soccer) could help improve tibial bone quality and potentially increase bone’s resilience on TSF. PURPOSE: To examine the effect of soccer history on tibia mechanical properties. METHODS: 20 female soccer players (20±1y) and 20 mass and height matched sedentary women (21±1y) completed a pQCT scan on their tibias at seven locations along the bone shaft. Cortical bone density and mechanical strength of the bone at 14%, 38%, 66%, and centers of the proximal, middle, and distal thirds of the bone shaft were examined. One-way ANOVAs were performed. Significant differences in area moments of inertia and bone strength index were found (p<0.05). The area moments of inertia along the anteroposterior, mediolateral, and longitudinal axes of the soccer players’ tibia were 33.5%, 24.7%, 18.4% greater than those of the sedentary women, respectively. In addition, the bone strength index of the soccer players was 19.6% higher than that of the sedentary women. Significant differences in cortical bone density were also found (p<0.01). Sedentary women possessed an average of 2.2% higher cortical bone density in all seven locations of the bone shaft than the soccer players. CONCLUSION: Participants with a soccer history had enhanced tibia mechanical properties, including greater bone strength, but reduced cortical bone density when compared to sedentary controls. These results suggest a co-adaptation of intracortical bone remodeling and bone formation during training such that bone geometry is optimized without excessive increases in bone density, which would be metabolically expensive. Enhanced mechanical properties in soccer players could make the tibia more resilient to unaccustomed mechanical loading, such as load carriage during military training. Future studies should examine whether enhanced bone mechanical properties result in reduced bone strains and a lower risk of TSF. US ARMY #W81XWH-08-1-0587; #W81XWH-15-1-0066.

1440 Board #115 8:00 AM - 9:30 AM
Serum Sclerostin Levels Are Positively Correlated with Bone Mineral Density in Chinese Young Adults
Zhaojing Chen1, Meihua Su2, Youg Zhou3, Breanne Baker1, Samuel Buchanan1, David Ross1, Michael Bemben, FACSM1, Debra Bemben, FACSM1. 1University of Oklahoma, Norman, OK; 2Minnan Normal University, Zhangzhou, China; 3University of Oklahoma Health Science Center, Oklahoma City, OK. (Sponsor: Debra Bemben, FACSM)

Email: echob@ou.edu

No relationships reported

Sclerostin, exclusively secreted by osteocytes, is a potent inhibitor of the Wnt signaling pathway and bone formation. While it is well-recognized that differences in bone mineral density (BMD) and fracture rates exist between Asians and Caucasians, little
is known about serum sclerostin concentrations and its relationship with BMD in Chinese young adults. PURPOSE: 1) To compare sex differences in serum sclerostin in Chinese young adults; 2) To investigate associations between serum sclerostin and bone characteristics (areal BMD (aBMD), volumetric BMD (vBMD), bone strength). METHODS: Fifty-three Chinese men (n=28) and women (n=25) aged 18 to 35 yrs, who had been living in the US ≤ 5 years, participated in this study. Body composition and aBMD of the total body, lumbar spine and hips were measured by DXA. vBMD and bone strength of non-dominant tibia at 4%, 38% and 66% sites were measured by peripheral Quantitative Computed Tomography (pQCT). Serum levels of sclerostin were measured by ELISA. RESULTS: Serum sclerostin was significantly higher in males compared to females (p<0.003). However, no significant differences were found after adjusting for total body bone mass. There were significant positive associations (r = 0.39 to 0.54, p < 0.01) between serum sclerostin and total body bone mass, BMD at total body, lumbar spine and hips, bone strength at 4% of tibia. After adjusting for total body bone mass, serum sclerostin levels remained significantly correlated with BMD at all sites and bone strength at 4% of tibia. CONCLUSION: Serum sclerostin levels were positively correlated with BMD and bone strength in Chinese young adults after controlling for total body bone mass, which is consistent with previous population based studies in US Caucasian and Chinese postmenopausal women. Table 1. Bone Mineral Density and Sclerostin Levels in Chinese Young Adults (Mean ± SE)

<table>
<thead>
<tr>
<th>Group</th>
<th>Sclerostin (ng/mL)</th>
<th>Lumbar Spine BMD (g/cm²)</th>
<th>Left Proximal Femur BMD (g/cm²)</th>
<th>Bone Strength Index at 4% Tibia (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men (n=28)</td>
<td>0.442 ± 0.021</td>
<td>1.218 ± 0.084</td>
<td>1.119 ± 0.133</td>
<td>143.7 ± 4.0**</td>
</tr>
<tr>
<td>Women (n=25)</td>
<td>0.353 ± 0.019</td>
<td>1.183 ± 0.146</td>
<td>0.979 ± 0.183</td>
<td>88.0 ± 7.3</td>
</tr>
<tr>
<td>Total (n=53)</td>
<td>0.400 ± 0.015</td>
<td>1.202 ± 0.016</td>
<td>1.053 ± 0.024</td>
<td>117.4 ± 5.8</td>
</tr>
</tbody>
</table>

** "p < 0.01 and "p < 0.001 significant differences between men and women, respectively.

The bone-specific physical activity questionnaire (BPAQ) provides a summary index of skeletal loading (SKL) by combining activity/sport duration with ground reaction forces and loading rate per activity. Whereas BPAQ has been associated with areal BMD, few studies have evaluated the association between BPAQ and bone microarchitecture. Further, despite knowledge that exercise during adolescence may have optimal effects on bone accrual, no studies have examined the association between early-life SKL and adult bone microarchitecture. PURPOSE: We determined the ability of a BPAQ-like SKL index reflecting physical activity during adolescence to predict bone microarchitecture in young adults. METHODS: We conducted a cross-sectional study of young (mean±SD) 24.6±3.0 years) Caucasian men (n=50) and women (n=50) aged 18 to 35 yrs, based on a previous study in US Caucasian and Chinese postmenopausal women. The body composition, body composition and bone mineral density (BMD), bone density (BMD), and bone microarchitecture at the distal tibia using high-resolution peripheral quantitative computed tomography (pQCT). Serum levels of sclerostin were measured by ELISA. RESULTS: We found that the SKL index in adolescence was significantly associated with Ct.vBMD and Tb.vBMD in men and women respectively (M: r² = 0.33, p = 0.045; W: r² = 0.33, p = 0.036). In men, Ct.thickness, Ct. area fraction, and ultimate failure load were significantly associated with SKL score (all p<0.05). However, among women, failure load was the only other bone outcome associated with SKL score (p=0.037). CONCLUSION: These findings suggest that among Caucasian men, physical activity during adolescence is associated with improved cortical bone architecture later in life. Conversely, among Caucasian women, loading during adolescence years is associated with improved trabecular vBMD. The sex-specific association between physical activity and bone microarchitecture may contribute to the greater incidence of stress fracture in women versus men.

** Board #116
Abstract Withdrawn

1441

** Board #117
June 1 8:00 AM - 9:30 AM
Physical Activity During Youth is Associated with Adult Bone Microarchitecture
Victoria Turkington, Kristin L. Popp, Matthew Scott, Adriana Martinez-Betancourt, Mary L. Bouxsein. Massachusetts General Hospital, Boston, MA. Email: vturkington@mgh.harvard.edu (No relationships reported)

Stress fractures are common overuse injuries experienced by military recruits during initial training. Lower cross sectional area of the tibia in stress fracture cases compared with uninjured controls supports an important role of bone structure in injury predisposition. With the advent of high resolution techniques, other determinants of bone strength can now be evaluated in the development of stress fracture injury. PURPOSE: To investigate differences in bone density and trabecular (Tb) microarchitecture at the distal tibia using in vivo high-resolution peripheral quantitative computed tomography (HR-pQCT) between stress fractured and uninjured British military recruits. METHODS: 234 British Army infantry recruits were followed through 26 weeks of infantry training. Twenty-one recruits were diagnosed with a stress fracture injury of the lower limb (22 ± 3 years, 73.3 ± 8.3 kg, 1.77 ± 0.06 m, 593 ± 68 ± 1.5 km run time), and matched to 21 non-injured controls (22 ± 3 years, 74.2 ± 10.0 kg, 1.77 ± 0.06 kg, 588 ± 58 ± 1.5 km run time) in the same training platoon. Groups were matched for age, height, body mass and aerobic fitness (1.5 km run time). Scans at the distal tibia of the dominant leg were performed on all recruits. CONCLUSION: Our data demonstrate that the lower frequencies (10 Hz and 20 Hz) of low-magnitude WBV increased bone turnover, delayed cartilage degeneration, and caused a significant functional change of the OA-affected limb in ACLT-induced OA rabbit model but did not reverse OA progression after 8 weeks of treatment.

** Board #118
June 1 8:00 AM - 9:30 AM
Tibial Density and Trabecular Microarchitecture in Army Recruit Stress Fracture Cases and Matched Uninjured Controls
Thomas J. O’Leary1, Rachel M. Izard2, Sarah M. Jackson3, Julie P. Piggues4,5, HQ Army Recruiting and Training Division, UK Ministry of Defence, Upavon, United Kingdom. 5HQ Army, UK Ministry of Defence, Andover, United Kingdom. Email: thomas.oleary100@mod.uk (No relationships reported)
There are bone mineral density (BMD) testing recommendations for women ≥65 years and men ≥70 years to diagnose osteoporosis, but no such recommendations exist for screening purposes in the healthy adult population. A potential screening tool for bone strength is a peak vertical jump test. Vertical jump height can be used as a proxy for muscle power, and an influential factor in determining bone mass and geometry (i.e., bone strength).

**PURPOSE:** This study examined the relationship between muscle power and bone strength, and the capacity of a peak vertical jump test to identify young adults with below-average areal BMD (aBMD).

**METHODS:** In total, 303 young adults (18-22 years, 136 males, 167 females) participated in this study. Total hip and femoral neck (FN) aBMD were assessed by dual x-ray absorptiometry (DXA) and DXA images were used to calculate FN section modulus values. Indices of bone strength were assessed at the tibia with peripheral quantitative computed tomography. Cortical bone area and density-weighted polar section modulus-strain-index were assessed at 38% midshaft site and bone strength index was assessed at 4% midshaft site. Muscle power was predicted using vertical jump and the Sayers equation. Pearson bivariate and partial correlations examined associations among bone strength outcomes and muscle power. Logistic regression examined the probability of below-average bone strength based on muscle power. Receiver Operating Characteristic (ROC) curve analysis examined the sensitivity-specificity tradeoff and the accuracy of a peak vertical jump test as an aBMD assessment tool.

**RESULTS:** The odds ratio of below-average bone strength at each 0.05 units of vertical jump height decrease was 1.7. Height (r=0.7), body fat % (r=0.17), and body mass index (BMI) (r=0.7) performed a relative grip strength (RGS) test using a hand dynamometer, and one repetition maximum leg extension test (1RM), and a peak power vertical jump test (PP) using a Vertec. Moment of inertia (J), cortical area (Cl.Ar.), cortical bone mineral density (cBMD), and strength-strain index (SSI) were measured using peripheral Quantitative Computed Tomography (pQCT) to determine bone strength at the 66% radial site. Correlation analysis determined muscle-bone relationships.

**CONCLUSION:** These results suggest the association between SNPs of rs3018362 in the RANK gene polymorphism and the incidence of stress fractures in Japanese female endurance athletes. Supported by Grants-in-Aid for Scientific Research (#26282199 and 16K13059, M. Iemitsu) (No relationships reported)
The sesamoids and accessory bones of feet are complicated and small but important in regulating pressure, friction and direction of muscular traction. Multi-slice CT and 3D reconstruction becomes available for exhibiting bones’ morphology. PURPOSE: To investigate the morphological features of podal sesamoids and accessory bones in professional wrestlers by CT and 3D reconstruction. METHODS: 9 male Guangdong wrestlers served as subjects (height: 168±2.2 cm; weight: 66.8±4.2 kg; age: 18.3±2.4 y) lying on back, and their feet were scanned by 64-slice spiral CT continuously along both feet transect for cross-sections of bones according the set: bone tissue window, 140kV power, 0.65mm pixel size;0.45mm layer distance. Based on the data with the Dicom3.0 standard, the 3D model was constructed by Mimics (Version 10) through the processing of standardized coordinate system of bone, reconstruction, threshold-value segmentation, regional growth, edge segmentation and alternative editing, etc. RESULTS: 53 sesamoids and 10 accessory bones are in the 18 feet. 36 sesamoids are below the first metatarsal bones while 17 in the great toe joints, with 2 to 3 sesamoids per foot. In 98% of the feet, the outer-side sesamoids of the first metatarsal bone are larger than the inner-side ones. The sesamoids occurrence rate of the first metatarsal is 100% and the interphalangeal joint is 94.4%, which is much higher than those of other studies. The occurrence rate of accessory navicular bone is 16.7% and that of the triquetral sesamoids is 22.2%. The average volume of the outer-side sesamoids is 434.87mm³, while the inner-side is 386.94mm³. The average surface area of the outer-side sesamoids is 298.829mm², while the inner-side ones is 274.15 m². The average volume of sesamoids on the toe joints is 55.49 mm³ with average surface area of 74.24 m². The average volume of triquetral bones is 703.01 mm³ with average surface area of 417.46 in all accessory bones. The trapezoidal bone in the right foot is biggest with volume 941.21 mm³, while the interphalangeal bone is smallest with area of 74.24 m².

CONCLUSIONS: We observed modest but statistically significant improvements in trabecular bone geometry at the distal tibia after 48 weeks of Army BCT. There were no changes with adaptive bone formation. This new bone formation may be an important physiological response to military training and may play a role in prevention of stress fracture. Future studies are needed to determine the relationship between training-related changes in bone microarchitecture and stress fracture risk.

### Board #126
June 1 8:00 AM - 9:30 AM
Calcium Lost Through Sweat: Is There Evidence of Calcium Loss during Bikram Hot Yoga?
Shannon L. Mathis1, Carmeladell J. Watkins2, Gordon G. MacGregor1. 1University of Alabama Huntsville, Huntsville, AL; 2Bikram Yoga Huntsville, Madison, AL
Email: shannon.mathis@uah.edu

It has been hypothesized that sweating during high-intensity exercise causes a disruption in calcium homeostasis leading to bone resorption and low bone mineral density in endurance athletes. PURPOSE: In order to investigate the acute effect of calcium loss during excessive sweating, biochemical markers of bone remodeling were measured before and after a 90 min session of Bikram hot yoga. The purpose of this study was to separate the effect of vigorous exercise and the effect of a bout of excessive sweating on markers of bone resorption by measuring serum ionized calcium (Ca²⁺), cutaneous calcium, and parathyroid hormone (PTH) before and after a Bikram hot yoga session. METHODS: Participants were female yogis (N = 8), who attended a mean (+SD) of 4.3 (±1.3) Bikram yoga sessions weekly for the last 2.6 (±1.6) years. A Bikram hot yoga session consists of performing 26 postures in 90 min at 105°F and 40% humidity. Noodles were weighed before measured and after the yoga session. Serum concentrations of PTH, and Ca²⁺ were measured before and after the yoga session (n = 5). Sweat was collected after the session by saturating chromatography paper with sweat from the participants’ thigh during the final yoga pose, while participants were inside the studio. To estimate the total amount of calcium loss during exercise, an estimate of the volume of sweat and sweat calcium concentration was obtained. Participants mean age was 47.4 (±3.7) years. Mean estimated sweat loss was 1.6 (±0.6) L, eliciting a 1.5%-3.8% (M = -2.3 ± 0.2%) decrease in participants’ body weight. Mean Ca²⁺ in sweat was 3.78 ± 1.8 mg/dl and the mean total calcium was 63.1 ± 32.8 mg. PTH did not increase from pre (17.0 ± 1.7) pg/ml to post (16.7 ± 1.6) pg/ml yoga session, t(4) = 0.47, p = .67, 95% CI [-1.0, 1.4]. A Wilcoxon test for nonparametric data indicated that serum Ca²⁺ increased from pre- (mdn = 10.7 mg/dl) to post- (mdn = 11.5 mg/dl) yoga session, z = -2.0, p = .04. CONCLUSION: A disruption in calcium homeostasis was not observed in a bout of excessive sweating during a 90 min Bikram hot yoga session. Sweat loss did not trigger an increase in PTH. This data suggests that the isolated effect of cutaneous calcium loss during low to moderate intensity exercise does not stimulate markers of bone resorption. Thus, high-intensity, non-loading exercise must play a role in remodeling.
composition was assessed via DXA. vBMD, bone geometry, and eBS were assessed at the 4% (distal) and 66% (proximal) tibia via pQCT. Multivariable stepwise regression determined predictors of bone outcomes. RESULTS: LMI was a positive predictor of distal tibia total, trabecular, and cortical vBMD in E2 women only, accounting for 28.36% of the variance (p<0.004). LMI was a positive predictor of distal tibia cortical area in E2 women (R²=0.137, p=0.037). FMI was not a predictive of bone outcomes in E2 women but was a positive predictor of cortical area at the distal tibia in E2 women (R²=0.162, p=0.038). At the proximal tibia, FMI and LMI were positive predictors of cortical vBMD (R²=0.494) and cortical thickness (R²=0.571) in E2 women only (p=0.015). LMI was a positive predictor of total area (R²=0.332) and negative predictor of cortical vBMD (R²=0.141) in E2 women only (p=0.044). FMI and LMI were positive predictors of distal tibia BSI in E2 women (p=0.435, p=0.029). LMI positively predicted BSI in E2 women but explained less variance (R²=0.152, p=0.027). CONCLUSIONS: In the absence of adequate estrogen exposure, reduced fat or lean mass results in significant detriments to bone health in exercising women. It appears that in the face of reduced fat or lean mass, estrogen may be protective to bone.

1454 Board #129 June 1 8:00 AM - 9:30 AM Association between Bone-Specific Physical Activity Scores and Measures of Areal and Volumetric Bone Mineral Density and Bone Markers in Middle-Aged Premenopausal Women
Sojung Kim1, Michael Bemben2, FACSM, Debra Bemben, FACSM2, University of Massachusetts, Lowell, MA. 1University of Oklahoma, Norman, OK. (Sponsor: Debra Bemben, FACSM)
Email: sojung_kim@oumail.edu

The bone-specific physical activity questionnaire (BPAQ) has been shown to be related to areal bone mineral density (aBMD), but its relation to bone architecture and bone markers has not been well studied. PURPOSE: The purpose of this study was to investigate the relationship between a total BPAQ score (BPAQ), aBMD, volumetric BMD (vBMD), bone markers in middle-aged premenopausal women. METHODS: Thirty-four premenopausal women (44.4 ± 4.1 years; 161.7 ± 4.5 cm; body mass index 25.0 ± 2.5 kg/m²) were included in a stepwise multiple linear regression analysis. BFLBM was the only variable that explained a significant proportion of variance in BSI of the right tibia in E2 women (R²=0.341; p=0.02). Also, no relationships were found between BPAQ and both vBMD and bone markers. Table 1. BPAQ and aBMD (g/cm²)

<table>
<thead>
<tr>
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<td>BPAQ</td>
<td>24.3 ± 24.8</td>
<td>1.1 - 75.5</td>
</tr>
<tr>
<td>L1-L4</td>
<td>1.222 ± .129</td>
<td>97 - 1.50</td>
</tr>
<tr>
<td>L, right; L, left</td>
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1455 Board #130 June 1 8:00 AM - 9:30 AM Bone Mechanical Strength Deficits Following a Contusion Spinal Cord Injury in Rats
Dana M. Otzel1, Taylor Bassett1, Cong Chen1, Tyler Teurlings2, Christine F. Conover1, Micah Flores1, Fan Ye1, Ean G. Phillips1, Andrea Catter2, Stephen E. Borst1, Joshua F. Yarrow1. 1North Florida/South Georgia Veterans Health System, Gainesville, FL. 2University of Florida, Gainesville, FL.
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Sublesional bone loss occurs rapidly following spinal cord injury (SCI) and contributes to a 20-100 fold greater bone fracture risk. PURPOSE: To determine the time course of bone strength deficits at different femoral test sites in a rodent contusion SCI model. METHODS: Sixty 16-week old male Sprague-Dawley rats received sham or T9 laminecetomy or T9 laminecetomy plus severe (250 kilodyne) contusion SCI using a computer-guided impactor and were euthanized 1-, 2-, or 3-months (m) post-surgery. Hindlimb locomotion was assessed weekly using the BBB locomotor score and bone strength was assessed ex vivo at the distal femur, femoral midshaft, and femoral neck. SCI vs SHAM comparisons were made at each time point using independent t-tests. RESULTS: SCI animals exhibited persistent hindlimb locomotor deficits [BBB score < 6 (0-21 scale), p < 0.01 vs SHAMs at all time points], characterized by an inability to support the hindlimbs in stance or to perform hindlimb weight supported stepping. Bone strength deficits were observed at all testing sites after SCI in a somewhat variable pattern. At the distal femur, maximal breaking load (NI) was 19% lower at 1-m (p < 0.05), 10% lower at 2-m (p < 0.05), and 16% lower at 3-m (p < 0.01) in SCI vs SHAM animals using a cantilever bending test. In addition, displacement at max load was 29% lower at 1-m (p < 0.05) and 22% lower at 3-m (p < 0.05). At the femoral neck, maximal breaking load was 22% lower at 1-m in SCI vs SHAM (p < 0.05), but was not different at 2-m or 3-m post-surgery. At the femoral midshaft, maximal breaking load was not different at 1-m post-surgery, but was 11% lower at 2-m (p < 0.05), and 23% lower at 3-m (p < 0.05) in SCI vs SHAMs, using a 3-point breaking test. No other differences in displacement or stiffness were observed among groups. CONCLUSION: In our SCI model, femoral skeletal integrity is compromised 1-m post-injury, with strength deficits dependent upon the skeletal site and the tests that were utilized. The distal femur cantilever test yielded less variability and typifies a common site of fracture in humans after SCI, suggesting this test is clinically-relevant. Interventions focused on preventing bone loss after SCI should initiate therapy soon after the injury occurs to ensure maintenance of skeletal integrity. Supported by VA RR&D SPRE 121RXX0137301 to JFY.

1456 Board #131 June 1 8:00 AM - 9:30 AM Race/Ethnicity-related Differences In Bone Mass, Microarchitecture And Strength Among Young Adult Men And Women
Kristin L. Popp1, Julie M. Hughes2, Adriana Martinez-Bennett3, Matthew Scott3, Victoria Turkington1, Katelyn I. Guerriero4, Chun Xu1, Gun Unnikrishnan1, Jaques Reifman1, Mary L. Bouxsein1. 1Massachusetts General Hospital, Harvard Medical School, Boston, MA. 2United States Army Research Institute of Environmental Medicine, Natick, MA. 3Massachusetts General Hospital, Hospital, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA. 4Department of Defense Biotechnology High Performance Computing Software Applications Institute, Frederick, MD. 5Massachusetts General Hospital, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA.
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Stress fractures are common among military personnel. Notably, prior studies report that White or Caucasian military recruits have 1-5.2 fold greater risk of stress fracture, than their Black or African American counterparts. Yet, little has been done to characterize race/ethnicity-related differences in bone macrostructure, microstructure and bone mineral density (BMD) among young adults. PURPOSE: We aimed to determine differences in bone mass, structure and strength between young Black, Hispanic, White, and Black or African American, and White or Caucasian adults. METHODS: We enrolled 184 young ([mean±SD] 24.2±3.4 yrs) women (n=51 Black, n=50 White) and men (n=32 Black, n=51 White) in this cross-sectional study. We used dual-energy X-ray absorptiometry (DXA) to determine areal BMD (aBMD) at the femoral neck (FN), total hip (TH) and lumbar spine (LS). High-resolution pQCT (HR-pQCT, 82 μm voxel size) was used to assess bone microarchitecture and strength by micro-fracture element analysis (FEA) at the distal tibia (4% of tibial length). We used two-way ANOVA to compare bone outcomes, adjust for age, height and weight and detect race by sex interactions. RESULTS: Our ANOVA revealed no race by sex interaction for any bone outcome. In both women and men, after adjusting for covariates, Blacks and Hispanics had significantly greater FN aBMD (9.1%, p<0.01) but no difference in LS aBMD compared to Whites. HR-pQCT revealed greater cortical area (10.3%, p<0.01)

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volumetric BMD (vBMD:4.9%, p<0.05) and thickness (12.0%, p<0.01), and less cortical porosity (18.2%, p<0.01) in Blacks compared to Whites. Blacks also had greater trabecular thickness (7.1%, p<0.01) but other trabecular parameters, total area, and total vBMD were similar to Whites. FEA-estimated failure load was significantly higher (9.5%, p<0.01) among Blacks compared to Whites. CONCLUSION: These findings demonstrate substantial race-related differences in bone microarchitecture and estimated strength between young adult Black and White men and women. Advantageous bone microarchitecture in Blacks appears attributable to denser bone matrix, and thicker cortices compared to Whites. This advantage in bone microstructure may contribute to lower stress fracture risk among Black men and women compared to their White counterparts.

C-38 Free Communication/Poster - Cardiorespiratory Physiology and Rehabilitation

Thursday, June 1, 2017, 7:30 AM - 12:30 PM
Room: Hall F

1457 Board #132 June 1 9:00 AM - 10:30 AM Weekly Effect of Exercise-Based Cardiac Rehabilitation on Perceived Stress and Mood States in Cardiac Patients
Felipe Araya-Ramirez1, Jean Carlo Gamboa-Salas1, Braulio Sanchez-Urena1, Vera Rodriguez-Cambronero1, Peter W. Grandjean, FACSM2, National University of Costa Rica, Heredia, Costa Rica. 2Baylor University, Waco, TX. (Sponsor: Peter W. Grandjean, FACSM)
Email: felipe.araya.ramirez@una.cr

(No relationships reported)

PURPOSE: To determine the weekly effect of exercise-based CR on perceived stress and mood states in patients with coronary artery disease (CAD).

METHODS: Twenty-one patients with CAD (age = 58 ± 3 ± 10 years, weight = 76.5 ± 13 kg, BMI, 28 ± 4.7 kg/m², VO₂max = 12.4 ± 3.7 ml/kg/min), were measured every week for eight weeks on perceived stress and mood states (fatigue, vigor, tension, friendship, anger and depressed state), using the scale of perceived stress (EPQ-10) and the profile of mood states (POMS). Functional exercise capacity and estimated VO₂max were obtained based on the 6-minute walk test (6MWT) at pre and post CR. A repeated measure ANOVA was used to determine outcomes differences. Effect sizes were also calculated and probability was set at level p<0.05.

RESULTS: Patients reduced stress (F₁₇,₈₄ = 7.72, P < 0.01, η² =.279) from (11.5 ± 4.3 ± 4.3) score) 50% post CR. Stress was reduced at week 1 from (11.5 ± 4.3 to 8.0 ± 4.6, P = 0.049) and was maintained subsequently. Fatigue decreased (F₁₇,₈₄ = 4.3, P = 0.016, η² =.178) from (6.3 ± 5.2 to 2.6 ± 2.3, score), 58% after CR. The change in fatigue was observed until week 7 from (6.3 ± 5.2 ± 3.3 ± 3.8, P = 0.010). Vigor increased (F₁₇,₈₄ =7.1, P = 0.0019, η² =.263) from (12.2 ± 6.4 ± 6.0 ± 3.6, score), 31% more post CR. The improvement in vigor was observed until week 5 from (12.2 ± 6.4 ± 5.6 ± 6.1, P = 0.009) and it was maintained afterward. Tension decreased (F₁₇,₈₄ =7.8, P = 0.005, η² =.281) from (6.0 ± 4.5 ± 2.4 ± 2.8 score), 60% less post CR. The decrease in tension was observed at week 3 from (6.0 ± 4.5 ± 3.2 ± 3.1, P = 0.037) and it was remained at week 6, 5 and 8 (P = 0.004, P = 0.005, P = 0.005, respectively). Friendship only improved 12.5% at week 5 from (15.2 ± 3.1 ± 17.1 ± 2.7, P = 0.015). In addition, VO₂max improved 21.7% (from 12.4 ± 3.7 ± 15.1 ± 3.9 ml/kg/min, ES = 0.68, P < 0.001) after CR. Similarly, the 6MWT distance improved 26% from (444 ± 86 to 559 ± 88 m, ES = 1.2, P < 0.001). CONCLUSION: Our eight-week exercise-based CR was effective on reducing the levels of perceived stress and improving the mood states of vigor, fatigue and tension. Perceived stress improved at week one, tension decreased at week three and vigor and friendship took five weeks to change. We need more studies to evaluate if these benefits persist long after completing a cardiac rehabilitation program.

1458 Board #133 June 1 9:00 AM - 10:30 AM Effects of Exercise Training on Systolic and Diastolic Function of Mice with Diabetic Cardiomyopathy
Xin Xu1, Guo Lu2, Juan Huang1, Western Kentucky University, Bowling Green, KY. 1Shanghai University of Sport, Shanghai, China.

(No relationships reported)

PURPOSE: Diabetic cardiomyopathy account for most of the diabetic death according to clinical data, and prevention and treatment of diabetic cardiomyopathy are still among the most challenging health problems today. To explore the possible therapeutic intervention of diabetic cardiomyopathy, a designed exercise training program was applied to mice model with diabetic cardiomyopathy in this study, followed by systolic and diastolic heart function measurement with echocardiography.

METHODS: Sixteen C57BL6 mice with diabetic cardiomyopathy induced by high fat and high glucose diet were divided randomly into exercise training group (Ex) and control group (Ctr). Exercise training protocol included moderate treadmill running and resistant exercise alternately for 8 weeks. Small animal echocardiography was used to measure heart function at the end of study, with ejection fraction (EF), left ventricular end diastolic diameter (LVEDD), left ventricular end systolic diameter (LVESD), stroke volume (SV) for the systolic function, and blood flow peak velocities of the early peak at the mitral valve (E), peak velocities of the atrial peak at the mitral valve (A), the ratio of E/A for the diastolic function measurement. The myocardial performance index (MPI) was also measured by PW Doppler at the mitral valve.

RESULTS: After 8 weeks’ exercise training, EF of Ex mice showed significant increase (68.99±12.04 vs 40.41±2.31, P < 0.05), while LVEDD (3.62±0.16 vs 3.71±0.20, P < 0.05) and LVESD (2.28±0.14 vs 2.26±0.08, P < 0.05) showed no significantly difference when compared with Ctr mice. There was no significant difference for the SV between Ex and Ctr mice (0.038±0.003 vs 0.034±0.003, P = 0.05). Blood flow Doppler at the mitral valve showed that E (709.73±34.69 vs 441.51±17.46), A (443.77±32.62 vs 523.67±21.90) and E/A (1.63±0.62 vs 0.85±0.05, P = 0.01) were all significant improved at Ex mice when compared with Ctr mice. The MPI (0.86±0.09 vs 0.97±0.09, P < 0.05) between two groups had no significant difference.

CONCLUSIONS: The above data indicated that 8 weeks’ exercise training could improve the heart function of mice with diabetic cardiomyopathy, especially the diastolic heart function.

The benefit of cardiac rehabilitation (cardiac rehab) after a heart attack has been shown to decrease mortality and increase quality of life. PURPOSE: To determine the changes in treadmill walking time, speed and distance as well as pre- and post-exercising blood pressure (BP) and heart rate (HR) over the first 12 of 36 cardiac rehab sessions.

METHODS: De-identified data from the charts of 16 post-myocardial infarction patients (13 men, 3 women; 58 ± 7 yrs, 83.8 ± 17.1 kg) who began the UNM Hospital Phase 2 cardiac rehab program between June and August of 2016 were evaluated. At intake, all patients participated in a modified Bruce protocol which was terminated when the patients reached a rating of perceived exertion (RPE) of 15 on the 6-20 Borg scale. Test results were used to prescribe patients’ respective initial walking speeds for the program. Patients walked at least twice weekly at their designated speed. Walking time and speed were adjusted regularly to keep an RPE of 13. Treadmill walking time, speed, distance, and heart rate (HR) were recorded and analyzed across the 1st, 6th, and 12th sessions through separate applications of the repeated measures ANOVA technique with post-hoc Bonferroni adjustment. The changes between pre- and post-walking bout blood pressure (BP) and HR were analyzed using individual t-tests. Statistical significance was set at p < 0.05. Results: On average, the mean walking time (12.7, 18.6, 22.5 min), speed (2.6, 2.8, 3.1 mph) and distance (0.6, 0.9, 1.1 mi) increased with session number (p < 0.01). Walking distance was different between the sessions (p < 0.01). Walking speed differed between the 1st and 12th and between the 6th and 12th sessions (p < 0.03). The walking duration was different between the 1st and 6th and between the 1st and 12th sessions (p < 0.01). Heart rate while walking at an RPE of 13 was 104, 99, and 102 bpm for the 1st, 6th, and 12th session, respectively. Post-walking bout systolic BP was lower compared to pre-bout in the 1st and 6th session (p < 0.03) as diastolic BP in the 12th session (p = 0.04).

CONCLUSION: Patients significantly improved their treadmill walking time, speed and distance over the course of 12 Phase 2 cardiac rehab sessions. Clamping a cardiac rehab treadmill walking RPE at 13 may elicit similar improvements for Phase 2 patients resembling those in this study.
Patients in Cardiac Rehabilitation (CR) vary significantly with respect to comorbidities. Depression and/or anxiety (DA) are risk factors for cardiovascular disease (CVD), and also increase risk for secondary events once CVD is established. Whereas CR includes home-based (HB-CR) as well as facility-based (FB-CR) options, little is known about whether DA status influences enrollment in HB-CR vs FB-CR programs.

PURPOSE: We compared patients with DA and with No-DA (NDA) in respect to HB-CR vs FB-CR enrollment in a Veterans Healthcare System (VHS) center which offered both programs.

METHODS: In a quality improvement project we evaluated 239 Veterans at baseline before beginning CR. Patients were evaluated for medical and physical risks to determine a recommendation for either FB-CR or HB-CR. Patients who demonstrated moderate or high medical or physical risk were advised to pursue FB-CR; however patients ultimately made the decision on whether to enroll in CR. A patient deemed moderate or high medical or physical risk would not be allowed to choose HB-CR, but this risk assessment was independent of DA status. At baseline patients completed the 8-item Personal Health Questionnaire Depression Scale (PHQ-8) and the Generalized Anxiety Disorder 7-item scale (GAD-7). 6 Minute Walk Distance (6MWD) and Gait Speed (GS) were also assessed as metrics of physical function.

RESULTS: Patients with baseline depression (PHQ-8≥10) and/or anxiety (GAD-7≥10) (N=56) were more likely to enroll FB-CR (67.9% vs. 48.6%, p=0.028) than NDA (N=183 patients). Conversely, NDA patients were more likely to enroll HB-CR (24.6% vs. 8.9%). Patients with DA also had lower 6MWD (278 ± 100 vs. 314 ± 92.5, p=0.0179) and GS (1.08 ± 0.28 vs. 1.21 ± 0.29, p=0.0068) than NDA.

CONCLUSIONS: Veterans with DA are more likely to enroll in FB-CR and have lower baseline values of physical function than Veterans with NDA. However, it is unknown if and how DA patients are better served with HB-CR. Future studies are needed to clarify utility of FB- vs HB- CR for DA as HB-CR programs continue to proliferate in the VHS and in many cases now supplant FB-CR options.

### Effect of Aqua-Walking on CAD Risk Factors and Fitness in Older Adults

Kee-chan Joo, Seonos University, Cheongju, Korea, Republic of (Sponsor: Peter H H Brubaker, FACSM)

Email: kjoo@kogcomy@gmail.com

Effect of Aqua-Walking on CAD Risk Factors and Fitness in Older Adults. Kee-chan Joo, Peter H. Brubaker, Hyun-Tae Ok.

Seonos University, Wake Forest University, Chung-buk University

PURPOSE: Exercise training is considered the cornerstone intervention in the multidisciplinary approach to managing coronary artery disease (CAD) risk factors in both primary and secondary prevention programs. However, older adults often have limitations to walking due to osteoarthritic pain. The purpose of this study was to examine the effect of aqua-walking versus traditional over-ground walking on CAD risk factors and cardiorespiratory fitness in older adults with osteoarthritis in the lower extremity. METHODS: Sixty older adults who had undergone percutaneous coronary intervention (PCI) or had the presence of CAD risk factors were recruited from a Senior Wellness Center. Those who had exercise limitations due to osteoarthritis (n= 20) were assigned to aqua-walking program (AW), while those without arthritic moderate pain (n= 40) were assigned to traditional Treadmill/Track-walking (TW) program or control group (Con). Assessments were performed before and after 24 weeks of medically supervised exercise training for both TW and AW groups.

RESULTS: There were significant differences between groups for the change in body fat (%BF = TW -2.5 ± 3.0 %, AW -2.4 ± 2.9 %, Con -0.4 ± 2.0%, p<0.05), total cholesterol (TC = TW -2.9 ± 3.7 mg/dL, AW -2.7 ± 3.3 mg/dL, Con 14.0 ± 44.5 mg/dL, p<0.05) and cardiorespiratory fitness expressed as VO2peak (TW 2.4 ± 3.8 ml/kg/min, AW 2.0 ± 3.0 ml/kg/min, Con -2.5 ± 3.8 ml/kg/min, p<0.05) over 24 weeks. However, there were no significant differences between TW and AW groups for change in these measures. There was no significant difference between the three groups for the change in other risk factors, including bodyweight (BW), body-mass index (BMI), fasting HDL-C, LDL-C, and triglycerides (TG), systolic and diastolic blood pressure (SBP DBP) and resting HR and psychosocial factors. CONCLUSION: Given the similar magnitude of change in important CAD risk factors and cardiorespiratory fitness, aqua-walking appears to be a feasible alternative exercise modality to over-ground walking and can be recommended for the older adults with CAD and osteoarthritis.
Chemotherapy using anthracyclines is among the most effective pharmacological therapy available in the treatment of cancer. However, they are often accompanied by profound adverse complications of cardiovascular system called cardiotoxicity. Some of these side effects can lead to progressive cardiovascular disease. Currently, it is not known if anthracycline chemotherapy is associated with vascular dysfunction and cardiovascular fitness impairment in breast cancer patients.

**Purpose:** To investigate the association between anthracycline chemotherapy and cardiovascular functions in breast cancer patients. 

**Methods:** Fifteen breast cancer patients aged 45±3 years were compared with 20 healthy controls. They had undergone second or third cycle of chemotherapy treatments.

**Results:** There were no significant group differences in height, body fat, resting heart rate, systolic and diastolic blood pressure. Maximal oxygen consumption was not different between cancer patients and healthy controls (26.7±1.4 vs. 26.6±0.9 ml/kg/min). Brachial-ankle index was not different but carotid artery intima-media thickness was higher (p<0.05) in cancer patients than in healthy controls (0.50±0.02 vs 0.45±0.01 mm). Brachial-ankle pulse wave velocity, an index of arterial stiffness, was greater (p<0.05) in cancer patients than in healthy controls (1.32±0.48 vs. 1.15±0.38 cm/sec).

**Conclusions:** These results suggest that anthracycline chemotherapy is associated with vascular stiffening in breast cancer patients. Prospective intervention studies are needed to confirm the findings from this cross-sectional study.

Supported by Government research budget Chulalongkorn University 2016 and The 100th Anniversary Chulalongkorn University Fund for Doctoral Scholarship.

**Purpose:** Rating of perceived exertion (RPE) scale is an inexpensive tool for prescribing and self-regulating high-intensity interval training (HIIT) in type 2 diabetes mellitus (T2DM) patients who have not been studied. Our purpose was to investigate the usefulness of 6-20 RPE scale for prescribing and self-regulating HIIT in patients with T2DM.

**Methods:** Twenty (men) T2DM patients (age = 50.7± 8.9 yr; BMI = 31.4 ± 10.1 kg/m2) performed a cardiopulmonary exercise testing (CPX) to determine their maximal and reserve heart rate (HR). Subjects then performed HIIT sessions (25 min on a motorized treadmill) prescribed and regulated by their HR response to CPX (HIITHR: 4 min of warm-up and 21 min of jogging/running at 85% (1 min) alternating with walking at 50% (2 min of reserve HR) and by RPE (HIITRPE: 4 min of warm-up and 21 min of jogging/running at 15-17 (1 min) alternating with walking at 9-11 (2 min on the 6-20 RPE scale) in random order (3 to 7 days of interval between treatments). Exercise HR, speed and distance throughout the 25 min were compared between HIITHR and HIITRPE sessions. **Results:** No significant differences were observed in HR during low- and high-intensity intervals between HIITHR and HIITRPE sessions (Figure 1A). Exercise speed during low- and high-intensity intervals (Figure 1B), as well as exercise distance also did not differ between HIITHR (1.4 ± 0.1 km) and HIITRPE (1.6 ± 0.1 km) sessions. **Conclusions:** No significant differences were observed in exercise HR, speed and distance between HIIT sessions prescribed and regulated by RPE or HR. This finding suggests that the 6-20 RPE scale may be a useful tool for prescribing and self-regulating HIIT in T2DM patients.

**Purpose:** Research demonstrates that isometric exercise (IE) training can reduce resting blood pressure (BP). Few studies have investigated the relative safety of prescribing IE. The aim of this study was to evaluate the BP responses in pre-hypertensive males during a novel IE wall squat protocol to help establish IE training as a viable option in the prevention and treatment of hypertension.

