

C-10 Thematic Poster - Bioenergetics and Training

Thursday, June 1, 2017, 8:00 AM - 10:00 AM
Room: 403

1227 **Chair:** Gretchen A. Casazza. *UC Davis Sports Medicine, Sacramento, CA.*

(No relationships reported)

1228 Board #1 June 1 8:00 AM - 10:00 AM

Resistance Exercise Attenuates Mitochondrial Function: Effects Of NSAID Intake And Eccentric-Overload Training

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(No relationships reported)

Although nonsteroidal anti-inflammatory drugs (NSAIDs) have been shown to modulate skeletal muscle adaptations and protein metabolism in response to resistance exercise, little is known about the effects of NSAIDs on mitochondrial function. Thus, the current study aimed to examine the effects of resistance exercise with concomitant NSAID consumption on mitochondrial oxidative phosphorylation in skeletal muscle. Twenty participants were randomized in a single-blinded fashion to either an experimental group receiving ibuprofen (IBU: 27±5 yr; n=11; 1200 mg/d) or a control group receiving a low-dose acetylsalicylic acid (CON: 26±4 yr; n=9; 75 mg/d) During this period, 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 IBU (23%) and CON (29%) with no difference across medical treatments. Although OXPHOS decreased in both legs, the decrease was greater (interaction P= 0.015) in WS (33%, 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.

1229 Board #2 June 1 8:00 AM - 10:00 AM

Human Skeletal Muscle Oxidative Capacity Is Up-regulated After High-intensity Training In Competitive Soccer Players

Dan Fransson¹, Nikolai Baastrup Nordsborg², Peter Krstrup³, Magni Mohr⁴. ¹*University of Gothenburg, Gotheburg, Sweden.* ²*University of Copenhagen, Copenhagen, Denmark.* ³*University of southern Denmark, Odense, Denmark.* ⁴*University of the Faroe Island, Torshavn, Faroe Islands.*

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(No relationships reported)

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 s 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 2 x 7-9 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.

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.

1230 Board #3 June 1 8:00 AM - 10:00 AM

Decreased Energy Availability During Intensified Training is Associated with Non-Functional Overreaching in Female Runners

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(No relationships reported)

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). VO₂max, heart rate (HR), systolic blood pressure (SBP), plasma epinephrine and norepinephrine and blood lactate concentrations were measured at 65, 75 and 85% of VO₂max and immediately after maximal exercise.

RESULTS: 7 runners became OR and 9 were AF (Δperformance: -9±2% 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±48kcal/d) and maintained EA. ΔEA correlated with Δperformance and ΔVO₂max (R = 0.61 and 0.66, p < 0.05). VO₂max 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.

1231 Board #4 June 1 8:00 AM - 10:00 AM

The Effect of Aerobic and Resistance Training Exercise on Blood Pressure Response in College Aged Students

Mark Rudich, Randy Canivel, Bradley Warren. *Southern Methodist University, Dallas, TX.*

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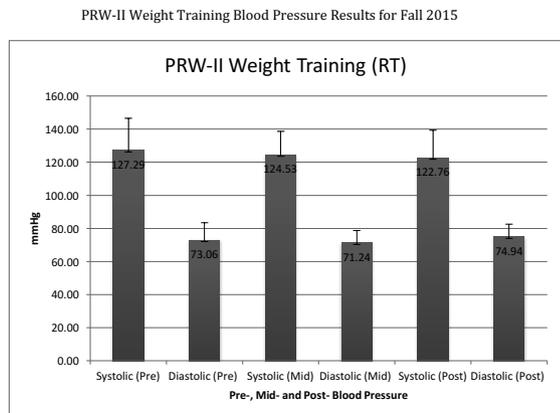
(No relationships reported)

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 contradicting 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 ±

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.

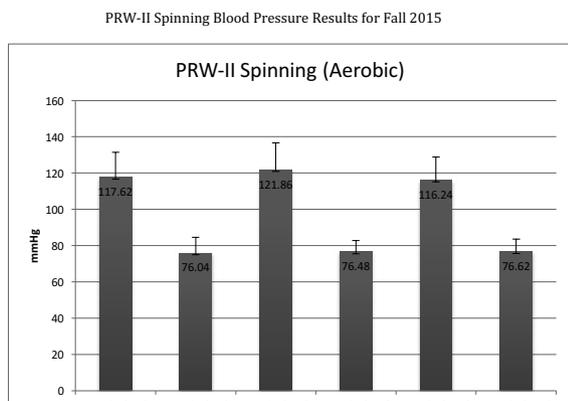
Supported by Just-in-Time Teaching & Technology Grant (CTE: SMU)

Figure 1.