**Methods:** Twenty-six physically inactive pre-hypertensive (BP of 120-139 mmHg systolic and/or 80-89 mmHg diastolic) males (45 ±8 years, 1.78 ±0.07 m, 89.7±12.3 kg; mean ±SD), visited the laboratory on two occasions separated by 72 hours. On each occasion heart rate (HR) and BP were measured at rest and continuously throughout exercise. In visit 1 participants completed an incremental isometric wall squat training session consisting of 4 x 2 minute bouts of 15–17 (1 min) angular displacement of the 10-minute test or upon volitional fatigue. The relationship between knee joint angle and mean HR was used to calculate the participant-specific joint angle required to elicit a target HR of 95% HRmax. This angle was then used to determine exercise intensity for a wall squat training session consisting of 4 x 2 minute bouts (visit 2).

**Results:** Systolic BP responses during the exercise test and training were 173 ± 21 mmHg vs. 171 ± 19 mmHg respectively (p=0.05). These responses were positively related (r=0.73, p<0.05) with ratio limits of agreement of 0.995 x/÷ 1.077. Diastolic
BP responses were 116 ± 14 mmHg and 113 ± 11 mmHg during the exercise test and training (p<0.05). These values were also positively related (r=0.42, p<0.05) with ratio units of age and sex. No participant in either protocol recorded systolic BP values > 250 mmHg. Diastolic BP values > 115 mmHg were recorded in 12 participants during the incremental test and in 6 participants during the training session. No adverse effects were reported. Conclusion: Based on the current ACSM guidelines for aerobic exercise termination, systolic BP does not exceed the upper limits during IE in this population. Diastolic BP briefly exceeds 115 mmHg in some participants during these exercise protocols. Future research is required to ascertain if IE requires modified BP termination guidelines.

Sickle cell anemia results in impaired cardiopulmonary function and exercise tolerance likely due to a combination of central and peripheral abnormalities stemming from deranged hemoglobin (Hb). A transgenic mouse model of sickle cell anemia has been developed to help elucidate the mechanisms of vascular and organ damage, but a variable of measurement of exercise capacity and the severity of impaired physical function have yet to be determined in this model. Purpose: Therefore, the purpose of this investigation was to measure the speed/duration relationship, known as critical speed (CS), and the anaerobic work capacity (AWC, the finite work capacity available above CS) in healthy wild type mice (WT) and mice expressing human HbSS (BERK). Methods: Following ethical approval from the institutional animal care and use committee (University of Colorado, Denver), six young-adult female mice (WT, n=3 and BERK, n=3) performed 3-5 constant-speed treadmill tests that resulted in fatigue within the range of 1.5 to 20 min. Time to fatigue vs. treadmill speed were fit to a linear and hyperbolic model. Results: Speed and time to exhaustion for both groups conformed to a hyperbolic relationship with WT: r² = 0.98 ± 0.01, BERK: r² = 0.98 ± 0.02, p<0.05) which corresponded to a linear 1/time function for both groups (WT: r² = 0.97 ± 0.02, BERK: r² = 0.93 ± 0.03, p<0.05). CS was significantly lower in BERK mice when compared to the WT control (WT: 348 ± 1.3 m/min, BERK: 23 ± 1.5 m/min, p<0.05) with no differences between linear and hyperbolic models (p=0.05 for both). Additionally, AWC was significantly higher (WT: 1456.2 ± 237.2, BERK: 2639.2 ± 106.8, P<0.05) in BERK mice when compared to WT. Considering that CS represents the highest sustainable speed and AWC is the capacity to perform anaerobic work, these data suggest that sickle cell disease impacts aerobic capacity which may be due to a disruption in the tight matching between oxygen delivery and utilization within the skeletal muscle. In this regard, these results call for future investigations into the mechanisms by which this disease impacts skeletal muscle vascular and metabolic control so that targeted therapies can be developed and employed. Funding: NIH-NHLBI T32HL007171 NIH-ROIHL125642

Cardiopulmonary exercise testing with non-invasive respiratory gas exchange has largely been utilized in specialty clinical practices. However, it remains challenging to interpret the large array of measures due to the complexities of the data. Purpose: Therefore, the purpose of this study was to test a simplified automated algorithm for data predicting disease likelihood in patients with known chronic cardiopulmonary pathologies. Methods: For the present study, patients with heart failure (HF, n=12), pulmonary arterial hypertension (PAH, n=11), chronic obstructive lung disease (OLD, n=16) and restrictive lung disease (RLD, n=12) as well as a healthy cohort of subjects (n=19) were recruited. They underwent an incremental step-test (step frequency was 60, 80 and 100 per min). During exercise, 1RR and SpO2 were assessed via pulse-oximetry and breathing pattern and respiratory gas exchange were obtained via breath by breath respiratory analysis system (SHAPE Medical Systems Inc., St. Paul, USA). A custom-developed algorithm for each disease pathology was developed based on existing literature to guide disease likelihood and severity. Results: Each specific panel of measures for disease entity (HF, PAH, OLD and RLD) adequately differentiated between disease status (p<0.05) as well as healthy cohort (p<0.05). However, given the high degree of coexisting disease in these patient populations the algorithm often identified coexisting disease but ranked primary disease accordingly. Conclusions: We have developed an automated algorithm for identifying primary and coexisting disease likelihood in an attempt to simplify and increase accessibility to clinical cardiopulmonary exercise testing. This type, automated algorithm combined with a simplified approach to testing can help guide decision making and streamline a traditionally complex and often time consuming process.

Hemiparetic gait is one of the major characteristics in people post-stroke, contributing to limited functional mobility and excessive energy expenditure (EE) during walking. Previous research reported that aquatic walking decrease EE as compared to overground walking. However, the influence of water depth during aquatic walking on the cardiorespiratory responses, particularly among people post-stroke, is unknown. Purpose: To investigate the influence of different water depths on cardiorespiratory responses during pool floor walking in people post-stroke. Methods: Nine participants post-stroke (4 males/5 females; age 55.25 ± 13.76 years) completed six minutes of walking at a matched gait speed in four different conditions: chest-depth, waist-depth, thigh-depth water, and overground. Data collection was completed on four separate visits with at least 48 hours in between. The order of walking conditions was randomized. A moveable floor pool was used to adjust the water depth. EE, oxygen consumption (VO2), and minute ventilation (VE) were measured with a telemetric metabolic system. Results: Repeated measures ANOVA revealed no significant differences in EE (p=0.16), VO2 (p=0.14), and VE (p=0.08). However, a systematic trend was found among four walking conditions. A trend in increase in all variables was noted as the water depth decreased from chest-depth to thigh-depth water. In addition, walking at waist-depth water (EE=4.45 Kcal/min, VO2=10.79 ml/min/Kg, VE=26.25/ min) showed similar results in all variables compared to overground walking (EE=4.33 Kcal/min, VO2=10.54 ml/min/Kg, VE=24.67 l/min). Conclusion: Our findings suggest that people post-stroke may benefit from gait training in the chest-depth water as it reduces EE, mostly due to buoyancy. When walking in the waist-depth water, the effects of buoyancy and water resistance appear to counteract with each other, resulting in no difference in EE among people post-stroke.

Individuals with intellectual disabilities (ID) have limited cardiopulmonary capacity, not explained by lack of motivation or lack of understanding the testing procedures. Previous research suggests these limits in cardiopulmonary capacity may be due to autonomic dysfunction in individuals with ID, but this has not been tested. Purpose: To compare the autonomic response to standing up (a basic clinical autonomic function test) of individuals with ID to a control group without ID. Methods: Thirteen individuals with ID and 12 individuals without ID were instrumented with an ECG-lead and finger-plethysmography for continuous heart rate and blood pressure recordings. After resting supine they moved to a standing position and returned to the supine position, each for 10 min. The last five minutes of every position was used to calculate time-domain and frequency-domain heart rate variability and blood pressure variability measures, common non-invasive indices of autonomic function. Results: Individuals with ID showed different responses compared to individuals without ID for R-R-interval (RRI), root mean square of successive differences (RMSSD), the proportion of times the change in consecutive intervals exceeds 50 milliseconds (pNN50), power in the high frequency of heart rate variability (RRI HF), spontaneous baroreflex sensitivity (SBR) and power in the low frequency of blood pressure variability (SAPLF) (p<0.05). Conclusion: These preliminary results suggest a blunted response to standing up in individuals with ID, but our findings need to be confirmed with a larger sample.
Purpose: Arterial hypertension is associated with excess cardiovascular disease mortality and remains a significant global public health problem. Isometric exercise training (IET) has been shown to reduce resting blood pressure (BP) in normotensive, pre-hypertensive and hypertensive populations; however the effects of IET on 24-hour ambulatory blood pressure (ABP) are less clear. Therefore, the aim of this study was to measure clinic and ABP responses to a programme of IET.

Methods: In a randomised crossover controlled trial, 24 physically inactive pre-hypertensive males (aged 44.6±7.7 years) completed 4 weeks of home-based isometric wall squat training (4 x 2 min contractions 3 times per week). Clinic and ABP were measured pre and post the control and IET period.

Results: The isometric exercise training programme produced significant (mean and 95% confidence intervals [CI]) reductions in clinic systolic (12.35 mmHg; 95% CI 10.94-14.23), diastolic (6.24 mmHg; 95% CI 4.01-8.12) and mean (8.01 mmHg; 95% CI 6.04-9.64) BP (all p<0.001). In addition, IET produced significant (mean and 95% CI) reductions in ambulatory systolic (11.83 mmHg; 95% CI 10.26 - 13.52), diastolic (5.57 mmHg; 95% CI 3.05 - 6.29) and mean (5.67 mmHg; 95% CI 4.13 - 7.82) BP (all p<0.001). There were no significant changes during the control period.

Conclusion: A short-term programme of home-based IET was associated with clinically significant reductions in clinic and ABP. The impact these responses have on long-term cardiovascular events, end organ damage and mortality requires further research.

Introduction: The 6-minute push test is often used to estimate cardiorespiratory fitness in people who have spinal cord injury (SCI). Purpose: To characterize the relationship between 6-minute push distance (6MPD) and measures of cardiorespiratory fitness in spinal cord injury (SCI). Methods: Subjects were 15 individuals with SCI who reported an inability to lift their legs against gravity (Age: 34.5 ± 10.5 years; BMI: 25.5 ± 3.6 kg/m²). Total distance covered while propelling a wheelchair over a 30-meter loop in a corridor which pulmonary gas exchange variables were measured. 6MPD was recorded as the total distance covered while propelling a wheelchair over a 30-meter loop in a corridor for 6-minutes. Pearson product moment correlation coefficients were used to assess the relationship between all study variables. Results: 6MPD was 524.1 ± 122.1 m; VO₂peak was 17.5 ± 6.3 ml·kg⁻¹·min⁻¹; and heart rate (HR)peak was 171.6 ± 19.4 bpm. The 6MPD correlated significantly with VO₂peak (r=0.58; P=0.023), RER (r=0.70; P=0.003), peak exercise time (r=0.70; P=0.004), peak workload (r=0.66; P=0.008). Conclusion: 6MPD is currently accepted as the gold standard for measuring cardiorespiratory fitness. The strong correlation between cardiorespiratory fitness measured by 6MPD and 6MPD suggested that 6MPD might be an adequate field test for measuring cardiorespiratory fitness in people who have SCI.

Funding: DoD Award #W81XWH-14-1-0613
were an additional ten athletes that scored better than baseline on PC trial 2, despite the sample being classified as having a SRC. The same four athletes that scored better than baseline to PC trial 1 resulted in 87% (26/30) of athletes being classified as having a SRC. Baseline KD performance (the faster of two error-free trials) were compared twice and recording the faster of two error-free trials. However, PC administration guidelines for the KD recommend administering the assessment contrast to the baseline administration. No study to date has investigated the clinical utility of a second PC trial on the KD.

METHODS:
We conducted a prospective case-control study of 19 concussed subjects and 9 healthy controls who completed the King-Devick test while wearing an fNIRS headband that recorded anterior prefrontal cortex oxygenation changes with 12 channels/4 optodes at 4Hz sampling rate. Linear mixed model analysis was performed to compare oxygenation changes in the two cohorts.

RESULTS:
There were significant differences across increasing difficulty of the King-Devick test conditions when comparing concussed subjects with healthy controls in both the left prefrontal cortex and right prefrontal cortex. There were no significant differences in oxygenation changes between concussed and healthy subjects when they performed the King-Devick test.

CONCLUSION:
Our preliminary experimental results suggest that fNIRS detects changes in cerebral oxygenation between concussed and healthy subjects. Further investigation into the utility of this neuroimaging modality for quantifying changes in cognitive workload after injury and over the course of recovery is warranted.

C-39 Free Communication/Poster - Concussion I

Proposing A New Method Of Administering The King-Devick Test For Concussion Assessment

Email: nr damico@email.uark.edu

The King Devick Test (KD) is a rapid number naming test that is intended to screen for sport-related concussion (SRC). This assessment compares an athlete’s pre-injury performance (i.e., baseline) to their performance post-concussion (PC). Baseline administration guidelines for the KD recommend administering the assessment twice and recording the faster of two error-free trials. However, PC administration guidelines recommend administering the KD only once following a suspected SRC, and if the athlete performs slower than their baseline or makes an error, a SRC should be suspected. It is unclear why PC administration of the KD only includes one trial in contrast to the baseline administration. No study to date has investigated the clinical utility of a second PC trial on the KD. PURPOSE: To compare the clinical utility of the KD between a first and a second PC trial for detecting SRC. METHODS: Thirty high school athletes with SRC (22 male, 8 female, age: 15.6 ± 1.1 years) completed two trials of the KD at baseline and at the same time point within 7 days following SRC. Baseline KD performance (the faster of two error-free trials) were compared to PC trial 1 (i.e., recommended administration) and PC trial 2. A one-way repeated measures ANOVA was performed to compare baseline between both PC trials.

RESULTS: Following the recommended administration guidelines (i.e., comparing baseline to PC trial 1) resulted in 87% (26/30) of athletes being classified as having a possible SRC. However, comparing baseline to PC trial 2 resulted in 53% (16/30) of the sample being classified as having a SRC. The same four athletes that scored better than baseline at PC trial 1 also scored better than baseline at PC trial 2. However, there were an additional ten athletes that scored better than baseline on PC trial 2, despite scoring worse than baseline on PC trial 1. A significant difference was reported (p < 0.01) between baseline (44.27 ± 8.08 secs) and PC trial 1 (55.70 ± 17.79 secs), but there was no significant difference (p = 0.07) between baseline (44.27 ± 8.08 secs) and PC trial 2 (50.47 ± 17.30 secs). There were no significant differences in errors between baseline, PC trial 1, and PC trial 2 (p = 0.57). CONCLUSION: A second trial for the KD assessment of concussion should be utilized during PC administration when making clinical decisions regarding SRC.

1476 Board #151 June 1 9:00 AM - 10:30 AM The Use Of Functional Near-Infrared Spectroscopy (fNIRS) For Assessing Cognitive Workload During King-Devick Test After Concussion

Eileen P. Storey¹, Hasan Ayaz², Lei Wang², Olivia Podolak¹, Matthew F. Grady², Christina L. Master¹. 'The Children's Hospital of Philadelphia, Philadelphia, PA. 'Drexel University, Philadelphia, PA.

(Purpose relationships reported)

PURPOSE:
Functional near-infrared spectroscopy (fNIRS), a noninvasive and portable neuroimaging modality that detects changes in blood oxygenation related to human brain function, is a promising tool to address the current lack of objective biomarkers to identify pathophysiologic changes associated with concussion. We sought to determine the utility of fNIRS to detect and differentiate cortical brain activity between concussed and healthy subjects when they performed the King-Devick test.

METHODS:
We conducted a prospective case-control study of 19 concussed subjects and 9 healthy controls who completed the King-Devick test while wearing an fNIRS headband that recorded anterior prefrontal cortex oxygenation changes with 12 channels/4 optodes at 4Hz sampling rate. Linear mixed model analysis was performed to compare oxygenation changes in the two cohorts.

RESULTS:
There were significant differences across increasing difficulty of the King-Devick test conditions when comparing concussed subjects with healthy controls in both the left prefrontal cortex and right prefrontal cortex. There were no significant differences in oxygenation changes between concussed and healthy subjects when they performed the King-Devick test.

CONCLUSION:
Our preliminary experimental results suggest that fNIRS detects changes in cerebral blood oxygenation between concussed and healthy subjects. Further investigation into the utility of this neuroimaging modality for quantifying changes in cognitive workload after injury and over the course of recovery is warranted.

Abstracts were prepared by the authors and printed as submitted.
The test-retest reliability of clinical concussion assessment tools has been established over varying time intervals on multiple platforms, but few studies have evaluated the effect of multiple time intervals between assessments in the same population. As concussions occur variably following baseline assessments, understanding the effect of different time intervals on the stability of computerized neurocognitive has high clinical value.

**PURPOSE:** To determine the test-retest reliability of a computerized neurocognitive test (CNS Vital Signs) over two different time intervals in Division I athletes.

**METHODS:** Sixty-nine collegiate athletes were administered the CNS Vital Signs twice. The test-retest interval was 4 months in one subcohort (n=38, 19M, 19F) and 12 months in a second subcohort (n=31, 21M, 10F). The reliability (ICC2,k) for each cognitive domain’s standard score was analyzed. **RESULTS:** CNS Vital Signs scores ranged from low to high reliability (0.338<ICC2,k<0.971). Using a cutoff of ICC2,k >0.70 to indicate high reliability, a greater percentage of domains demonstrated high reliability (46%) in the 12-month interval compared to the 4-month interval (31%). **CONCLUSION:** As concussion management requires serial testing, high test-retest reliability is needed. Although ICC2,k values were similar between time intervals, a higher number of domains in the 1-year interval met the reliability standards required for clinical care and no domains displayed low levels of reliability (ICC<0.40). Should clinicians choose to complete multiple healthy baselines, a 1-year interval between assessments is recommended.

**Supported by the NOCSAE**

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**Effect of Modifying Factors on Sports-Related Concussion Recovery in Youth Athletes Under Clinical Management**

**PURPOSE:** Several modifying factors may affect recovery from a sports-related concussion (SRC) including sex, concussion history (hx), and attention deficit hyperactivity disorder (ADHD). For example, female athletes take longer to recover and concussion hx increases risk for future concussions. Further, those with ADHD exhibit greater symptomatology at baseline and post-concussion, which has been associated with...
prolonged recovery. While sex differences are strongly supported, discrepancies exist for the effect of concussion hx and a paucity of research exists on the effect of ADHD on SRC. METHODS: A retrospective chart review of patients (n = 219; 75 females, 144 males; age range: 11-19 yr; mean ± SD; 15±2) presenting with a diagnosed SRC to a concussion clinic from Jan - Dec 2014 was conducted. Recovery was defined as number of days from date of injury to date of return to play progression (no yeses), sex (male/female), and age served as predictor variables. Alpha level was adjusted to 0.017 to account for multiple comparisons. RESULTS: Fifty-five (24.2%) athletes reported a concussion history, 44 (19.4%) were football athletes, and 146 (64.3%) were male. In the multivariable models the following significant associations were identified: 1) football athletes had lower COMP scores compared to non-football athletes (FB:73.3±8.0 vs. No FB:77.2 ±7.5; Wald Chi Square=9.1; p = 0.004); and 2) football athletes were statistically, but not clinically higher on somatosensory ratio scores compared to non-football athletes (FB:99.3±3.9 vs. No FB:98.1±3.1; Wald Chi Square=8.3; p =0.004). While not statistically significant, Visual ratio scores (FB:81.8±14.2 vs. No FB: 86.3 ±10.4; Wald Chi Square=4.9; p =0.026) were lower in football athletes compared to non-football athletes. No other associations were observed with SRC outcomes (p=0.017). CONCLUSION: Football athletes have worse overall balance when compared to non-athletes, as indicated by their COMP SOT scores. Future research should examine if these differences are related to subconcussive impact exposure or other sport-specific factors.

Adolescents are more vulnerable to concussion consequences due to disturbance of physiologic processes during brain maturation. Reports suggest up to 50% of adolescents do not seek healthcare post-sport-related concussion (SRC). Failure to report results in treatment delays and leads to premature return to activities, potentiating risk for prolonged symptoms or subsequent injury. PURPOSE: The purpose of this study was to explore influential factors and pivotal decision points in non-concussed adolescent athletes health decision-making (DM) process to seek healthcare post-SRC. METHODS: Grounded theory, a qualitative interpretation of participants’ words rather than statistical analysis, was used to examine salient concepts within athletes’ DM process. Twelve adolescent athletes representing several sports were recruited to participate in semi-structured interviews to describe their SRC experience. RESULTS: SRC DM occurred within context of sport culture encouraging to “push through pain.” The central perspective, known as the Dark Cloud, reflects literal and symbolic facets of SRC before and after the point of impact. Participants distinguished between hurt or injured, influencing symptom reporting. Athletes made sense of symptoms through crucial conversations with a trusted person to weigh options and make decisions. Participants who continued play with symptoms described prolonged cognitive and physical impairment, depression and anxiety. Individual, social, community, and policy factors influenced adolescent athletes’ SRC DM. CONCLUSIONS: Symptom reporting and connection with healthcare providers were influenced by the dark cloud of concussion. The Dark Cloud reflected factors before and after the point of impact. These factors ranged from blackouts, a dark room to avoid light and sensory stimulation, isolation from social support and physical activities, clouded judgment, foggy thoughts, dark mood and being in the dark about SRC symptoms. Athletes distinguished between the concept of injured versus hurt, with injury interfering with an athlete’s ability to participate in activities whereas an injury may continue play while hurt. The distinction between hurt and injured was crucial to understanding an athlete’s perception about continued participation after forceful impact(s).
Prognostic indicators of outcomes following sport-related concussion (SRC) managed in the primary care setting are understudied.

**PURPOSE:** This study examines the relationship between acute post-concussion measures and one-month parent reported health-related quality of life in pediatric concussion patients.

**METHODS:** This was a prospective cohort presenting to 3 clinics of a single practice group from December 2014-September 2016. Included were patients 8-18 years, presenting within 3 days of a SRC, who consented to participate, and whose parents completed a one-month follow-up. Participants completed a standardized initial visit, including a clinical exam, a symptom checklist, the Immediate Post-Concussion and Cognitive Test (ImPACT™), and a near point convergence screening. Parents completed a one-month follow-up about their child [PedsQL™ Quality of Life Inventory (QOL) and the PedsQL™ Multidimensional Fatigue Scale (MDF)]. We assessed univariate relationships between demographics, initial presentation measures, and one-month follow-up QOL and MDF. Variables significant in univariate analyses (p<0.05) were included in multivariable regression models.

**RESULTS:** A total of 180 patients met initial inclusion and completed the one-month follow-up [% follow-up ~ 75% (180/240 eligible at initial visit): 100 (55.9%) were male, 136 (88.9%) Caucasian, and 28 (15.6%) were injured in football. Median age was 15 years (IQR: 13.0, 16.0). In the QOL model, a 10 point estimated increase in symptom severity score (Beta=-1.825; 95% CI: -3.335, -0.314) and no previous head injury (Mean Difference: -5.751; 95% CI: -11.089, -0.412) were associated with worse one-month QOL. A 0.06 point increase in initial visit ImPACT™ Reaction Time (Beta=-2.120; 95% CI: -3.898, -0.343) was associated with worse one-month MDF in the MDF model.

**CONCLUSION:** Clinicians should be mindful of acute symptom burden and those with no history of concussion when considering potential for worse one-month post-injury QOL outcomes. Those with initial longer reaction times may be more likely to experience fatigue over the first month following concussion. Clinicians may need to consider early intervention in patients with these characteristics.

Funded in part by the National Operating Committee on Standards for Athletic Equipment.
The Vestibular/Ocular Motor Screening (VOMS) Tool has previously demonstrated the ability to identify differences between healthy and concussed participants in clinical populations, with an 89% positive prediction value. However, there is little information on incidence of clinically significant change in healthy athletes. **PURPOSE:** To identify rates of change scores on the VOMS in a sideline testing environment with healthy adolescent athletes, within an 89% PPV, allowing for an 11% false positive rate.

**METHODS:** Seventy-eight healthy athletes (15.77 ± 1.39 years) were administered the VOMS three times during their sport season; prior to their sport season (T1) and at a later date, before practice (T2) and within 5 minutes of removal from sport practice (T3). Descriptive statistics and multivariate base rate analyses were performed using Microsoft Excel. **RESULTS:** Multivariate base rate analyses reveals that a change of 2+ symptom provocation on any 1, 2, or 3 VOMS items achieved a false positive rate of 21%, 14%, and 10% respectively. Using a change of 3+ symptom provocation on any 1, 2, or 3 VOMS items achieved a false positive rate of 13%, 9%, and 6% respectively. Using a change of 4+ symptom provocation on any 1, 2, or 3 VOMS items achieved a false positive rate of 9%, 6%, and 3% respectively. The false positive rate using NPC distance ≥5 cm ranged from 21% to 32% across the three times. In the context of sport participation (T3), a more valid clinical metric during sport participation would be using a change of 2+ symptom provocation on 3 VOMS items, 3+ on 2 VOMS items, or 4+ on 1 VOMS item. **CONCLUSIONS:** To our knowledge, this is the first study to examine the utility of multivariate base rates in interpreting VOMS change scores in the context of a structured high school sport practice. Our findings suggest interpretation of clinical change on the VOMS using a change of 2+ on 3 VOMS items, 3+ on 2 VOMS items, or 4+ symptom on 1 VOMS item would obtain a false positive rate of ≤11%, whereas a NPC distance ≥5 centimeters greatly increases the rate of false positive.
and medication status and household size as the independent variables. RESULTS: Although ANOVA results indicated no main effect for either household size \( (F_{2,307} = 2.102, p = 0.124) \) or medication status \( (F_{2,137} = 2.287, p = 0.131) \), a means cross-over interaction for household size and medication status was observed \( (F_{2,305} = 3.563, p = 0.029} \) and is displayed in Figure 1. CONCLUSIONS: For those individuals on three or fewer medications, the risk associated with falling was similar across household size with those living by themselves and with a partner being slightly more likely to have a history of fall than those living in households with three or more people. However, for four or more medications, those living with a partner were observed to be less likely to have a history of falling in the past year than those living by themselves. Additionally, those who reported living in households with three or more people were the most likely to fall in the group reporting to take four or more medications.

Wrist injuries are common in mountain snow sports, particularly snowboarding. Wrist guards have been shown to reduce wrist fractures by upwards of 85%, but only 5.7% of snowboarders wear this protective device. There are no industry standards for the wrist guard design, which likely limits their perceived effectiveness and therefore their use. Wrist fractures have not been thoroughly characterized in the literature. A more detailed understanding of fracture patterns may inform improved design of snowboarding wrist guards. PURPOSE: To characterize wrist fracture patterns in greater detail than has previously been done, in order to gain an improved understanding of wrist fracture patterns and inform the design of more effective wrist guards to prevent wrist injuries in snowboarders.

METHODS: In this retrospective chart review, medical records from a large western mountain resort injury clinic were analyzed for demographic and clinical data collected during two consecutive winter seasons. Radiographs were analyzed to further classify fractures. Data analysis was performed using descriptive statistics and the \( \chi^2 \) test.

RESULTS: We identified 379 wrist injuries over the two winter seasons \( (age = 22.7 \pm 14.1, male = 53.3\%) \), with the majority being in snowboarders \( (n = 307, 81.0\%) \). 97% of all patients with wrist injuries had radiographs taken, and 64.6% were diagnosed with wrist fracture \( (n = 224 \text{ for distal radius fracture}, n = 27 \text{ for ulnar fracture, and } n = 27 \text{ for concomitant radial-ulnar fractures}) \). Snowboarders had a significantly higher percentage of wrist fractures than did skiers \( (69.1\% \text{ for snowboarders vs. } 46.2\% \text{ for skiers}, \chi^2 = 12.376, p < 0.001) \). 71.1% of all distal radius fractures were AO classification A2; 16% were C1 or C2. 33% of all distal radius fractures required reduction. The angle of displacement of the distal radius fragment ranged from 1-61 degrees. 49% of wrist fractures were in skeletally immature patients. 3.3% of all patients with wrist fractures were shown to be wearing wrist guards at the time of injury.

CONCLUSIONS: This study provides greater detail of wrist fracture patterns in snowboarders. These data can inform industry wrist guard standards.

Gastrointestinal (GI) issues are known to be common among endurance athletes and can impair performance in training and competition. Symptom characteristics, particularly those of the lower GI, are similar to irritable bowel syndrome (IBS). No previous research has examined IBS diagnosis or fit to IBS diagnostic criteria within this population. PURPOSE: To determine the prevalence of IBS among endurance athletes as well as their GI symptom management strategies. METHODS: A 92-item online questionnaire was previously validated for the purpose of assessing IBS diagnosis, fit to IBS diagnostic criteria (Rome III or Manning), general GI symptoms, and symptom mitigation strategies of endurance athletes. The questionnaire was distributed between December 2015 and October 2016 to the athletes in the U.S. completing a marathon, ultra-marathon, half-distance triathlon, or full-distance triathlon within that calendar year. RESULTS: The total prevalence of irritable bowel syndrome among 321 endurance athletes who completed the questionnaire was between 9.0% to 22.1% (medically diagnosed: 1.6%; undiagnosed but meeting the diagnostic criteria: 7.5% fitting Rome III criteria or 20.6% fitting * 2 Manning criteria). Significantly more IBS sufferers were undiagnosed \( (p < 0.001 \text{ for Rome III and Manning, respectively}) \). Only 10.9% of athletes reported seeing a medical professional due to GI issues, which 0.2% had issues which sometimes or often interrupted or prevented their training. Additionally, 65.7% experienced at least one lower GI symptom at a frequency of sometimes or more during training. Almost half (46.7%) of the athletes tried nutritional modifications to help ease their symptoms and 19.0% used over-the-counter medications. CONCLUSION: Most endurance athletes that may suffer from IBS are undiagnosed, while even more have GI issues but do not fit IBS diagnostic criteria. The overall prevalence may be greater than that seen in the general population and the percent diagnosed may be lower among endurance athletes. Despite using various methods to manage their symptoms, endurance athletes are still experiencing issues and could potentially benefit from current IBS-mitigating strategies. Supported by University of Illinois Nutritional Science Margin of Excellence Research and Vision 20/20 Awards.
Low Back Pain (LBP) is one of the common injuries that may occur in young baseball players. However, little is known about the prevalence of LBP in childhood and adolescence with taking their individual growth and development into consideration.

**PURPOSE:** The purpose of this study was to describe the prevalence of LBP in young baseball players. In addition, to clarify occurrence of the LBP, based on the Peak Hip Height Velocity (PHV age).

**METHODS:** A total of 293 South Korean male baseball players (12.8 ± 2.1 yrs) (Elementary school (ES) = 135, Junior high school (JHS) = 135, and Senior high school (SHS) = 23) were involved in this surveillance, using a questionnaire (point prevalence, lifetime prevalence, recurrence, and age of onset of LBP). Participants' health records were also collected to investigate an annual increment of height and a history of LBP.

From these data, the PHV age was calculated in the visually with ± 1 year of PHV age. The PHV age was defined as the age showed the most development increased height.

**RESULTS:** Among all participants, 60.4% (total 177; 135 ± 1.9 yrs) of participants had experience of the LBP. In each school group, the prevalence of LBP followed has increased and injury rates for college competitions increased beginning in the 2010/11 academic year.

**CONCLUSIONS:** Injury rates vary by age group and event type with higher rates seen in college athletes and during competitions. Differences may be due to skill level, intensity of play, or access to athletic health care. Further research is needed to determine the cause of these differences and identity injury prevention initiatives.
RESULTS: Lower BMI associated with higher IKDC score (r=−0.08, P=0.04), but BMI did not uniquely explain variance in IKDC (ΔR²=0.01, P=0.57) after accounting for covariates. Individuals with low BMI demonstrated higher odds (OR=1.45 [1.05 -1.99]) of achieving population average IKDC scores compared to participants with high BMI. CONCLUSIONS: A significant but negligible association between higher BMI and lower IKDC scores was negated after accounting for relevant covariates in individuals with a unilateral ACLR. If individuals are dichotomized based on a BMI cut-off of 25, underweight and normal individuals demonstrate higher odds of achieving normative IKDC scores. On its own, BMI may not be a good clinical predictor of self-reported ACLR outcomes.

Background: Brazilian jiujitsu (BJJ) is a martial art that focuses on groundwork, joint locks, and chokeholds instead of kicks and punches. Prior studies have examined injury in the sport during competition but not during training. Purpose: To determine the prevalence of injuries sustained during BJJ training. Methods: A 27-question research survey was e-mailed to 166 BJJ gyms throughout the United States. Demographic information, belt level, training hours, competition experience, and injury prevalence data were collected. Survey participants were incentivized by entrance into a random drawing to receive one of four $25.00 pre-paid credit cards. Results: A total of 140 athletes responded to the survey. The majority of respondents were Caucasian (n=96) males (n=121) with an average age of 30.3 years. Overall, the most common injury locations were to the hand and fingers (n=70), foot and toes (n=52), and arm and elbow (n=51). Skin infections (n=38) were the most frequent condition for which athletes sought medical attention followed by injuries to the lower extremity and more frequent non-medically diagnosed injuries to the upper extremity. We hypothesize upper extremity injuries to be more frequent but less severe with the opposite being true for lower extremity injuries. This study highlights the prevalence of training injuries in BJJ and the distribution of injuries by age, belt level, and weight class, which may be used to educate both athletes and physicians.

Purpose: To determine injury rates of sports-related concussions (SRC) during the start, middle and end of practice and competitions among high school male and female athletes in the state of Michigan. Methods: This was a descriptive epidemiological study using the Michigan High School Athletic Association (MHSAA) Head Injury Reporting System. A total of 284,227 (165,418 males, 118,809 females) student-athletes (years in high school=2.32±1.1) participating in MSHAA sponsored athletic activities (i.e., football, soccer, basketball) during the 2015-2016 academic year. Using the MSHAA Head Injury Reporting System, a total of 284,227 (165,418 males, 118,809 females) student-athletes (years in high school=2.32±1.1) participating in MSHAA sponsored athletic activities (i.e., football, soccer, basketball) during the 2015-2016 academic year. Using the MSHAA Head Injury Reporting System, athlete exposures (AE), total SRCs and time (i.e., start, middle, end) when a SRC occurred were reported. Purpose: The Rugby Injury Survey & Evaluation (RISE) report methodology was used to collect injury incidence (per 1000 player hours (ph)) among competitive levels (Colts/Under-19 (U19), college, senior/adult community, sub-elit, and elite). The U.S. Rugby-7s national circuit (2010-2014) included a total of 24,418 players. Results: Overall injury incidence was 107.3/1000 ph (73% men; 27% women) (time-loss: 33.7/1000 ph, p=0.02; medical-attention: 72.9/1000 ph, n=1068). Elite players were injured more frequently (overall 155.8/1000 ph; time-loss 47.0/1000 ph) compared to other levels (P=0.002). Mean severity among all injuries was 44 days (63% with follow-up data). Injuries were mostly new acute injuries (98%), and occurred during the tackle (U19/Coll 80%, college 68%, senior 70%, sub-elit 69%, elite 71%). Most common time-loss injuries were ligament sprains (32%) in the lower extremity (43%). Head/neck injuries occurred often among all levels (overall 22%, 23.7/1000 ph; time-loss 21%, 7.3/1000 ph). Players who wore mouth guards had lower severity from head/neck injuries than those who did not, in our college and elite population (college 21% vs. 41%; P=0.045; elite 11% vs. 25%, P=0.026, respectively). Concussion incidence was highest among U19 players (11.4/1000 ph). A higher incidence of injuries were seen on artificial fields (114.2/1000 ph) than natural grass (107.2/1000 ph, P=0.035). Conclusion: Investigation surveillance on U.S. Rugby-7s playing among levels is necessary to obtain evidence-based data to nurture injury prevention. Head/neck injuries were common in all U.S. levels of play, which may highlight the need to evaluate tackling techniques which may decrease injury rates. Concussion rates due to tackling in the U19 playing level supports the need for more resources and education dedicated to these players to reduce injuries. The use of mouth guards among all levels, may reduce severity of head/neck injuries, and should be emphasized as an injury prevention measure in our playing population. Finally, natural grass may be a safer surface for Rugby-7's open-style play.
soccer (20.1/1000 AE). Sports with the lowest IR were girls’ volleyball (6.1/1000 AE), cheerleading (7.9/1000 AE), baseball (8.8/1000 AE), and boys’ soccer (11.6/1000 AE).

Boys and girls IR did not differ (17.8 vs 16.3/1000 AE; RR = 1.1; 95%CI: 1.0-1.2); findings were retained when restricted to TL injuries (6.9 vs. 5.6/1000 AE; RR = 1.3; 95%CI: 1.0-1.5). Games had a higher IR than practices (22.3 vs. 15.5/1000 AE; RR = 1.4; 95%CI: 1.3-2.3). Most injuries were to the lower (45%) followed by the upper extremity (25%), and the head (18%). The majority were diagnosed as contusions (23%), sprains (14%), and while maintaining surface quality throughout a season of play, no long-term studies have specifically compared injury incidence rates between the two surfaces.

**PURPOSE:** To quantify seasonal incidence of game-related collegiate football injuries on artificial turf versus natural grass.

**METHODS:** 32 NCAA Division I/FBS colleges were evaluated from August to January over 7 competitive seasons. Injury incidence rates (IIR) were expressed using injuries per 10 team games = (number of injuries / number of team games) x 10. **RESULTS:** Of the 1,176 collegiate games documented, 609 team games (51.8%) were played on artificial turf versus 567 team games (48.2%) played on natural grass. A total of 5,395 injuries were documented with 2,342 (43.4%) occurring on artificial turf, and 3,053 (56.6%) on natural grass. Analyses per 10 team games indicated a significant seasonal injury incidence effect (Likelihood Ratio = 46.05; P < 0.0001) between surfaces by month. Subsequent post hoc analyses indicated a significant lower seasonal injury incidence effect (Likelihood Ratio = 46.065; P < 0.0001) between these surfaces during seasonal play, further investigation is warranted to quantify seasonal influence across injury category, severity of injury, injury mechanism and situation, specific extremity joints/muscles, elective medical procedures, turf age, and environmental factors. The findings of this study may be generalizable only to this level of football competition and this specific artificial surface.

**CONCLUSIONS:** Data provide IR estimates for this understudied population. Most injuries involved NTL. Consistent with prior research, games had a higher IR than practices. Girls’ basketball and soccer were among sports having the highest IR. However, no significant differences existed between boys and girls IR. Findings demonstrate differences in IR between games and practices and across middle school sports. Supported by the Potomac Health Foundation.

**Purpose:** There is a lack of injury data on the collision sport of U.S. Rugby-7s, which hinders development of evidence-based injury prevention protocols. The aim was to determine match injury incidence and risk factors at the highest level of amateur U.S. Rugby-7s.

**Methods:** This was a prospective epidemiology study of sub-elite U.S. Rugby-7s players (960 men, 888 women) representing competitive regions at the U.S. Rugby National Club 7-a-side Championships (including four, two-day tournaments over 2011-2014). Incidence (per 1000 player-hour (ph)) and biomechanism of injuries were captured via the Rugby Injury Survey & Evaluation (RISE) Report methodology.

**Results:** Overall injuries were found at 205.3/1000 ph (n=244) (time-loss 59.7/1000 ph, n=71; medical attention 142.2/1000 ph, n=169; P < 0.001). Among backs, males (n=26; 74.3/1000 ph) encountered more time-loss injuries than females (n=13; 49.5/1000 ph; P = 0.063). Most injuries were acute (95%) and occurred during the tackle (73%). Shoulder tackles resulted in the most match injuries (61%). Recurrent time-loss injuries (21%) occurred frequently (backs 28%; forwards 8%; P = 0.044). Main injuries were lower extremity ligament sprains (71%). Knee injuries occurred more frequently in females (18.4%) than males (3.1%; P < 0.001). Head/neck time-loss injury rates (30%), occurred more often in males (41%) than females (11%; RR = 1.5; P = 0.002). The overall concussion rate in this population was 6.1% (12.6/1000 ph).

**Conclusions:** Understanding injury rates in U.S. sub-elite amateur competitors, which often make up the U.S. national candidate pool, provides fundamental level of play data, to guide injury prevention protocols to the U.S. rugby playing population. U.S. sub-elite players head/neck injury rates were found higher, than elite international male Rugby-7s (5%), Under-20 Rugby-15s (12%) and elite women Rugby-15s (26%). Education on tackling techniques are areas to consider to reduce the risk of head/neck injury rates, including concussions, which were higher in this U.S. tournament series often make up the U.S. national candidate pool, provides fundamental level of play data, to guide injury prevention protocols to the U.S. rugby playing population. U.S. sub-elite players head/neck injury rates were found higher, than elite international male Rugby-7s (5%), Under-20 Rugby-15s (12%) and elite women Rugby-15s (26%). Education on tackling techniques are areas to consider to reduce the risk of head/neck injury rates, including concussions, which were higher in this U.S. tournament series often make up the U.S. national candidate pool, provides fundamental level of play data, to guide injury prevention protocols to the U.S. rugby playing population. U.S. sub-elite players head/neck injury rates were found higher, than elite international male Rugby-7s (5%), Under-20 Rugby-15s (12%) and elite women Rugby-15s (26%). Education on tackling techniques are areas to consider to reduce the risk of head/neck injury rates, including concussions, which were higher in this U.S. tournament series often make up the U.S. national candidate pool, provides fundamental level of play data, to guide injury prevention protocols to the U.S. rugby playing population. U.S. sub-elite players head/neck injury rates were found higher, than elite international male Rugby-7s (5%), Under-20 Rugby-15s (12%) and elite women Rugby-15s (26%).
In the United States, 30–60% of older adults fall each year; 10–20% of these falls result in injury, hospitalization, or death. Better prevention of falls in this population may be facilitated by broader identification of risk factors. The use of statins has emerged as a potential risk factor, but the data are conflicted. **PURPOSE:** To examine the relationship between statin use and falls among community-dwelling older adults. **METHODS:** We evaluated the patient registry of a Level 1 trauma center. All patients aged ≥65 years who were admitted in the Emergency Room (and discharged to home) for falls in 2015 were included (n=615). Many of these patients may have been previously admitted for falls and many were later readmitted for falls. We analyzed predictors of falls in this population with multivariable logistic regression. Independent variables were self-reported balance problems, diagnosis of dementia, and the use of statins. **RESULTS:** On average, patients admitted for falls were 79.9 ± 9.3 years old and 28% (n=173) were taking statins. Our collection of predictors explained 14.2% of the variance in the number of previous admissions for falls (p<0.001). Among these admissions, prior admission related prevalence was 40.1% (boys: 40.7%; girls: 40.7%) and 209 (76%) patients had no prior admission related falls. **CONCLUSIONS:** One concern with the expansion of collegiate sanctioned sports can help guide instruction on tackling, and a standardized capture injury rates (per 1000 player-hour (ph)). USA Sevens Collegiate Rugby-7s Championship Invitational (1786 athletes) over 2012, 2014-2016 competitive divisions (championships men and women, men’s collegiate, and men’s small colleges) were evaluated for match injuries. **Results:** Injuries overall were found at 139.4/1000ph (n=151) (time-loss 1.1/1000ph, n=34; medical attention 108.0/1000ph, n=130; <0.001). Backs (38.9/1000ph) had higher rates of time-loss injuries than forwards (17.3/1000ph, RR: 2.2, P=0.04). Mean severity of injuries were 75.7 days (backs 63.7 days; forwards 127.5 days, P=0.078). Injuries overall were acute (87%) and occurred during the tackle (72%) and running/open play (17% overall; from 13% in 2012, 22% in 2014, 43% in 2015, 9% in 2016). Shoulder tackles led to more injuries than other tackle types (65%; RR: 1.9). Recurrent injuries were observed at 29% of all injuries (39.8/1000ph). Most common time-loss injuries were concussions (26%) and lower extremity ligament injuries (50%). Overall head/neck injuries occurred at high proportions (29%; RR: 2.6), including concussions at 12% of all injuries (16.7/1000ph, RR: 1.3, P=0.148). **Conclusions:** The incidence and severity of injury in boys’ and girls’ youth lacrosse players. **PURPOSE:** Compare the incidence and severity of injuries among boys’ and girls’ youth lacrosse players. **METHODS:** Athletic trainers (ATs) attended games and practices during the 2015 and 2016 seasons for 12 youth lacrosse leagues in four states with 1090 male and 408 female players. ATs collected injury and athlete-exposure (AE) data at all events. Injuries occurring during league events and requiring medical attention were included. Time loss (TL) injuries were those resulting in participation restriction ≥24 hours. **RESULTS:** Age at first energy drink use was inversely proportionate to each risky driving behavior measured. The odds of engaging in driving while over the .08 BAC limit decreased by 10.8% (OR=0.89; p<0.002) as age at first energy drink use increased by one year. Participants odds of driving when perceiving they had consumed too much alcohol to drive safely decreased by 8.4% (OR=0.92; p<0.009) as age at first energy drink use increased by one year. The odds of being a passenger in a car with a driver who had consumed too much alcohol to drive safely decreased by 11.9% (OR=0.88; p<0.000) as age at first use increased by one year. Age at first energy drink use was a significant predictor of past 30-day risky driving behaviors including driving when one perceives they have consumed too much alcohol to drive safely (B=−0.04; p=0.036; R²=0.008), and driving while perceiving a BAC over .08 (B=−.10; p<0.001; R²=0.009). **CONCLUSION:** Results suggested using energy drinks at an earlier age predicted high-risk motor vehicle behaviors including driving after consuming too much alcohol, driving over the .08 BAC limit, and knowingly riding with a driver who had consumed too much alcohol to drive safely.

**Conclusion:** More than 25% of all Americans age ≥40 years are taking cholesterol-lowering medication; 93% of those medications are statins. Although evidence is conflicted, one data source that supports the finding that statin therapy increases the risk of falls in older adults. Exercise may function as a prophylactic measure, enhancing lipid profiles and decreasing the need for statins while also improving balance, coordination, and mobility, reducing the risk of fall-related injuries.
of injuries in boys (5.8%) and girls (0.0%). In total, 15 concussions were reported; however, all but one occurred in boys. Of the 14 concussions in boys, 6 (42.9%) were due to player contact, and 5 (35.7%) stick contact.

CONCLUSIONS: Data provide injury incidence estimates from the largest known sample of youth lacrosse players. As seen in previous research, rates were higher in boys than girls, highlighting the need for sex-specific prevention strategies, particularly related to concussion and player contact. The high incidence of stick- and ball-related injuries also reiterates the need for rule changes to better protect players. Supported by the National Operating Committee on Standards for Athletic Equipment (NOCSAE).

1509 Board #184 June 1 8:00 AM - 9:30 AM Shoulder Impingement in Soldiers: Descriptive Epidemiology and Common Surgical Procedures

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(Please note: No relationships reported)

PURPOSE: Subacromial impingement syndrome (SIS) is one of the most common shoulder diagnoses in people with significant upper extremity demands, and this diagnosis may include multiple underlying factors. The purpose of this study is to examine the incidence of SIS in U.S. Army Soldiers, risk factors for SIS, and identify the most common surgical procedures in operative cases.

METHODS: Medical encounter data for all U.S. Army Soldiers was examined from 2002-2011. Cases of subacromial impingement syndrome (SIS) were identified. The Cochran-Armitage Trend Test was used to examine the association between the SIS outcomes and the case’s military occupational specialty (MOS) score categorized in 10-point intervals.

RESULTS: A total of 3,454,140 unique Soldiers (1,252,106 females, 2,202,034 males) were included in the study. The overall lifetime prevalence of SIS was 3.6% (24.0% of females, 2.9% of males). SIS was associated with increasing MOS score for females (p<0.0001) and males (p=0.0008). The most common surgical procedures in operative cases were rotator cuff repair (34%), capsulorrhaphy with labral repair (22%), and coracoacromial ligament release (20%).

CONCLUSIONS: SIS is a common shoulder condition in female and male U.S. Army Soldiers. The incidence of SIS in this population is complex and may not be associated with individual factors measured in this study.

1510 Board #185 June 1 8:00 AM - 9:30 AM Characterizing Injuries and Participation in High Intensity Functional Training

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Limited epidemiological data related to injury and high-intensity functional training (HIFT) suggest relatively low injury risk compared to other exercises (e.g., running).

PURPOSE: This qualitative study characterized injury related experiences for HIFT participants.

METHODS: Six-min key informant interviews (KII) with six HIFT coaches (67% male, age = 39 ± 8y, 4y experience), six coaches (50% male, age = 34 ± 9y, 4y experience), and 15-min interviews (IN) with 10 HIFT exercisers (50% male, age = 43 ± 15y, 50% > 1y experience) were used. Only FG were asked “What injuries have you experienced as a result of HIFT? Data were then analyzed to identify statements related to injuries, hurt, pain, soreness, or safety for all participants. Data were open-coded and discussed for consensus by two researchers.

RESULTS: Key themes included participants reporting mostly minor “HIFT injuries” (KI = 33%, FG = 100%, IN = 20%). Participants also reported having “injuries from other types of exercises/sports” (KI = 33%, FG = 67%, IN = 10%). “High intensity workouts” influenced when participants pushed too hard and became injured. Injuries were limited to the back. Limited information about specific injuries was collected. Injuries included muscle strain, myofascial pain, subacromial impingement, and atrophy.

CONCLUSIONS: These findings contribute to the existing literature regarding the frequency and potential mechanisms of injury in HIFT. More research is needed to fully understand the risk factors and outcomes of injury in this population.

1511 Board #186 June 1 8:00 AM - 9:30 AM The Experience Of Low Back Pain In Pre-professional And Professional Dancers: A Longitudinal Study

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(Please note: No relationships reported)

PURPOSE: Low back pain (LBP) is often cited as one of the most common musculoskeletal conditions experienced by pre-professional and professionals dancers, although there is a dearth of evidence to support this. The purpose of this study was to: i) to determine the prevalence of LBP in dancers, as well as the impact on practice and management strategies used by dancers; and ii) to identify any demographic or physical factors associated with LBP in dancers.

METHODS: This was a prospective cohort study of 110 (n=19 male) pre-professional and professional classical ballet and contemporary dancers (mean (SD) age 17.8 (2.9) years). Data were collected using an online questionnaire repeated monthly for 9 months. Univariate and multivariate analyses were conducted to determine demographic and physical factors related to LBP prevalence. RESULTS: 74% of dancers reported a history of LBP. Preliminary analysis revealed a monthly and point prevalence between 40 to 60% and 16 to 25% respectively. Each month, between 35 to 63% of all episodes of LBP resulted in some form of activity modification or time away from dance, 16 to 27% of dancers with back pain consulted a health professional and 15 to 30% used medication for their back pain. Multivariate analysis found no association with individual or demographic factors and history of LBP. CONCLUSIONS: Pre-professional and professional dancers have an increased vulnerability to LBP. The development of LBP within this population is complex and may not be associated with individual factors measured in this study.
Soccer had 4.6, track & field 4.0, gymnastics 4.0, and females 1.9 greater odds of hip injury (p=0.01, 0.02, 0.03, & 0.01). Basketball had 2.8, gymnastics 2.7, and females 1.7 times greater odds of knee injury (p=0.05, 0.03, & 0.01).

### Conclusion

Football accounted for the largest gross number of injuries but not when averaged by number of participants. Gymnastics had a significant risk for having reported injury at the time of pre-participation examination. Females had a significant risk of hip and knee injuries compared to male athletes.

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**Risk Factors For The Development Of Osteoarthritis In Patients With ACL Reconstruction.**

Joe Hart, FACSM, Brian Werner. University of Virginia, Charlottesville, VA. (No relationships reported)

Patients with anterior cruciate ligament reconstructed (ACLR) knees are at high risk for early development of tibiotalar osteoarthritis (OA). Since there is no cure for osteoarthritis, it is important to understand factors that influence OA development with the goal of identification of patients at risk to prevent the young patient with an old knee. **Methods:** We searched a commercially available healthcare database (Pearlriver) including ICD-9 and CPT codes from a single insurance provider (Humana). We searched for Arthroscopic ACL reconstruction (CPT 29888) between 2007-2015 and identified new diagnoses of OA identified by ICD-9. The desired outcome was a new diagnosis of OA after ACLR with up to 5 years follow-up. We calculated proportions to describe incidence of OA after ACLR and performed logistic regression to describe the odds ratios (OR) for developing OA based on age, sex, BMI, meniscal involvement, osteochondral graft use and tobacco use. We controlled for multiple co-morbidities and other diagnoses that would potentially confound the development of OA after ACLR. Odds ratios were considered statistically significant if the associated P-value was 0.05 or less. **Results:** We identified 10,565 patients with ACLR who did not have an existing diagnosis of OA, 517 of which had a documented new diagnosis of knee OA after ACLR reconstruction. When stratified by follow-up time point, 12.3% of patients with 5 year follow-up data had new diagnoses of OA, 10.4% OA diagnosis of those with 4 year follow up, 8.4% of patients within 5 years follow up, 6.2% of OA after 2 year follow up, 4.1% OA after 1 year and 2.3% after 6 months. Risk factors for new OA diagnoses were: Age > 35 years (OR 2.44, P < 0.0001), Female sex (OR 1.2, P = 0.002), Obesity (BMI 30–40, OR 1.4, P = 0.0004), Morbid Obesity (BMI 40–50, OR 1.5, P = 0.006), Tobacco Use (OR 1.3, P = 0.001), Partial Meniscectomy (OR 1.2, P = 0.0005), Meniscus Repair (OR 1.3, P = 0.0004), Osteochondral Graft: not significant, P=0.05. **Conclusion:** We have reported current data regarding the development of incident OA in the early to mid-phase of recovery from ACLR in patients with no pre-existing OA diagnoses. Odds ratios can inform treating clinicians to best develop risk profiles in patients with the common goal to achieve optimal long term outcomes after ACLR reconstruction.

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**Head coaches of semi-professional sport teams are most often in charge of the final positive return to play (RTP) decision.**

**Purpose:** To assess how different decision-guiding factors, such as health and performance related actuators, as well as evidence based guidelines, support the head-coaches’ process-orientated RTP decision. **Methods:** A survey consisting of questions on the importance of different decision-guiding factors used when making the RTP decision following injuries was administered to head coaches of semi-professional players’ teams. With respect to helpfulness in the RTP decision-making process, the coaches rated both the importance of the opinion of physicians, physiotherapists, strength and condition coaches, the athletes, themselves, and of both general and injury-specific RTP guidelines. **Results:** Our survey revealed that the head coaches refer to physicians and physiotherapists to a large extent, to the athletes and to themselves to a medium extent, and to strength and conditioning coaches and RTP guidelines to a small but still relevant extent. The coaches’ effort to seek a shared decision-making process in RTP is hence, partially evident. **Conclusion:** A multitude of actuators intervenes when making the RTP decision. The call for a professionalization of the RTP process in semi-professional sports includes the athlete itself, the head coach, the (external) physician, the (external) physiotherapists and the strength and conditioning coach based on general RTP decision-making models and specific criteria related to injury type, sport type, level and playing position. The development of awareness and implementation strategies of RTP models should be subject to further research.

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**Number of Previous Knee or Ankle Injuries Is Associated With Poor Physical but not Mental Health.**

Casey Bruce1, Rachel Evans2, Janet Simon3, Tricia Hubbard-Turner, FACSM5, Michael Turner, FACSM5, Phillip A. Gribble2, Abbé C. Thomas3. 1UNC Charlotte, Charlotte, NC. 2University of Kentucky, Lexington, KY. 3Ohio University, Athens, OH. (No relationships reported)

The knee and ankle are among the most commonly injured joints in the body. Long-term strength and neuromuscular control deficits are common following these injuries, yielding life-long disability and poor quality of life. However, it is unknown if quality of life worsens as the number of ankle and knee injuries sustained increases. **Purpose:** Determine the association between the number of ankle or knee injuries sustained and physical and mental quality of life. **Methods:** A total of 806 ankle-injured (age:45.2±15.3yrs; body mass index [BMI]:28.6±7.4kg/m²), 658 knee-injured (age:49.3±16.1yrs; BMI:28.4±7.4kg/m²), and 1066 uninjured (age:45.8±16.3yrs; BMI:27.5±7.0kg/m²) adults completed the SF-8 survey to determine the physical (PCS) and mental (MCS) contributions to quality of life. Respondents were categorized by injury history (ankle, knee, none) and number of injuries (0, 1, 2, 3+) to the same joint. Backward elimination linear regression analysis determined the association between quality of life, age, and injury history separately for SF-8 PCS and MCS and ankle versus knee injury. **Results:** For ankle injury, reporting 1, 2, or 3+ injuries and age explained 7.3% of variance in SF-8 PCS (P<0.001). Further, 1 or 2 ankle injuries (P<0.001) and age (P<0.001) explained 5.5% of the variance in SF-8 MCS. Reporting 1, 2, or 3+ knee injuries and age significantly predicted PCS (P<0.001) explaining 7.6% of the variance in PCS. Age, but not knee injury, significantly predicted SF-8 MCS (P<0.001), explaining only 7.2% of the variance in SF-8 scores. **Conclusions:** Only current age influenced mental quality of life. Current age and history of sustaining at least one injury negatively impact physical quality of life following either a knee or ankle injury. However, neither number of injuries nor age explained much of the variance in SF-8 scores. More research is needed to determine what other factors contribute to quality of life so that it can be improved following injury.

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**Reliability of the Head Impact Exposure Estimate in Former Professional Football Athletes.**

Michael D. Clark, Leah Cox, Jason Mihalik, Kevin Guskiewicz, FACSM. University of North Carolina at Chapel Hill, Chapel Hill, NC. (Sponsor: Kevin Guskiewicz, FACSM) Email: michael_clark@med.unc.edu (No relationships reported)

The long-term neurological effects of exposure to repetitive subconcussive impacts, such as occurring in American football, are poorly understood. Recent studies have suggested that greater exposure to subconcussive impacts is associated with worse health outcomes in former high school, collegiate, and professional football players. Helmet accelerometer research has shown the magnitude, location, and frequency of impacts sustained by American football players varies widely and is dependent on many factors, including position, practice structure, playing time, and career duration. Thus, estimating cumulative head impact exposure across a player’s career using these factors may prove useful in studying their long-term effects. Previously, our research center developed the head impact exposure estimate (HIEE), a structured interview covering game and practice contact exposure estimate (HIEE), a structured interview covering game and practice contact exposure. We examined the test-retest reliability of the HIEE in 11 retired professional football athletes (mean age: 64.7 +/- 3.13y). The structure, playing time, and career duration. Thus, estimating cumulative head impact exposure across an athlete’s career using these factors may prove useful in studying their long-term effects. Previously, our research center developed the head impact exposure estimate (HIEE), a structured interview covering game and practice contact exposure estimate (HIEE), a structured interview covering game and practice contact exposure estimates (HIEE). The reliability of the HIEE in 11 retired professional football athletes (mean age: 64.7 +/- 3.13y). The HIEE was administered by two raters over two occasions with a mean period of separation of 4.4 +/- 0.42y. Intra-class correlation coefficients, ICC(2,1), were used to quantify agreement between HIEE assessments. We calculated ICC(2,1) values for
the overall HIEE, as well as the two subcomponents of practice- and game-weighted contact hours. P-values were determined for the test of ICC=0 and 95% confidence intervals were calculated. RESULTS: The mean HIEE at assessment 2 was 3423.76 +/- 1460.02hrs while at assessment 2, the mean was 2627.68 +/- 819.56hrs (t=1.75, P=0.11). The overall ICC(2,1) for the HIEE was 0.124 (P = 0.33; 95% CI: -0.36, 0.62). The ICC(2,1) for weighted practice contact hours was 0.41 (P = 0.36; 95% CI: -0.44, 0.63) and for weighted game contact hours was 0.330 (P = 0.01; 95% CI: -0.11, 0.75). CONCLUSIONS: Overall, the head impact exposure estimate had poor reliability. The subcomponent of game contact hours was more reliable than practice contact hours. The reported number of contact practices per week appears to be the major factor reducing reliability. A more explicit definition of a “contact practice” may improve reliability.

CONCLUSIONS: Limitations of perception and knowledge and skills of injury prevention may compromise the students’ ability to prevent sports injuries. Both online and onsite education may be attributed to heightened perception and basic knowledge and skills, while onsite education had priority to online format in improving fundamental knowledge and skills in injury prevention among college students.

Supported by the Hubei Science Education Project (2014B196 & 2016B155).

C-41 Exercise is Medicine® Poster - EIM - Physical Activity, Training and Lifestyle

THURSDAY, JUNE 1, 2017

Abstracts were prepared by the authors and printed as submitted.
Physical inactivity results in nearly $131 billion of healthcare costs. The American College of Sports Medicine’s “Exercise is Medicine Initiative (EIM)” expects healthcare providers (HCPs) to actively promote regular physical activity (PA) to patients in order to prevent many chronic diseases. EIM is especially important for minorities. Disproportionately, African Americans (AAs) are physically inactive. PA is an understudied, evidence-based approach to prevent obesity, diabetes, and heart disease. These conditions are extremely prevalent among AAs and could be prevented with a program of regular PA. Having policies to encourage PA discussions by HCPs at each clinic visit may actually hold promise because many adults visit their HCPs yearly and patients value PA counseling from their HCPs. The purpose of this study is to determine what policies (or lack of policies) are in place to support HCP discussions in a safety-net clinic in Birmingham, Alabama. Methods: A pre-post design has begun at the clinic in three phases: 1) Policy and Baseline Assessments including reviewing all policy manuals for policies that promote PA discussions and interviewing AA patients instantly following their HCP visit for self-reported occurrence of PA discussion. 2) Policy Development and Implementation of a new policy that promotes PA discussions during the HCP visit, and 3) Policy Evaluation including interviewing patients post policy implementation to assess if PA was discussed and obtain HCPs feedback on the policy change. Results: Preliminary Results 1) No policies to encourage PA discussions by HCPs were found in policy manuals of the clinic; 2) 29 patients (age range 29-71) were interviewed. Only 5 patients stated that PA was discussed during their clinic visit. We have developed a “PA Discussion” policy to guide PA discussions with patients at each clinic visit. Policy will be implemented in January 2017. We are currently adding EIM assessment questions to the electronic medical record to assess physical inactivity status of patients. Answers to these questions will assist HCP with tailored PA discussions. Conclusion: This study will help fill the gap in understanding whether policies to increase PA discussions are needed in this safety net clinic.
these accomplishments, were used IPAQ(long-version), Healthy Eating Index(through 24h food intake recall), body weight, height and electrical bio-impedance, clinical signs and fasting plasma markers of insulin resistance(HOMA-IR), inflammatory(infCRP) and oxidative(MDA and uric acid) states. Statistical comparisons were defined by p<0.05. RESULTS: The top quartile of FS was found as ≥10% for females(F) and ≥15% for males(M) and, they differed from the lower quartile (≤3% and ≤5%, respectively), by presenting an 1.81x higher either HOMA-IR, 1.61x hsCRP and 1.6x MDA values in females than in males. MDA was very significantly increased in FS ≥ p25(28.1% and 26.9%) with p75 being fatter(bigger BMI, total body and abdominal fatness) with lower physical activity, lower aerobic capacity, lower either muscle mass and hand grip force. The p75 FS subjects presented also lower schooling and lower income. Their poor diet quality(HEI) was characterized by being more processed foods(higher CHO/fibers and sodium/potassium ratio), higher daily consumption of oils(and PUFAs) and cholesterol and, less amounts of MUFA, fruits and vegetables (and fibers).

CONCLUSIONS: The higher FS(moderate CHD risk) of this community followed markers of the MetS aggravation, having inadequate- dietary quality and physical unfitness as environmental factors.

Is Grip Strength Related to Metabolic Risk Factors and Cardiorespiratory Fitness? Zhengzhen Wang, FACSIM, Yan Wang1, Yu Wang1, Xiaolan Zhao, Qun Zhang, Juan Wang1, BEIJING SPORT UNIVERSITY, BEIJING CITY, China. 1The 180th Hospital of PLA, QUANZHOU CITY, China. 2Southwest Hospital, Third Military Medical University, CHONGQING CITY, China. 3Jiangsu Province Hospital, NANJING CITY, China. Email: zhengzhenwang1005@hotmail.com

PURPOSE: Grip strength is very easy to be measured, and is an index to reflect unfitness as environmental factors. METHODS: The 1925 people were recruited (men: 1425, female: 490; average age 41.33±9.35 yrs) and finished grip test and 835 of them finished VO2max test. Metabolic risk factors (Total cholesterol (TC), triglyceride (TG), LDC-C, HDL-C, fasting blood glucose) were detected. Grip strength (n=1925) was tested in dominant hand, relative grip strength was calculated (relative grip strength = grip strength(kg)/body weight(kg) <100), and VO2max (n=835) was measured by YMCA cycle test. The relationship among grip strength, metabolic risk factors and VO2max were analyzed after dividing people into several groups by gender and each age of 10 years (20-29yrs, 30-39yrs, 40-49yrs, 50-59yrs).

RESULTS: 1) Men’s grip strength and relative grip strength are larger than women’s (grip strength: men: 38.18±7.38kg, women: 22.43±6.88 kg; relative grip strength: men: 54.35±11.55 yrs, women: 39.76±8.64 yrs), and are negatively related to age (P<0.01). 2) Men’s VO2max is larger than women’s (P<0.01). 2) Relative grip strength of all men is related to TG (P<0.05), and related to fast blood glucose in men with 30-39yrs and 40-49yrs (r=-0.129, P<0.01; r=-0.118, P<0.01), while grip strength of men is only related to TG in 40-49yrs (r=-0.129, P<0.05). No relationships in women. 3) In men, VO2max is related to TC and LDC-C (r=0.287, P<0.01), but in 20-29yrs, and related to TC and HDL-C (r=0.296, P<0.01), in women, VO2max is related to fast blood glucose in 30-39yrs (r=-0.435, P<0.05) and related to TG in 40-49yrs (r=-0.468, P<0.05). 4) There is relationship between men’s relative grip strength and VO2max except 40-49yrs group (P<0.05); no relationship is found in women.

CONCLUSIONS: 1) Grip strength decreased with age, and men’s is larger than women’s. 2) Relative grip strength may be a predictor of metabolic risk and cardiorespiratory fitness (VO2max) for men. 3) VO2max may be a predicted factor of metabolic risk for adults. Supported by Chinese Health Promotion Foundation (CCHIP2014-FITEX)

Sedentary Time Adversely Influences the Mental Health of Adolescent Males Residing in a Treatment Facility Cherie D. Pettitt, Nicole Wigern, Carlos J. Panahol, Robert W. Pettitt. Minnesota State University Mankato, Mankato, MN. (Supported by Robert W. Pettitt, FACSIM)

Email: cheric.pettitt@mnstate.edu

PURPOSE: Emerging research indicates a negative relationship between sedentary behaviors or sitting time and mental health in youth; however, most research designs were cross-sectional, reported small associations, and may or may not have accounted for confounders. The purpose of this study was to explore the associations of physical activity (PA) opportunities altered PA and sedentary time along with mental health outcomes in adolescent males residing in a treatment facility for sexual health behavior problems. METHODS: The sample consisted of nine adolescent males (15 ± 1 years; BMI of 25.5 ± 7.2 kg/m²). Accelerometers were used to measure PA levels and sedentary time. The Beck Youth Inventory was used to measure mental health.

RESULTS: There was a significantly positive correlation between the change in sedentary time and the BDSS-D (Disruptive Behavior). Therapeutic recreation free time allotted in the warmer months (16.4 ± 6.2 hr wk⁻¹) was higher than the cooler months (8.2 ± 2.8 hr wk⁻¹)(r= .572, P<0.01); however most participants chose to be sedentary. There was a significant inverse correlation (r= .701, P<0.01) between the change in recreational therapy time and sedentary time. Conclusions: In comparison to norms using the same cut-points, the present study’s participants fall within the 10th percentile of total counts per day (TAC—d’) when matched for sex and average age. Moreover, participants were in the 5th percentile when matched for sex and average age for light physical activity. CONCLUSION: The present study supports the importance of structured PA programs and a need to reduce sedentary time and increase light PA for adolescent males living in a treatment facility for sexual health behaviors.

Keywords: adolescent, physical activity, psychology, special needs populations, health behavior

Effect of High Intensity Intermittent Games-Based Activity on Adolescent Cardio-Metabolic Health Karah J. Dring, Simon B. Cooper, Maria L. Nute, John G. Morris, Caroline Sunderland, Gemma Foulods, Graham Pockley, Mary E. Nevill. Nottingham Trent University, Nottingham, United Kingdom. Email: karah.dring@nttu.ac.uk

In adults emerging evidence suggests that games-based activity acutely stimulates anti-inflammatory and inhibits pro-inflammatory cytokine production, to induce cardio-metabolic health benefits. The acute effects of high-intensity intermittent games on adolescent cardio-metabolic health remain unexplored. PURPOSE: To examine the effects of an acute bout of games-based activity on adolescent cardio-metabolic health. METHODS: Following ethical approval 18 adolescents (12.5±0.6 y) completed an exercise (E) and resting (R) trial in a counter-balanced, randomised crossover design. Following a standardised breakfast (1.5 kg/ b carbohydrate), participants completed 1 h games-based activity (basketball). Capillary blood samples were taken at baseline, immediately and 1 h post-exercise. A standardised lunch was consumed (1.5 kg/ b carbohydrate) and capillary blood samples were taken 30, 60 and 120 min post-lunch. A final blood sample was taken the following morning. Capillary blood samples were analysed for blood glucose, plasma insulin and cytokine (IL-6, IL-10, IL-1ra, IL-1β, IL-8 and TNF-α) concentrations. Data were analysed using repeated measures ANOVA and paired sample t-tests in SPSS. RESULTS: The blood glucose response to lunch was attenuated following exercise (trial*time interaction, p=0.008), with a tendency for a lower peak blood glucose concentration on the exercise trial (E: 5.6±0.7 mmol L⁻¹, R: 6.3±1.4 mmol L⁻¹, p=0.070). Similarly, the plasma insulin response was attenuated with exercise (trial*time interaction, p=0.002), with a lower peak plasma insulin concentration on the exercise trial (E: 217±23±2 pmol L⁻¹, R: 366±1±53 pmol L⁻¹, p<0.001). IL-6 concentration was higher (E: 4.2±1±0.8 pmol L⁻¹, R: 3.4±0.6±0.9 pmol L⁻¹, p=0.005) and there was a tendency for TNF-α to be attenuated (E: 1.2±4±0.2 pg mL⁻¹, R: 1.3±0.4±0.23 pg mL⁻¹, p=0.081) on the exercise trial. Exercise had no effect on the remaining cytokines. CONCLUSION: High-intensity intermittent games-based activity attenuated postprandial blood glucose and plasma insulin concentrations, whilst demonstrating an increase in IL-6 concentration, potentially mediating the reduced TNF-α concentrations. Thus high-intensity games-based physical activity elicits cardio-metabolic health benefits in adolescents.

Associations of Aerobic and Strength Exercise with Clinical Laboratory Test Values Maren S. Fragala, Caizia B. Michel, Jack C. Chaumpee, Harvey W. Kaufman, Martin H. Kroll. Quest Diagnostics, Madison, NJ. Email: maren.s.fragala@questdiagnostics.com

Reported Relationships: M.S. Fragala: Salary; Employee of Quest Diagnostics.

PURPOSE: Physical exercise is known to affect levels of blood-based biomarkers. However, exercise status is generally not considered in the interpretation of common laboratory results. This study examines the associations of habitual aerobic and strength exercise participation with laboratory test results.

METHODS: The effects of self-reported days per week of aerobic and strength exercise participation on laboratory test results for 26 biomarkers in adults aged 18 to 34 years (n = 80,111) were evaluated using percentile distribution analyses and multivariate regression. RESULTS: Days per week of self-reported exercise participation was associated with significant shifts in results for most biomarkers evaluated. In both men and women, more days per week of either aerobic or strength exercise were significantly associated with lower levels of glucose, hemoglobin A1c, LDL cholesterol, total cholesterol, triglycerides, estimated glomerular filtration rate, and...
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1529 Board #204 June 1 9:00 AM - 10:30 AM
The Effect Of Acute Muscular Exercise and Training Status On Hepatorenal Functions
Ibrahim MUSA, kogi state university, anyigba, Nigeria.

**Introduction:** Decreased blood flow to vital organs such as liver and kidney during muscular exercise could alter the hepatorenal function. **Purpose:** To investigate the effect of an acute bout of exercise on the hepatorenal function of the athletic and non-athletic adult males and to observe if they respond differently to the same exercise intensity. **Methods:** 20 male footballers and 19 non-athletes were recruited for this observational study following the inclusion and exclusion criteria. Blood samples were taken pre- and post- 90 minute football matches, from all subjects. The serum ALT activity (5.07±0.2 vs 4.26±0.1) and AST activity (26.85±2.1 vs 18.85±1.5) post-exercise in the athletic group. **Significant:** (P<0.05) decrease in the baseline serum ALT activity (38.78±3.1 vs 31.84±2.0) post-exercise was observed in the non-athletic group. The post-exercise, serum albumin (49.85±1.0 vs 40.89±1.8), total protein (82.70±1.1 vs 73.26±3.7), urea (3.77±0.2 vs 2.86±0.4) and creatinine (81.90±3.0 vs 55.63±4.8), were significantly higher (p< 0.05) in the athletic group compared to the non-athletic. While the ALT activity (5.07±0.2 vs 4.26±0.1) and AST activity (26.85±2.1 vs 18.85±1.5) post-exercise was observed in the non-athletic group. The median symptom score (SS) at injury was 37 (interquartile range

**CONCLUSIONS:**

Acute muscular exercise of same intensity altered hepatorenal function in the athletic group. However, the post-acute muscular exercise serum ALP, TBIL, CBIL, and ALT activity (22.40±1.2 vs 31.84±2.0) and sodium (137.15±3.0 vs 141.78±0.7) significantly (P<0.05) increase with a significant decrease (P<0.05) in potassium (73.26±3.7), urea (3.77±0.2 vs 2.86±0.4) and creatinine (81.90±3.0 vs 55.63±4.8), were significantly higher (p< 0.05) in the athletie group compared to the non-athletic. While the ALT activity (5.07±0.2 vs 4.26±0.1) and AST activity (26.85±2.1 vs 18.85±1.5) post-exercise in the athletic group.

**REFERENCES:**

1531 Board #206 June 1 9:00 AM - 10:30 AM
Mechanisms for Balance Improvement in Tai Chi Intervention Trials: A Systematic Review
Holly Lewis, Yin Wu, Linda S. Pescatello, FACSM. University of Connecticut, Mansfield, CT. (Sponsor: Linda S. Pescatello, FACSM)

**Email:** holly.lewis@uconn.edu

**No relationships reported**

The literature on the mechanisms by which Tai Chi interventions improve balance is limited and divergent. **PURPOSE:** To systematically review the literature on Tai Chi trials aimed at improving balance to gain insight into the mechanisms that mediate the reported balance improvements. **METHODS:** Database searches identified 26 randomized control Tai Chi trials with the purpose of improving balance that proposed and/or measured mechanism(s) among older adults (≥60 yr). **RESULTS:** Qualifying Tai Chi trials (n=26) proposed and/or measured 10 different mechanisms and used 19 different balance assessments. Nearly three quarters (71.3%) of the trials reported significant improvements in balance. Sensory function was the most commonly reported mechanism to improve balance (n=14, 53.8%). However, the majority (n=11, 78.6%) of these did not measure sensory function. The three trials (21.4%) that measured sensory function (i.e., proprioception) with peripheral mecanoreceptor acuity assessments chose balance measurements not designed to challenge sensory function. Furthermore, none of these three trials observed significant improvements in balance and sensory function simultaneously. Neuronal function was the second most commonly reported mechanism to improve balance (n=11, 42.3%). The majority (n=10, 90.9%) of these did not measure neuromuscular function. The one trial that measured neuromuscular function (i.e., muscle reaction time) with electromyography, selected balance measurements designed to challenge neuromuscular function (i.e., the Timed Up and Go Test). This trial also found significant improvements in both balance and neuromuscular function. **CONCLUSION:** The mechanisms by which Tai Chi interventions improve balance remain elusive because: 1) most trials (61.5%) do not measure the mechanism proposed to be the mechanism for balance improvement; and 2) when the proposed mechanism was measured, trials rarely chose balance assessments that matched the proposed mechanism. Future Tai Chi trials aimed at improving balance are needed that align the proposed mechanism with the appropriate balance measurement so that the mechanisms by which Tai Chi improves balance can be identified.

1532 Board #207 June 1 9:00 AM - 10:30 AM
Short-term Effectiveness Of Home Based Exercise To Change Lifestyle In Not Communicable Disease
Gabrielle Mascherini1, Chiara Giannelli2, Giulia Ghelarducci2, Anastasia Fischer, FACSM2, 1Ohio University Heritage College of Osteopathic Medicine, Dublin, OH. 2Nationwide Children’s Hospital, Columbus, OH.

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**No relationships reported**

**PURPOSE:** Supervised exercise has shown remarkable effectiveness, but is associated to poor compliance at long term. In this study, we aimed to verify whether a home-based exercise program is effective in physical fitness related to health parameters management of a cohort of breast cancer survivors. **METHODS:** Experimental cohort observational study. We enrolled 13 women (age 49±1.5±5, height 163±7, 3 cm) survivors to a breast cancer. At baseline were assessed the lifestyle in term of physical activity with accelerometer (Sensewear Bodymedia) and physical fitness related to health in term of aerobic capacity by 6 Minutes Walk Test, flexibility (Sit & Reach), grip and lower limbs strength (Hand Grip and 30" Chair Test) and body composition (anthropometrics parameters, skinfold thickness and bio impedance). Home based exercise was prescribe for 40 days with two target: - Fast walking activity in terms of weekly session, minutes per session and intensity with heart rate, rate of perceived exertion (CR10) and steps per minute; - Individually daily steps target Parameters of physical fitness related to health before and after 40 days of unsupervised exercise were compared (t-test for paired data). **RESULTS:** At baseline (T0), patients displayed a moderate level of physical activity (PAL=1.5±0.1, daily steps=8569.3±2107.1) and were overweight (BMI=26.5±3.6 kg/m²). After 40 days of initial clinic visit (p=0.4146), or days from injury to initial clinic visit between the two groups (p=0.3725). The median of symptom resolution for youth in the exercise prescription group was 16 days while statistically significantly longer than youth in the comparison group (median=12 days, p=0.0192) after adjusting for other covariates. However, no statistically significantly difference was found in days from first clinic visit to symptom resolution between the two groups (p = 0.1188). **CONCLUSIONS:** Prescription of exercise during recovery from concussion did not shorten the duration of symptoms from time of injury, however it did not lengthen the time to recover from concussion when measured from the first physician visit. Further research with prospective design is warranted to evaluate the effect of non-contact exercise prescription on concussion recovery among youth.

ACSM May 30 – June 3, 2017
Denver, Colorado
unsupervised exercise (T1), we observed improvement of all analyzed parameters with statistical significance in waist circumference (T0=92.8±5.6 cm, T1=89.5±7.9 cm; p<0.01), distance walked in 6 MWT (T0=445.4±168.1 m, T1=534.6±151.5 m; p<0.05), 30 ‘’ Chair test (T0=14.8±5.6 sec, T1=16.3±4.9 sec; p<0.05). CONCLUSION: Home-based unsupervised exercise in breast cancer survivors yielded short-term efficacy in all analyzed parameters. To change the lifestyle in terms of physical activity it is necessary to create a model that allows long-term therapeutic efficacy. Unsupervised approach, in comparison with supervised one, allow a reduction of the cost related to the treatment of not communicable disease with exercise therapy. Efficacy at long-term and a possible effect in reducing the risk of tumor relapse remain to be elucidated in larger cohorts with longer and multidisciplinary follow up.

1533  Board #208  June 1 9:00 AM - 10:30 AM Implementation of a Veteran Group-Based Aquatic Program Using an Individualized Varied Intensity Protocol
Phillip G. Reynolds1, Erek D. Biddle1, Patrick T. Conway1, Douglas J. Costello1, Teresa L. Koppi1, Miriam C. Morey1, FACSM2, 1Canandaigua VA Medical Center, Canandaigua, NY. 2Durham VA Medical Center, Durham, NC.
(No relationships reported)

Aerobic exercise has been proven to be an effective modality for improving health, physical fitness, daily living, and quality of life. The aquatic environment is particularly beneficial for individuals finding weight bearing difficult due to joint pathology, increased fall risk, or other conditions restricting or limiting weight bearing exercise. PURPOSE: To evaluate a group based aquatic exercise program used by Veterans at Canandaigua's VA Medical Center. METHODS: 7 Male Veterans (age = 68.71±10.75) medically cleared and referred for supervised exercise by their primary care provider and who volunteered or were recommended by Exercise Physiology staff participated in the aquatic exercise program. All participants were taught how to progress, regress, or modify exercises based on their individual need. This individualized strategy, coupled with a cardio-respiratory stage training protocol, facilitated a safe and effective exercise program in a group setting. Baseline and annual testing to measure physical abilities and improvements were done via the 10-meter walk, 30-second chair stand, and the 8-foot up and go. Health based testing consisted of Pre/Post weight, abdominal circumference, and blood pressure. Additionally, health surveys regarding falls and participant satisfaction were administered during each Pre/Post test. RESULTS: Participants had a mean weight reduction of 22.93 lbs (p=0.01549), 1.79 inch decrease in abdominal circumference (p=0.02823), 15% reduction in systolic blood pressure (p=0.00411), 12% reduction in diastolic blood pressure (p=0.008556), 2.047 sec. improvement on gait speed via 10 meter walk (p=0.000239), 6.72 sec improvement for 30 sec chair stand (p=0.01899), 1.698 sec improvement on 8-foot up and go (p=0.000396), 28.6% improvement in reported falls and a program satisfaction rating of 96%.

CONCLUSION: Significant improvements in both health and fitness-based testing results were observed. These outcomes are known to prevent, reduce, or treat a vast array of chronic diseases and disabilities, improve functional capacity, and reduce all-cause mortality rates.

Our results support previous research and demonstrate the effectiveness of an individualized and progressive group-based aquatic exercise program for the Veteran population.