RT=Resistance Training

Figure 2.



1232 Board #5 June 1 8:00 AM - 10:00 AM
6 Weeks of Eccentric Cycling Training Improves Walking Economy in Healthy Individuals

Albino G. Schifino, Andrew J. Weiler, Luis F. Diaz, Chee-Hoi Leong. *Central Connecticut State University, New Britain, CT.* (Sponsor: Dr. Sean Walsh, FACS) Email: a.g.schifino@my.ccsu.edu (No relationships reported)

Low muscular strength is associated with physical decline. Progressive strength training has been demonstrated to improve physical functional outcomes. Because eccentric exercise is a potent stimulus for increasing muscle size, strength and power, it has the potential to serve as a time-effective intervention to improve ambulatory function at a lower metabolic cost compared to traditional strength training. **PURPOSE:** To examine if a 6-week eccentric cycling training intervention could improve walking economy in healthy individuals. **METHODS:** Seven healthy individuals (six males and one female; age=27±6 yrs; mass=73.4±9.7 kg; height=1.7±0.9m) trained on an eccentric ergometer for 6 weeks (3x/week; 10-30 min; 54-66% of HR_{max}). Metabolic cost of walking (C_w ; J/kg/m) was assessed one week prior to, and one week following eccentric cycling training. C_w was determined as the net energy cost (J/kg/s), divided by walking speed (m/s) during steady-state walking at 5 walking speeds (0.7, 1.11, 1.39, 1.67, and 1.9 m/s). Cohen's *d* effect sizes (*ES*) were calculated for all analyses and *ES* magnitudes of 0.10, 0.30, and 0.50, were interpreted as small, medium, and large effects, respectively. **RESULTS:** Following eccentric cycling training, post-training C_w was significantly improved while walking at 0.7m/s ($P=0.03$; Table 1). Although there were no statistical significance detected at the walking speeds of 1.11, 1.39, 1.67, and 1.9 m/s (all $P>0.05$), the lower post-training C_w observed provide strong evidence for a trend of decreased C_w following eccentric cycling training. **CONCLUSIONS:** Our results demonstrate that 6 weeks of 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 1. Pre- versus post-training C_w values following eccentric training. Data presented as mean±SD.

| Walking Speed (m/s) | C_w (J/kg/m) | | <i>P</i> | <i>ES</i> |
|---------------------|----------------|---------------|----------|-----------|
| | Pre-training | Post-training | | |
| 0.7 | 2.1±0.44 | 1.9±0.42* | 0.03 | 0.75 |
| 1.11 | 2.1±0.38 | 2.0±0.27 | 0.56 | 0.24 |
| 1.39 | 2.3±0.43 | 2.1±0.24 | 0.06 | 0.68 |
| 1.67 | 2.7±0.42 | 2.5±0.27 | 0.09 | 0.64 |
| 1.9 | 3.3±0.57 | 3.0±0.90 | 0.09 | 0.69 |

*Significantly different compared to pre-training ($P<0.05$).

1233 Board #6 June 1 8:00 AM - 10:00 AM
Effect Of Acute Acetaminophen Ingestion On Running Endurance Performance

Fotini Pagotto Dagli, M. Maridaki, G. Paradisis, T. Piliandis, E. Zacharogiannis. *National and Kapodistrian University of Athens, Athens, Greece.* 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 VO_{2max} . 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% VO_{2max} . 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 18.9 ± 1.04 vs ACT 18.3 ± 1.00). Subjects also during TT ran the 2nd km (PLA 250.43 ± 32.02 vs ACT 245.61 ± 32.60 s) and 3rd 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.

1234 Board #7 June 1 8:00 AM - 10:00 AM
MVPA, Peak 1, And Peak 30 Min Cadence Relationship With Cardiovascular Health

Christopher Arboleda¹, Jessica G. Redmond², Tiago Barreira¹. ¹Syracuse University, Syracuse, NY. ²Utica College, Utica, NY. Email: carboled@syr.edu (No relationships reported)

The link between cardiovascular health and moderate-vigorous physical activity (MVPA) in adults has been investigated to a great extent, however little is known about the relationship between peak cadence and cardiovascular health.

PURPOSE: To determine the relationship between peak cadences (mean daily peak 1 min [P1] and mean daily peak 30 min [P30]) and MVPA with indicators of cardiovascular health (i.e. VO_{2max} , HDL, triglycerides, blood pressure, blood glucose levels, body mass index (BMI), and waist circumference).