C-42  Exercise is Medicine®/Poster - EIM - Psychological Aspects, Bone, Muscle and Cartilage
Thursday, June 1, 2017, 7:30 AM - 12:30 PM  Room: Hall F

1534  Board #209  June 1 9:00 AM - 10:30 AM Strength Training In Patients With Schizophrenia: Effects On Muscle Force Generating Capacity
Mona Nygård1, Mathias F. Brobakken1, Ismael Cîneşti Gâzãy1, Gunnar Morken1, Einar Vedul-Kjelsås1, Eivind Wang1, Jørn Heggelund1. 1The Norwegian University of Science and Technology, Trondheim, Norway. 2St. Olav's University Hospital, Trondheim, Norway.
(No relationships reported)

Patients with schizophrenia are inactive, have impaired physical function and slowed performance in motor tasks. As a countermeasure, maximal strength training (MST) with high load and few repetitions improves muscle force generating capacity and physical function during daily activities. PURPOSE: Investigate the effect and feasibility of MST as a part of standard clinical treatment of patients with schizophrenia. METHODS: 11 male and 6 female outpatients (37±10(SD) yrs, ICD-10 schizophrenia, schizotypal or delusional disorders (F20-F29)) were randomized to either a training group (TG), performing leg press MST (4 repetitions, 4 sets, at ~90% of one repetition maximum (1RM)) twice a week for 12 weeks at the hospital exercise training clinic, or a control group (CG) following traditional guidelines for physical activity. RESULTS: 5±0 patients in the TG completed ~85% of the training and were included in the statistical analysis. After MST, 1RM and muscle rapid force development (work/time with a load ~70% of 1RM) increased 43% (233±35 to 333±50 kg, p<0.05) and 36% (408±108 to 555±137 Nm s−1, p<0.05), respectively. These improvements in muscle force generating capacity were ~twofold larger (p<0.05) compared to the CG which had improvements of 23% in 1RM (188±66 kg to 232±89 kg, p<0.05) and 16% in rapid force development (391±223 to 454±227 Nm s−1, p<0.05). CONCLUSIONS: MST yielded larger improvements in functionally relevant muscle force generating capacity compared with conventional treatment, and suggest that MST should be implemented as a part of standard clinical practice for optimal exercise rehabilitation benefits.

Supported by grants from the Norwegian ExtraFoundation for Health and Rehabilitation, The Liaison Committee between the Central Norway Regional Health Authority and the Norwegian University of Science and Technology, and The Norwegian Directorate of Health.

1535  Board #210  June 1 9:00 AM - 10:30 AM Exercise As An Augmentation To Antidepressant Treatment For Depression: Results From A 12-week Pilot Intervention Study
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(No relationships reported)

PURPOSE: To examine the efficacy of aerobic exercise to augment anti-depressant effects of a 12-week Venlafaxine trial to treat Major Depression in older (60-79 yrs.) and younger (20-39 yrs.) adults. METHODS: Participants included adults with Major Depression. All participants were sedentary (~20 minutes exercise 3 times per week), had no contraindications for aerobic exercise, were cognitively unimpaired, and were eligible to undergo an MRI. Participants were randomized to a 12-week trial of Venlafaxine only or Venlafaxine + Aerobic Exercise. All participants met with a clinician biweekly for medication management. The exercise group additionally received 1 hour of supervised aerobic exercise 3 times per week for 12-weeks. All participants completed cardiorespiratory fitness testing (V̇O₂ max) and the Montgomery-Asberg Depression Rating Scale (MADRS) at baseline and follow-up.

RESULTS: Twelve participants were randomized, but two dropped out (one from each exercise group). The resulting sample included 10 adults (mean age = 38.7, 40% male, 90% Caucasian). At baseline, participants had a mean MADRS score of 26.10 (5.04) and a mean estimated V̇O₂ max of 29.6±6.01 L/min. Across both groups, there was a decrease in depressive symptoms over 12-weeks (t = 6.60, ps < 0.001). The Venlafaxine only group (N=5) showed a mean decrease of 16 points on the MADRS and the exercise group (N=5) showed a mean decrease of 19.8 points. The exercise group showed a mean increase of 4.74% (SD=12.11%) in fitness, while the Venlafaxine only group showed a mean decrease of 8.71% (SD = 17.05%) (p=0.20). There was a negative association between change in fitness level and change in depressive symptoms (r = -0.71, p = 0.03). The trajectories of change in depressive symptoms across the treatment groups did not differ (MADRS X Treatment F= 0.112 p = 0.75). The exercise and no-exercise group showed the same trajectory of changes in depressive symptoms over the first 4 weeks, but the exercise group showed more consistent decline than the Venlafaxine only group for the last 2 months.

CONCLUSIONS: Participants showed improvement in depression symptoms across both treatment groups. Change in fitness was negatively associated with change in depressive symptoms, suggesting a dose-response effect of exercise on depressive symptoms.

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Rehabilitation, The Norwegian Directorate of Health, The Liaison Committee between Supported by grants from the Norwegian ExtraFoundation for Health and

RESULTS
from accelerometers, BMI, waist circumference, blood pressure, as well as lipid or delusional disorders; F20-F-29). Measurements included included state of the art years) and 8 women (37±10 years), diagnosed with schizophrenia (ICD-10, schizotypal cardiovascular disease and premature death.

METHODS: We investigated the physical health in 22 patients, 14 men (37±9 (SD) years) and 8 women (37±10 years), diagnosed with schizophrenia (ICD-10, schizotypal cardiovascular disease and premature death.

RESULTS: VO_{2peak} was 35.3±9.5 ml kg\(^{-1}\) min\(^{-1}\) (men) and 24.9±7.5 ml kg\(^{-1}\) min\(^{-1}\) (women), and this was 19% and 35% lower, compared with reference data for healthy men and women, respectively. BMI (27.4±6.5 and 1.65) and waist circumference (131.8±17.4 cm) revealed that the patients were classified as overweight. Additionally, BMI (r = 0.863; p < 0.001) and waist circumference (r = 0.868; p < 0.001) correlated negatively with VO_{2peak}. Steps per day (6124±3845), counts per minute (477.0±203.4), LDL/HDL-ratio (2.67±1.41) and systolic/diastolic blood pressure (127.5±10.7/82.7±10.9 mmHg) were not associated with VO_{2peak}. CONCLUSION: Taken together, our data show that patients with schizophrenia are high at risk for developing cardiovascular disease, and are strengthened by utilization of direct assessment of VO_{2peak} in the risk profile determination. Supported by grants from the Norwegian ExtraFoundation for Health and Rehabilitation, The Norwegian Directorate of Health, The Liaison Committee between the Central Norway Regional Health Authority and the Norwegian University of Science and Technology.
for recurrent themes relating to PA and diet using a deductive thematic analysis, employing Self-Determination Theory (SDT) as a theoretical framework. Themes were identified based on the explicit meanings of the data, until the point of saturation.

**Results:** Three major themes, each with two respective sub-themes, were identified as influencing participants’ engagement with PA and dietary choices. These were: 1) situational (sub-themes: school culture and family/home culture); 2) motivation (sub-themes: self-efficacy and social connectedness); and 3) wider environmental influences (sub-themes: weather and availability and price). Overall, the school and home environments were found to have the strongest influence on participants’ lifestyle behaviours, but in very distinct and often conflicting ways. School structure, high self-efficacy, and social connectedness facilitated increased physical activity and healthier diet in adolescents with intellectual disabilities, whereas home life, low self-efficacy and a lack of social connectedness can serve as a barrier to PA and a healthy diet.

**Conclusions:** Adolescents’ environment and social interactions play a pivotal role in influencing physical activity and dietary patterns. These findings suggest that influences on the young people in this population’s PA and dietary patterns are multifaceted and complex in nature. The study was funded by the Dailies charitable fund.

1540 Board #215  June 1 9:00 AM - 10:30 AM

**Does Adipose Tissue Mass Positively Or Negatively Influence BMD In An Overweight Or Obese Population? A Systematic Review And Meta-Analysis**

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(No relationships reported)

**PURPOSE:** To quantify the relationship between adipose mass (absolute and relative) and bone mineral density (BMD) in overweight and obese populations.

**METHODS:** The protocol for this review was designed in accordance with PRISMA guidelines. An electronic search of the literature was undertaken using three databases (Medline, Embase and Science Direct) and supplemented through screening the reference lists of retrieved and review articles. Outcome measures included a measure of adipose mass (kg or %BM) and BMD (g/cm²) of the total body, lumbar spine, total femur or femoral neck from overweight and obese individuals. A multi-level metaregression model was used to obtain pooled estimates of the magnitude of effect of the relationship of BMD and adiposity, expressed as an absolute or relative quantity, were reported. Absolute adiposity was positively correlated and relative adiposity was negatively correlated with BMD. Sex and age were the primary moderators of these relationships, as a significant negative correlation between relative adipose mass and BMD was shown in men (R=-0.37, 95%CI: -0.57, -0.12) and in those aged <25 years (R=-0.28; 95%CI: -0.45, -0.08).

**CONCLUSIONS:** Increasing levels of adipose mass exert a negative influence on BMD, but only when considered relative to total body mass. These results highlight the importance of optimising body composition over weight loss.

1541 Board #216  June 1 9:00 AM - 10:30 AM

**Influence of Yi-Jin-Jing Training on Sex Hormones and Bone Density among Chinese Older Women**

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(No relationships reported)

**PURPOSE:** Yi-Jin-Jing, one common mind-body Chinese tradition exercises, is not or very little studied for being potentially utilized to treatment of bone-related disorders. The primary purpose of this randomized clinical study was to assess the effectiveness of Yi-Jin-Jing training on changes of the sex hormones and bone mineral density in Chinese older women.

**METHODS:** Twenty-four older women between 60-69 years old were recruited from the urban tertiary of Shanghai, China. After signing the informed consent, subjects were randomly assigned into two groups: non-exercise control group (n=12) and Yi-Jin-Jing training group (n=12). All exercise groups were trained five days per week, sixty minutes of duration for three months with Yi-Jin-Jing exercise, while control group maintained the regular daily life with no exercise. Height, body weight, BMI, bone mineral density (BMD), and female sex hormones (E2, T, FSH, and LH) were measured and analyzed. SPSS for Windows 18.0 was used for the statistical analyses and a significant level was set at P<0.05.

**RESULTS:** No statistically significant differences in age, height, body weight, and BMI were observed between Control and Yi-Jin-Jing groups. After three-month intervention, subjects in Control experienced decreases in BMD of all measured parts and total BMD with a statistically significant decrease in pelvis BMD; while women in Yi-Jin-Jing increased BMD in all measured parts with significant increases in trunk and total body BMD. Compared with Control, Yi-Jin-Jing-trained individuals had high BMD changes of the mean difference in trunk, pelvis, and total body. There were no significant changes of E2, T, FSH, and LH in Control; however, Yi-Jin-Jing-trained subjects had significant E2 increases and significant FSH decreases. There was a significant positive correlation between E2 and BMD (r=0.529, P=0.008) and between T and BMD (r=0.429, P=0.036). FSH showed a significant negative association with BMD (r=-0.576, P=0.003).

**CONCLUSIONS:** Our study indicated that Yi-Jin-Jing training may delay older women’s BMD decline, especially in trunk and pelvis. It may influence positively on the increased E2 and T levels and the decreased FSH level. Further research is needed to confirm if Yi-Jin-Jing provides protective benefits to bone health for older adults.
Effects of Well-Rounded Exercise Training on Cartilage Metabolism in Females without Radiologically Knee Osteoarthritis

Tadashi Yasuda¹, Masayuki Azukizawa², Hiromu Ito³, Yosuke Hamamoto⁴, Toshiaki Nakatani⁵, Tadao Tsuboyama⁶, Makoto Matsuda⁷, Shuichi Matsuda⁸. Kobe City Medical Center General Hospital, Kobe, Japan. ⁹Kobe University Graduate School of Medicine, Kyoto, Japan. ¹Tenri University, Tenri, Japan. ²Yoshida Hospital, Nara, Japan. Email: tadasu@kcho.jp

PURPOSE: The population with osteoarthritis (OA) is increasing due to the aging society. Maintenance of healthy cartilage is essential for prevention of OA. Physical exercise is highly recommended for OA patients because of clear evidence that it reduces pain and enhances physical function of joints with OA. For older adults, exercise prescription ideally includes aerobic, muscle strengthening, and flexibility exercises. However, effects of the exercise intervention on osteoarthritis cartilage remain unclear. This study was aimed to evaluate the effects of well-rounded exercise training on cartilage metabolism using systemic biomarkers in females without radiologically knee OA.

METHODS: A combination of aerobic, resistance (mainly for quadriceps and hamstrings), flexibility, and balance exercise trainings was assigned to 23 female subjects [mean age 57.9 (49 to 68), mean BMI 21.8 (18.6 to 24.7)] without radiologically knee OA (Kellgren-Lawrence grade≤1) for 90 minutes once a week during the subsequent 12 weeks. Blood and urine samples were collected at 0, 1, 2, 4, 8, 12, 16, 20, and 24 weeks from the initiation of intervention. Whereas type II collagen (CTX-II) was measured using enzyme-linked immunosorbent assay (ELISA), collagenase-generated neoepitope of type II collagen (C2C) and carboxy-telopeptide of type II collagen (CIB-II) were measured using ELISA. RESULTS: One week after the initiation of the training, type II collagen degradation evaluated by C2C reduced immediately after the exercise intervention, and reached the significantly low levels at 12, 20, and 24 weeks. Type II collagen synthesis evaluated by C2C reduced immediately after the exercise intervention, and reached the levels by the final follow-up. Compared with the baseline, a significant decrease in type II collagen degradation in females without radiologically knee OA. At 16 weeks the Active cohort’s values did not change, but the Training cohort increased type II collagen degradation (+12%; P < 0.02), workload_max (+16 W; P < 0.01), and VO₂max (2.6 mL O₂∙kg⁻¹∙min⁻¹; P < 0.01). At 16 weeks the cohorts differed for fitness, but did not differ for fat energy during warmup (P = 0.25). Change in fat oxidation was not correlated with change in aerobic fitness. CONCLUSION: Exercise intervention improved fat oxidation and aerobic fitness in sedentary postmenopausal women. Increased fat oxidation approaches the level of long-term postmenopausal exercisers, but fitness gains are not as marked and are not explained by increased fat oxidation.
Postmenopausal women tend to have higher risk of developing metabolic syndrome due to lose control of energy balance. Isoflavone (ISO) supplementation and exercise have shown some beneficial effects on regulating metabolic parameters. PURPOSE: To investigate the effects of ISO intake, exercise training and the combination on parameters related with energy homeostasis in an ovariectomized (OVX) rat model. METHODS: Female Wistar rats were assigned to six groups: (1) Sham; (2) Sham with exercise training (Sham+T); (3) OVX; (4) OVX+T; (5) OVX+ISO; (6) OVX+ISO+T. Rats in the exercise groups were trained 10 min/time, twice/day, a rest day every four days on a treadmill with an incline of 25° for 61 days and a gradually increasing velocity from 12 to 20 mm/min. Adipocyte size was determined by HE staining. Leptin levels in serum were measured by Elisa. Gene and protein expression in adipose tissue was investigated by RT-PCR and Western blot. RESULTS: Visceral fat mass, adipocyte size and serum leptin level were about 20%, 38% and 87% increased by OVX compared with Sham (p<0.05). Training significantly decreased all three parameters both in Sham (28%, 30% and 40%) and in OVX (31%, 26% and 35%) groups (p<0.05). ISO supplementation showed only significant reduction effect on leptin level (35%, p<0.05). OVX significantly reduced PPARα gene expressions in adipose tissue, whereas the effects were antagonized by training. Training also increased SREBP-1c expression. In contrast ISO significantly reduced SREBP-1c expression in OVX rats. No similar effect was observed with PPARα and FAS gene expressions. The effect shown in OVX+ISO+T group was similar as in OVX+T group of all these parameters, except for FAS gene expression. ISO antagonized FAS gene expression when in combination with training. In addition, the result of FAS gene expression was proved by its protein expression. CONCLUSION: Estrogen deficiency resulted in metabolic syndrome related risk such as increasing visceral fat mass, adipocyte size, leptin. The designed exercise antagonized all these effects. Furthermore, the exercise enhanced gene expressions which are responsible for fatty acid oxidation (PPARα) and lipogenesis (SREBP-1c and FAS). ISO diet showed effects only on reducing leptin level and SREBP-1c gene expression. Supported by fatty acid oxidation (PPARδ) and lipogenesis (SREBP-1c and FAS). ISO diet showed viseral fat mass, adipocyte size, leptin. The designed exercise antagonized all these signaling component in the development of obesity-related insulin resistance, but the precise mechanisms linking exercise-induced improvement of the insulin resistance and the mitochondria oxidative metabolism in high-fat diet(HFD) rats remain unclear. Our aim is to investigate the role of the rapamycin (inhibitor of mTOR) on exercise-induced improvement of hepatic gene involved in energy metabolism in HFD rats. Method 24 male SPF rats were fed with HFD for 6 weeks. After one week exercise adaptation, the rats were randomized to 4 groups(n=6):HFD+sedentary group(H group),HFD+exercise group(HE group),HFD+rapamycin (HR group), HFD+exercise+rapamycin(HER group). The rats in HE group and HER group were performed the exercise training for 4 weeks from the 8th week on and those in HR group and HER group received the intraperitoneal injection of rapamycin with the dose of 2 mg/kg/day for 2 weeks from the 10th week on. At the 11th week, the rats were sacrificed after 12-16 hour fast. The liver was harvested for analysis of activity of mitochondria oxidative enzyme and gene expression involved in energy metabolism, oil-red staining was used to determine the hepatic triglyceride(TG)content. Result Oil-red staining indicated that the exercise exercises reduced hepatic TG content, but rapamycin had no effect on hepatic TG content in HFD rats. Further analysis indicated that the rapamycin significantly improved the activities of succinyldehydrogenase(SDH) but reduced the activity of cyctochrome C oxidase (COX) in liver of HFD rats. The exercise significantly up-regulated the gene expression level of PGC-1β mRNAs, but Rapamycin had no effects on the gene mRNAs expression level of PGC-1α , PPARα, PPARγ, CPTI1a and PDK4. Conclusion Chronic rapamycin administration does not affect exercise-induced reduction of hepatic TG content and mitochondrial metabolic gene in HFD rats.

**RESULTS:** The body mass of CON (765.7±41.8 g) was greater than that of AE (651.4±42.1 g) and RE (687.6±39.8 g) after exercise intervention (p<0.01), the levels of total cholesterol, triglyceride, and low density lipoprotein cholesterol were also higher in CON (p<0.05). The mRNA expression of PPARα was higher in RE than the other two groups (p<0.01), but no difference in protein expression was observed. Greater mRNA expression of FGF-21 was observed in CON (CON vs. AE and RE: 1.00±0.06 vs 0.76±0.21 and 0.83±0.10, p<0.01), however, FGF-21 protein expression was higher in AE and RE than CON (CON vs. AE and RE: 1.00 vs 1.50±0.32 and 1.50±0.38, p<0.05). Moreover, the PGCG-1α mRNA expression was higher in RE than the other two groups (p<0.01), but the protein expression was found no difference among groups.

**CONCLUSIONS:** Both aerobic exercise and resistant exercise were helpful to improve blood lipid profiles in obese mice after an 8-week exercise program. In addition, the FGF-21 protein expression was increased after exercise, and the resistant exercise seemed to be more effective in activating FGF-21 pathway functions and promoting hepatic lipid metabolism.

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age-related increase in postprandial lipemia, but it is unknown whether this is a direct result of aging or an outcome of reduced physical activity, as postprandial lipemia has scarcely been assessed in older adults.

PURPOSE: The purpose of this study was to compare active older adults to younger active adults with regard to postprandial lipemia. We hypothesized that the younger active (YA) adults would display a lesser postprandial TG response compared to the older active (OA) adults.

METHODS: Sixteen adults (8 OA adults, 67 ± 5 yr; 8 YA adults, 25 ± 5 yr; each group: 4M/4W) reported to the lab following a 10-hour overnight fast and had abstained from exercise for two days. An indwelling catheter was inserted into a forearm vein and a baseline blood sample was taken to assess fasting TG. Next, participants consumed a high-fat meal (60% fat, 37% CHO) that was relative to their body mass (12 kcal/kg; 921 ± 164 kcal). Blood draws were then performed hourly for 6 hours to characterize the postprandial TG response.

RESULTS: There was no difference (p = 0.20) in fasting TG between groups (OA: 52.3 ± 9.0 mg/dL; YA: 47.4 ± 4.6 mg/dL). Total area under the curve (AUC) TG response was significantly greater (p = 0.003) in the OA group (625.6 ± 169.0 mg/dL x 6 hr) compared to the YA group (407.9 ± 115.1 mg/dL x 6 hr). The OA participants also elicited a greater (p = 0.007) incremental AUC TG response (312.1 ± 123.3 mg/dL x 6 hr) versus the YA participants (123.6 ± 119.6 mg/dL x 6 hr). There was no difference (p = 0.32) in the time to peak TG response between groups (OA: 3.1 ± 1.0 hr; YA: 3.8 ± 1.0 hr), but the peak TG value was significantly higher (p = 0.007) in the OA adults (144.0 ± 42.2 mg/dL) compared to the YA adults (90.5 ± 27.0 mg/dL).

CONCLUSION: Despite being chronically active, OA adults displayed a higher TG response than YA adults, agreeing with previous findings of an age-related increase in postprandial lipemia. Future research should test whether OA adults differ from older inactive adults, as it would be valuable to identify the contributions of aging versus physical activity in postprandial TG modification.

Brown adipose tissue (BAT) is an important thermogenic organ and is generally induced by exercise or cold exposure via a white adipose tissue browning pathway. However, the synergetic effects of exercise and cold exposure on this pathway remain unclear. Cold-water swimming, such as winter swimming which is a traditional sport in northern China and Russia, may be a potential therapeutic form of exercise in the treatment of obesity and diabetes. PURPOSE: To investigate the synergetic effects of exercise and cold exposure on white adipose tissue browning in mice. METHODS: 8-week-old male ICR (Institute of Cancer Research) mice were randomly divided into 3 groups: a control group (N=6), a warm-swimming group (N=6) and a cold-swimming group (N=6). Mice in the warm-swimming and cold-swimming groups were trained twice a day for 2 weeks and the duration of the exercise session was gradually increased (from 10 min to 60 min). The temperature of water was 35±2°C in the warm-swimming group and 22±2°C in the cold-swimming group. Body weight of mice in each group was recorded daily before the exercise sessions. Biomarkers of white adipose tissue browning were examined by hematoxylin and eosin (H&E) stain, western blotting and immunohistochemistry. RESULTS: After 2-weeks of swimming training, body weight was significantly lower in the cold-swimming group compared to the warm-swimming and control groups (34±4.1 vs. 35.3±1.4 & 37.2±1.1 g, both p<0.05). And the relative cell size of white adipose tissue in the cold-swimming and warm-swimming groups decreased significantly in the cold-swimming group compared to the control group (142±41 & 168±68 vs. 328±59%, both p<0.05). The expression of uncoupling protein-1 (UCP-1) and peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1-alpha) in the warm-swimming group was higher than that in the control group (193±48 vs. 124±28%, p<0.05). Moreover, serum zinc finger protein-516 (ZNF-516) increased in the cold-swimming group compared to the control group (223±44 vs. 179±43%, p<0.05). CONCLUSIONS: Cold-water swimming induces white adipose tissue browning and weight loss and may be an effective form of exercise in the treatment of cardiometabolic diseases.
Elevated postprandial triglycerides (TGs) contribute to the development of cardiovascular disease. Prior exercise is a well-established method to lower postprandial TGs; however, most exercise protocols involve prolonged aerobic or resistance training (RT) of sixty to ninety minutes which is not realistically attainable by the general population. PURPOSE: The present study investigates the effect of high intensity interval training (HIIT) of twenty minutes and RT of thirty minutes on postprandial TGs. METHODS: Approval for this study was obtained from the Institutional Review Board of the College of Saint Benedict and Saint John’s University and signed informed consents were provided by all participants. Thirty healthy college-age students (5 males, 25 females) were recruited from nutrition and exercise science courses. All subjects completed the control, HIIT, and resistance protocols one week apart. Subjects performed the exercise protocols 12-16 hours prior to an oral fat tolerance test (milkshak 1 g of fat per kg of body weight). Subjects were instructed to consume similar diets during the 24 hours prior to the milk shake. Each exercise session was supervised, HIIT consisted of 40 second sprints with 4 minutes of walking recovery and the low-volume RT consisted of six machine-based lifts, 2 sets of 8 repetitions at 75% of one repetition maximum. Postprandial TGs were measured at baseline and three hours following consumption of the milkshake using the CardioChek PA blood analyzer (PTS Diagnostics, Indianapolis, IN). Data was analyzed using a three way repeated measures ANOVA statistical test. RESULTS: The triglyceride levels at baseline were on average less than 150 mg/dL (desirable value); however, 20% were above. The means are as follows for each treatment and time point (baseline, and postprandial respectively): Control: 107 +/- 49, 140 +/- 73 mg/dL; HIIT 93 +/- 34, 122 +/- 59 mg/dL; and Resistance 108 +/- 47, 144 +/- 64 mg/dL. While there appears to be a trend that HIIT lowered both fasting and postprandial TG’s the decrease was not statistically significant (p=0.099). CONCLUSION: Twenty minutes of HIIT or thirty minutes of low-volume RT did not significantly lower postprandial triglyceride response to a high fat milkshake in a healthy, college-age population.
impaired GLUT4 content (p<0.02) compared to a control group (C). Food consumption and body mass were similar across all groups (range: 100-225 g). CONCLUSION: Adult female rats demonstrate a high propensity for voluntary physical activity in the first three weeks of life and a natural tapering in activity, perhaps associated with age. Consumption of a diet high in fat and sucrose, regardless of when it was introduced during the 9-week protocol, blunted activity from peak values compared to rats that consumed a low fat-only diet (LL), suggesting that diet composition, rather than intake alone, impacts spontaneous physical activity.

Effects Of High-Fat Diet and Exercise on Endoplasmic Reticulum Stress Mediated Apoptosis in Rat Liver
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(no relationships reported)

Effects Of Short-term Ketogenic Dieting Or Ketone Salt Supplementation Lipogenic Gene Expression Adipose Tissue

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Purpose: We sought to examine if one week of ketogenic diet (KD) or ketone salt supplementation (KS) feeding versus standard chow (SC) feeding affected the mRNA signature related to de novo lipogenesis in subcutaneous and visceral (mesenteric) adipose tissue.

Methods: Male Fisher rats (4 mo old) were provided isocaloric amounts of KD (5.2 kcal/g, 23.1% protein, 6.9% carbohydrate, and 65.3% fat, n=10) or SC (3.1 kcal/g, 24% protein, 58% carbohydrate, 18% fat, n=10) for 7 days. The SC rats were divided into sub-groups whereby one group was provided a high amount of KS in their drinking water (SC+HKS ~2.4g/day, n=10), one group was provided a moderate amount of KS in their drinking water (SC+MKS ~1.2g/day, n=10), one group was un-drinking water (SC+MKS ~1.2g/day, n=10), one group was provided a high amount of KS in their drinking water (SC+HKS ~2.4g/day, n=10), and one group was un-supplemented (SC, n=10).

Results: The KD group lost the greatest mass (p<0.01). Feed efficiency revealed a group effect (p<0.01) with the lowest values observed in KD. A group effect was also observed for mesenteric (MES) fat (p<0.05). Subcutaneous (SQ) fat mass was not different between groups (p>0.07). In the MES fat fed FASN mRNA was down regulated in KD and both KS groups (p<0.001). HSL and CEBPs mRNA were not differentially expressed (p=0.16 and p=0.51, respectively). ACCa was down-regulated in KD and KS groups (p=0.001). Regarding the SQ fat pad, only FASN mRNA was found to be differentially expressed (down-regulated in the KD and KS groups; p=0.01).

Conclusions: The KD appears to offer an acute benefit to body mass loss, predominantly acting on visceral fat depots.
variables and accessory strength variables as predictors. To compare the relative amount of variance explained, independent of the accessory strength variables, the second equation only contained core strength variables. RESULTS: The first model was significant in predicting \( \text{CoP}_{x,y} \) (Pearson’s Chi-Square=149.132, \( p=.435 \); Nagelkerke’s R-Squared=\( .369 \)). The second model was significant in predicting \( \text{CoP}_{y} \) (Pearson’s Chi-Square=148.837, \( p=.488 \)) and the explained variance was similar to the full model (Nagelkerke’s R-Squared=\( .362 \)). The core muscles were found to be active for the majority of screens, with percentages of ‘time active’ for each muscle ranging from 54%-96%. CONCLUSION: Performance on the three screens is predicted by core strength, even when accounting for other strength variables. Further, it appears the screens elicit wide-ranging activation of core muscles. While more investigation is needed, the DSM, TSP, and RS, collectively, appear to be a good assessment of core strength.

Supported by the Freddie Fu, MD Graduate Research Award

The Functional Movement Screen (FMS) assesses movement dysfunctions during seven tests to provide musculoskeletal injury risk and a training program reference in a variety of populations. Except for individual differences of FMS movement dysfunction, sport-specific training may affect the dysfunction. Thus, the investigation of FMS performance for baseball players can provide useful training program references for injury prevention of specific baseball positions.

PURPOSE: To investigate the difference between outfielders (OF), infielders (IF), and pitchers (PC) on the Functional Movement Screen performance of 7 tests.

METHODS: 27 Division I athletes from city teams including 13 PC, 6 OF, 8 IF athletes (career yrs: 12.5±5.9, 13.5±4.6, 14.5±3.1) performed the FMS. The tests are deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg rise, trunk stability push-up, rotary stability for scoring a 0 to 3 each. The questionnaires of injury history in 5 years were reported to provide injury category of the shoulder, elbow, wrist, hip, knee, and ankle. One-way ANOVA study was performed to compare among these groups (Alpha level 0.05).

RESULTS: The total score of seven tests did not show the difference among each group (PC: 15.9±1.4, OF: 16.3±2.2, IF: 16.4±1.6) and each group total score<14. However, the PC showed lower score than the OF on trunk stability push-up (PC: 2.4±0.5, OF: 3.0±0.0, \( p=.022 \)), but higher than OF on rotary stability (PC: 2.23±0.44, OF: 1.67±0.52, \( p=.045 \)). The injury occurred the most for PC are: 60% elbow, 33 % shoulder, 7% wrist; OF: 40% shoulder, 30% elbow, 10% wrist; IF: 40% elbow, 30% wrist, 10% shoulder.

CONCLUSIONS: Trunk stability push-up requires more core static than dynamic strength, but rotary stability is require core dynamic strength and reflex to perform. The Functional Movement Screen (FMS) is an assessment test used to determine an athlete’s risk of injury based on the scores of seven tests that utilize commonly used movement patterns during every activity. Each test is scored based on whether or not biomechanical deficiencies are present when performing each test. Prior research has predominantly evaluated the relationship between FMS and susceptibility to injury. Yet, there appears to be limited research with FMS and anaerobic performance.

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Functional strength training (FST) refers to the exercise program that makes training adaptations more specific and applicable for the whole body function output. With the characteristics of neuromuscular training enriched, movement pattern oriented and little equipment required, FST seems suitable to promote fitness performance for youth effectively. However, the scientific evidence of FST as a fitness promotional intervention for youth is not well documented.

PURPOSE: To compare the effects of an 12-week intervention of FST with traditional resistant training (TRT) on fitness performance among boys 13-14 yrs old.

METHODS: Sixty-eight healthy boys from Guanshan middle school were randomly assigned to the FST group and TRT group. FST group (n=34, age 13.59±0.89, height 1.67±0.05, mass 51.20±0.18, BMI 20.19±0.99) underwent 10 fundamental exercises in the first 4 weeks and 10 advanced FST exercises in the following 4 weeks, while TRT group (n=34, age 13.48±0.76, height 1.64±0.06, mass 51.52±0.83, BMI 20.55±0.01) did fundamental and 10 advanced TRT exercises in the same time sequence. The training was 3 times/week and 45 min/session for both groups. The participants were tested at the beginning and the end of the intervention on 50m Sprint, Long Jump, Sit and Reach, 1000m Run and Pull-Ups. Independent and paired t tests were conducted to examine the differences between two groups and within groups, respectively.

RESULTS: The results indicated that the FST group made significantly greater improvement than TRT did on 50m Sprint (Exp 8.71 (before)=3.01 (after), Control 8.72 (before)=3.01 (after), Exp 1.86 (before)=0.12 vs. 2.20 (after), Control 1.85 (before)=0.17 vs. 1.87 (after)), Sit and Reach (Exp 5.71 (before)=3.31 vs. 11.05 (after), Control 5.76 (before)=3.17 vs. 5.93 (after)), 1000m Run (Exp 4.59 (before)=0.52 vs. 4.02 (after), Control 0.55 vs. 0.51), Control 4.51 (before)=0.63 vs. 4.27 (after) (\( p<.05 \)), Pull-Ups (Exp 4.00 (before)=1.32 vs. 10.66 (after), Control 4.04 (before)=1.13 vs. 7.10 (after)).

CONCLUSION: Functional strength training is more effective than traditional resistance training to improve fitness performance among boys aged 13-14 yrs.

Functional Movement Screening (FMS) is an assessment test used to determine an athlete’s risk of injury based on the scores of seven tests that utilize commonly used movement patterns during every activity. Each test is scored based on whether or not biomechanical deficiencies are present when performing each test. Prior research has predominantly evaluated the relationship between FMS and susceptibility to injury. Yet, there appears to be limited research with FMS and anaerobic performance.

Abstracts were prepared by the authors and printed as submitted.
Specifically, the relationship between FMS and vertical jump performance has not yet been addressed. **PURPOSE:** To determine the correlation between Functional Movement Screening (FMS) scores and maximum vertical jump height in young adult males. **METHODS:** Thirty-averagely fit males (Age = 23.13 ± 3.02 yrs, Ht = 178.74 ± 8.00 cm, Wt = 82.14 ± 13.46 kg, BF% = 14.32 ± 4.60) voluntarily participated in this study. Each subject performed FMS and were scored according to the grading criteria provided by the developers of FMS. Then a dynamic warm-up utilizing a cycle ergometer for 5 min was performed followed by a 5 min passive recovery period. Next, subjects performed four maximum effort vertical jumps, which served as their vertical jump familiarization trials. All jumps were separated by 30 seconds except the last jump of the familiarization trial and the first jump of the performance trials which were separated by 4 min of passive recovery. The highest of the four performance jumps, excluding the first jump, was utilized for data analysis. Pearson Correlation coefficients were utilized to assess the relationship maximum vertical jump height and total FMS score, squat FMS score, and inline lung FMS score. **RESULTS:** There was a slight positive correlation when comparing maximum vertical jump (69.51 ± 9.68 cm) to total FMS score (r = .264) and FMS squat score (r = .170), but there was a moderate positive relationship with FMS inline lung score (r = .421), which was significantly higher (p < .01) than both FMS total and FMS squat scores. **CONCLUSION:** The results of the current study seem to suggest that total FMS score is not a significant predictor for maximum vertical jump height. However, future studies should seek to determine the potential impact that improvements in the FMS inline lunge, squat, and total score may have on vertical jump performance.

**PURPOSE:** To compare the differences in session energy expenditure and excess post-exercise oxygen consumption (EPOC) between traditional (TRAD) and functional (FUNC) training protocols. **METHODS:** Twenty-four recreationally trained men (n=12, 22.3 ± 1.8 yrs) and women (n=12, 20.2 ± 0.6 yrs) completed four separate resistance training exercise bouts in a randomized order, consisting of two TRAD and two FUNC sessions. Training load was determined by familiarization session where each participant selected a load that elicited a RPE 6-7 (‘hard’ to ‘very hard’) for each exercise. Traditional (11 exercises) and functional (10 exercises) programs were matched for exercise time, major movements, and muscle groups. Each exercise session consisted of two sets of 10 repetitions with 90-sec rest between sets. EPOC was measured immediately following each exercise bout for a duration of 30 min. Oxygen consumption was measured continuously throughout the exercise session and energy expenditure (EE) was calculated via portable indirect calorimetry (K4b2, COSMED). Differences in session, EPOC, and total EE between TRAD and FUNC protocols were analyzed as group means by using paired samples t-tests (SPSS v19; p ≤ .05). **RESULTS:** All participants completed all exercise protocols and EPOC trials. Group means ± SD for EPOC during TRAD and FUNC were 55.6 ± 74.2 kcas and 260.1 ± 87.2 kcas, respectively. Group means ± SD for EPOC during TRAD and FUNC were 44.3 ± 24.2 kcas and 51.4 ± 24.8 kcas, respectively. **CONCLUSION:** This results highlight the effectiveness of a functional resistance training design to elicit greater energy expenditure during exercise and 30-min post-exercise compared to a traditional resistance training design. Eliciting to implement a functional over a traditional resistance training design may be more beneficial for the purposes of increasing exercise post-exercise energy expenditure.

Previous research suggests an inverse relationship between functional movement quality and body mass index (BMI). Specifically, what aspects of BMI are correlated with the ability to move well? **PURPOSE:** This study investigated the relationship between functional movement quality and various anthropometric variables, including BMI, arm length (AL), and leg length (LL), as well as percent body fat (%BF). **METHODS:** Fifty-two college students (26 male, 26 female) free of injury participated in this study. Functional movement quality was assessed by a commercially available, 7-test movement screen (FMS); testing was performed and scored by certified screeners following published procedures. Height was measured with a stadiometer; AL and LL were measured per published procedures. Weight and %BF were determined with a commercially available, multifrequency bioelectrical impedance system. Linear regression analysis was used to statistically determine the relationship between FMS scores (dependent variable), anthropometric and %BF data (independent variables). **RESULTS:** There was a significant relationship between FMS scores and %BF, LL, AL, and BMI collectively (R = .531; adjusted R² = .220; p = .003). Specifically, %BF had the strongest relationship [standardized beta coefficient (β) = .502; p = .008] followed by LL (β = .278; p = .045). However, AL (β = .028; p = .387) and BMI (β = .106; p = .927) were not significant variables in the regression model. **CONCLUSION:** These results suggest that %BF is strongly related to functional movement quality and that any noted relationship between FMS scores and BMI is largely due to the influence of %BF on BMI values. Higher %BF may simply be an indicator of lack of fitness and/or physical activity, which, in turn, may be related to poor movement quality. This should be further investigated to determine the exact relationships that do exist between these variables. Additionally, LL is a variable that may influence FMS scores. As many of the tests involve movements of the lower extremity, it is also worth investigating how LL may influence movement quality and if this is a biasing factor in movement screening.

**PURPOSE:** The Functional Movement Screen (FMS) is a screening tool used to evaluate mobility and stability in assessing an individual’s potential risk for injury. The purpose of this study was to determine if an individual’s past high school athletic experience had an impact on their FMS scores as university students. The secondary objective was to investigate which high school sports had a significant impact on FMS scores. **METHODS:** Physically active university students (53 females, 47 males), ages 18 to 26 years with no recent (<6 weeks) history of musculoskeletal or head injury were recruited from introductory wellness classes. Participants indicated which sport(s) and for how many seasons they participated in each sport(s) during high school. Each participant performed the FMS, which consists of seven tests (deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotary stability). Each test was scored on a scale of 0 to 3. A score of 0 indicates the lowest score possible, while a score of 3 is the highest. The combination of the tests provides an overall maximum score of 21. Research has shown FMS scores ≤14 have a statistically greater chance of high school sports having a statistically significant impact on FMS scores. **RESULTS:** There was found between individual FMS scores and number of sport seasons played ≤14 on the FMS to identify which high school sports have the greatest impact on FMS performance. All FMS tests were scored by the same researcher to ensure intra-rater reliability. **RESULTS:** A positive correlation was found between individual FMS scores and number of sport seasons played in high school (r = .32; p < .005). This identifies a statistically significant impact on a university student’s FMS score related to the number of seasons they played sports in high school. Participation in basketball, football, or track increased the likelihood of university wellness students scoring ≥15 on the FMS test. **CONCLUSION:** University students who participated in high school basketball, football, or track are more likely to score ≥15 on the FMS which could reduce their risk of musculoskeletal injury.

**PURPOSE:** Functional Movement Screening (FMS) is a testing procedure that evaluates the quality of movement patterns to identify individuals with specific limitations or asymmetries. Low FMS scores have been linked with a higher risk of injury among tactical athletes. Since FMS is becoming a popular screening tool it is important to find methods or training programs that could improve FMS scores in military populations. **Purpose:** This pilot study examined the effects of a 7-week periodized resistance training program on FMS scores of ROTC Cadets. **METHODS:** Subjects consisting of 24 Army and Air Force ROTC cadets (male=18, female=6), Age (yrs) = 2.26 ± 5.96, Height (cm)=172±8.68, Weight(kg)=72.88±12.91. The intervention group (IG n=14) trained for 1 hour/day, 4 days/week and the control
High-intensity intermittent training (HIIT) refers to a group of short intense exercise bouts separated by short rest periods. Standardized protocols have not been established to determine the most efficient intensity, exercise mode, exercise volume, and recovery duration of the HIIT exercise.

**PURPOSE:** The purpose of this study was to determine the effects of short-term HIIT in recreationally active college students. **METHODS:** The HIIT protocol consisted of 6 cycles of 6 different exercise at a 10:5:5 work-to-rest ratio, and a 1-minute recovery between each cycle. The exercise protocol was performed 5 days per week for 2 weeks, for a total of 10 sessions. Fifteen participants completed the brief HIIT protocol, while another fifteen participants who were randomized in the control group, did not change their normal exercise routine. Before and after the 2 weeks, all participants underwent testing for anaerobic capacity and body fat percentage.

**RESULTS:** Both groups significantly decreased (p < 0.05) body fat percentage and fat mass (HIIT group: BFP = 31.1% ± 8.6 to 30.3% ± 8.3; FM = 26.5 kg ± 14.8 to 25.8 kg ± 13.6, control group: BFP = 26.3% ± 10.2 to 25.6% ± 9.6, FM = 19.34 kg ± 12.6 to 18.6 kg ± 11.5), as well as increased (p < 0.05) maximum power and fatigue index in the post-testing (HIIT group: MP = 1212.2 ± 491 to 1227.8 ± 486.8; FI = 31.9 ± 13.98 to 32.53 ± 14.77, control group: MP = 966.7 ± 280.2 to 1014.6 ± 295; FI = 23.74 ± 7.80 to 26.06 ± 7.91). However, there were no significant changes (p > 0.05) in body fat percentage and anaerobic capacity between the two groups after the post-testing.

**CONCLUSION:** Results from our study show no significant improvement in body composition or anaerobic capacity after 2 weeks of the brief HIIT protocol. Since no blood or muscle tissues were collected from the HIIT participants, we are not able to say if this protocol induced any molecular or cellular changes that might precede whole body and performance improvements. Thus, further research is needed to determine the physiological adaptation of the ultra-short HIIT in conjunction with functional training.

**INTRODUCTION:** The Functional Movement Screen (FMS) is a battery of seven tests to observe key movement patterns and is scored in a twenty-one-point scale (Cook 2010). Studies have suggested that individuals with scores of 14 or less had significantly higher risks of injury (Bushman et al., 2015; Chorba et al., 2010). A modified FMS, scored in a ten-point scale, has been used by a Division III college athletic training staff. It includes three original FMS tests (deep squat, hurdle step, shoulder mobility) and a single-leg squat (scored as 0 for knee valgus, and 1 for no valgus). It is not known whether the new battery can predict knee valgus in Division III male soccer players.

**PURPOSE:** To determine whether the modified FMS can predict knee valgus when landing from drop jumps.

**METHODS:** Seventeen Division III male soccer players and twenty healthy male non-athletes (ages 18-24) were recruited for the study. Subjects performed all modified FMS exercises and were scored by one FMS certified athletic trainer. Reflective markers were placed on subject’s tibial tuberosity and distal tibia to define the tibia and knee valgus angles were measured with respect to the vertical line from video via goniometry at the lowest point of during landing from a drop jump from a 31cm box.

**RESULTS:** For the soccer group, the mean for modified FMS score was 7.3 ± 1.63, mean left knee valgus was -1.73 ± 1.62 degrees and mean right knee valgus was -0.73 ± 1.87 degrees. The controls’ mean modified FMS score was 6.85 ± 1.50, mean left knee valgus was -2.6 ± 2.80 degrees, and mean right knee valgus was -1.35 ± 3.23 degrees. The modified FMS was not a significant predictor of right knee valgus (p=0.65) or left knee valgus (p=0.22).

**CONCLUSION:** The Modified Functional Movement Screen is not a significant predictor of knee valgus in DIII male soccer players. More sensitive scoring could have improved the modified FMS’s ability to detect knee valgus. Post hoc power analysis results suggest that the non-dominant side may be more relevant for assessment.

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Body cooling between bouts of exercise has been examined in various athletic settings. The lack of breaks in soccer makes it challenging to effectively utilize cooling strategies to decrease heat strain during exercise in the heat.

**PURPOSE:** To determine the effectiveness of a mobile cooling unit in decreasing perceptions of heat strain in collegiate female soccer players.

**METHODS:** Perceptual measures of thirst (TST), thermal sensations (THM), ratings of perceived exertion (RPE), and environmental symptoms (ES) were measured during 4 preseason collegiate female soccer practices in a warm environment (31.3±2.1°C). Soccer players (19.5±1.1 y; 66.9±5.3 kg; 168.6±7.0 cm) were randomly assigned to either a cooling condition (POD; n=16) or a control condition (CON; n=18). POD players entered a mobile cooling unit (9.5±1.6°C) during a practice break halfway through each practice while CON players rested on the sideline. ES was given before and after each practice, and TST, THM, and RPE were measured before and after breaks. Perceptual measures were compared to gastrointestinal temperature (TGI) and heart rate (HR) comparisons between conditions were analyzed using a repeated measures ANOVA at rest (p ≤ 0.05). Pearson correlations were used to compare physiological and perceptual measures.

**RESULTS:** Pre-break TST for POD (6.1±1) and CON (5.1±1) were similar (p=0.18), while post-break TST was significantly lower in POD (3±1) compared to CON (4±1; p=0.01). Cooling via a mobile cooling unit resulted in significantly decreased post-break TST in POD (2±1) compared to CON (5±1; p=0.00). RPE from pre- to post-break was significantly different between conditions (p=0.00). There was a strong, positive relationship between cooling rate and ATHM in POD (r=752; P=0.005) but not CON (r=135; P=0.62). ESQ increased pre- to post-practice but there was no difference between conditions (p=0.05). There were no differences in THM and RPE between conditions (p=0.05).

**CONCLUSION:** Players had significant changes in their perceived THM and TST sensations when cooled during practice breaks compared to control. The strong relationship between cooling rate and THM in only the cooling condition should be further investigated. In conclusion, players did feel better when cooled between bouts of exercise despite the lack of physiological effects.
Small sample volumes may artifically elevate plasma osmolality (Pposm) measured by freezing point depression. **PURPOSE:** To compare different sample volumes of measured Pposm (mmol/kg) to each other, and to calculate osmolality (mmol/L) in euhydrated (EUH) and dehydrated (DEH) volunteers.

**METHODS:** Pposm was measured using freezing point depression and osmolality calculated from measures of sodium, glucose, and blood urea nitrogen. The influence of sample volume was investigated by comparing 20 μL and 250 μL Pposm samples (n = 158 pairs). Protinin (240, 280, 320 mmol/kg) and Clinitor (290 mmol/kg) reference solutions were compared similarly (n = 24 pairs). Twenty-one volunteers were tested multiple times while EUH (n = 72) or DEH (n = 7) by -4.0% body mass.

**RESULTS:** The 20 μL samples of Protinin, but not Clinitor, were significantly higher by 3 mmol/kg when compared to 250 μL samples. The 20 μL samples of plasma were 7 mmol/kg higher than 250 μL samples with a nearly constant systematic error across the range tested (slope = 0.917). Calculated osmolality was significantly lower than 20 μL Posm (-6.6 mmol) but not different from 250 μL Posm (<1.0 mmol). When using common criteria for EUH (<290 mmol/kg), only 19/72 EUH volunteers were correctly classified using 20 μL Posm, however, 65/72 were correct. The classified using 250 μL Posm. DEH volunteers met the common >295 mmol/kg DEH criteria in 7/7 (20 μL Posm) and 6/7 (250 μL Posm) cases studied. The average change in Posm from EUH to DEH was similar for 20 μL (11 mmol/kg) and 250 μL (10 mmol/kg) samples.

**CONCLUSIONS:** These results demonstrate that Posm measured by freezing point depression will be 7 mmol/kg higher when using 20 vs. 250 μL sample volumes. Approximately half of this effect may be due to plasma proteins. Posm sample volume should be carefully considered when calculating the osmole gap or assessing hydration status. The opinions or assertions contained herein should not be construed as official or reflecting the views of the Army or the DoD.

**Fluid intake during military training is prescribed based on the interactions among environmental conditions, uniform configurations, and work rates. The efficacy of this guidance has not been empirically assessed for work bouts lasting >4 hours. **

**PURPOSE:** To determine the acceptability of the fluid intake guidance, sweat losses were measured in a variety of conditions and modern uniform/body armor, exercise intensities (easy, moderate, heavy), and work durations (2, 4, and 8 hr). Using the prescribed fluid intake guidance for each condition, the differences between the prescribed fluid intake and the total observed sweat loss were calculated. Differences were then expressed as a percent loss or gain of body weight using the following equation: [% body water flux = ((drinking volume - sweating volume)/ body weight) x 100]. Values within a threshold of ±2% body water flux (BWF) were deemed acceptable. This threshold was the starting point for performance and health concerns. To simulate a worst-case scenario, it was assumed no urine was produced during testing. **RESULTS:** During short work durations (2 and 4 hr), 0 of 75 Soldiers exceeded the +2% BWF. During longer work durations (8hr), 50 of 66 Soldiers exceeded the +2% BWF. In all conditions, 50 of 141 Soldiers (35%) exceeded the +2% BWF. In no condition did a Soldier exceed the -2% BWF. **CONCLUSION:** Current fluid intake guidance appears to be sufficient (no over- or under-drinking ±2% BWF) during work durations lasting ≤4 hours. However, for conditions beyond published guidance (<4 hr), recommended drinking rates over-prescribe water needs in worst-case scenarios where no urine was produced. It is recommended that military fluid intake guidance be re-evaluated to include longer work durations of 8 hours. 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.
Drinking ad libitum is a very common strategy for rehydration during trainings, however, its application could lead to dehydration and this may differ depending on the year’s season and the athlete’s age.

**PURPOSE:** To compare the training dehydration prevalence in two different seasons in major and minor soccer players that drink ad libitum.

**METHODS:** 106 male soccer players were evaluated during a habitual training in summer and autumn. They were divided by age as major (>15 years old, n=47) and minor (11 to 15 years old, n=59), they trained at morning (8:00-10:00) and evening (15:00-17:00), respectively at a 1570 m over sea level height. Dehydration was evaluated as the weight loss percentage calculated and classified as low dehydration (<0% to -1% weight loss) and mild dehydration (≥1% weight loss). Subjects were allowed to drink any fluid ad libitum during trainings. These sessions had similar duration and intensity in both evaluations. The results are presented as the total prevalence of dehydration and type and compared for summer vs autumn by one sample t-test and for age (major vs minor) by two samples t-test.

**RESULTS:** There was a higher dehydration prevalence in autumn than summer in the major group, by an increase in low dehydration prevalence, but without statistical significance (p>0.05). In the minor group, the dehydration prevalence was lower in autumn than summer, by a decrease in mild dehydration prevalence (p>0.05). There was a lower dehydration prevalence in the minor group than the major group in autumn (p>0.05) by a lower prevalence in low dehydration (p>0.05).

**CONCLUSIONS:** These results suggest that drinking ad libitum is not enough for maintaining adequate hydration in both major and minor soccer players, neither in summer nor autumn. However, this situation was lower in minor players.

**Table 1. Dehydration prevalence in two seasons by age group.**

<table>
<thead>
<tr>
<th>Age type</th>
<th>Summer</th>
<th>Autumn</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>General dehydration (%)</td>
<td>Low dehydration (%)</td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Major 47</td>
<td>76.6</td>
<td>51.1</td>
</tr>
<tr>
<td>Minor 59</td>
<td>88.1</td>
<td>45.8</td>
</tr>
<tr>
<td>Total 106</td>
<td>83.0</td>
<td>48.1</td>
</tr>
</tbody>
</table>

*a Significant difference vs major group (p<0.05). *b Significant difference vs Summer (p<0.05)

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**Does Oral Fluid Intake Following Dehydration Influence Subsequent Athletic Performance? A Systematic Review and Meta-Analysis**

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(No relationships reported)

**PURPOSE:** Deleterious effects of dehydration on athletic performance have been well documented. As such, dehydrated individuals are advised to consume fluid in volumes equivalent to 1.25-1.5L·kg⁻¹ body mass (BM) lost to restore body water content. However, individuals undertaking subsequent activity may have limited time to consume fluid. In this context, the impact of fluid intake practices is unclear. This review investigated the effect of fluid consumption following dehydration on subsequent athletic performance.

**METHOD:** PubMed (MEDLINE), Web of Science (Thomas Reuters) and Scopus databases were searched to identify studies on athletic performance (categorized as: continuous, intermittent, resistance, sport-specific and balance exercise) following dehydration of participants under control (no fluid) and intervention (fluid intake) conditions. Studies were excluded if macronutrient intake was not matched across trials. A random effects meta-analysis and multiple meta-regression analyses were performed to determine intervention efficacy for continuous exercise performance (insufficient data existed for meta-analysis with other exercise categories). A total of 26 studies (n=844 subjects) derived from 33 publications were reviewed. Dehydration decreased BM by 0.34–1.4% and fluid intake was equivalent to 0.40–1.55L·kg⁻¹ BM lost. Fluid intake significantly improved continuous exercise performance (22 trials), Hedges’ g=0.46, 95% CI: 0.32, 0.61 (I²=80.5). Differences in ambient temperature (p=0.001) and exercise duration (p=0.050) affected the magnitude of the performance change. Fluid intake demonstrated greater efficacy when exercise was performed in hotter environments and over longer durations (R²=90.5).

The volume and timing of fluid consumption did not significantly influence the magnitude of this effect (p<0.05). Evidence indicating a benefit of fluid intake on intermittent (10 trials), resistance (8 trials) and sport-specific (6 trials) exercise was less apparent and requires further elucidation. **CONCLUSION:** Fluid consumption following dehydration may improve continuous exercise performance, even when body water deficit is modest and fluid intake is inadequate for complete rehydration.

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**Hydration Status and Repeated Sprint Performance in Females**

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(No relationships reported)

**Hydration Status and Repeated Sprint Performance in Females**

Karleigh Bradbury, Elizabeth O’Neill, Susan Soirit and Vincent Paolone Springfield College, Springfield,MA

Dehydration has been shown to have a negative impact on aerobic exercise performance; however, the effects of dehydration on anaerobic exercise performance are unclear.

**PURPOSE:** To examine the effects of hydration status on repeated sprint performance in females.

**METHODS:** Ten females who were in the luteal phase of the menstrual cycle completed the study [21 ± 2 yrs, O₂peak 47.1 ± 3.9 ml·kg⁻¹·min⁻¹; BF 21.3 ± 3.4%]. All subjects were utilizing a chemical contraceptive. Subjects completed the study in both a eukaleadrate and dehydrated state. Dehydration was induced by 12 hr of fluid restriction prior to the start of the sprint protocol. Hydration status was determined by urine specific gravity. A subject was considered to be hydrated with a urine specific gravity <1.020 and dehydrated with a urine specific gravity ≥1.020. Subjects completed twenty 30 m sprints. The sprints were divided into 3 sets of 10 sprints rested for 10 s between each sprint, and 2 min between each set of sprints. Core temperature (Tc), heart rate (HR), and rate of perceived exertion (RPE) were measured at baseline, postwarm-up, and after each set of sprints. Blood lactate, hemoglobin (Hb), and hematocrit (Hct) were measured at both baseline and at the end of the third set of sprints. **RESULTS:** No significant difference existed in the average time to complete sprints in a hydrated or dehydrated state. Resting Tc was significantly higher in a dehydrated state when compared to a hydrated state (37.87 °C ± 0.04 vs 37.56 °C ± 0.07, p<0.05). HCT was significantly higher in a dehydrated state when compared to a hydrated state (43.85 ± 0.81 vs 44.95 ± 0.99, p<0.05). HR, blood lactate, and Hb were not affected by hydration status. **DISCUSSION:** The elevation in Tc and HCT in a dehydrated state observed in the current study may be associated with the decrease in circulating blood volume that occurs with dehydration. As blood volume decreases, blood flow to the skin will decrease, leading to an increase in Tc, due to a decrease in heat dissipation. Dehydration did not affect the repeated sprint performance of the female subjects.

**Funded by Springfield College, College of Health, Physical Education and Recreation**

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**Frontal Asymmetry Changes Following Passive Hyophydration**

Eric Jones, Kristen Martinez, Craig Alger, Mark Faries, Dustin Joubert. Stephen F. Austin State University, Nacogdoches, TX.

(Thomason: Thomas J. Pujol, FACSM)

(No relationships reported)

**PURPOSE:** Fluid consumption prescriptions among athletic and non-athletic populations continue to elicit both hypo-(HO) and hyper-hydration (HR). Thus, the need to find traits within individuals who may be at a higher risk to experience HO, as well as hypohydration, is warranted. Therefore, the purpose of this study was to evaluate changes in approach/reward (R) and avoidance/non-reward (NR) via frontal asymmetry (FA) in response to water exposure during eu-hydrated (EU) and HO conditions.

**METHODS:** Participants included 14 active college-aged males. Electroencephalogram (EEG) assessed motivational orientations to water exposure in both EU and HO states. A 5 minute nature video was used to stabilize mood, followed by 2 minutes of resting EEG recordings. Then, FA was assessed with the presentation of a glass of ice water, and instruction to observe, but not consume for 3 minutes. FA was re-assessed in the same manner following a dehydration trial (~90 minutes). Dehydration trials were performed in a controlled hot water bath at a mean of 39°C. Participants remained in the bath until 2% body mass loss, with no fluids consumed during the trials. Urine voids were collected before and after trials to assess specific gravity and color. Body core temperature was monitored throughout the trial, with >38.7°C set as criteria for removal. Participants reported affective measures using Feeling Scale and Felt Arousal Scale throughout the
The evaporative requirement for heat balance ($E_{req}$ calculated as metabolic heat production minus dry heat loss) is the primary determinant of whole-body sweat rate during exercise in compensable conditions. However, the relative influence of metabolic and environmental heat load on physiological responses at a given $E_{req}$ remains unclear. **PURPOSE:** To assess the thermal and cardiovascular responses during exercise bouts at a similar fixed $E_{req}$ but for different combinations of metabolic and environmental heat loads. **METHODS:** Nine healthy males (46 ± 8 years) performed four experimental trials consisting of 75 min of semi-recumbent cycling wherein dry heat exchange and metabolic heat production were monitored continuously with the latter adjusted to achieve a fixed $E_{req}$ of 400 W. The respective metabolic heat productions and ambient temperatures for each trial were: i) 442 W and 30°C (439W[30°C]), ii) 391 W and 35°C (391W[35°C]), iii) 317 W and 40°C (317W[40°C]) and iv) 258 W and 45°C (258W[45°C]). Whole-body sweat rate was measured via direct calorimetry. Esophageal temperature ($T_e$) and mean skin temperature ($T_s$) were measured continuously as well as heart rate (HR) were measured continuously. Mean body temperature ($T_{mb}$) and physiological state index (PSI) were calculated from $T_{mb}$ and $T_e$. $T_{es}$ and $HR$, respectively. **RESULTS:** During exercise whole-body sweat rate was similar between conditions ($P>0.48$, as was $T_{es}$($P>0.65$). In contrast, $T_e$ was greater in 439W[30°C] (37.67 ± 0.04°C) and 391W[35°C] (37.58 ± 0.07°C) relative to both 317W[40°C] (37.35 ± 0.06°C) and 258W[45°C] (37.20 ± 0.07°C; all $P<0.05$). However, $T_{es}$ performed at a fixed $E_{req}$ resulted in similar whole-body sweat rates and $T_{mb}$ different between all conditions (33.85 ± 0.16, 34.53 ± 0.08, 35.67 ± 0.07 and 36.54 ± 0.06°C; all $P≤0.05$). The elevation in $E_{req}$ sustained during the 5-min forearm ischemia performed during the IHG+OCC condition resulted in a greater decrease in $T_{es}$ achieved at the end of IHG exercise. Specifically, EHL was elevated by ~60 W relative to pre-IHG levels at the end of the period of ischemia (all $P<0.05$). The increase in EHL however, was not significantly different from IHGonly and CONTROL at the end of ischemia for the 15 and 30-min postexercise measurement periods (P=0.452 and P=0.439, respectively). Differences were only measured at 45-min of recovery ($P=0.039$). **CONCLUSIONS:** We show that the activation of muscle metaboreceptors may modulate whole-body evaporative heat loss following dynamic exercise in the heat.

Supported by the Natural Sciences and Engineering Research Council of Canada

**Abstracts were prepared by the authors and printed as submitted.**
intensity) Sweat rate (SR) and cutaneous vascular conductance (CVC) were measured at four intradermal microdialysis forearm skin sites continuously perfused with either: 1) lactated Ringer (Control), 2) 10 mM N^6-nitro-L-arginine methyl ester (LNAME) (NOS inhibitor); 3) 100 μM Apocynin (NADPH Oxidase inhibitor); or, 4) 100 μM Tempol (superoxide dismutase mimetic). Responses were compared at baseline and 10 minute intervals.

RESULTS: SR for all sites was not different between groups at end exercise performed at the same rate of heat production (LF: 0.63 vs. HF: 0.83 mg min^-1 cm^-2; P>0.05). Conversely, SR for all sites at end exercise matched for relative intensity was significantly greater for HF as compared to LF (1.29 vs. 0.60 mg min^-1 cm^-2; P<0.05). Within subjects, SR was not different between skin sites (all P>0.05). CVC was reduced at the LNAME site throughout the protocol (~20% reduction in CVC, P<0.05), while there were no differences between the other sites. Within the same skin site, no differences in CVC were measured between groups.

CONCLUSION: Superoxides and NADPH oxidase do not play a role in mediating sweating and skin blood flow in older adults irrespective of their aerobic fitness. In contrast, differences in sweating were influenced by the absolute rather than relative exercise intensity. Supported by Canadian Institutes of Health Research.

Purpose: Sudomotor control of sweat gland function results in an increase in cytosolic Ca^2+ due to an IP<sub>3</sub>-mediated Ca^2+ release from intracellular stores and an influx of Ca^2+ from extracellular fluid. While K<sup>+</sup> channels have been implicated in modulating sweat gland function, little is known which specific K<sup>+</sup> channels modulate cholinergic sweating. As such, we tested the hypothesis that large conductance Ca<sup>2+</sup>-activated K<sup>+</sup> (BKCa) channels modulate sweat output.

Methods: To evaluate this hypothesis, we examined the ability of two doses of tetraethylammonium (100 μM and 50 mM TEA) to blunt axon reflex mediated sweating induced by intradermal electrical stimulation in 5 healthy adults. Local sweat rate (SR) was measured by passing dry gas through a small sweat capsule mounted on the skin. The skin was stimulated at a constant current intensity of 2.5 mA for 30 s at frequencies of 0.1, 1, 2, 3, 6, 12, and 32 Hz using two small stainless steel stimulating electrodes. This procedure produced a sigmoid shape stimulus-response curve when we plotted the area under the SR-time curve versus stimulus frequency. Results: In control conditions peak local SR during 64 Hz stimulation averaged 0.51 ± 0.104 mg min^-1 cm^-2 which was significantly (p<0.05) reduced by application of 50 mM TEA to 0.317 ± 0.060 mg min^-1 cm^-2. 100 mM TEA did not reduce peak sweat rate (0.542 ± 0.153 mg min^-1 cm^-2).

The stimulus-response curve during 50 mM TEA was significantly different from Control with a significant reduction in the plateau (0.302 ± 0.026 versus 0.254 ± 0.27; p<0.05) but with a similar EC<sub>50</sub> values (10.2 ± 1.1 and 6.7 ± 1.3 Hz for Control and 50 mM TEA, respectively). Conclusion: Blockade of BKCa channels does attenuate sweat gland function during axon reflex mediated sweating induced by intradermal electrical stimulation. Our data support the hypothesis that BKCa channels on the epithelial cells of the human sweat gland can modulate local sweat rate.

Impairments in heat dissipation in individuals with Type 2 Diabetes mellitus (T2D) have been observed during exercise in warm ambient conditions. This decline in heat loss may be related to diminished bioavailability of nitric oxide, an important contributor to the heat loss responses, due to increased oxidative stress. PURPOSE: To assess if local administration of ascorbate (ASC, a non-selective anti-oxidant) increases local heat loss responses of cutaneous vasodilation (CVC) and sweating during exercise in the heat in individuals with T2D. METHODS: Older adults (62 ± 9 years) with (n=10, T2D) and without (n=10, NoT2D) T2D, matched for age, body surface area and fitness performed 30-min of moderate-to-high intensity cycling (70% of VO<sub>2peak</sub>, followed by a 20-min recovery in the heat (35°C). Local CVC and sweat rate were assessed at four skin sites continuously perfused via intradermal microdialysis with either: 1) lactated Ringer (Control), 2) 10 mM ASC, 3) 10 mM N^6-nitro-L-arginine methyl ester (L-NAME, a non-selective NOS inhibitor), or 4) a combination of ASC+ L-NAME. Responses were compared at baseline, end-exercise and end of recovery.

RESULTS: In both T2D and NoT2D participants, CVC did not differ from Control at the ASC site throughout the protocol (all P>0.18). In T2D, CVC at the L-NAME site was attenuated throughout the protocol relative to Control with reductions of 17%, 16% and 16% during baseline, end-exercise and end of recovery, respectively (all P<0.05). In NoT2D, attenuations in CVC at the L-NAME site consisted of 18%, 29% and 23% from Control at the same respective time periods (all P<0.01). In T2D, CVC was attenuated at the combination site relative to Control throughout the protocol (baseline: 20%; end-exercise: 27% and end of recovery: 23%) (all P<0.01). Conversely, in NoT2D the combination of ASC+L-NAME attenuated CVC during basal (14%, P<0.01) and recovery (20%, P<0.01) only. No differences in sweat rate were observed between Control and any treatment site in either group (all P<0.10).

CONCLUSION: We show that oxidative stress does not impair CVC or sweating in T2D. Further, reducing oxidative stress in the presence of NOS inhibition in NoT2D alters other mechanisms in the regulation of CVC, however this response is not observed in adults with T2D. Supported by the Canadian Institutes of Health Research.

Purpose: The purpose of the present experiment was to quantify how maximum skin wettedness (ω<sub>sk</sub>) is altered by aerobic training, and compare it to what is achieved following heat acclimation (HA). METHODS: Eight sedentary individuals (6 males, 2 females) participated in an 8-week aerobic training regime followed by a 9-day heat acclimation (HA) protocol. Participants completed on separate days, i) a treadmill humidity ramp protocol to assess ω<sub>sk</sub> and ii) a 60-min treadmill march (450 W of heat production) in an uncomfortable environment: 38°C, 60% RH, on three separate occasions: pre-training (PRE-T), post-training (POST-T), and post-heat acclimation (POST-HA). Heart rate (HR), core temperature (T<sub>co</sub>) and mean skin temperature (T<sub>s</sub>) were recorded. Whole body sweat loss (WBLS) was calculated as the change in nude body mass and sweating efficiency (Swr) was derived by dividing the sweating
required to achieve $v_{\text{m}}$ (with 100% evaporation) by the actual whole-body sweat rate between the 30th and 60th minute of exercise. RESULTS: Aerobic training increased aerobic capacity by 14% (PRE-T: 45.6±11.8 mL·kg$^{-1}$·min$^{-1}$; POST-T: 52.0±11.1 mL·kg$^{-1}$·min$^{-1}$; P<0.001). In the humidity ramp trial, $v_{\text{m}}$ was lower PRE-T (0.75±0.07) compared to POST-T (0.87±0.12, P<0.01) and POST-HA (1.00±0.00, P<0.001), and POST-T was lower than POST-HA (P<0.04). In the UC trial, $T_{\text{SA}}$ was greater PRE-T (1.13±0.16°C) compared to POST-T (0.96±0.10°C, P<0.001) and POST-HA (0.96±0.20°C, P<0.001). PRE-T $T_{\text{SA}}$ was higher after 60-min (38.0±0.4°C) compared to POST-T (37.2±0.9°C, P<0.001) and POST-HA (37.1±0.4°C, P<0.001). WBSL was significantly greater POST-HA (913±126 g) compared to POST-T (794±78 g; P<0.002) and POST (671±83 g, P<0.001), however $S_{\text{m}}$ was similar throughout (PRE-T: 67±10%); POST-T: 68±11%; POST-HA: 66±8%). CONCLUSIONS: Aerobic training and HA independently increase $S_{\text{m}}$. The reduction in thermal strain during uncompensable heat stress is observed from PRE-T to POST-T, and to POST-HA.

1593 Board #268 June 1 9:00 AM - 10:30 AM The Effect of a Tattoo on Sweating Function
Maurie J. Luetkemeier, Joseph Hanisko, Kyle Aho. Alma College, Alma, MI.

Purpose: The purpose of this study was to compare the sweat volume and Na$^+$ concentration of tattooed and non-tattooed skin. METHODS: The participants were 10 healthy males (age = 21±1 yr) all with a unilateral tattoo covering a circular area 3-cm in diameter. Sweat was stimulated by iontophoresis using agar gel disks impregnated with 0.5% pilocarpine nitrate. The non-tattooed skin was located contralateral to the position of the tattooed skin. The disks used to collect sweat were composed of Tygon® tubing wound into a spiral so that the sweat was pulled into the tubing by capillary action. The sweat volume was determined by weighing the disk before and after sweat collection. The sweat Na$^+$ concentration was determined by flame photometry. RESULTS: The average volume of sweat collected from tattooed skin was significantly less than non-tattooed skin (19±15 ±1.5; 36±25 ±1; P<0.0001). All 10 participants generated less sweat from tattooed skin than non-tattooed skin and the effect was -0.77. The average sweat Na$^+$ concentration from tattooed skin was significantly higher than non-tattooed skin (69.1 ± 28.9-μEq/L vs. 42.6 ± 15.2-μEq/L; P<0.001). $S_{\text{m}}$ independently increase ω (CONCLUSIONS: 67±10%; POST-T: 68±11%; POST-HA: 66±8%).

1594 Board #269 June 1 9:00 AM - 10:30 AM Measurement Of Sweat Sodium Concentration In Exercising Individuals: Inter-instrument Reliability Of The B-722 Laqua Twin
Eric D.B. Goulet1, Lindsay B. Baker1. 1University of Sherbrooke, Sherbrooke, QC, Canada. 2Gatorade Sports Science Institute, Bellington, IL. Email: eric.goulet@usherbrooke.ca (No relationships reported)

Optimal replacement of sodium losses during or after prolonged exercise is best achieved when sweat losses and sweat sodium concentration are known. Both can be estimated under field conditions during a controlled test where the changes in body mass from before to after exercise is taken as a representation of sweat losses and sweat sodium samples are collected using the absorbent patches technique. The B-722 Laqua Twin (LaT), a low cost, battery operated, hand-held and easy-to-use sodium analyzer has been shown to have excellent intra- and inter-day reliability and sweat sodium samples are collected using the absorbent patches technique. The average volume of sweat collected from tattooed skin was significantly less than non-tattooed skin (19 ± 15 μL; 36 ± 25 μL; P<0.0001). All 10 participants generated less sweat from tattooed skin than non-tattooed skin and the effect was -0.77. The average sweat Na$^+$ concentration from tattooed skin was significantly higher than non-tattooed skin (69.1 ± 28.9 μEq/L vs. 42.6 ± 15.2 μEq/L; P<0.001). Nine of ten participants had higher sweat Na$^+$ concentration from tattooed skin than non-tattooed skin and the effect size was 1.01. CONCLUSION: Tattooed skin generated less sweat and a higher Na$^+$ concentration than non-tattooed skin when stimulated by pilocarpine iontophoresis.

1595 Board #270 June 1 9:00 AM - 10:30 AM Elevations In Biomarkers Of Acute Kidney Injury During Exercise Heat Stress: Evidence Of A Dose-response
Christopher L. Chapman, David Hostler, FACSM, Suman Sarker, Todd C. Rideout, Blair D. Johnson, Lindsey Russo, Zachary J. Schlader. University at Buffalo, Buffalo, NY. (Sponsor: David Hostler, FACSM) Email: cc338@buffalo.edu (No relationships reported)

Purpose: We tested the hypothesis that elevations in biomarkers of acute kidney injury (AKI) are influenced by the magnitude of hyperthermia and dehydration elicited by exercise in the heat. Methods: Nineteen healthy males (age = 22±3 yr) wearing firefighter protective clothing completed two trials where they walked on a treadmill (4.8 kph, 5% grade) in a 38°C, 50% relative humidity environment. In one trial subjects completed two 20 min exercise bouts (SHORT), and in the other three 20 min exercise bouts (LONG) were completed. Each exercise bout was separated by 10 min of standing rest. Venous blood samples were obtained before (Pre) and immediately post (Post) exercise, and following 1 h passive recovery in a moderate environment (Rec). Primary dependent variables were intestinal temperature, changes in body weight and plasma volume, plasma osmolality, serum creatinine, serum uric acid, and plasma neutrophil gelatinase associated lipocalin (NGAL), a marker of acute renal tubular injury. Glomerular filtration rate was estimated (eGFR) from creatinine. Data are presented as a change from Pre. Results: Changes in intestinal temperature (±1.0 ± 0.8 vs. 1.1 ± 0.3°C, P<0.01), body weight (-0.6 ± 0.7 vs. -0.7 ± 0.5°C, P=0.04) and plasma volume (-1.2 ± 0.5 vs. -0.6 ± 0.8, P=0.03) during exercise were exacerbated in LONG. Changes in osmolality during exercise did not differ between SHORT (+2 ± 3 mOsm/L) and LONG (+1 ± 4 mOsm/L, P=0.80). Increases in creatinine were greater in LONG at Post (0.18 ± 0.16 vs. 0.08 ± 0.06 mg/dL, P<0.01) and Rec (0.25 ± 0.19 vs. 0.18 ± 0.08 mg/dL, P<0.01). Increases in uric acid did not differ between SHORT (Post: 0.4 ± 0.2 vs. 0.4 ± 0.3 mg/dL) and LONG (Post: 0.5 ± 0.5, Rec: 0.8 ± 0.6 mg/dL). Reductions in eGFR were greater in LONG (Post: -15.5 ± 13.4 vs. -8.5 ± 5.5 mL/min/1.73 m², Rec: -21.0 ± 15.1 vs. -16.6 ± 6.6 mL/min/1.73 m², P=0.02). Increases in NGAL were greater in LONG at Post (21.9 ± 21.0 vs. 10.6 ± 9.6 mg/mL, P<0.01) and Rec (12.4 ± 9.8 vs. 2.1 ± 9.1 mg/mL, P=0.02). Conclusion: Elevations in biomarkers of AKI are influenced by the magnitude of hyperthermia and dehydration elicited by exercise in the heat. These changes are not likely due to the differential hyperosmolality or hyperuricemia. These findings are suggestive of a dose-response relationship between hyperthermia, dehydration and the magnitude of AKI.

1596 Board #271 June 1 9:00 AM - 10:30 AM Functional Changes in Motor Cortical Brain Regions following Passive and Exertional Heat Stress
Ivan C.C. Low1, X.R. Tan1, Mary C. Stephenson1, T.W. Soong1, Jason K.W. Lee, FACSM3. 1National University of Singapore, Singapore, Singapore. 2Agency for Science, Technology Research, Singapore, Singapore. 3DSO National Laboratories, Singapore, Singapore. (Sponsor: Lee Kai Wei Jason, FACSM) (No relationships reported)

Endurance performance is impaired when exercising in the heat. Hyperthermia-induced fatigue cannot be entirely explained by alterations in peripheral mechanisms. The central nervous system may have key roles in hyperthermia-induced fatigue and they warrant further investigations.

Purpose: To evaluate functional changes in the brain following passive or exertional heat stress.

Methods: Five moderately-trained athletes (mean ± SD: age 23.6 ± 1.7 years; body fat 9.3±2.0%, VO2max 58.6±8 mL·kg$^{-1}$·min$^{-1}$) underwent a motor-task-based oxygen-level-dependent (OODL) MRI scan while doing a water-perfused thermal suit in a familiarization and four randomized, counterbalanced trials. ODL MRI scans were conducted after (a) running on a motorized treadmill at 70% VO2max with ingestion of ambient water (EX) or (b) ice slurry (ICE), (c) passive heating via warm water immersion at 41°C (PAH), or (d) rest (CON). Serum osmolality was evaluated from blood samples collected at the start and end of each trial. Rectal temperature ($T_r$) and heart rate (HR) were assessed using two-way ANOVA with $p<0.05$ considered as significant.
RESULTS: Participants started all trials euthyroid (mean serum osmolality: 292 ± 1 mOsmol/kg; p = 0.719), with similar baseline HR (66 ± 2 beats/min; p = 0.098) and T\(_{\text{rec}}\) (36.9 ± 0.1°C). Post-intervention HR and T\(_{\text{rec}}\) remained well below fail criterion. Therefore, it is hypothesized that cardiorespiratory fitness, and not heat intolerance, may be the primary determinant of heat intolerance. Future work should seek to identify selection criteria for warfighters that would likely fail an HTT.

CONCLUSIONS: The presence of elevated HR in both hot and thermoneutral conditions, with evidence of lower V\(_{\text{O2max}}\), suggests further exploration of the utility of criterion, while T\(_{\text{rec}}\) remained well below fail criterion. Therefore, it is hypothesized that cardiorespiratory fitness, and not heat intolerance, may be the primary determinant of heat intolerance. Future work should seek to identify selection criteria for warfighters that would likely fail an HTT.

Conclusions: Heat tolerance testing has been utilized within military settings to assess one’s readiness to return to duty after sustaining an exertional heat stroke (EHS). The military protocol (2-h walk at 5km/h with a 2% grade in 40°C ambient temperature [T\(_{\text{rec}}\)] and 40% relative humidity [RH]) has also been applied in athletic settings to assist clinicians when returning athletes to play after EHS. However, the efficacy of the military protocol has been questioned for use in athletic settings due to its relatively low intensity compared to the physical demands of most sports.

Purpose: To examine the physiological responses from a modified heat tolerance test (mHTT) and identify potential measures to assess individual heat tolerance from mHTT.

Methods: Thirty participants completed a VO\(_{2\text{max}}\) test (T\(_{\text{rec}}\): 22 ± 1.1°C, RH: 39 ± 3.9%), and a mHTT trial (0.1°C for ICE trial; 0.0°C for CON trial). Task-based fMRI detected lower BOLD signals from primary motor cortex in PAH (fold changes from baseline: 0.46 ± 0.1°C for ICE trial and 36.3 ± 0.1°C for CON trial. Task-based fMRI detected lower BOLD signals from primary somatosensory cortex for PAH (0.39 ± 0.23) compared to EX (1.04 ± 0.18, p < 0.01) and CON trials (0.98 ± 0.10, p = 0.02).

Conclusions: Preliminary results from task-based fMRI analysis showed that passive heating led to functional suppression in the sensorimotor areas in the brain.

**Outcomes from a Modified Heat Tolerance Test to Track Thermal Strain**

Yuri Hosokawa, Luke N. Belval, William M. Adams, Robert A. Huggins, Yasuki Sekiguchi, Rebecca L. Starnes, Douglas J. Casa, FACSM. University of Connecticut, Storrs, CT. Email: yuri.hosokawa@uconn.edu

(No relationships reported)

Heat tolerance testing has been utilized within military settings to assess one’s readiness to return to duty after sustaining an exertional heat stroke (EHS). The military protocol (2-h walk at 5km/h with a 2% grade in 40°C ambient temperature [T\(_{\text{rec}}\)] and 40% relative humidity [RH]) has also been applied in athletic settings to assist clinicians when returning athletes to play after EHS. However, the efficacy of the military protocol has been questioned for use in athletic settings due to its relatively low intensity compared to the physical demands of most sports.

**PURPOSE:** To examine the physiological responses from a modified heat tolerance test (mHTT) and identify potential measures to assess individual heat tolerance from mHTT.

**METHODS:** Thirty participants completed a VO\(_{2\text{max}}\) test (T\(_{\text{rec}}\): 22 ± 1.1°C, RH: 39 ± 3.9%), and a mHTT trial (0.1°C for ICE trial; 0.0°C for CON trial). Task-based fMRI detected lower BOLD signals from primary motor cortex in PAH (fold changes from baseline: 0.46 ± 0.1°C for ICE trial and 36.3 ± 0.1°C for CON trial. Task-based fMRI detected lower BOLD signals from primary somatosensory cortex for PAH (0.39 ± 0.23) compared to EX (1.04 ± 0.18, p < 0.01) and CON trials (0.98 ± 0.10, p = 0.02).

**CONCLUSION:** Preliminary results from task-based fMRI analysis showed that passive heating led to functional suppression in the sensorimotor areas in the brain. Supported by DFRP Grant, No. 95102335.

**RESULTS:** Participants started all trials euthyroid (mean serum osmolality: 292 ± 1 mOsmol/kg; p = 0.719), with similar baseline HR (66 ± 2 beats/min; p = 0.098) and T\(_{\text{rec}}\) (36.9 ± 0.1°C). Post-intervention HR and T\(_{\text{rec}}\) remained well below fail criterion. Therefore, it is hypothesized that cardiorespiratory fitness, and not heat intolerance, may be the primary determinant of heat intolerance. Future work should seek to identify selection criteria for warfighters that would likely fail an HTT.

**CONCLUSIONS:** The presence of elevated HR in both hot and thermoneutral conditions, with evidence of lower V\(_{\text{O2max}}\), suggests further exploration of the utility of criterion, while T\(_{\text{rec}}\) remained well below fail criterion. Therefore, it is hypothesized that cardiorespiratory fitness, and not heat intolerance, may be the primary determinant of heat intolerance. Future work should seek to identify selection criteria for warfighters that would likely fail an HTT.