METHODS: 106 apparent healthy men and women (aged of 18-36 yrs) were recruited for the study. MVPA and peak cadence were measured using an ActiGraph GT3X+ accelerometer worn at the waist (24 h/day for 7 consecutive days) attached by an elastic belt. The accelerometer was only removed for water based activities. MVPA was determined using Troiano cut-point of 2020, P1 was determined as the highest number of steps achieved in any minute during the wake period and P30 was the best 30 min at any time of day, independent of order. Lipids and glucose were measured following an overnight fast. Blood pressure was measured following 10 minutes of seated rest. Subjects completed the VO_{2max} test on a treadmill using a metabolic cart. Participants were only included in the analysis if they had all the cardiovascular health data and 4+ days with 10+ hours of wake wear accelerometer data. Pearson Correlation was used to determine the relationship between variables.

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 (-.36 and -.26 respectively), glucose (-.25 and -.22 respectively), HDL (.33 and .25 respectively), and BMI (-.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 $r = -.29$.

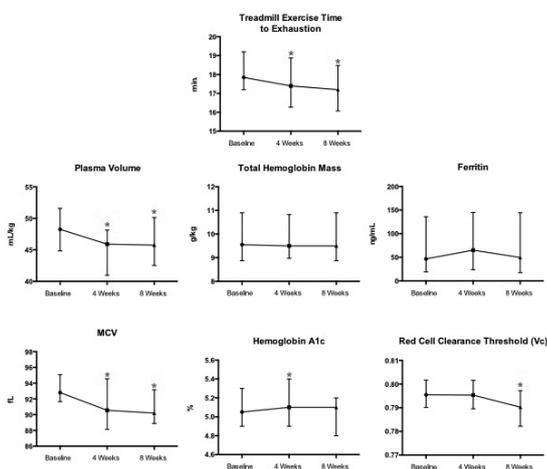
CONCLUSION: P1 and P30 were significantly correlated with a larger number of cardiovascular health variables than MVPA. Both those measures should be investigated further as an alternative measure of physical activity.

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 Shave³, Jennifer Michaud-Finch¹, James Otto⁴, Anwesha Chaudhury¹, Richard Burden⁵, Brian Moore⁶, Carlo Brugnara², Aaron L. Baggish, FACSM¹. 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.
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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 hour) 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.



* = P < .05 compared to baseline value. Significance assessed using mixed linear modeling with adjustment for age and marathon finish time (fixed effects) and subject baseline values (random effect).

Values are expressed as median with interquartile range.

C-11 Thematic Poster - Exercise and Cancer

Thursday, June 1, 2017, 8:00 AM - 10:00 AM
Room: 404

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

(No relationships reported)

1237 Board #1 June 1 8:00 AM - 10:00 AM Stroke Volume and Cardiac Output Response to Maximal Exercise is Attenuated in Anthracycline Treated Cancer Survivors

Ashley M. Larson¹, Peter H. Brubaker, FACSM¹, Jennifer Jordan², Gregory Hundley². ¹Wake Forest University, Winston Salem, NC. ²Wake Forest Baptist Medical Center, Winston Salem, NC.

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(No relationships reported)

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 and peak 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.

| | Δ (Peak - Rest) | |
|-------------------------|-----------------|---------------|
| | ATS | CON |
| HR (bpm) | 82.75 ± 9.55 | 90.25 ± 19.70 |
| SV (ml/m ²) | 2.28 ± 1.27 | 5.34 ± 9.99 |
| Q (L/m ²) | 2.11 ± 0.89 | 4.31 ± 2.31 |
| EF (%) | 14.5 ± 0.82 | 17.75 ± 3.58 |

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.

1238 Board #2 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 Lowe², Andrew R. Levy¹, Vishal Mevani³, Simon N. Rogers⁴. ¹Edge Hill University, Ormskirk, United Kingdom. ²Astraglobe Limited, Cheshire, United Kingdom. ³Northampton General Hospital, Northampton, United Kingdom. ⁴University Hospital Aintree, Liverpool, United Kingdom. (Sponsor: Prof Lars McNaughton, FACSM)

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(No relationships reported)

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

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

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 male. Of the responders, 30% said 'Yes' they 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 (33%) 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 addressed 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.