Military personnel who have suffered a heat stroke injury may have to undergo a heat tolerance test (HTT). The HTT is usually a “one-test, one-attempt” to assess a heat-injured warfighter’s thermoregulatory capacity with implications of discontinued training, reassignment, or separation, if not passed. An HTT is passed if heart rate (HR) and core temperature do not exceed 160 bpm and 38.6°C, respectively, after 120 min has elapsed. It is hypothesized that pre-screening individuals to assess their HR response prior to an HTT could reduce the risk of a failed test.

**PURPOSE:** To determine if exercising in a thermoneutral environment, prior to an HTT, can accurately correlate with an end of trial (EOT) HR during exercise in the heat.

**METHODS:** Ten trained individuals (age: 25.7 ± 2.3 yrs, height: 171.1 ± 7.6 cm, weight: 63.3 ± 9.5 kg) completed 120 min of continuous treadmill walking (3.3 mph, 4% grade) in a thermoneutral (22°C, 40% relative humidity) and hot (40°C, 40% relative humidity) environment to assess HR response. All trials were conducted in the morning and required a urine specific gravity of <1.018 to start. During each trial, HR was monitored every 5 min until EOT and HR at 30 min was correlated with EOT HR within each trial and between the thermoneutral and hot trials.

**RESULTS:** There was a strong correlation (30 min HR versus EOT HR) for thermoneutral and hot trials, r = 0.94, r = 0.91, respectively. Additionally, there was a strong correlation between thermoneutral 30 min HR and hot EOT HR, r = 0.83. Significance of actual vs. predicted EOT HR for thermoneutral, hot, and thermoneutral-hot comparisons were p = .99, p = .80, and p = .92, respectively.

**CONCLUSIONS:** These findings suggest exercise in thermoneutral conditions accurately correlates with EOT HR when performing exercise in the heat. By pre-screening warfighters in thermoneutral conditions prior to their HTT, it may be possible to reduce HTT failures due to inadequate aerobic conditioning rather than inadequate thermoregulatory capacity. Future work should seek to identify selection criteria for warfighters that would likely fail an HTT.

**Accuracy Of ECTemp Models In Predicting Core Temperature And Circadian Rhythm Indicators From Heart Rate**

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(No relationships reported)
difference between finish time (FT) and predicted FT ($R^2 = 0.07\pm 0.06°C$ vs. $0.15\pm 0.07°C$ at $r = 0.06 < 0.01$) but similar for amplitude ($0.80\pm 0.07°C$ vs. $0.90\pm 0.06°C$, $r = 0.74$).

CONCLUSIONS: While both models performed well (overall $R^2 = 0.28\pm 0.14$), the Sigmoid model had more accurate estimates of exercise and rest CT as well as closer estimates of circadian rhythm indicators. Consequently, the modified CTemp model appears to have potential as a CT estimator in conditions unsuitable for direct CT measurement regardless of activity level. Disclaimer: The views expressed are those of the authors and do not reflect the official policy of the Department of Defense, or the U.S. Government.

**Exertional Heat Stress Increases Metabolic and Physiological Responses to Exercise**

Utilizing Machine Learning

Comparison Of Rectal Temperature Prediction Models Utilizing Machine Learning

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**Exertional heat stress increases gastrointestinal barrier permeability and risk of exertional heatstroke (EHS) via a TL1A-mediated inflammatory pathway. Oral curcumin supplementation is known to inhibit both the MyD88 & TRIF-dependent pathways of TL1A signaling.** PURPOSE: This work investigated the effect of 3d of 500mg/d dietary curcumin supplementation on gastrointestinal (GI) barrier permeability and systems-physiology responses to exertional heat stress in non-heat acclimated humans. METHODS: Eight subjects ran (65%VO_{2,max}) for 60min in a Darwin® chamber (37°C/26%RH) two times (CURCUMIN/PLACEBO). Ingested fatty acid binding protein (I-FABP) and associated pro-inflammatory (MCP-1, TNFα, IL-6) and anti-inflammatory (IL-1ra, IL-10) cytokines were assayed from plasma collected before (PRE), after (POST), 1hr (1-POST), and 4hrs after (4-POST) exercise. Core (Tc), skin (Tsk), and mean body temperature (Tb) during exercise, Tb, and physiological stress index (PSI) were measured throughout exercise. Group differences were determined with 2-way (Condition x Time) MANOVAs. RESULTS: Intriguingly, the interaction of Condition x Time was significant (p<0.05) for I-FABP and IL-1ra. Post hoc analysis indicated the increase in I-FABP from PRE to POST (87%) was greater than in CURCUMIN (39%) and 1-POST (33%) in PLACEBO. Consistent with CURCUMIN, IL-1ra increased at POST (18%) and 4-POST (35%) in PLACEBO but not CURCUMIN. The PSI, which indicates EHS risk, was also lower (p<0.05) in CURCUMIN from PRE to POST (61%) and 1-POST (42%) in PLACEBO but not CURCUMIN. The PSI is a measure of multiple factors such as Tc, heart rate, respiratory rate, and physiological stress index (PSI). The PSI was measured throughout exercise. Peripheral blood mononuclear cells (PBMC) were isolated from blood samples that were taken before (PRE), after (POST), 1hr (1-POST), and 4hrs after (4-POST) exercise. The protein content of markers along the TLR4 signaling pathway (TLR4, toll-like receptor 4) and the cytokines IL-1α, IL-1β, IL-6, IL-10, TNFα, and MCP-1 were measured.

**Curcumin Improves Systemic Responses to Exertional Hyperthermia but Doesn’t Alter Protein Expression in Circulating Leukocytes**

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(No relationships reported)

**Curcumin improves systemic responses to exertional hyperthermia but doesn’t alter protein expression in circulating leukocytes.**
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**Comparison of Lower-Body Only and Lower-Body with Upper-Body Resistance Exercise**

**Methods:** Ten subjects (ages 19-92; 2.4 y; height=179.1±8.6 cm; mass=81.4±7.7 kg) participated in the study. Experimental visits consisted of either a LB or (UB) condition. Depicted UB participated in a three circuit of 1RM competition maximum (1RM) hip sled and 80% 1RM lat pull-down exercises to failure followed by a final 90% 1RM hip sled set to failure. During LB, participants completed four sets of hip sled to failure at 90% of 1RM. The beginning of each hip sled set was separated by 4-minutes. For all sets a thermostated sample vastus lateralis temperature was measured.

**Conclusion:** Resistance exercise without muscle damage and sustained muscle temperature above 38.6°C are required to enhance muscle performance.

**Intramuscular Temperature Changes During Warm-up and Cycling Exercise**

**Purpose:** To examine the effect of different warm-up protocols on intramuscular temperature during an exercise protocol.

**Methods:** Participants were divided into two groups: control (C) and cycling (CYC). The warm-up and cycling exercise protocol for both groups involved 5 minutes of walking and 2 sets of 6 repetitions of a 1/4 squat with a 90° knee flexion angle. The main difference between the two groups was that the CYC group cycled for 5 minutes at 40% of their maximal power output (mean ± SD = 234 ± 78 W) immediately before the beginning of the main protocol.

**Results:** There were no significant differences in intramuscular temperature between the two groups, with values ranging from 36.5°C to 38.1°C throughout the exercise protocol.

**Conclusion:** The effect of a cycling warm-up on intramuscular temperature during cycling exercise is minimal.

**Impact of Heat Stress and Prolonged Exercise on the Oral Microbiome of Individuals Engaged in Equestrian Activities**

**Methods:** The study recruited 30 participants, 15 men and 15 women, who engaged in equestrian activities under exertional heat stress conditions. Oral samples were collected under these conditions and analyzed for their microbiome content.

**Results:** The study found that prolonged exercise in the heat led to significant changes in the oral microbiome, with a shift towards lower abundance of Firmicutes and higher abundance of Bacteroidetes in both men and women. Furthermore, the study observed a sex difference in the microbiome composition, with a greater shift in men compared to women.

**Conclusion:** Prolonged exercise in the heat may lead to shifts in the oral microbiome, potentially affecting the immune function of the oral cavity.

**Environmental Factors Affecting Microbiome Composition in Response to Heat Stress**

**Methods:** The study recruited 20 participants, 10 men and 10 women, who engaged in prolonged exercise under heat stress conditions. Oral samples were collected before and after exercise and analyzed for their microbiome composition.

**Results:** The study found that prolonged exercise under heat stress led to a significant shift in the oral microbiome composition, with a decrease in the abundance of Firmicutes and an increase in Bacteroidetes. This shift was more pronounced in women compared to men.

**Conclusion:** Heat stress affects the composition of the oral microbiome, with implications for oral health.

**Deep Tissue Heating Increases Mitochondrial Respiratory Capacity of Human Skeletal Muscle**

**Methods:** The study recruited 10 healthy men and women, who engaged in deep tissue heating under CURCUMIN and PLACEBO conditions. Muscle biopsies were taken before and after the heating protocol and analyzed for mitochondrial respiratory capacity.

**Results:** Deep tissue heating under CURCUMIN increased mitochondrial respiratory capacity, while PLACEBO had no effect. The increase in mitochondrial respiratory capacity was more pronounced in women compared to men.

**Conclusion:** Deep tissue heating increases mitochondrial respiratory capacity of human skeletal muscle, with potential therapeutic implications.

**Effects Of Lower-body Versus Upper- And Lower-body Resistance Exercise On Intramuscular Temperature**

**Methods:** The study recruited 10 healthy men and women, who engaged in lower-body (LB) and lower-body with upper-body (UB) resistance exercise. Intramuscular temperature was measured in the vastus lateralis during the exercise protocol.

**Results:** There were no significant differences in intramuscular temperature between the two groups, with values ranging from 36.5°C to 38.6°C throughout the exercise protocol.

**Conclusion:** Lower-body and lower-body with upper-body resistance exercise have similar effects on intramuscular temperature.
RESULTS: Temperature had no effect on MSTN (p = .967), MYF5 (p = .444), MYF6 (p = .343), MYF7 (p = .458), MYOD (p = .201), FOXO3 (p = .102), atragon1 (p = .543), or MRUR1 (p = .693). MSTN, MYF5, and FOXO3 decreased over the 3 h trial period (p < .001, p = .003, p = .004 respectively), whereas MYF6 and MYOD increased (p = .026, p = .004, respectively). Core temperature was significantly higher in hot (37.2 ± 0.1 °C, p = .001) and cold (37.1 ± 0.1 °C, p = .013) environments compared to room temperature (36.9 ± 0.1 °C). Whole body oxygen consumption was monitored during the 3 h exposure. Muscle samples were analyzed for gene expression using qRT-PCR. RESULTS: Temperature exhibited a heightened inflammatory response [p-IKKα/β (+81%, p = .04), p-IKβs (+432%, p = .01), p-NFκB5p65 (+283%, p = .04)]. Intermediate enzymes of lipid [p-ACC (+33%, p = .02)] and glycerone [p-OGSKα/β (+367%, p = .03)] biosynthesis were also down regulated, with elevated p-AMPK (±80%, p = .01) suggesting an energetic deficit. Apoptosis activators Caspase 8 (+53%, p = .04) and FOXO1 (+74%, p = .02) were up regulated, as was p-JNK (+41%, p = .03). Through follow-up analysis we determined these undesirable responses were linked to up-regulation of TLR4 (+24%, p = .03) and MyD88 (+308%, p = .01), as well as p-NIK (+199%, p = .02) but not IRAK-1 (p = .46). Conclusion: Despite a robust activation of the HSR, repeated thermal stress imparts an exaggerated pro-inflammatory and pro-apoptotic response to LPS stimulation in C2C12 myotubes. This may be due to elevated TLR4 signaling capacity. We speculate that reduced glycogen storage in HEAT may have contributed to lower stress tolerance, with the upregulation of apoptosis serving as a negative–feedback mechanism (to reduce myotube number).

PURPOSE: The purpose of this study was to compare the effects of exposure to hot, cold, and room temperature conditions on skeletal muscle gene expression related to myogenesis and proteolysis. When considered in conjunction with previous research, many human diseases lead to loss of skeletal muscle function and mass. Local and environmental temperature can alter the exercise-stimulated response of several genes involved in skeletal muscle growth and breakdown. However, the impact of environmental temperature, independent of exercise, has not been addressed in a human model. PURPOSE: The purpose of this study was to compare the effects of exposure to hot, cold, and room temperature conditions on skeletal muscle gene expression related to myogenesis and proteolysis. METHODS: Recreationally trained male subjects (n=11, age 27 ± 5, height 183 ± 5 cm, weight 84.1 ± 13.0 kg) each completed three trials in hot (33 °C), cold (7 °C), and room temperature (20 °C) conditions. Whole body oxygen consumption was monitored during the 3 h exposure. Muscle biopsies were taken from the vastus lateralis before and after the 3 h temperature exposure. Muscle samples were analyzed for gene expression using qRT-PCR. RESULTS: Temperature had no effect on MSTN (p = .967), MYOG (p = .444), MYF5 (p = .343), MYF6 (p = .458), MYOD (p = .201), FOXO3 (p = .102), atragon1 (p = .543), or MRUR1 (p = .693). MSTN, MYF5, and FOXO3 decreased over the 3 h trial period (p < .001, p = .003, p = .004 respectively), whereas MYF6 and MYOD increased (p = .026, p = .004, respectively). Core temperature was significantly higher in hot (37.2 ± 0.1 °C, p = .001) and cold (37.1 ± 0.1 °C, p = .013) environments compared to room temperature (36.9 ± 0.1 °C). Whole body oxygen consumption was also significantly higher in hot (0.38 ± 0.01 L/min, p < .001) and cold (0.52 ± 0.03 L/min, p = .001) compared to room temperature (0.35 ± 0.01 L/min). CONCLUSIONS: These data demonstrate that acute temperature exposure alone does not elicit significant changes in muscle gene expression related to myogenesis and proteolysis. When considered in conjunction with previous research, exercise appears to be a necessary component to observe gene expression alterations between different environmental temperatures in humans.

Supported by the National Institute for General Medical Science (NIGMS, 5P20GM103427 and P20GM109090), a component of the National Institutes of Health (NIH).
technologies were used to determine the relationship between exercise-induced increases in IL-6 and lipid-related metabolites. METHODS: Male runners (N=24, age 36.5±1.8 y) ran on treadmill to exhaustion (2:26±0.1 h, 24.9±1.3 km, 69±1.9% VO2peak) with vastus lateralis muscle biopsy and blood samples collected before and after the running bout. RESULTS: The runners experienced a 33.7±4.2% decrease in muscle glycogen, 39.0±8.8%, 24.0±4.3%, and 1:4.1:0.1-fold increases in plasma IL-6, IL-8, and MCP-1, respectively, and 95.0±18.9% and 158±0.6% increases in cortisol and epinephrine, respectively (all P<0.05). The metabolomics analysis revealed changes in 209 plasma metabolites, especially long- and medium-chain fatty acids, fatty acid oxidation products (dicarboxylic and monohydroxy fatty acids, acylcarnitines), and ketone bodies. OPLS-DA modeling supported a strong separation in pre- and post-exercise samples (R2Y=0.964, Q2Y=0.902). OPLS-AR analysis failed to produce a viable model for the relationship between IL-6 and all lipid-related metabolites (R2Y = 0.76, Q2Y = 0.0748), but did reveal a relationship between changes in serum cortisol and lipid-related metabolites (R2Y=1, Q2Y = 0.434). Multiple structure equation models were evaluated based on IL-6, with the best fit pathway model showing a linkage of exercise time to IL-6, then carnitine, and 13-methylaminopyridine acid (a marker for adipose tissue lipolysis) and sebacate. CONCLUSION: This metabolomics-based analysis showed that the substantial increase in lipid metabolites after prolonged and intensive running was related more to changes in cortisol than increases in IL-6 and epinephrine, or muscle glycogen depletion. Taken together, the metabolomics-based data from this study do not support a strong relationship between the modest increase in IL-6 and the large increase in lipid-related metabolites following prolonged and intensive running.

Funding: Reoxcyn Discoveries Group, Salt Lake City, UT.

1613 Board #288 June 1 8:00 AM - 9:30 AM

Apopotis Of Human Peripheral Blood Mononuclear Cells Following Maximal Aerobic Exercise In Obesity

Chun-Jung Huang, FACS*, Aaron L. Slusher*, Peter J. Ferrandi†, Michael Whitehurst, FACS*. †Florida Atlantic University, Boca Raton, FL. *Virginia Commonwealth University, Richmond, VA.

(No relationships reported)

PURPOSE: The pro-apoptotic (BAX) and anti-apoptotic (BCL-2) proteins have been shown to play an essential role in the regulation of exercise-mediated leukocyte apoptosis. These apoptosis-related proteins are up-regulated in peripheral blood mononuclear cells (PBMCs) of obese individuals; however, the impact of acute exercise-mediated apoptosis still remains unclear. Therefore, the purpose of this study was to investigate whether or not obesity would modify the expression of BAX and BCL-2 following maximal aerobic exercise.

METHODS: Twenty one healthy obese (N=10; 22±2yrs) and normal-weight (N=11; 23±4yrs) subjects participated in an acute bout of maximal aerobic exercise. Blood samples were collected prior to, immediately after exercise, and one hour into recovery (R1H) for analyses of BAX and BCL-2 using the Western Blot technique.

RESULTS: A similar expression of BAX and BCL-2 at baseline was observed between obese and normal-weight subjects. Furthermore, repeated measures analyses of variance (ANOVA)s demonstrated a significant elevation in BAX immediately following exercise in both groups (p=0.017). While no group by time interaction was found for BCL-2, a significant decrease from baseline to R1H was observed (p=0.010).

CONCLUSIONS: Our results support that acute exercise mediates a transient alteration of apoptosis in human PBMCs. Further investigation on how exercise training may potentially delay the process of leukocyte apoptosis can promote an effective immune response in obesity.

1614 Board #289 June 1 8:00 AM - 9:30 AM

Effect of Low Level Laser on Nasal Mucosa Immunity of Rats with Six-week Incremental Exercise

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(No relationships reported)

PURPOSE: Nasal mucosal immune suppression, induced by long-term high-intensity training, could lead to an increasing risk of upper respiratory tract infections. This study aimed to examine the effect of laser irradiation on nasal mucosa structure and nasal immune function.

METHODS: 16 male Sprague Dawley rats, aged 8 weeks, were randomly divided into 4 groups: Control (C), Exercise (E), E+Low power laser (EL, 1 mw, 6.79 J/cm²), and E+High power laser (EH, 2 mw, 13.58J/cm²). The rats in all E-related groups underwent an incremental treadmill exercise protocol: 6 days/week, 30 min/day; 10 m/min velocity during wk1, 20 m/min for wk2, with 5 m/min/wk increment in the following weeks. The laser treatments were He-Ne laser (2 h after exercise, 2 min) at two irradiation point (each side of the nasal ala). Pre- and post-6-week intervention, Structure of mucosa of nose was observed by HE staining, slgA concentration of nasopharyngeal washing were examined by ELISA, and the expression of CD4+ and CD8+T lymphocytes of nasal mucosa were analyzed by immunohistochemistry.

RESULTS: 1) Following changes (p<0.01) occurred in Exercise group after 6-wk exercise: nasal mucosa was seriously damaged, cilia layer of free edge essentially fell off, and the decline of slgA (↓57%, ES=0.77) level and ratio of CD4+/CD8+ (↓41%, ES=0.53) were observed in nasal mucosa. 2) Compared with E group, the structure of nasal mucosa were obviously improved in EL group. In addition, the slgA concentration (↑107%, p<0.01, ES=0.55), CD4+ cells (↑127%, p<0.01, ES=0.59), and ratio of CD4+/CD8+ (↑40%, p<0.05, ES=0.36) of nasal mucosa were enhanced markedly in EL group Compared with that of E group. 3) However, compared with E group, the EH treatment did not show significant effects as those by the EL group (p>0.05), with the following changes: slgA (↑40%, ES=0.29), CD8+ (↑12%, ES=0.13), and ratio of CD4+/CD8+ (↑20%, ES=0.15).

CONCLUSIONS: The long-term high-intensity exercise training would lead to destruction of nasal mucosa structure and the declining of nasal immune function. Low energy laser irradiation, especially EL treatment, had a beneficial effect on nasal mucosa immune function.

1615 Board #290 June 1 8:00 AM - 9:30 AM

Brief Exercise Enhances NK Cell Killing Activity in Children Who Survived Acute Lymphoblastic Leukemia (ALL)

Fadia Haddad1, Leonard S. Sender2, Martin Perlsteyn3, Dan M. Cooper1, Frank P. Zaldivar1, Ronen Bar-Yoseph1, Shlomit Rudom-Azikh1, †University of California, Irvine, Irvine, CA. 2CHOC Children’s Hospital, Orange, CA.

(No relationships reported)

Natural Killers (NK) cells are unique innate immune cells that increase up to 5 fold in the circulation with brief exercise and are known to play a key role in immune surveillance and first-response defense against pathogens and cancer. PURPOSE: To study the effect of brief bout of exercise on NK cells cytotoxic function in both healthy children and those who survived acute lymphoblastic leukemia (ALL) using NK cell killing activity assay.

METHODS: 8 ALL children in remission and 7 age-matched controls (11-17 y.o.) performed 16 min cycle ergometer interval exercise at a constant work equivalent to 64±1% peak VO2. PBMCs were isolated before (BL) and immediately after (PK) exercise. Flow-cytometry was used to detect NK cell cytotoxicity against erythroleukemic cells (K562) using NKTEST® kit (Allele Biotechnology, San Diego) in various PBMC effector: target (T) ratios (12.5, 25, and 50 to 1). At the 25:1 ratio, IL2 activation was also quantified. NK Kill activity is reported as % (proportion of dead vs. total target cells). A two way ANOVA was used to detect differences between PK vs BL and ALL vs Controls. RESULTS: Brief exercise enhanced NK cell killing activity similarly for both ALL and Controls (Figure 1A). NK cell kill activity was significantly increased in response to IL2 at both BL and PK (Figure 1B). Activation by IL2 was reduced in ALL compared to Controls (51% vs. 123%). The reduced activity was partially mitigated following exercise but remained lower than controls (74% vs. 147%). CONCLUSION: We speculate that exercise-induced NK cell killing activity may contribute to the previously identified cancer surveillance properties of NK cells. Exercise has the potential to be used as adjunctive therapy in ALL. Supported by UCI SOM Faculty Grant, NIH Grant P01HD-048721 & PERC System Biology Fund.
Previous studies have reported an enhanced antibody response following vaccination coupled with acute exercise. Researchers have speculated that this immunomodulation may be due to the release of damage-associated molecular patterns in response to exercise and the concomitant migration of dendritic cells to lymph nodes. Because the majority of work in this area has been done in humans, rendering the invasive techniques required unrealistic, no study has yet examined the cell populations within the lymph nodes following acute exercise. PURPOSE: To determine if acute exercise changes the dendritic cell population within lymph nodes draining the exercising muscle.

METHODS: Female BALB/c mice received an intramuscular injection of physiological saline in right and left quadriceps, and then performed either 90 minutes of moderate intensity treadmill running (EX) or remained near the treadmill without running (NO EX). Twenty-four hours following the injections, mice were euthanized (n = 7 per treatment group) and inguinal lymph nodes were collected. Cell populations within the inguinal lymph nodes were processed by flow cytometry using the antibodies allophycocyanin-Cy7-conjugated anti-mouse CD11c and Alexa Fluor 700-conjugated anti-mouse MHC Class II (MHCII). Results were analyzed using FlowJo.

RESULTS: Exercise did not significantly alter total cell number within the lymph nodes (EX: 5.86E+06 ± 8.37E+05 vs. NO EX: 4.82E+06 ± 8.44E+05, p = 0.40). However, EX mice had both a higher percentage (16.3 ± 4.69% vs. 5.25 ± 1.53%, p = 0.03) and absolute number (2.53E+06 ± 2.73E+06 vs. 7.24E+05 ± 0.00, p = 0.00) of CD11c+ MHCII+ cells present in the inguinal lymph nodes as compared to NO EX mice. Exercise had no effect on the expression of the costimulatory molecules CD80 (Rho=0.71, p<0.05), the concentration of HSCs tended to be increased (2 fold, p=0.099), and decrease the presence of pre exercise effector cells was significantly lower (Rho=-0.69, p<0.05). Exercise did not significantly alter total cell number within the lymph nodes following acute exercise.
difference in cytotoxicity of pre, post, 1h post effectors incubated with pre-exercise serum (Pre vs. post vs.1h post =-0.321±0.046 vs. 0.282±0.047 vs. 0.233±0.047, p<0.05).

CONCLUSION: 1h post exercise serum enhanced resting NK cell cytotoxicity, indicating that factors present in serum after acute exercise can prime effector cell function. Future work will identify levels of glucocorticoids and cytokines present in 1h post exercise serum.

C-47 Free Communication/Poster - Muscle Dynamics

Thursday, June 1, 2017, 7:30 AM - 12:30 PM
Room: Hall F

1620 Board #295 06:00 AM - 10:30 AM
Changes in Quadriceps Motoneuron Pool Excitability due to Static Stretch and/or Explosive Contraction

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(No relationships reported)

PURPOSE: To observe how static stretch and/or explosive contraction (vertical jump) changes quadriceps motoneuron pool excitability (MNPE). METHODS: Fifteen healthy people (13 males and 2 females) completed four data collection sessions on separate days with a 48-hour interval between sessions. A 4 (condition) × 3 (time) cross-over randomised controlled laboratory study was performed. Conditions were A) stretching and jumping, B) control (no stretching) and jumping, C) stretching and control (no jumping), and D) control (no stretching and jumping). Thomas test was used to stretch both quadriceps (30 ± 5 for each quadriceps). For jumping, two-legged maximal vertical jumps were performed (assessed by Vertec: 3 trials with a 30-s rest interval). To assess quadriceps MNPE, the right side of vastus medialis peak Hoffmann reflexes normalised by peak motor response were recorded at baseline, 0-min post-condition, and 20-min post-condition. For the conditions including the jumping task, jump heights were also recorded after measurements of MNPE at each time point. To test condition effects over time, mixed model analysis of variances were performed and between-time effect sizes (ES) were calculated. RESULTS: Quadriceps MNPE did not change among four conditions at any time point (Fmax, t=1.71, p=0.12). There was a trend that quadriceps MNPE at 0-min post-condition, as compared to the baseline values, was reduced under the condition A (5%, ES=0.46) and C (8%, ES=0.43), and increased under the condition B (10%, ES=0.46). An increased quadriceps MNPE under the condition A appeared to be maintained until the 20-min post-condition measurement (8%, ES=0.52). Jump heights did not change among two conditions (A and B) at any time point (Fmax, t=2.14, p=0.13). Jump heights between-time ES were very small (<0.1 for all values). CONCLUSIONS: Our data suggest that (1) static stretch and/or explosive contraction may increase MNPE for 20-min, (2) a combination of static stretch and explosive contraction may decrease MNPE, (4) three sets of 30-s stretch does not acutely affect explosive performance, and (5) changes in MNPE may reduce MNPE, (2) explosive contraction may increase MNPE for 20-min, (3) a change in MNPE may reduce MNPE, (4) explosion may increase MNPE for 20-min, and (5) changes in MNPE may reduce MNPE.

1621 Board #296 06:00 AM - 10:30 AM
Trunk And Hip Flexor Muscle EMG Responses To Four Phases Of Two Different Style Sit-Ups
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(No relationships reported)

We previously found that a modified sit-up (MSU) emphasizing the abdominal muscles and a freestyle (FS) sit-up elicited similar abdominal and hip flexor muscle electromyographic (EMG) activity. PURPOSE: To investigate the interaction between muscle activity and trunk movement, this study compared the effects of the MSU and FS on EMG activity and kinematics during four sequential phases of the sit-up, where each of the following was the dominant action: (1) concentric trunk flexion, (2) concentric hip flexion, (3) eccentric hip extension, and (4) eccentric trunk extension.

METHODS: Twenty male subjects (23.8 ± 3.5 years) performed each exercise for 30 seconds, which were performed in a randomized order: (1) concentric trunk flexion, (2) eccentric trunk extension, (3) eccentric hip extension, and (4) concentric hip flexion. Under conditions B (1h post exercise serum) versus C (1h post exercise serum), jump heights were also recorded after measurements of MNPE at each time point. To test condition effects over time, mixed model analysis of variances were performed and between-time effect sizes (ES) were calculated. RESULTS: Quadriceps MNPE did not change among four conditions at any time point (Fmax, t=1.71, p=0.12). There was a trend that quadriceps MNPE at 0-min post-condition, as compared to the baseline values, was reduced under the condition A (5%, ES=0.46) and C (8%, ES=0.43), and increased under the condition B (10%, ES=0.46). An increased quadriceps MNPE under the condition A appeared to be maintained until the 20-min post-condition measurement (8%, ES=0.52). Jump heights did not change among two conditions (A and B) at any time point (Fmax, t=2.14, p=0.13). Jump heights between-time ES were very small (<0.1 for all values). CONCLUSIONS: Our data suggest that (1) static stretch and/or explosive contraction may increase MNPE for 20-min, (2) a combination of static stretch and explosive contraction may decrease MNPE, (4) three sets of 30-s stretch does not acutely affect explosive performance, and (5) changes in MNPE may reduce MNPE.

In order to complement sport training and to induce regeneration processes of muscle, ice pack application (IPA) is often used by athletes. Physiological mechanisms are relatively well investigated while there is faintly research aimed at investigating muscle contractile properties (MCP) after IPA treatment. To test the acute effects of IPA cooling on MCP, we used tensiomyography (TMG), as a non-invasive and selective method of neuromuscular assessment.

PURPOSE: To investigate the influence of IPA on MCP by TMG method.

METHODS: Sixteen healthy male participants (50% males; 19-20 y) participated in this study. Tensiomyographic assessment was performed before and immediately after 15 minutes of IPA treatment on vastus medialis. From tensiomyographic response we extracted and analysed delay time (Td), contraction time (Tc), half-recovery time (Tr), and maximal displacement (Dm).

RESULTS: After IPA we found that Td, Tc, and Tr time values increased (p<0.010) by 6.2% (ES=2.61), 6.0% (ES=2.06), 29.7% (ES=1.99), and 26.6% (ES=2.01), respectively, while Dm decreased (p=0.001) by 12.7% (ES=2.61).

CONCLUSION: Our results suggest that IPA treatment significantly altered MCP after only 15 minutes of exposure. This plays an important role in skeletal muscle behavior immediately after cooling procedures and should be taken into account when planning training or rehabilitation programs.

1623 Board #298 06:00 AM - 10:30 AM
Effects of Different Neuromuscular Electrical Stimulation Parameters on Quadriceps Neuromuscular Performance in Competitive Athletes
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(No relationships reported)

Purpose: To evaluate the effects of six weeks of training with two different types of neuromuscular electrostimulation (NMES) currents on muscle performance in competitive athletes. Methods: This controlled and randomized clinical trial included 20 athletes, equally divided into three groups: medium frequency current group with 500 μs (MF-500) (n=7), low frequency current group of with 500 μs (LC-500) (n=5) and control group (CG) (n=8). Each group had evaluated, before and after the intervention: the peak torque of knee (PT), muscle thickness and signs of electromyography (EMG) of the vastus lateralis (VL), and the sensory discomfort level (V AS). The training with NMES was performed 3 times per week and consisted of 18 sessions, 15 minutes per session (36 isotonic voluntary contractions per session), 6s duration in each contraction (with 1s rise time - TON and 1s descent time - TOFF). For statistical analysis of homogeneity was applied Levene’s test. Mixed ANOVA test was used to verify the existence of significant differences between the measurements. The significance level was 5%. Results: There was no significant difference between any groups for all variables (p>0.05): PT (MF-500: pre = 225.2 ± 42.2 Nm and post = 219.9 ± 54 Nm; PC500: pre = 231.1 ± 82.2 Nm and post = 244.3 ± 79.9 Nm; CG: pre = 234 ± 40.1 Nm and post = 225.3 ± 43.2 Nm), muscle thickness (MF-500: pre = 22.9 ± 2.5 mm and post = 23.7 ± 2.8 mm; PC500: pre = 23.5 ± 2.6 mm and post = 23.5 ± 2.7 mm; CG: pre = 25.9 ± 4.7 mm and post = 25.9 ± 4.7 mm) and EMG (MEF-500: pre = 0.4 ± 0.4 RMS and post = 0.5 ± 0.5 RMS; PC-500: pre = 0.7 ± 0.4 RMS and post = 0.7 ± 0.3 RMS; CG: pre = 0.8 ± 0.5 RMS and post = 0.7 ± 0.4 RMS). In addition, all current produced similar levels of discomfort, with no significant difference (p>0.05) in the...
**PURPOSE:** Limited studies have compared upper and lower body strength and flexion/extension ratio (F/E) differences at various contraction velocities between males and females participating in resistance training. F/E ratios typically range from 0.50 to 0.75 where lower ratios may be indicative of increased injury risk. These experiments tested the hypothesis that the strength differences between genders would decline as contraction speed increased while F/E would not be different between genders. METHODS: Subjects (n=10 females and 10 males, mean age 21±0.9 yrs old) completed shoulder and knee flexion and extension on a Biodex isokinetic dynamometer at 60, 180 to 300 °/sec. The time spent performing resistance training was unaffected by gender or contraction speed. CONCLUSIONS: These results and 0.63±0.06 at 60 °/sec vs 0.65±0.3 and 0.88±0.09 at 180 °/sec. Shoulder F/E in males was significantly greater than females for flexion and extension at all speeds and 0.63±0.06 at 60 °/sec vs 0.65±0.3 and 0.88±0.09 at 180 °/sec, respectively. Shoulder flexion, male T/BW was 36 and 40% higher than females at 60, 180, and 300 °/sec, respectively. For shoulder extension, male T/BW was 36 and 40% higher than females at 60 and 180 °/sec, respectively. T/BW increased with decreased contraction speed for both genders and knee flexion in males and knee flexion in females (p<0.05). For knee flexion, male T/BW was 33, 41, and 45% higher than females, at 60, 180, and 300 °/sec respectively. For knee flexion, male T/BW was 31, 36, and 37% higher than females at 60, 180, and 300 °/sec respectively. For shoulder extension, male T/BW was 36 and 40% higher than females at 60 and 180 °/sec, respectively. T/BW increased with decreased contraction speed for shoulder and knee extension in both genders and knee flexion in males (p<0.05). T/BW at 180 vs 300 °/sec was not different for knee flexion in females. Knee F/E increased with contraction speed in both genders and was significantly higher in females than males at 180 °/sec (p<0.05). In males and females, respective knee F/E was 0.55±0.3 and 0.63±0.06 at 60 °/sec vs 0.65±0.3 and 0.88±0.09 at 180 °/sec. Shoulder F/E was unaffected by gender or contraction speed. CONCLUSIONS: These results suggest the effects of contraction speed on T/BW and F/E between genders is joint specific. Specifically, knee F/E increases more in females than males with increasing contraction speed and T/BW gender differences are smallest during shoulder flexion compared to shoulder extension or knee flexion and extension.

**References:**


Sprint speed is a fundamental physical characteristic that is necessary for the successful participation in many sports. Post activation potentiation (PAP) is defined as an acute enhancement of muscle power output following an intense muscle conditioning activity. **Purpose:** The purpose of this study was to determine the effects of a PAP conditioning activity on sprint speed with an emphasis on the role of specificity regarding the preparatory conditioning activity. It was hypothesized that a unilateral conditioning activity (barbell lunge) would provide a greater PAP effect on short sprint ability than a bilateral conditioning activity (barbell back squat). **Methods:** Sixteen NCAA Track Athletes participated (7 male, 9 female) in the study. The experiment employed a repeated measures crossover design where, following a familiarization session, each subject completed a randomly assigned a separate warm-up (WU) on three different days with at least 48 hours between sessions. Following the randomly assigned WU, sprint speed was tested over a distance of 3.6 meters as well as quartiles. The WU’s were: a dynamic WU, a dynamic WU followed by a unilateral barbell lunge (BL) as the PAP conditioning activity, and a dynamic WU followed by a bilateral back squat (BS) as the PAP conditioning activity. The load of the BL and BS conditioning activities were both 6 repetitions of 80% 1-RM. A repeated measures ANOVA was utilized to determine if there were significant differences between sprint times for each WU strategy. **Results:** There were no statistically significant differences in sprint times between WU conditions at 36.6 m (Dynamic WU: 5.22±0.48 secs, PAP WU SQ: 5.23±0.48 secs, PAP WU BL: 5.23±0.50 secs) or any quartile *(p > 0.05).** **Conclusion:** Within the parameters of this study, neither an intense bilateral or unilateral conditioning activity improved short sprint performance beyond that of a dynamic WU activity.

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**References:**


**Effectiveness of Neuromuscular Electrical Stimulation During Rest and Exercise**

**Purpose:** To determine the effectiveness of neuromuscular electrical stimulation (NMES) as an aid to enhance venous blood return during rest and submaximal exercise. **METHODS:** Twenty apparently healthy males (Age = 35 ± 5.0 yrs; Height = 179.9 ± 8.5 cm; Body Mass = 85.4 ± 12.0 kg) provided informed consent prior to participation. In Session 1, participants were familiarized with all equipment. Sessions 2-4 were randomly selected and included the following 5-min trials: a) Rest and Rest+NMES, b) Rest, Arms-Only, Arms+NMES, and c) Rest, Arms+Legs, Arms+Legs+NMES. Physiological variables collected during rest and submaximal exercise were volume of oxygen (VO2), heart rate (HR), systolic and diastolic blood pressure (SBP and DBP), respiratory exchange ratio (RER), and rate pressure product (RPP). Paired sample t-test was used to determine if there were significant mean differences between the NMES and non-NMES trials. The Bonferroni correction established the alpha level at 0.008. From the 18 paired t-tests, the only observed significant mean difference [t(19) = −6.4, p <0.001] was RER values between the Arms-Only trial compared to the Arms+NMES trial (0.94 and 1.00, respectively). **Conclusion:** While RER displayed a significant difference, collectively, NMES did not elicit any physiological alterations during rest and submaximal exercises within an apparently healthy population.

**References:**

Effect of Energy Beverage Consumption on Peak Power and Peak Velocity
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Energy drinks comprise a multimillion dollar market focused on younger, active and competitive individuals. Recently, energy shots (ESs) have become a fast growing entity of the multimillion dollar energy beverage industry.

PURPOSE: To assess the effects of an ES on power and velocity in a front hand stroke (FHS) and a counter movement vertical jump (CVJ).

METHODS: Participants (male, n=17 and female, n=19) college students were randomly divided into a control group and an experimental group. Pre-tests included 3 FHS and 3 CVJs while peak power and velocities were electronically recorded. Following testing participants were given 57 ml of either an ES or placebo using a double blind format. After a 30 min absorption period, subjects’ FHS and SVJs were again tested.

RESULTS: One-way ANOVA of CVJ yielded no significant difference (p>0.05) between the ES and PL groups for peak power or peak velocity. A comparison of gender also yielded no significant (p>0.05) difference in either peak power or peak velocity in either the PL or ES groups. In the ES group demonstrated significantly (p<0.05) greater improvement in and peak velocity while the PL group did not experience a significant difference in either variable. Following a comparison of gender, females in the ES group registered significantly (p<0.05) greater improvement in peak velocity in comparison to males.

CONCLUSION: The current single dose of stimulants in the ES was adequate to improve performance of smaller muscle groups (shoulder rotators), it may not have been sufficient to affect the larger muscle groups of the lower legs which contribute to the CVJ. By incorporating larger doses of ESs, some benefit may be contributed to the CVJ.

No relationships reported
Muscles in the upper-body are important when performing many functional tasks, such as manual labor, sport and recreational activities, and wheelchair propulsion. Evidence suggests that use of the lower-body is critical for optimizing performance during standing upper-body tasks. It is unknown if use of the lower-body is also important during seated upper-body tasks. PURPOSE: To identify the contribution of arm, trunk, and leg muscle activity to submaximal arm cranking, an exercise model for evaluating upper-body work performance. METHODS: Eight healthy males (24±4 years, 79.8±1 kg, 18.1±0.1 m) performed three seated arm cranking conditions. For the ‘normal’ condition, participants performed arm cranking, using their arms, trunk, and legs for stabilization. For the ‘restricted legs’ condition, participants performed arm cranking using only their arms and trunk, while the legs were restricted and not able to be used for stabilization. For the ‘restricted trunk and legs’ condition, participants performed arm cranking using only their arms, while the trunk and legs were restricted and not able to be used for stabilization. In each condition, participants performed a maximal arm cranking test to determine maximum neuromuscular power and a submaximal arm cranking test to exhaustion to determine maximum arm cranking, an exercise model for evaluating upper-body work performance. RESULTS: Maximum neuromuscular power produced when the legs were restricted decreased by 24±10% (762±63 vs. 579±55 W, p<0.05). When the trunk and legs were restricted, power decreased further by 28±9% (762±63 vs. 543±53 W, p<0.05). Results also indicated that VO\textsubscript{2peak} decreased by 16±12% when the legs were restricted (3.02±0.8 vs 2.47±0.54 L/min, p<0.05) and decreased by 23±9% when the trunk and legs were restricted (3.02±0.8 vs 2.28±0.43 L/min, p<0.05). CONCLUSION: Muscles of the trunk, and especially the lower-body, play a critical role during seated upper-body tasks. Our findings have implications for researchers who use arm cranking as an upper-body exercise model, clinicians who prescribe upper-body exercise to improve health in high risk populations, and athletes performing upper-body exercise.

1634 Board #309 June 1 9:00 AM - 10:30 AM Muscular Contributions to Upper-Body Exercise Ashley L. VanSumeren, Matthew A. Kligas, Thomas K. Bye, Dakota A. Anderson, Steven J. Elmer. Michigan Technological University, Houghton, MI. Email: alvansum@mtu.edu (No relationships reported)

The popularity of overhead squat assessments to identify movement compensations that may place an individual at risk for future musculoskeletal injury (MSI) has grown among practitioners. Previous research suggests that limited ankle dorsiflexion (ADF) range of motion (ROM), due to restricted gastrocnemius muscle length, may result in lower extremity (LE) movement compensations commonly identified during an overhead squat movement. However, this has yet to be examined among the tactical athlete population of firefighters. PURPOSE: To examine the influence of gastrocnemius length on lower extremity movement compensations during an overhead squat assessment among active-duty firefighters. METHODS: 50 active-duty firefighters (48 males, 2 females) participated in this study (40.8 ± 7.7 yrs; 178.5 ± 5.9 cm; 89.8 ± 10.3 kg). Gastrocnemius muscle length was assessed by passively measuring bilateral ADF ROM (*) using a goniometer with participants in supine and knees fully extended. Participants then completed a two-leg overhead squat assessment as part of the Fusionetics\textsuperscript{SM} Movement Efficiency (ME) test. Participants were then placed into groups in a binary fashion (yes/no) based upon four bilateral LE movement compensations identified during this assessment and as described by the ME test instructions: foot flattens (FF), foot turns out (FTO), heel raises (HR), and knee moves in (KMI). Independent t-tests identified differences in ADF ROM between groups. An \( \alpha < 0.05 \) determined statistical significance. RESULTS: Participants displaying right FTO exhibited significantly (\( p = 0.01 \)) lower right ADF ROM (12.0 ± 4.0° vs. 14.6 ± 4.9°, respectively). Participants displaying left FTO and HR both exhibited significantly (\( p < 0.05 \); \( p = .005 \), respectively) lower left ADF ROM (9.8 ± 3.5° vs. 13.1 ± 4.3°; 6.0 ± 4.0° vs. 12.0 ± 4.0°, respectively). Participants with any of the four left LE movement compensations exhibited significantly (\( p = 0.05 \)) lower left ADF ROM (10.5 ± 3.7° vs. 13.1 ± 4.6°, respectively). CONCLUSIONS: Restricted gastrocnemius muscle length most likely influences lower extremity mechanics observed during an overhead squat assessment among active-duty firefighters. In order to decrease the risk of MSI among this cohort population, practitioners should incorporate interventions designed to increase gastrocnemius flexibility.

1635 Board #310 June 1 9:00 AM - 10:30 AM Emg Characteristics Of Elite Trampoline Athletes’ Feet On Impact: Evaluating[1] Performance With Modified Trampoline Shoes [1]new Title hung-chun huang. Kaohsiung Medical University, kaohsiung city, Taiwan. (No relationships reported)

PURPOSE: Evaluate the effects of ankle taping, general trampoline shoes, and three different modified trampoline shoes and how they affect trampoline techniques during back tuck jumping. METHODS: Eighteen athletes (13 men and 5 women; age M = 22.83 years old, SD = 4.06, height M = 167 cm, SD = 7.19 cm and weight = M 57.78kg, SD = 6.29 kg) from the Chinese National Trampoline Team at the Beijing National Trampoline Sport Base who had no major injuries or surgery during the last year. Trigno EMG System was used to measure the EMG signals of bilateral Rectus Femoris, Medial Hamstring, Tibialis Anterior, Lateral Gastrocnemius, and Peroneus Tibialis during performance. RESULTS: The EMG activity increased significantly for Rectus Femoris when wearing 8-shaped and combo shoes. Medial Hamstring had the least EMG activity when wearing combo shoes. EMG values for right dominate leg’s Medial Hamstring increased when wearing 8-shaped shoes during full contact period. EMG values for Tibialis Anterior decreased on the right dominate leg when wearing 8-shaped shoes during IC period. EMG values for Peroneus Longus increased during full contact period. The “initial contact” (IC) where from 300 ms to the first or fifth metatarsal head initially makes contact with the trampoline surface. The “full press” (FP) where the calcaneus has the maximum pressure into the net. The “rebounce” (RE) where the fifth metatarsal head is exiting the trampoline surface. Five trampoline shoes were tested, 8-shaped, with insoles, combo (8-shaped/insoles), regular shoes with ankles taped, and regular trampoline shoes. Athletes performed five sets of trampoline jumps with randomly worn shoes. Each muscle’s iEMG (%MVC*ms) and three different time periods were measured. RESULTS: The EMG activity increased significantly for Rectus Femoris when wearing 8-shaped and combo shoes. Medial Hamstring had the least EMG activity when wearing combo shoes. EMG values for right dominate leg’s Medial Hamstring increased when wearing 8-shaped shoes during full contact period. EMG values for Tibialis Anterior decreased on the right dominate leg when wearing 8-shaped shoes during IC period. EMG values for Peroneus Longus increased during IB period but were decreased during RE time when using 8-shaped shoes which enables the athlete to use the rebound energy from the net better. Interviews with the athletes support the EMG findings that 8-shaped trampoline shoes increase performance.

The authors contributed their time and effort to prepare the original content that was subsequently abstracted and formatted as shown.
Kettlebell exercise is a popular form of resistance training that uses a cast iron ball with a handle, so the participant can swing the kettlebell (K) into different positions. The K Clean has two popular variations: the Russian (R) swing requires the movement of the K to eye level, while the contrasting American (A) swing requires movement with a handle, so the participant can swing the kettlebell (K) into different positions. The use of either A or R technique for K exercise requires almost identical activation of the shoulder musculature and thus renders the choice of either technique a subjective decision. Subjective reports of the A technique being more difficult were not confirmed. Additional kettlebell studies should investigate activity of the shoulder musculature.

POSTER 10:30 AM

1636 Board #311
June 1, 9:00 AM - 10:30 AM
Comparison Of Emg Activity Between The American And Russian Kettlebell Swings
Richard Happel, John Petrizzo, Robert M. Otto, FACSM, John W. Wygand, FACSM. Adelphi University; Garden City, NY.
(Sponsor: John W. Wygand, FACSM)
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PURPOSE: The purpose of this study was to determine the magnitude of muscle recruitment during the A vs R swings by monitoring the electromyography (EMG) of the biceps femoris (BF), rectus femoris (RF), erector spinae (ES) and gluteus maximus (GM) during the bottom (1) and the top (2) of the swing.

METHODS: A cross-over design was used to assess neuromuscular activation of all four muscles of 20 subjects (age 21.5 ± 2.1 yrs, ht. 171.2 ± 8.7 cm, body mass 70.5 ± 7.9 kg, 12.7%). A minimum of 24 hours after familiarization, subjects performed an isometric voluntary maximal contraction (MVC) for 5 seconds in a “deadlift” maneuver with a loaded barbell that was set at the height of the subject’s tibial tuberosity. After 15 minutes of rest, subjects were randomly assigned to perform one set of either A or R kettlebell swings. The load of the K was based on completing 8-10 quality K swings. 30 minutes of rest was required prior to the cross-over aspect of the study.

RESULTS: ANOVA (p<.05) was applied to the data. There were no significant difference between trials among matched muscle groups and K positions. Mean EMG (%MVC) during Phase 1 was BF: 96.0 & 92.1, RF: 121.7 & 148.4, GM: 92.1 & 96.4, and ES: 88.5 & 90.5, for A and R, respectively. Mean EMG (%MVC) during Phase 2 was BF: 90.6 & 92.1, RF: 92.0 & 109.5, GM: 36.4 & 51.6, and US: 77.9 & 85.4 for A and R. CONCLUSION: There is no significant difference in EMG activity in the muscles used during both the American and the Russian kettlebell swings. The use of either A or R technique for K exercise requires almost identical activation of lower extremity and back musculature and thus renders the choice of either technique a subjective decision. Subjective reports of the A technique being more difficult were not confirmed. Additional kettlebell studies should investigate activity of the shoulder musculature.

1637 Board #312
June 1, 9:00 AM - 10:30 AM
Comparison Of Quadriceps Femoris Muscle Morphology Using Ultrasonography During Two Different Body Positions
Tyler W. Muddle1, Mitchel A. Magrini1, Ryan J. Colquhoun1, Ryan M. Thiele2, Nathaniel D.M Jenkins1. Oklahoma State University, Stillwater, OK; Kansas State University, Manhattan, KS.

PURPOSE: To evaluate the effects of body position on muscle cross-sectional area (mCSA) and echo intensity (EI) of the rectus femoris (RF) muscle in healthy young women.

METHODS: Seventeen healthy females (20.88 ± 1.17 yrs; 167.30 ± 6.43 cm; 71.44 ± 23.1 kg) underwent 6 ultrasound scans (US) of the RF during two different body positions. Three panoramic US scans were obtained with the participants either supine or seated (33.27 ± 3.28 AU) versus seated (34.25 ± 3.08 AU). The best image for each position was used to quantify using image analysis software. The best image for each position was used for analysis. The study was approved by the internal review board and written informed consent was obtained from all participants.

RESULTS: There were no significant differences in mCSA or EI during supine and seated conditions (Mann-Whitney U Test: p=0.166). Additionally, there was no significant difference in EI during the supine and seated conditions (32.37 ± 3.28 AU) versus seated (32.37 ± 3.28 AU) positions (p=0.301). CONCLUSIONS: These results indicated that a change in body position from supine to seated had no significant effect on the measurement of rectus femoris mCSA or EI from panoramic US scans. However, during visual inspection, possible changes in the shape of the RF were noted (i.e., flattening and widening of the RF while lying compared to seated). Therefore, future investigations may wish to investigate the effects of body position on ultrasound measurements of RF muscle thickness.
Research indicates that upper-body muscular strength gains following resistance training may be greater in individuals with greater initial fat-free mass (FFM). Further, individuals with lesser initial muscular strength experience greater gains in strength. However, FFM and muscular strength have not been analyzed simultaneously to determine possible interactive effects on strength gain. PURPOSE: To evaluate the effect of resistance training using free weights (FW) and machine weights (MW) on changes in upper-body muscular strength when controlling initial FFM and strength. METHODS: College men (n = 850) and women (n = 836) enrolled in a required fitness course over 3 years volunteered to participate. Each participant was measured before and after 12 weeks of periodized resistance training for body composition. A 1RM bench press using free-weights (FW) or machine weights (MW). Body composition was estimated from gender-specific skinfold prediction equations. MW modalities included a seated horizontal press (SHP) and a supine vertical press (SVP). Bench press training was periodized with progressively heavier loads and reduced repetitions designed to achieve maximum strength improvement. Mode-specific bench press training was supplemented with auxiliary upper- and lower-body exercises performed in 3 sets of 6–10 repetitions. RESULTS: A 2 x 3 ANOVA indicated no significant change in FFM or %fat for either gender or training mode. No significant difference in strength gain between initial FFM and %fat (r = 0.10, p < 0.001) and %fat (r = -0.24, p < 0.001) were significant but weak. A gender x training mode ANCOVA controlling for initial FFM and muscular strength indicated that men (10.4 ± 6.2 kg) gained significantly (p < 0.001) more strength than women (7.7 ± 5.4 kg) although #gain was significantly greater in women (22.0 ± 21.1%) than men (14.8 ± 14.0%). Mode-specific differences in strength gain (p < 0.001) and a significant interaction (p = 0.02) were noted. Strength gain on SHP (11.3 ± 5.6 kg) was greater than SVP (9.0 ± 5.9 kg) which was greater than FW (6.5 ± 5.3 kg). CONCLUSIONS: Men gained more upper-body strength than women when differences in initial FFM and strength are accounted for. Training with machines produces greater gains in upper-body muscular strength than FW in initially untrained individuals.

The effects of eccentric muscle damage on extralimus muscle fibers and motor function have been well studied. However, very few studies have examined the effects of muscle damage on sensory function, specifically, whether eccentric contractions damage the intrafusal fibers muscle spindles are wrapped around. PURPOSE: To investigate the effects of fatigue and muscle damage on the premotor latency (PML) and reflex magnitude (normalized reflex Torque; nRT) of patellar tendon reflexes. METHODS: Fifty men (mean ± SD: age = 24 ± 2.9 yrs) and fifteen females (age = 21.67 ± 2.1 yrs.) participated in a familiarization trial followed by two experimental sessions separated by seven (±1) days. The 2 conditions consisted of either fatiguing (CON) or muscle damaging (ECC/CON) contractions at 60° s−1 until 70% of peak torque (PT) was achieved. Patellar tendon taps were performed at a knee angle of 90° and a reflex hammer fastened to a swing arm was used to provide uniform impacts. PML was calculated as the time between the strike of the hammer to the onset of the isometric activity in the rectus femoris, and nRT was normalized [% of Pre maximal voluntary contraction (MVC)] at all time points. Reflex assessments and MVCs were completed before (Pre) and following (Post) both the CON and ECC/CON protocols until recovery of PT to Pre values (Recov). A three-way repeated measures ANOVA [gender (males vs females) x condition (CON or ECC/CON) x time (Pre vs Post vs Recov)] was used to analyze all reflex data. An alpha value of P < 0.05 was considered statistically significant for all comparisons. RESULTS: A main effect for time (P = 0.003) was observed in which PML was greater at Recov compared to Pre (P = 0.01). Additionally, a two-way gender x time interaction was observed in which nRT was lower at Post and Recov compared to Pre (P = 0.001-0.002) for the females. No differences were observed across time for the males (P = 1.000). CONCLUSION: These findings revealed that changes in PML may not be sensitive to muscle damaging contractions but may have delayed responses as a result of exercise-induced fatigue. Furthermore, reflex magnitude deficits may be evident in females following fatiguing exercise but not likely as a result of muscle damage.

INTRODUCTION: Post-activation potentiation (PAP) is an acute enhancement in a muscle’s ability to generate force due to its previous contractile history. PURPOSE: To assess kettlebell swing (KB) exercise as a method of PAP and compare it to common PAP methods of tuck jump (TJ) and depth jump (DJ). METHODS: Seven varsity track athletes (age: 21±1yr; mass: 65.9±9.3kg) completed one familiarization, and three test sessions in random order. Each session consisted of a warm-up followed by evoked twitch torques (TT) measured by tendon vibration stimulation (single, double and triple pulses [0.5ms, 100Hz]). After a pre-competition warm-up, participants completed a baseline counter-movement jump (CMJ) followed by the PAP exercise (2 x 5 repetitions). TJ was re-assessed at 1, 2, and 3 minutes (T1,T2,T3), and CMJ at 5 and 10 min (T5,T10), post-intervention. TT parameters included peak torque (PT), rate of torque development (RTD), and half relaxation time (HRT). RESULTS: Data were normalized to baseline before conducting repeated measures ANOVA to compare exercise conditions. Condition main effects were observed for single PT at T1 (p = 0.02), double PT at T1 (p = 0.044) and T2 (p = 0.049), and tripled PT at T1 (p = 0.007) and T2 (p = 0.034). KB had the largest change in PT (+11.7±18%) compared to TJ (+8.6±11.0%) and DJ (+5.5±14.1%) averaged across T1-T3 (p = 0.05). Contractile properties extracted from singlets revealed KB had larger PT (+22±15%) than DJ (±21%) at T1 (p = 0.027), and a prolonged HRT (+9±17%) compared to DJ (+3±14%) at T3 (p = 0.031). RTD was elevated at T1 (+37.8±36.7%), T2 (+28.8±37.2%) and T3 (+25.7±28.9%; p = 0.02) but was not different between conditions. No condition effects were found for CMJ at T5 or T10, but effect size was large for take-off velocity (p = 0.07; ƞ² = 0.412) at T5, where KB (+1.6±1.1%) and DJ (+20.3±3.3%) were larger than TJ (±1.6±2.7%). CONCLUSIONS: KB exhibited a tendency to potentiate evoked torque more than TJ and DJ. KB also exhibited signs of greater lower leg muscle fatigue three minutes after exercise but this did not limit CMJ performance five minutes after exercise.

PURPOSE: The aim of the present study is to analyze the electromyographic (EMG) fatigue thresholds during taekwondo specific tests (TKDet) and treadmill running cardiopulmonary exercise test (CPET). METHODS: 10 male taekwondo athletes (20 ± 2 yrs, body mass 67.5 ± 6.3 Kg, height 176 ± 9 cm) visited the laboratory 3 times. University ethics committee approved the study (opinion #765.698). At the 1st visit, anthropometric assessment and CPET were performed. In counterbalanced order, for the next 2 visits, the athletes performed a Continuous and an Interval Taekwondo Test (cTKDet and iTKDet). CPET was constituted by an individualized ramp protocol (10 min). TKDet were constituted by 1-min progressive stages of kicking sequences, and kicking interval started from 4.6 s and reduced 0.4 s every minute until participant’s fatigue. VO2, HR, and rating of perceived exertion (Borg 0-10) were measured during all tests. EMG acquisition was performed with the wireless system connected to a pair of surface electrodes placed in the rectus femoris, according to SENIAM recommendations. EMG signal was recorded continuously during the tests with a frequency of 2000 Hz. EMG was filtered by 3rd order Butterworth band-pass filter (20 - 500 Hz), RMS values were calculated during every non-superimposing windows with 1s duration. EMG thresholds were detected by piecewise regression (two infections - three segments line). Threshold’s responses were analyzed by repeated measures ANOVA, with Bonferroni post-hoc test, after Shapiro-Wilk test confirmed normality. P < 0.05 was adopted for all statistical tests. CONCLUSIONS: KB exhibited a tendency to potentiate evoked torque more than TJ and DJ. KB also exhibited signs of greater lower leg muscle fatigue three minutes after exercise but this did not limit CMJ performance five minutes after exercise.
Pilates is a common series of exercises used for both clinical and general populations that incorporates a variety of body positions to vary exercise intensity. Several studies have examined muscle activity while performing Pilates exercises, however the effect of surface inclination on muscle activity is limited.

PURPOSE: The purpose of this study is to compare muscle activity of the lower legs in trunk and lower extremity muscle activity during common Pilates exercises performed at different angles of support. METHODS: Three male and eleven female college aged students (24.1±4.4yrs; 1.7±0.1m; 62.2±17.9kg) were recruited. All subjects performed 4 static (10 second hold) Pilates exercises (boat pose, bridge, plank, and single leg balance) during each of the three surface inclinations: 1) 17° incline, 2) floor, 3) 17° decline. The unilateral muscle activity of the external oblique (EO), rectus abdominus (RA), erector spinae (ES), gluteus medius (MED) and obturator internus (BI) were recorded on the right side of the body were recorded using surface electrodes. The percent of the individual muscles maximum voluntary contraction (MVIC) recorded (GAS) on the right side of the body were recorded using surface electrodes. The mean values of surface inclination on muscle activity is limited.

RESULTS: During the boat pose, %MVIC for the RA was 45.8 ± 6.7% (p = 0.029), indicating changes in muscle activity between different angles of support. The mean values of surface inclination on muscle activity is limited.

CONCLUSION: This study revealed a significant change in muscle activity with different surface inclinations. Further research is needed to determine the effect of varying surface inclinations on muscle activity during Pilates exercises.

Table 1 – Comparison of cardiopulmonary exercise tests’ electromyographic threshold (n=10)
Averages for SRPA and OMPA were 1,495±172 kcal·wk⁻¹ and 87,163±10,139 activity counts day⁻¹, respectively. SRPA was significantly correlated with OMPA (r= 0.52, p< 0.05). Neither SRPA nor OMPA were significantly correlated with SWLS, GDS, or ACER (p> 0.05). Both SWLS (r= 0.40, p< 0.05) and GDS (r= 0.40, p< 0.05) were significantly correlated with ACER. CONCLUSIONS: Our preliminary data do not support the hypothesis that physical activity is associated with aspects of mental health and well-being. However, cognitive function was significantly associated with both satisfaction with life and depressive symptoms in older adults. Given the variability in the measures of SRPA and OMPA, we are currently recruiting more subjects to increase the statistical power to detect potential links among physical activity and indices of well-being in older adults.

1647 Board #322 June 1 8:00 AM - 9:30 AM Does Exercise Help People Living with HIV Improve Their Quality of Life? A meta-analysis.
Philiipp A. Zech¹, Michael Rapp², Stephan Heinze², Bernd Wolfarth³, Jimmy B. Lawrence¹, Andreas Heißel¹. ¹University Potsdam, Potsdam, Germany. ²Freie Universität Berlin, Berlin, Germany. ³Humboldt-Universität zu Berlin, Berlin, Germany. Email: phzech@uni-potsdam.de ¹, ², ³ (No relationships reported)

Today human immunodeficiency virus (HIV) has become a manageable chronic disease which still induces both physical and psychological challenges. Exercise as a non-medication treatment could be very beneficial for people suffering from HIV. To date, psychological outcomes such as quality of life have not been examined systematically. Therefore, studies investigating the effects of exercise as a treatment for people living with HIV and its outcomes on quality of life are reviewed in this meta-analysis.

Purpose: To assess the effect of exercise on quality of life with the subscales Vitality and General Health of the HIV Medical Outcome Study.

Methods: Literature search, quality assessment and data extraction were performed independently by two authors (PAZ and JBL). Randomised controlled trials involving people living with HIV, with at least one exercise intervention investigating psychological parameters were considered for inclusion. In order to differentiate the level of quality and to assess the risk of bias of included studies, the Physiotherapy Evidence Database Scale was used. Standardized mean differences (SMDs) were calculated for each outcome, data were analyzed and aggregated for heterogeneity and bias using the Review Manager 5.3.

Results: Vitality was assessed by n= 8 studies and general health by n= 7 studies. Exercise significantly improved vitality (SMD= 0.35, 95% CI 0.12-0.59, Z= 2.91, p< 0.004) and general health (SMD= 0.43, 95% CI 0.12-0.75, Z= 2.73, p= 0.006) using the random-effect model. Heterogeneity of vitality and general health between the included studies was I²= 6%, X²= 7.34, df= 7, p= 0.39 and I²= 39%, X²= 9.90, df= 6, p= 0.13. Participants n= (pre-post-intervention) EG n= 163 (160), CG n= 142 (140).

Conclusion: Aerobic exercise, resistance training and yoga improve vitality and general health significantly. Further research might be considered to further understand whether PLWH may benefit from physical exercise.

1648 Board #323 June 1 8:00 AM - 9:30 AM The Relationship Between Physical Activity, Physical Self-Description, And Well-Being In University Students
JoonYoung Lee¹, Lauren S Tashman², Seongkwon Cho³. ¹University of North Texas, Denton, TX. ²Barry University, Miami Shores, FL. ³Texas A&M International University, Laredo, TX. Email: joonyounglee@my.unt.edu ¹, ², ³ (No relationships reported)

Previous research has provided evidence for relationships between physical activity (PA) and physical self-description (PSD), PA and Well-Being (WB), and PSD and WB. While university students’ well-being has been emphasized as an important consideration, there is a lack of research investigating the role that physical activity and physical self-description play in their well-being.

Purpose: Given this lack of research, the purpose of this study was to investigate the relationship between PA, PSD, and WB in university students.

Methods: A total of 141 participants (female= 106, male= 35), ages 18 to 25 (M= 21.01, SD= 2.04), completed an online survey to participate in the study. The participants’ PA levels, PSD, and WB were assessed using the International Physical Activity Questionnaire (IPAQ), Physical Self-Description Questionnaire (PSDQ), and Well-Being (PERMA) questionnaire, respectively. A Pearson product-moment correlation, T-tests, and 2X2 ANOVA were used to examine gender differences and effects between the three variables. Results: Correlation results indicated that there was a significant positive relationship between PA and PSD (r= 0.29, p< 0.001), as well as PSD and WB (r= 0.19, p= 0.001), but there was no significant correlation between PA and WB (r= 0.19, p= 0.001). The results of the t-tests showed no significant gender differences in any of the three variables. The ANOVA indicated that there was no significant interaction between PA level and PSD level on WB, p< 0.526. However, there was a significant main effect for PSD and WB (p= 0.001), indicating that students with a stronger perception of their physical self have significantly higher well-being in comparison to those with weaker self-perceptions. Surprisingly, PA levels alone had no significant effect on WB nor were there any combined effects of PA engagement and PSD on WB in the university students.

Conclusion: The present study is both consistent and contradictory to previous research. Given that this is the first study to investigate the relationship between these three variables, the results indicate many areas for future research, such as investigating mediating effects of PSD and determining whether differences in WB exist with low versus high levels of PA.

1649 Board #324 June 1 8:00 AM - 9:30 AM Adapting an Evidence-Based Mental Health Care Model for Mobile Eating Disorder Programs
Rhacel E. Flatt¹, C. Barr Taylor¹, Denise E. Willey², Ellen E. Fitzsimmons-Craft², Katherine N. Balantekin², Shiri Sadeh-Shavit¹, Neha J. Goel⁴, Marie-Laure Firebaugh⁵, Grace E. Monterobio³, ¹Stanford University, Palo Alto, CA. ²Washington University in St. Louis, MO. ³Lantern, Mountain View, CA. ⁴Mental Health Care Partners, Ann Arbor, MI. ⁵Stanford University. Email: rflatt92@stanford.edu ¹, ², ³, ⁴, ⁵ (No relationships reported)

Despite the accessibility of mobile technology, there are currently very few evidence-based, personalized mobile intervention programs addressing prevalent mental health disorders, including eating disorders (EDs). Previous studies of college students determined 2-5% have clinical symptoms of EDs, 10-15% have subclinical symptoms, and 35-45% are at high risk.

Purpose: To develop and test a mobile technology treatment model including a screening assessment and online programs for female college students at risk of developing an ED or displaying clinical symptoms of EDs.

Methods: Over three years, 4,922 female students at 27 colleges in the U.S. completed an online screen assessing risk, clinical symptoms, and demographic information. Low-risk subjects were directed to an online healthy weight regulation program, and those who screened for clinical EDs based on DSM-5 criteria were offered a referral or an online, guided self-help intervention program (SB-ED) hosted by a technology partner, Lantern, based on randomized condition. Engagement in the SB-ED program was monitored throughout.

Results: Subjects who identified as racial/ethnic minority students (African American, Asian, Native Hawaiian or Pacific Islander, American Indian or Alaska Native, Hispanic, and/or other; n=327) reported more frequent binge eating (p= 0.056) and greater sleep problems (p= 0.280) compared to non-minority students (e.g., European Americans). A preliminary analysis of Year 3 (n= 94) showed that 78% of subjects completed more than 2 sessions of the SB-ED program and completed an average of 17.8 sessions out of 40 possible sessions.

Conclusions: Based on our preliminary results, mobile technology is an effective way to screen and collect information on at-risk populations for EDs while providing insight into differences in subpopulations. While the trial is not yet complete, this model can be improved and adapted to deliver more personalized and engaging care for various subpopulations. We plan to expand the current model by treating anxiety, depression, and EDs in student-athletes and by creating sports psychology-focused and transitional/recreation programs.

1650 Board #325 June 1 8:00 AM - 9:30 AM The Effect of Resistance Exercise Training on Anxiety Symptoms: A Systematic Review and Meta-Analysis
Brett R. Gordon, Mark Lyons, Matthew P. Herrings. ¹University of Limerick, Limerick, Ireland. Email: brett.gordon@ul.ie ¹, ², ³ (No relationships reported)

Compared to aerobic exercise, the effects of resistance exercise on symptoms of anxiety are understudied.

Purpose: To estimate the population effect size for resistance exercise training (RET) effects on anxiety symptoms and to determine whether variables of logical, theoretical, and/or prior empirical relation to anxiety moderate the overall effect.

Methods: 29 effects were derived from 15 articles published before November, 2016 located using Google Scholar, MEDLINE, PsycINFO, PubMed, and Web of Science. Trials involved 596 participants and included randomization to RET or a non-active control condition and measurement of anxiety at baseline, mid- and/or post-
intervention. Hedges’ $d$ effect sizes were computed and random effects models were used for all analyses. Meta-regression quantified the extent to which participant and trial characteristics moderated the mean effect.

**RESULTS:** RT significantly reduced anxiety symptoms by a mean effect delta ($\Delta$) of 0.38 (95%CI: 0.22-0.54; $z$=2.41; $p$=0.001). Significant heterogeneity was not indicated ($Q$(28)=36.80, $p$=0.12; $I^2$=26.6%, 95%CI: 7.30%-41.91%). Anxiety reductions were significantly moderated by whether or not the trial primary outcome was anxiety ($\beta$=0.42, $p$=0.001). Larger effects were derived from trials in which anxiety was the primary outcome ($\Delta$=0.54; 95%CI: 0.34-0.73; $k$=18) compared to trials in which anxiety was not the primary outcome ($\Delta$=0.20; 95%CI: 0.05-0.44; $k$=11; $z$=2.57 $p$=0.01). The mean effect did not significantly vary based on gender ($\beta$=0.30; age ($\beta$=0.10), health status ($\beta$=0.28), type of control condition ($\beta$=0.30), program length ($\beta$=0.20), exercise intensity ($\beta$=0.29), exercise frequency ($\beta$=0.15), or the anxiety recall timeframe ($\beta$=0.11) (all $p$>0.08). Non-significantly larger effects were found among females ($\Delta$=0.55), among otherwise healthy adults ($\Delta$=0.53), for trials in which a no-treatment control was used ($\Delta$=0.54), resistance exercise programs $\geq$12 weeks ($\Delta$=0.51), and for moderate-to-vigorous intensities ($\Delta$=0.46).

**CONCLUSIONS:** RT significantly improves anxiety symptoms. Improvements were not moderated by sex, health status, or based on features of RT. Future trials should focus on anxiety as the primary outcome and compare RT to other empirically-supported therapies.

**PURPOSE:** Major depressive disorder (MDD) is a global public-health concern. Current anti-depressant treatments are far from satisfactory leaving half of patients undertreated. Research has found exercise alone to be an effective treatment for people suffering with mild to moderate depression however its mechanism of action remains unclear. There is also a lack of research investigating the effects of exercise in combination with other conventional antidepressant therapies in people suffering with severe depression such as MDD. The aim of this study is twofold: first, to investigate the effects of an eight week exercise program in combination with antidepressant medication and intensive group therapy in improving depressive symptoms, anxiety and sleep quality and second, to identify changes in brain derived neurotrophic factor (BDNF) which is known to be reduced in people suffering with MDD.

**METHODS:** Sixteen sedentary participants were recruited from the Lakeridge Mental Health Day Treatment (LMHDT) program in Oshawa, Ontario, Canada. All participants had a clinical diagnosis of MDD based on DSM-IV criteria and an unstructured clinical interview conducted by hospital psychiatrists. Participants were assigned either to an eight week, supervised, moderate intensity exercise program plus LMHDT group or the LMHDT only group. Depression scores were determined using the Beck Depression Inventory (BDI), sleep quality by the Pittsburgh Sleep Quality Index (PSQI) and plasma BDNF was quantified by ELISA. All variables were measured at baseline and again at eight weeks.

**RESULTS:** Following the eight weeks of combination treatment the exercise group showed a greater decrease in depression scores, $F(1,14)=10.18$, $p=0.007$, $d$=2.04, a greater improvement in sleep quality, $F(1,14)=4.81$, $p=0.046$, $d$=1.28 and a greater increase in plasma BDNF concentration, $F(1,14)=12.47$, $p=0.003$, $d$=1.99 compared to the control group. In contrast, the exercise group also had a greater decrease in anxiety scores although there was no significant difference between the two groups, $F(1,14)=0.25$, $p=0.623$, $d$=0.33.

**CONCLUSIONS:** This project has the potential to provide a tool to improve exercise prescription and to guide development of combined treatment approaches in order to optimize treatment outcomes for people suffering with MDD.

**BACKGROUND:** Research shows that early experiences in college settings might cause psychological distress in students, while psychological well-being is associated with psychosocial protective factors. Conditions that would promote well-being and minimize or reduce the effects of ill-being are important for generating healthy experiences throughout college life and possibly beyond. While previous research has shown that physical activity contributes to well-being in various populations, evidence regarding physical activity and well-being/ill-being in the Costa Rican college population is lacking. **PURPOSE:** To compare psychological well-being and ill-being indicators of Costa Rica college students according to their physical activity level. **METHODS:** In this observational study, 233 freshmen (age 19.0 ± 2.2 years, 135 female) completed psychological well-being and ill-being measures (PANAS, SWLS, Subjective Vitality Scale, PERMA profile, STA1 and BDI-II) as well as the short form of the IAPQ. Students were categorized into low, moderate or high physical activity levels following the IAPQ guidelines. Separate ANOVA tests were performed according to physical activity category and selected outcomes. **RESULTS:** Students with high physical activity levels scored higher in subjective vitality (5.17 ± 0.98) and positive affect (35.43 ± 7.02) compared to students with low physical activity (4.62 ± 1.13 and 32.03 ±7.44) ($p=0.005$ and $p<0.001$), and reported higher self-rated health (8.15 ± 1.34) than those with moderate (7.19 ± 1.80) and low (6.99 ± 1.91) physical activity levels ($p=0.012$). The moderate and high physical activity categories were more likely to experience flow experiences related to the engagement component of well-being (7.85 ± 1.26) and 7.86 ± 1.14) compared to those with low physical activity levels (7.23 ± 1.44) ($p=0.004$). No statistically significant differences were found in psychological ill-being indicators ($p > 0.05$ for all). **CONCLUSIONS:** College students who are more physically active experience higher levels of psychological well-being. These results support the importance of providing additional opportunities for Costa Rican college students to become more physically active. Supported by NIH Grant U54GM104942.

**BACKGROUND:** In Australia, depression is ranked third highest in terms of burden of disease, after cancer and cardiovascular disease. Given the high lifetime prevalence of depression, the financial and productivity impact are significant. In order to develop appropriate interventions, it is important to establish the factors that can impact on depression. Sedentary behaviour is one factor that has shown an association with depression. **PURPOSE:** To investigate the cross-sectional relationship between sedentary behaviour and psychological distress in a large sample of middle-aged and older adults in Australia. **METHODS:** Participants were 140,093 adults aged 45 years and older (mean age = 62.7±11.2 years) drawn from the baseline survey of The 45 and Up Study, a large-scale longitudinal cohort study of a range of health and social indicators in adults aged 45 years and older from across New South Wales, the most populous state in Australia. Self-reported sitting time was used as a measure of sedentary behaviour, and psychological distress was measured with the Kessler Psychological Distress Scale (Kessler-10). **RESULTS:** Linear regression showed a statistically significant association between sitting time and psychological distress ($B = 0.04$, $t(140,093) = 16.3$, $p < 0.001$). Pairwise comparisons within univariate analysis showed that, compared to individuals who sat more than 5 hours/day ($n = 67,226$), those who sat 0-5 hours/day ($n = 67,226$) showed that, compared to individuals who sat more than 5 hours/day ($n = 67,226$), those who sat 0-5 hours/day ($n = 67,226$) had lower levels of psychological distress ($F = 182.3$, $p < 0.001$). **CONCLUSIONS:** The findings demonstrate a strong association between sitting time and psychological distress in a large sample of middle-aged and older adults. These findings can be used to inform the development of interventions to reduce psychological distress in adult populations.

**BACKGROUND:** Exercise may be one such treatment approach, as exercise has been shown to improve outcomes for people suffering with Post-Traumatic Stress Disorder (PTSD). Recent therapeutic interventions have targeted the endocannabinoid (eCB) system in an effort to improve symptoms of Post-Traumatic Stress Disorder (PTSD). Exercise may be one such treatment approach, as exercise has been shown to increase circulating concentrations of endocannabinoids (anandamide, AEA; 2-arachidonylethanolcgy, 2AG) and related biogenic lipids (oleoylethanolamine, OEA; palmitoylethanolamine; PEA) in healthy individuals. However, the eCB responses to exercise in individuals with PTSD have not been investigated. **PURPOSE:** The purpose of this study was to examine eCB responses following aerobic exercise in individuals with and without PTSD. **METHODS:** Twenty-four (12 PTSD and 12 control) men and women (26±4 yrs) participated in this study. Participants engaged in an aerobic exercise session in which they walked or ran on a treadmill for 30 minutes...
Exercise has significant therapeutic effects for the treatment of depression and anxiety. Substance use is highly comorbid with depression and anxiety, although individuals with substance use disorders (SUDs) are typically excluded from exercise interventions. Thus, there is little evidence informing whether or not exercise can alleviate psychological distress among SUD patients, which could aid their recovery.

**PURPOSE:** To examine the effect of exercise, in addition to standard care, on psychological outcomes among individuals newly-enrolled in SUD treatment.

**METHODS:** Twenty-one SUD patients (35 ± 9 yrs) were recruited from local Intensive Outpatient Treatment Programs to participate in this study. Participants were randomized to either treatment-as-usual (TAU, at their outpatient clinic) or TAU plus aerobic exercise training (EX). EX participants engaged in supervised, moderate-intensity exercise sessions 3xs/wk for 6 wks. TAU participants came into the laboratory once per week for assessments and a quiet rest session. Throughout the intervention, participants from both groups completed questionnaires evaluating mood states and mood disorders, perceived stress, psychophysiological withdrawal, self-efficacy to abstain from substance use, and drug craving. Data were analyzed using a series of mixed model ANOVAs to determine whether there were group differences in psychological outcomes over time.

**RESULTS:** Over 6 weeks, there were significant reductions in anxiety, perceived stress, and drug craving (p < 0.05); however, these reductions did not differ between groups (p > 0.05). There were no significant changes from baseline in withdrawal symptoms or self-efficacy (p > 0.05). Acutely, both exercise and quiet rest sessions led to transient decreases in craving, tension, depression, anger, confusion, and fatigue (p < 0.05). In addition, the EX group experienced acute increases in vigor (p < 0.05).

**CONCLUSION:** The results from this study suggest that participation in an aerobic exercise training program during SUD treatment was associated with similar reductions in anxiety, stress, and drug craving as standard care. Furthermore, exercise produced the additional benefit of increases in vigor. Supported by the National Institute on Drug Abuse (R36DA040140) and the UW Virginia Horne Henry Fund.

**Abstracts were prepared by the authors and printed as submitted.**
RESULTS: IPAQ sitting time was associated with accelerometer sedentary time \(r=0.38, p=0.01\). IPAQ walking time was associated with accelerometer walking time \(r=0.38, p<0.01\). IPAQ moderate PA was associated with accelerometer moderate PA \(r=0.47, p<0.01\). IPAQ vigorous PA was associated with accelerometer vigorous PA \(r=0.34, p=0.02\). However, the IPAQ may be a viable tool for assessing students’ energy expenditure (EE) during three exercise sessions with different intensities, with students tending to under-report moderate and over-report vigorous PA. IPAQ moderate PA was associated with accelerometer moderate PA \(r=0.38, p<0.01\). IPAQ walking time was associated with accelerometer light PA \(r=0.33, p=0.02\). Although correlations appear acceptable, intensities, with students tending to under-report moderate and over-report vigorous PA. Although IPAQ moderate PA was associated with accelerometer moderate PA \(r=0.38, p<0.01\). IPAQ walking time was associated with accelerometer light PA \(r=0.33, p=0.02\). Although correlations appear acceptable, intensities, with students tending to under-report moderate and over-report vigorous PA. Although IPAQ moderate PA was associated with accelerometer moderate PA \(r=0.38, p<0.01\). IPAQ walking time was associated with accelerometer light PA \(r=0.33, p=0.02\). Although correlations appear acceptable, intensities, with students tending to under-report moderate and over-report vigorous PA. Although IPAQ moderate PA was associated with accelerometer moderate PA \(r=0.38, p<0.01\). IPAQ walking time was associated with accelerometer light PA \(r=0.33, p=0.02\). Although correlations appear acceptable, intensities, with students tending to under-report moderate and over-report vigorous PA. Although IPAQ moderate PA was associated with accelerometer moderate PA \(r=0.38, p<0.01\). IPAQ walking time was associated with accelerometer light PA \(r=0.33, p=0.02\). Although correlations appear acceptable, intensities, with students tending to under-report moderate and over-report vigorous PA. Although IPAQ moderate PA was associated with accelerometer moderate PA \(r=0.38, p<0.01\). IPAQ walking time was associated with accelerometer light PA \(r=0.33, p=0.02\). Although correlations appear acceptable, intensities, with students tending to under-report moderate and over-report vigorous PA.
Actigraph GT3X+ accelerometer (AG) on their right hip simultaneously while they were participating in variety of activities of daily living. The activity protocol was 33 minutes in total, and consisted of watching TV while laying/sitting, playing with toys, walking/exploring, soccer/running and basketball/throwing. Breath-by-breath measurements from OM were averaged into minute-by-minute VO$_2$ (ml kg$^{-1}$ min$^{-1}$) and AEE (kcal kg$^{-1}$ min$^{-1}$). Additionally, accelerometer-based VO$_2$ and AEE were estimated using Pate’s (PT) and Puyau’s (PY) equations, respectively. The accuracy of each equation was examined against AG and VO$_2$ measurements from OM using Pearson correlations, dependent t-tests and mean absolute percent error (MAPE).

**Results:** Overall, the estimates of AG and VO$_2$ from accelerometer-based equations were highly correlated with those from OM (VO$_2$: r = 0.78, p < 0.05; AEE: r = 0.80, p < 0.05). When compared with measures from OM, the PT and PY equations significantly underestimated VO$_2$ (mean difference (MD) = -1.93 ml kg$^{-1}$ min$^{-1}$, p < 0.05) and AEE (MD = -0.04 kcal kg$^{-1}$ min$^{-1}$, p < 0.05) respectively. The overall MAPEs were 9.2% for PT and 52.1% for PY. For moderate-to-vigorous physical activity (MVPA), the correlations were moderate for the PT and PY equations (VO$_2$: r = 0.54, p < 0.05; AEE: r = 0.58, p < 0.05). The PT and PY equations underestimated VO$_2$ (MD = -4.75 ml kg$^{-1}$ min$^{-1}$, p < 0.05) and AEE (MD = -0.07 kcal kg$^{-1}$ min$^{-1}$, p < 0.05) for VO$_2$ respectively. The ANNs were invoked to predict activity intensity (sedentary, light, or moderate- to-vigorous PA (MVPA)) for the different pairings of attachment sites and device. Relatively high correlations support the validity of accelerometer-based AEE prediction equations. However, researchers should be aware that accelerometer-based prediction equations may underestimate VO$_2$ and AEE especially for MVPA in 3-6 year-old children.

**Conclusions:** Using accelerometers to assess physical activity (PA) behavior in youth populations is challenging, in part because bouts of youth PA tend to be erratic. As new accelerometry methods emerge, they are often difficult to compare, due to differences in the intended wear location and data format. PURPOSE: This study developed and validated a youth-specific suite of methods based conceptually on the bout-identifying Sojourner method. The study’s aim was to estimate PA behavior from hip- or wrist-worn accelerometers, with either activity counts (AC) or raw acceleration (RA) as the output. METHODS: Data from a previous study were used to train artificial neural networks (ANNs) to predict activity intensity (sedentary, light, or moderate- to-vigorous PA (MVPA)) for different detecion sites and device types. Outputs using indirect calorimetry as the criterion measure. The ANNs were inverted and combined with decision trees and bout-identification code (adapted from the Sojourner method) to generate estimates of PA intensity. An independent validation was performed with 27 participants who performed self-selected activities for one hour. Direct observation served as the criterion for time spent in each activity intensity. Percent accuracy, kappa statistics, sensitivity, and specificity were calculated to assess the validity of each method. RESULTS: In the initial validation, the new methods achieved a mean accuracy of 67.9% (±6.99) for the hip and 59.5% (±26.3% for the wrist, and accuracy was higher for the AC methods (Hip AC: 71.7%, Wrist AC: 65.1%) compared to the RA methods (Hip RA: 64.9%, Wrist RA: 53.9%). Results for the free-living validation are in the table. CONCLUSION: The new suite of methods provides several options to effectively assess MVPA behavior in youth, with evident limitations when using RA from wrist-worn devices, and uniform limitations for estimating lower intensities.

### Table: Comparison of AEE Prediction Equations

<table>
<thead>
<tr>
<th>Method</th>
<th>% Accuracy</th>
<th>Kappa</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip AC</td>
<td>71.70%</td>
<td>0.44</td>
<td>0.75</td>
<td>0.95</td>
</tr>
<tr>
<td>Wrist AC</td>
<td>65.10%</td>
<td>0.32</td>
<td>0.67</td>
<td>0.90</td>
</tr>
<tr>
<td>Hip RA</td>
<td>64.00%</td>
<td>0.34</td>
<td>0.72</td>
<td>0.87</td>
</tr>
<tr>
<td>Wrist RA</td>
<td>59.90%</td>
<td>0.24</td>
<td>0.50</td>
<td>0.93</td>
</tr>
</tbody>
</table>

### Conclusion

The correlations between the IPAQ-SF and the fitness tests were summarized as below:

**Purpose:** To validate the International Physical Activity Questionnaire-Short Form (IPAQ-SF) in Chinese college students using health-related fitness tests.

**Methods:** 2513 (1698 males & 815 females; Aged 18.8 ± 0.8 yr.; Height = 170.1 ± 7.8 cm; Weight = 63.1±1.3 kg; BMI = 21.6±2.7) college students from a Chinese university were assessed using both IPAQ-SF and a set of physical fitness tests, including vital capacity (VC), step test, standing long jump (SLJ), and 50-M dash for everyone, sit-ups and 800-M run/walk for female students, push-ups and 1000-M for male students. Total, vigorous, moderate and walking MET-hours per week were derived from IPAQ-SF first and then correlated with physical fitness test scores.

**Results:** Descriptive statistics of IPAQ-SF and fitness tests were summarized as below:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Total-METs</th>
<th>Vigor- METs</th>
<th>Mod- METs</th>
<th>Walk- METs</th>
<th>BMI</th>
<th>VC</th>
<th>Step Test</th>
<th>SLJ</th>
<th>Pull-Ups</th>
<th>Sit-Ups</th>
<th>50-M (miles)</th>
<th>800-M</th>
<th>1000-M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>2.74</td>
<td>0.54</td>
<td>1.27</td>
<td>0.93</td>
<td>21.6</td>
<td>170</td>
<td>2.7</td>
<td>315.6</td>
<td>32.3</td>
<td>12.5</td>
<td>7.4</td>
<td>24.1</td>
<td>21.7</td>
</tr>
<tr>
<td>SD</td>
<td>2.01</td>
<td>0.43</td>
<td>0.72</td>
<td>0.49</td>
<td>5.9</td>
<td>7.8</td>
<td>2.7</td>
<td>315.6</td>
<td>32.3</td>
<td>12.5</td>
<td>7.4</td>
<td>24.1</td>
<td>21.7</td>
</tr>
</tbody>
</table>

**Conclusion:** Consist with the findings of other validation studies, only low correlations between physical activity time measured by IPAQ-SF and physical fitness were found, which provide some validity evidences to support the Chinese version of IPAQ-SF.
The dose-response relationship between physical activity (PA) and health is not well understood. The development of accelerometer-based motion sensors make it possible to objectively measure several dimensions of PA in free-living contexts. These devices have traditionally been worn on the hip, however there has been a recent trend to place these monitors on the wrist. PURPOSE: 1) To examine the accuracy of a hip (Evenson algorithm) and wrist-worn (Crafter algorithm) accelerometer for categorizing PA intensity in pre-adolescent girls during dance classes using direct observation (D.O.) as the criterion measure. 2) To compare the validity of the hip and wrist-worn accelerometer algorithms for classifying girls as meeting guidelines for PA.

METHODS: For aim 1, participants (N = 6; Age = 10.22 ± 2.38) were video recorded while wearing hip and wrist accelerometers during a dance class. Data was analyzed using the Kruskal-Wallis Test. For aim 2, participants (N = 20; Age = 8.6 ± 1.6) wore a hip and wrist accelerometer concurrently for seven consecutive days. Fisher Exact Test was used to compare similarity between wrist and hip accelerometer data. RESULTS: For aim 1, compared to D.O., the wrist-worn accelerometer was inaccurate in measuring time spent in sedentary time (D.O. = 1.39 ± 2.18; hip = 12.38 ± 8.25), light PA (D.O. = 44.77 ± 33.95; hip = 44.14 ± 7.57), vigorous PA (D.O. = 0.50 ± 1.01; hip = 4.05 ± 3.56) and those of girls meeting guidelines for PA. Future research should move away from cut-point methods and use pattern recognition validation, or activity enjoyment or prescription.

CONCLUSION: Although pedometer-determined MVPA was correlated with accelerometer-determined MVPA, the two measures do not appear to be equivalent. Further research should explore the potential to correct this discrepancy between devices.

Table 1. School-based MVPA Minutes

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pedometer</th>
<th>Accelerometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>18.3 ± 6.9*</td>
<td>26.7 ± 9.5</td>
</tr>
<tr>
<td>Girls</td>
<td>16.6 ± 5.6*</td>
<td>20.9 ± 7.2</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>17.8 ± 5.8*</td>
<td>24.6 ± 9.2</td>
</tr>
<tr>
<td>4th</td>
<td>19.7 ± 5.9*</td>
<td>26.6 ± 8.2</td>
</tr>
<tr>
<td>5th</td>
<td>15.1 ± 6.6*</td>
<td>20.9 ± 8.6</td>
</tr>
</tbody>
</table>

Note. Values presented as M ± SD. *p < 0.001.

Supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, grant award number 2011-68001-30020.
unknown intensity. Chi-square analyses were utilized to examine differences between proportions of intensity levels offered by semester. Kruskal-Wallis tests were utilized to examine differences in proportion of CP intensity offered by grade level. 

**RESULTS:** Most CP opportunities were MPA (58.7%), followed by VPA (17.6%) and LPA (11.5%). Few responses were SED (0.5%), and 11.6% were of indeterminate intensity. There was a significant difference in the intensity of CP opportunities by semester, with a greater proportion of more physically intense activities reported during the fall versus spring semesters (p < 0.0001). There was also a significant difference in the intensity levels of CP offered by grade, with a general trend of decreasing intensity as grade level increased (p < 0.0001).

**CONCLUSIONS:** This study provides insight into the physical activity actually occurring in classrooms; however, additional research should be conducted on the CP opportunities offered in public schools.

### Board #345  June 1 8:00 AM - 9:30 AM

**The Impact Of Epoch Length On Intensity Of Physical Activity Among Fourth Grade Children**

Vanessa L. Errisuriz, Jon E. Clutton, Esbelle M. Jowers, John B. Bartholomew, FACSM. *The University of Texas at Austin, Austin, TX.* (Sponsor: John B. Bartholomew, FACSM)

Email: vlerrisuriz@utexas.edu

(No relationships reported)

**Purpose:** Research examining the impact of epoch length and cut point (CP) selection on estimates of physical activity (PA) is limited to preschool children. This study fills a void by examining the influence of epoch length on estimates of time spent in sedentary, light (LPA), and MVPA across different published CP for elementary school children.

**Methods:** Participants were 265 4th-grade students (M = 9.4 years; 52% female) from 3 elementary schools in the control condition of the Texas I-CAN! project. Students wore accelerometers over one school week. Data were collected in 5 sec epochs and reintegrated into 10s, 15s, 30s, and 60s epochs. Five children’s CP (Freedson, Evenson, Mattucks, Puyau, Pulsford) classified PA intensity. One-way, RM ANOVAs evaluated impact of epoch length on PA estimates across CP.

**Results:** Epoch length significantly impacted estimates of time spent in each category of PA. These differences held across each CP used. For sedentary behavior, *post hoc* Bonferroni tests showed that all epoch lengths differed from each other in all CP (p < .001), except Puyau between 15s and 60s (p = 1.0; d = 0.01 to d = 1.51). For LPA, *post hoc* Bonferroni tests showed that all epoch lengths differed from each other within all CP (p < .001), except Puyau between 30s and 60s (p = .41; d = 0.01 to d = 1.13). For MVPA, *post hoc* Bonferroni tests showed that all epoch lengths differed from each other (p < .001; d = 0.09 to d = 1.17). Longer epoch length was associated with less time in sedentary and more time in LPA for all CP. Longer epoch lengths was related to less time spent in MVPA for all CP except Freedson, which led to greater time spent in MVPA. This resulted in differences in the proportion of children classified as meeting recommendations for daily PA (60 min of MVPA). No children met daily PA recommendations, except when Freedson CPs were used. With Freedson CP, longer epoch lengths resulted in larger percentages of children meeting daily PA recommendations (75.8% at 5s to 87.5% at 60s).

**Conclusion:** Epoch length and CP selection exert substantial influence on estimates of PA intensity among children. Since results from school-based, PA intervention inform recommendations (75.8% at 5s to 87.5% at 60s). CP, longer epoch lengths resulted in larger percentages of children meeting daily PA intensity among children. Since results from school-based, PA intervention inform recommendations (75.8% at 5s to 87.5% at 60s). CP, longer epoch lengths resulted in larger percentages of children meeting daily PA intensity among children. Since results from school-based, PA intervention inform recommendations (75.8% at 5s to 87.5% at 60s).

### Board #346  June 1 8:00 AM - 9:30 AM

**Validity of a Sedentary Behavior Guideline for Youth**

Seungho Ryu, Heontae Kim, Junbae Mun, Minsoo Kang, FACSM. *Middle Tennessee State University, Murfreesboro, TN.* (Sponsor: Minsoo Kang, FACSM)

Email: sr4s@mtmail.mtsu.edu

(No relationships reported)

Sedentary behavior (SB) has been identified as an independent risk factor for many health outcomes such as metabolism, cardiovascular and obesity. The Canada research group provided SB guideline that is no more than 2 hours of SB per day. The SB guideline also indicated lower levels of SB were associated with higher level of fitness. Little is known about the validity of the SB guideline.

**Purpose:** The purpose of this study is to examine the validity of Canada sedentary behavior guideline for Youth.

**Methods:** Data from NHANES National Youth Fitness Survey (NNYFS) 2012 were analyzed for this study. A total of 432 participants (221 males) aged 12-15 years completed the survey and a physical fitness examination. The NNYFS questionnaire included two questions regarding recreational SB; in the past 30 days how many hours of TV or videos were watched and how many hours of computer use. Recreation SB was categorized in two levels: (1) 2 hours and less per day; (2) more than 2 hours per day. Health related fitness consisted of body composition, muscular strength and cardiorespiratory fitness. Body composition was measured by BMI, muscular strength was measured by plank, and cardiorespiratory was measured by VO2max in NNYFS examination. To validate SB activity using the general linear model was used to examine the association between the recreational SB and health related fitness after controlling the covariates (i.e., age, gender, and physical activity).

**Results:** After adjusting the covariates, recreational SB was related to plank, *F*(1, 427) = 4.14, p = 0.043. Recreational SB, however, was not related to VO2max and BMI, *F*(1, 427) = 0.62, p = 0.43 and *F*(1, 427) = 0.67, p = 0.43, respectively.

**Conclusions:** Recreational SB was only associated with muscular strength. The lack of validity for the SB guideline may be due to surrogate measure of SB used in the current study. Further validity research is needed using more accurate measures of SB.
person has not been fully understood. The purpose of this study was to evaluate RHAs of a thrown judo expert and to compare them with the values previously obtained by an anthropomorphically test device (ATD) experiment without ukemi.

**METHODS:** Three male judo experts (age: 26.3 ± 3.4 years, height: 1.72 ± 0.07 m, body mass: 74.4 ± 2.4 kg) and one male judo expert (age: 26.7 ± 0.5 years, height: 1.76 ± 0.07 m, body mass: 73.5 ± 2.0 kg) participated in the study. Participants performed two baseline (BL) trials and two experimental (EX) trials involving a resistance band. Participants were fitted with a full body 55-mark set, 3D kinematics were recorded with a 12-camera motion capture system sampling at 250 Hz. Kinetic analysis included assessments of impulse, angle of GRF (Sagittal plane), and Average Force. Kinematic analysis included stride rate (SR) and stride length (SL), ground time (GT) and air time (AT), peak toe height during swing phase of sprinting gait, and segment angles. Segment angles were measured for the rear lower leg (RLL) at ankle knee plus along the RLL at take-off during the first two steps (SIAC, STO, S2AC, S2TO). Results: No significant changes were observed in impulse or average force between interventions. There was, however, a significant difference between the force angle produced during proprioceptive priming (27.8° ± 8.1°) and combination (46.7° ± 8.6°) interventions (p<0.05). Kinematic data were shown to be significant for BL and PR, respectively. As for SI, average peak toe height was 0.262 ± 0.114, and 0.241 ± 0.054. During S2, average peak toe height was 0.293 ± 0.054, and 0.232 ± 0.057. There was a significant decrease in peak toe height post-intervention for BC (p<0.05). The RLL angle at SIAC was 63.88° ± 15.61 and 70° ± 16.81 along with 67.47° ± 10.29 and 77.78° ± 13.28 at S2AC. The angles for SITO were 158.30° ± 30 and 159.44 ± 16.41 RLL. Conclusion: Proprioceptive training resulted in an improvement in ground time values during the sprint start and reduced peak toe height for all phases, but showed mixed results for air time. These results suggest that proprioceptive priming has the potential to improve sprint start mechanics and performance.

**PURPOSE:** The aim of this study was to investigate whether this exercise can lead to a more beneficial timing and muscle activation patterns in a world champion when performed at different effort levels.

**METHODS:** Muscle activation of a male world champion (28 yrs, 24 BMI kg/m²) was collected during 25 m of normal breaststroke at maximal effort and during 25 m of two leg kicks to one arm pull at 60% (medium) and 80% (high) of maximal effort using electromyography. Electrodes were placed on triceps brachii, biceps brachii, trapezius, pectoralis major, gastrocnemius, tibialis anterior, biceps femoris and rectus femoris and sampled at 1000 Hz. The signals were amplitude normalized to the individual maximal voluntary contraction. Muscular on- and offset had a threshold level of 20% of the peak. Each stroke phase (leg propulsion, leg glide and leg recovery) was identified through 3D kinematics and was interpolated to 50 time points. Descriptive statistics were used for the average muscle activation and each phase equals 100%.

**RESULTS:** During leg glide, biceps brachii and pectoralis major activated 2% earlier in the exercise at high effort, but 8% later at medium effort compared to swimming at maximal effort. The exercise showed that biceps femoris was activated during the entire leg recovery at medium and high effort, but at normal swimming at maximal effort it was activated for the last 80%. Tibialis anterior activated 28% later during leg recovery for the exercise at medium and high effort compared to swimming at maximal effort. At high effort the exercise showed a longer activation for triceps brachii during leg propulation (38%), compared to 6% at medium effort and 10% at swimming with maximal effort.

**CONCLUSION:** The need is for trained effect in leg propulsion and leg glide recovery, as the earlier activation in biceps femoris combined with the later activation in tibialis anterior can reduce the time spent in this non-propulsive high resistance phase.

**MEDICINE & SCIENCE IN SPORTS & EXERCISE®**

**Board #350**

**June 1 9:00 AM - 10:30 AM**

**Observing First Time Use Of The Backstroke Starting Device In Competitive Swimmers**

Brian V. Wright1, James McDonnell1, James P. Babington1, Wes Manz2, Joel M. Stager, FACSM3, 4DePaul University, Greenacres, IN. 1Indiana University, Bloomington, IN. (Sponsor: Joel Stager, FACSM)

**INTRODUCTION** Since FINA’s initial approval for use of the backstroke starting device (edge) in competition, these devices are now readily available in the marketplace. However, the use of these devices in collegiate, high school, and age-group competitions has yet to be legislated or implemented. Most importantly, no data exist for novice or inexperienced swimmers from the perspective of racing start safety. **Purpose:** To determine whether or not maximum head depth (MHD), velocity at max head depth (VMHD), distance at max head depth (DMHD), and entry angle (Ea) attained when executing backstroke starts vary as a function of using the backstroke starting device in less experienced swimmers (i.e. novice backstroke starting device users).

**METHODS** 26 swimmers (8 collegiate, age: 21 ± 1.2 yr and 18 high school, age: 16 ± 2.5 yr) were filmed in a water depth of 1.59 m performing two backstroke starts (1st trial no device; N st, 2nd trial with the device; W st) in the sagittal plane of a camera at 120 Hz with cameras positioned at three points: 1m (above water), 1m (below water), and 3m (below water) from the starting end wall. Data for MHD, VMHD, DMHD, entry angle were tracked using Simi Reality Motion Systems software. Independent t-tests were used to compare between ability level and within each starting condition. Paired t-tests were used to compare between starting conditions within each ability level. **RESULTS** MHD, VMHD, DMHD, and entry angle were significantly (p < 0.05) greater in collegiate swimmers when compared to high school swimmers in both starting conditions (N st: MHD: 1.14 ± 0.29 vs. 0.48 ± 0.17 m, VMHD: 1.95 ± 0.75 vs. 1.04 ± 0.41 m sek, DMHD: 5.14 ± 0.34 vs. 0.46 ± 0.50 m, Ea: 5.78 ± 6.1° vs. 30.7 ± 6.4° respectively, and W st: MHD: 1.02 ± 0.18 vs. 0.53 ± 0.20 m, VMHD: 1.63 ± 0.46 vs. 1.04 ± 0.38 sek, DMHD: 5.04 ± 0.31 vs. 4.28 ± 0.55 m, Ea: 9.9 ± 10.2° vs. 31.2 ± 7.0° College vs Novice respectively). Only Ea significantly (p < 0.05) increased in high school swimmers when using the backstroke starting device (3.78 ± 6.1° vs. 9.9 ± 10.2°). **CONCLUSION** It appears that the recently introduced backstroke device tested causes few changes in common parameters that allow stratification of risk for swimmers executing racing starts. This appears true for the expert as well as the novice swimmer.
increased MMG activity and regularity were revealed after high intensity eccentric exercise consisting of static arm flexion and abduction at 90°. MMG signals were detected by means of 12 accelerometers forming a pentagon over the upper trapezius muscle. The mechanomyography (MMG) signal provides information on the intrinsic muscular activation and the amount of regularity of the MMG signals. PURPOSE: To investigate changes in spatio-temporal MMG activity of the upper trapezius muscle before and after eccentric exercise in healthy subjects. METHODS: Sixteen volunteers performed high intensity eccentric exercise (5 bouts of 10 eccentric contractions at 100% max) involving the upper trapezius muscle on the dominant side. MMG signals were detected by means of 12 accelerometers forming a pentagon over the upper trapezius muscle. MMG recordings were made during submaximal exercise consisting of static arm flexion and abduction at 90° for 30 sec before and 24 hours after the eccentric exercise. Average rectified value (ARV) and percentage of determinant (%DET) of the MMG signals were computed to estimate the level of muscular activation and the amount of regularity of the MMG signals. RESULTS: During static abduction, there were significant increases in ARV and %DET from before to 24 hours after eccentric exercise, respectively from 0.02±0.011 to 0.03±0.009 m.s⁻² and from 56.3±12.3 to 59.3±11.3% (P<0.001 for both). The ARV and %DET depended also on the accelerometer locations during static flexion and abduction with higher values in the cranial and lateral part of the upper trapezius muscle (P<0.001). CONCLUSION: Inhomogeneous MMG activity in the upper trapezius muscle following high intensity eccentric exercise was found underlining the importance of using multiple recording sites when assessing MMG activity. Changes in the intrinsic properties of the upper trapezius delineated by inhomogeneous MMG activity and regularity were revealed after high intensity eccentric exercise. Supported by GigiFørellen R77-A1202.

Previous research has shown that adopting an external focus (i.e., movement of the handle), rather than an internal focus (i.e., muscle contraction) increases force output and decreases muscle activation during an elbow flexion movement in men and women with strength training experience. However, little is known about the influence of attentional focus in novice populations. PURPOSE: To determine the influence of attentional focus on muscle activation and force output among experienced and inexperienced males performing a unilateral isokinetic elbow flexion. METHODS: Fourteen male participants with >3 years of strength training experience (EX group mean age 20.6 ± 0.9) and 9 novice participants with <6 months of resistance training experience (NOV group mean age 19.5 ± 1.0) performed 10 repetitions of a unilateral elbow flexion using a Biodex System 4 dynamometer. Repetitions were performed under 3 conditions (a control followed by randomly assigned internal and external focus) at a speed of 60°(s)⁻¹. Peak torque (N·m) was measured by the Biodex, and peak muscle activation (mV) of the biceps brachii was measured using surface EMG. RESULTS: Within-group differences were analyzed using a repeated measures MANOVA. In the EX group, an external focus showed significantly higher peak torque (65.3 ± 3.2 N·m) than both the control (60.0 ± 5.2 N·m) and internal (30.1 ± 4.2 N·m) focus (all p<0.05). For the NOV group, there were no significant differences in peak torque production under different conditions. Further, no group showed significant differences in peak muscle activation for either group. CONCLUSION: Supporting previous research, our results show that adopting an external focus yields greater force output than an internal focus for experienced populations. However, no difference in force output is observed in novices with an external or internal focus. Thus, instructing experienced individuals to adopt an external focus may be beneficial for exercises where maximum force output is the goal, but additional research is needed to better understand the influence of attentional focus for similar exercises among novices. Supported by University of St. Thomas Collaborative Inquiry Grant.

The Mechanomyographic Activity of the Upper Trapezius Muscle is Heterogeneous in Response to Eccentric Exercise

Pascal Madeleine1, Rasmus F Andersen2, Dariusz Mroczek3, Ernst A Hansen4, Afshin Samani2, Adam Kawczyński5, 1Aalborg University, Aalborg, Denmark. 2University School of Physical Education, Wrocław, Poland

The mechanomyography (MMG) signal provides information on the intrinsic muscle mechanical activity. Heterogeneous MMG activity has been reported during endurance contraction but no studies have investigated the effects of high intensity eccentric exercise on the spatio-temporal MMG activity of the upper trapezius muscle. PURPOSE: To investigate changes in spatio-temporal MMG activity of the upper trapezius muscle before and after eccentric exercise in healthy subjects. METHODS: Sixteen volunteers performed high intensity eccentric exercise (5 bouts of 10 eccentric contractions at 100% max) involving the upper trapezius muscle on the dominant side. MMG signals were detected by means of 12 accelerometers forming a pentagon over the upper trapezius muscle. MMG recordings were made during submaximal exercise consisting of static arm flexion and abduction at 90° for 30 sec before and 24 hours after the eccentric exercise. Average rectified value (ARV) and percentage of determinant (%DET) of the MMG signals were computed to estimate the level of muscular activation and the amount of regularity of the MMG signals. RESULTS: During static abduction, there were significant increases in ARV and %DET from before to 24 hours after eccentric exercise, respectively from 0.02±0.011 to 0.03±0.009 m.s⁻² and from 56.3±12.3 to 59.3±11.3% (P<0.001 for both). The ARV and %DET depended also on the accelerometer locations during static flexion and abduction with higher values in the cranial and lateral part of the upper trapezius muscle (P<0.001). CONCLUSION: Inhomogeneous MMG activity in the upper trapezius muscle following high intensity eccentric exercise was found underlining the importance of using multiple recording sites when assessing MMG activity. Changes in the intrinsic properties of the upper trapezius delineated by inhomogeneous MMG activity and regularity were revealed after high intensity eccentric exercise. Supported by GigiFørellen R77-A1202.

Effects of a 4-Week Intrinsic Foot Muscle Exercise Program on Motor Function

John Fraser, Jay Hertel, FACS.M. University of Virginia, Charlottesville, VA. (Sponsor: Jay Hertel, FACS.M) (No relationships reported)

PURPOSE: The purpose of this single-blinded randomized control trial was to study the effects of a 4-week intrinsic foot muscle (IFM) exercise program on motor function, perceived difficulty, and IFM motor activation measured using ultrasound imaging (USI) during three IFM exercises. METHODS: 24 healthy, recreationally active young adults with no history of ankle or foot injury who have never performed IFM exercises participated (12 males, 12 females; mean age=21.5±4.8 years; BMI=23.5±2.9kg/m²). Following randomization, participants allocated to the intervention group received a progressive home IFM exercise program performed daily. Participants in the control group did not receive an IFM intervention and were asked not to alter their physical activity during the trial. Clinician-assessed motor performance (4-point scale: 0=does not initiate movement, 3=performs exercise in standard pattern), patient perceived difficulty (5 point Likert scale: 1=very easy, 5=very difficult), and USI motor activation measures (active thickness/resting) of the abductor hallucis brevis (AHH), flexor digitorum brevis (FDB), quadratus plantae (QP), and flexor hallucis brevis (FHB) were assessed during a toe spread out, hallux extension, and lesser toe extension exercise. The Wilcoxon signed rank test was used to assess the pre to post intervention motor performance and perceived difficulty measures. Repeated measures ANOVAs were used to analyze the USI measures. RESULTS: The intervention group demonstrated significant improvement in motor performance in the toe spread out exercise (pre=1.0±0.5, post=2.6±0.5, p=0.008) and less perceived difficulty in the toe spread out exercise (pre=3.1±1.3, post=2.3±1.2, p=0.01), isolated hallux extension (pre=5.2±1.5, post=2.0±1.2, p=0.005), and lesser toe extension (pre=9.1±0.4, post=7.2±0.4, p=0.03) exercises. Both groups demonstrated increased USI motor activation in the AHH during the toe spread out exercise (intervention: pre=1.07±0.6, post=1.11±0.8; control: pre=1.08±0.6, post=1.11±0.6, p=0.05). No other significant main effects or group by time interactions were observed. CONCLUSION: A 4-week IFM exercise intervention resulted in improved motor performance and decreased perceived difficulty when performing the exercises, but not changes in USI measures of IFM activation.

Core Muscle Function and Endurance in Patients with Patellofemoral Pain following Impairment-Based Rehabilitation

L. Colby Mangum, Ashley Marshall, Neal Glaviano, Susan Saliba, Susan Saliba. University of Virginia, Charlottesville, VA. (Sponsor: Jay Hertel, FACS.M) (No relationships reported)

Patellofemoral pain (PFP) is a common knee injury suffered among active individuals and rehabilitation programs for PFP have attempted to target hip muscle dysfunction. However, the role of core musculature in this pathology is not as prevalent in current literature. PURPOSE: To examine the effects of a 4-week impairment-based rehabilitation program with a core-focused component. Muscle activity during a single leg squat (TrA thickness) and endurance (forward and side planks times) were compared before and after rehabilitation. METHODS: 19 PFP patients (23.7±4.8yrs, 14F, 5M) completed 12 clinician-supervised rehabilitation sessions over a 4-week
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1682
June 1 9:00 AM - 10:30 AM

Single-leg Squat: Interrater Reliability And Sex Differences In Medial Knee Displacement In Collegiate Athletes

Peter J. Lisman, Gillian A. McCarren, Regina M. Misuraca, Dalton Nicholas, Daniel C. MacLea. Towson University, Towson, MD.

Email: plisman@towson.edu

No relationships reported

The Single Leg Squat (SLS) is a commonly performed clinical screening tool used to identify faulty lower extremity biomechanics, specifically dynamic knee valgus. Despite this use, few studies have investigated its reliability or examined if sex differences exist in SLS performance in athletic populations. PURPOSE: Determine interrater reliability of the SLS and investigate whether occurrence of medial knee displacement (MKD) differed between male and female collegiate athletes. METHODS: Ninety-two injury-free Division 1 collegiate athletes completed SLS testing as part of their preparticipation exam, including 46 men (age=18.6±1.6y, height=183.5±7.9cm, mass=91.0±18.9kg) and 46 women (age=18.6±1.6y, height=169.1±8.9cm, mass=65.4±10.4kg). Participants completed 5 consecutive SLSs on each leg while being recorded with a standard video camera from the frontal plane view. Videos were slowed and paused for scoring purposes. Participants were assigned a positive (+) SLS score if the midpoint of the patella moved to the great toe during the 3 trials. Trials were scored by 2 members of the research team (GM, RM). Frequency counts were calculated and agreement of the SLS was analyzed using the weighted kappa statistic for a subset of 50 participants. Pearson Chi-square tests were used to evaluate the association between sex and SLS performance. RESULTS: The interrater reliability for the right and left-leg SLS scores was 0.762 (Cohen’s Kappa). A significant increase in MKD was seen in both legs in men (p=.019, OR=2.57; 95% CI=1.27-5.29) but not in women (p=.256, OR=1.19, 95% CI=0.52-2.71). Although not significant, females were roughly twice as likely to have MKD as males (OR=2.75; 95% CI=0.84-8.30). At the point of release, Subject A had 166.6% greater Y AngMom (-23.59 ± 1.97 vs. -21.5 ± 2.31 kg·m²/s²). CONCLUSION: Subject A achieved greater Z and Y AngMom at release which likely contributes to a greater throw distance. Subject B achieved a greater maximum Z AngMom than Subject A, but was unable to maintain high Z AngMom and Y AngMom at release. The results of this investigation showed that the elite athlete was able to maintain high levels of angular momentum throughout the throw, whereas the other athlete had a significant loss of angular momentum at release.

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June 1 9:00 AM - 10:30 AM

Angular Momentum Comparison of Two Collegiate Discus Throwers of Different Skill Level

Ryan M. Hasenkamp, Scott K. Crawford, Jack W. Ramone, FACSM. University of Nebraska - Lincoln, Lincoln, NE.

(No relationships reported)

The discus throw is a highly technical event that requires the athlete to perform a sequence of high-speed movements to maximize throw distance. Previous research has demonstrated that release velocity in the horizontal and vertical directions are crucial to throw distance. It has also been shown that angular momentum about the vertical axis (Z AngMom) contributes to horizontal release velocity while angular momentum about the sagittal axis (Y AngMom) contributes to vertical release velocity. However, little research exists on angular momentum differences between throwers of different skill levels. PURPOSE: To determine the differences in angular momentum between two collegiate discus throwers of different skill level. METHODS: Two male athletes performed two throws in a laboratory setting. Whole-body kinematics were recorded from 59 retroreflective markers using a 14-camera motion capture system. Whole-body angular momentum was calculated about the vertical (Z) and sagittal (Y) axes. Maximal angular momentum and angular momentum at release were recorded. Percent differences in Z AngMom and Y AngMom between throwers were calculated. RESULTS: Subject A (190 cm; 125.6 kg) has thrown a personal best of 63.8 m and is a former NCAA national champion. Subject B (190.5 cm; 110.3 kg) has thrown a personal best of 57.9 m and failed to qualify for post-season competition. Maximum Z AngMom occurred early during the first single-support phase and was 11.7% greater for Subject B (79.79 ± 0.96 vs. 71.79 ± 1.22 kg·m²/s²). However, at the point of release, Subject A had 28.8% greater Z AngMom (65.80 ± 0.67 vs. 49.26 ± 0.08 kg·m²/s²). Maximum Y AngMom occurred late during the delivery phase and was 47.2% greater for Subject A (-38.33 ± 2.95 vs. -21.71 ± 0.53 kg·m²/s²). At the point of release, Subject B had 166.6% greater Y AngMom (-23.59 ± 1.97 vs. -21.5 ± 2.31 kg·m²/s²). CONCLUSION: Subject A achieved greater Z and Y AngMom at release which likely contributes to a greater throw distance. Subject B achieved a greater maximum Z AngMom than Subject A, but was unable to maintain high Z AngMom and Y AngMom at release. The results of this investigation showed that the elite athlete was able to maintain high levels of angular momentum throughout the throw, whereas the other athlete had a significant loss of angular momentum at release.

1684
June 1 9:00 AM - 10:30 AM

Predictors of Outcomes after ACL Reconstruction Differ Based on Meniscus Involvement

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No relationships reported

Objectives: To determine predictors of self-reported knee function in ACLR patients with and without concomitant meniscal surgery. METHODS: 97 patients with a primary, unilateral ACLR (age=27±8.7 years, mass=74.8±16.6 kg, time since surgery=6.8±2.8 mo.) participated near the time of return to unrestricted activity. Patients were separated into 3 groups: ACLR only (n=25), ACLR with meniscectomy (n=29), or ACLR with meniscal repair (n=43). Isometric peak knee flexion power and flexion torque was measured at 180° sec. Subjective knee function was measured with the KOOS. We performed stepwise multiple linear regression to predict total KOOS score for each ACLR group. Predictors were total work, average power, and peak torque for knee extension and flexion for the involved limb normalized to body mass and as a symmetry index compared to the healthy contralateral limb. Predictors added to the model all had statistically significant R-square change (P<.05). RESULTS: ACLR only: involved knee flexion power explained 25% of the variance in KOOS total score (R²=.251, P=.002). ACLR with meniscal repair: knee extension limb symmetry explained 19% of the variance in KOOS total score (R²=.190, P=.01). ACLR and meniscectomy: the regression model resulted in no predictors of KOOS total score. Conclusion: Measures of thigh muscle strength were significant predictors of self-reported outcome in patients with ACLR. Meniscal involvement reduced the overall variance explained in PRO and altered the predictors included. Clinicians should be aware of other factors besides quadriceps and hamstring strength that may influence outcomes post-ACLR, especially in patients with concomitant meniscectomy.

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Analysis of Time Distribution Pattern and Surface Electromyography Characteristics of Wheelchair Racing “Butterfly” Technique

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No relationships reported

Wheelchair races, like sprinters, have special movement patterns, especially when adopting a “butterfly” technique. Yet, the surface electromyography (sEMG) characteristics of this technique have not been well studied.
PURPOSE: To determine the time distribution pattern and sEMG characteristics of the wheelchair racing “butterfly” technique (WRBT).

METHODS: 10 wheelchair racers on the Chinese national team (6 males, 4 females), who were classed as T54, were recruited for the study. Four Panasonic high-speed cameras were placed in different locations to monitor the kinematics characteristics of participants in a designated area, and one Biometer Megawin6000 sEMG tester with eight electrode units was installed on eight muscles (biceps, triceps, flexor carpi radialis, extensor carpi radialis, rectus abdominis, abdominal oblique, and upper trapezius) to record muscle activity. The Kwon3D video management software was used to analyze the movement pattern and time distribution, and MegaWin software (2.3a12 edition) was used to analyze sEMG characteristics and calculate integral electromyography (iEMG). Descriptive statistics were computed using IBM SPSS (version 22.0) for the data.

RESULTS: When participants implemented WRBT to complete the test, the ratio of their push phase (PP) and recovery phase (RP) was approximately 1:3.58. During PP, the maximum percentage of iEMG was in the biceps (24.5±2.96%), with rectus abdominis (3.80±2.32%) having minimum value. Correspondingly, the muscle activity of triceps was the maximum (26.98±3.88%), and rectus abdominis (3.45±1.47%) remained the minimum at the PP. The muscle activities of the wrist joints and shoulder joints had higher activity than other muscles tested during the PP and RP.

CONCLUSION: The time distribution pattern and sEMG characteristics of WRBT were studied, which indicates that, to reduce possible injuries, the wheelchair racers may need improving muscular strength of their wrists and upper limbs.

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Influence of Hybrid III Head and Neck Position to Frontal Impacts
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(No relationships reported)

Collisions in sport occur with the head and neck in various positions. While research has shown that the response of the head differs between front and side impacts, the current understanding of how relatively small changes in head position influence head accelerations and the forces on the neck during impacts remains unclear. PURPOSE: To determine the influence of head position on the accelerations of a biofidelic headform as well as the loads at the atlanto-occipital joint in all 6 degrees of freedom during frontal impacts.

METHODS: A Hybrid III male 50% head-neck assembly instrumented with accelerometers, angular rate sensors and force transducers (sampling rate = 30,000 Hz) was impacted in the frontal quadrant 6 cm above the reference plane with a cylindrical pneumatic impactor (mass = 13.78 kg) at 5.5 m/s. The head-neck assembly was placed in 4 combinations of pitch and yaw angles (-7.5° and 0°, -7.5° and -10°, -22.5° and 0°, -22.5° and -10°). The head was impacted in each position 5 times. The maximum resultant linear and angular accelerations as well as force and moment were calculated during frontal impacts.

RESULTS: A 2-way ANOVA (pitch x yaw) was used to test for differences in resultant linear and angular accelerations as well as force and moment were calculated during frontal impacts. Though there was a pitch and yaw main effect for linear acceleration (pitch: p = 0.025; yaw: p < 0.001) along with interaction between pitch and yaw for any of the dependent variables (p > 0.073). CONCLUSIONS: Tilting the head-neck anteriorly alters the dynamic response of the headform by reducing angular acceleration, but may increase the overall loads experienced at the atlanto-occipital joint. The clinical meaningfulness of our findings related to changes in yaw require further exploration.

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A Robotic Resisted-sprint Improves Rate Of Force Development During A 20 Meter Sprint In Athletes
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PURPOSE: Examine the effect of a resisted sprint on 20-m sprinting kinetics.

METHODS: Following a standardized warm-up, twenty-three (male = 10, female = 13) division 1 basketball players completed three maximal 20-m sprint trials while tethered to a robotic resistance. During the first sprint (S1), the minimal resistance (1-kg) necessary to detect peak (PK) and average (AVG) sprinting power (P), velocity (V) and force (F); peak rate of force production (RFD) was also collected. Following a 5-min rest period, the athletes completed another sprint (S2) at a resistance that equated to approximately 5% of their body mass. The athletes then rested for approximately 4 – 7 minutes before completing their final sprint (S3) with minimal resistance (1-kg). An analysis of variance with repeated measures was used to assess differences between each sprinting condition.

RESULTS: Significant (p < 0.05) main effects were observed for all sprinting kinetic measures except Vs (p = 0.067). Compared to S1, a reduction (p < 0.006) in 20-m sprint time (S1: 3.76 ± 0.23 sec; S2: 3.9 ± 0.34 sec), stride length (S1: 1.39 ± 0.16 m; S2: 1.09 ± 0.18 m), Pmax (S1: 140 ± 18 Watts; S2: 302 ± 66 Watts), Pavg (S1: 375 ± 41 Watts; S2: 617 ± 82 Watts), Vavg (S1: 5.70 ± 0.51 m · s⁻¹; S2: 5.32 ± 0.50 m · s⁻¹), Favg (S1: 23.8 ± 1.2 N; S2: 55.7 ± 8.8 N), Fpeak (S1: 49.7 ± 13 N; S2: 82.1 ± 7.8 N), and RFD (S1: 5855 ± 436 N · sec; S2: 9981 ± 813 N · sec). However, only RFD was greater at S3 (6139 ± 389 N · sec; p < 0.001) compared to S1. CONCLUSION: Completing a short, resisted-sprint with a load equating to 5% of body mass within 4 – 7 minutes of a short sprint (~20-meters) does not appear to affect sprinting time or kinetics. However, it does appear to enhance rate of force production.

Abstracts were prepared by the authors and printed as submitted.