1239 Board #3 June 1 8:00 AM - 10:00 AM
Stress Hormone Response To Acute Aerobic Exercise During Prostate Cancer Treatment
 Erik D. Hanson¹, Samy Sakkal², William S. Evans¹, John A. Violet³, Glenn K. McConell², Alan Hayes². ¹University of North Carolina at Chapel Hill, Chapel Hill, NC. ²Victoria University, Melbourne, Australia. ³Peter MacCallum Cancer Centre, Melbourne, Australia. (Sponsor: Claudio Battaglini, FACSM)
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 (No relationships reported)

Exercise training has been used to reduce the side effects of cancer treatment. However, the stress response to acute exercise during hormone dependent cancer treatment is unclear. **PURPOSE:** To examine the effects of a single bout of moderate intensity exercise on cortisol (CORT), epinephrine (EPI), and norepinephrine (NE) levels during prostate cancer (PCa) treatment with and without androgen deprivation therapy (ADT). **METHODS:** Men with PCa on ADT (N=11, 67 (2yr)), not on ADT (N=11, 67 (2y)), and non-cancer controls (CON, N=8, 64 (3y)) had blood samples taken before a 45min discontinuous cycling bout at 60% of peak wattage and after 0h, 2h, and 24h of recovery. Stress hormone concentrations were measured via ELISA. Differences between groups and time points were determined using two-way repeated measures ANOVA. Percent changes were expressed relative to baseline. **RESULTS:** Men on ADT had significantly greater mass and % fat, more advanced cancer, and suppressed testosterone (all $P < 0.05$). NE increased by 385% ($P < 0.001$) at 0h and remained elevated at 2h and 24h (118% and 24%, both $P < 0.05$) with no group differences. CORT significantly increased at 0h (36%, $P = 0.012$), significantly decreased at 2h (-24%, $P < 0.001$) and remained suppressed at 24h (-11%, $P = 0.037$). ADT CORT levels were 32% lower than PCa ($P = 0.006$) with no differences vs. CON. A significant group x time interaction was present for EPI ($P < 0.001$) where CON increased by 817%, ADT by 700%, and PCa by 333% at 0h but PCa and ADT absolute levels were attenuated relative to CON (ADT: -54%, PCa: -52%, $P = 0.004$). **CONCLUSIONS:** Compared with age-matched CON, PCa and ADT exhibited similar hormonal responses to a single acute aerobic exercise bout for NE and CORT but an attenuated EPI response. Future studies should examine the stress response to multiple exercise bouts to verify these findings and to explore the functional hormonal effects (e.g. immune and metabolic responses) during cancer treatment.

1240 Board #4 June 1 8:00 AM - 10:00 AM
Exercise Improves Vo2max And Body Composition In Adt-treated Prostate Cancer Patients
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 (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 present 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 ($p = 0.015$) 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 ($p < 0.001$) 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. Supported by NHMRC Project Grant AppID 534409

1241 Board #5 June 1 8:00 AM - 10:00 AM
Cardiopulmonary Fitness in Prostate Cancer Patients Defines Subpopulations at Risk of Metabolic and Performance Declines
 Richard A. LaFountain, Debbie Scandling, Connor M. Geraghty, Ciaran M. Fairman, Brian C. Focht, FACSM, Steven T. Devor, FACSM, Carmen B. Swain, Subha V. Raman, Orlando P. Simonetti, Steven K. Clinton. The Ohio State University, Columbus, OH.
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 (No relationships reported)

Androgen deprivation therapy (ADT) plays a critical role in the treatment of prostate cancer (PC), the most common malignancy in American men. ADT results in diverse physiological effects impacting health and quality of life. **PURPOSE:** To characterize the cardio-metabolic phenotype of men with prostate cancer prior to ADT, define the heterogeneity of this population, and identify those at greater risk of complications who may benefit from dietary and fitness interventions. **METHODS:** Metabolic evaluation of ventilatory gas exchange was completed in a sample of 19 men with prostate cancer age range of 49- 74 years (mean and SD; 62.9 ± 7.6) immediately prior to initiation of ADT. Patient body mass index (BMI) was calculated, range 21.9 to 39.7 (29.2 ± 4.1 kg/m²). Peak oxygen consumption (VO₂peak) data was collected via treadmill Bruce protocol to volitional exhaustion. Cardiopulmonary testing measures including respiratory exchange ratio (RER), O₂ pulse, max heart rate (HRmax), and test duration, were recorded. **RESULTS:** VO₂peak was measured in PC patients ranged from 20.4 ml/kg/min to 35.2 ml/kg/min (27.6 ± 4.8 ml/kg/min). Metabolic parameters, RER (1.06 ± 0.1) and O₂ pulse (15.7 ± 3.2) were measured at peak exercise. Test duration (9.2 ± 1.6 min) resulted in average peak heart rate (156.9 ± 15.1 bpm). **CONCLUSIONS:** VO₂peak ranged in PC patients from 5th percentile to the 75th percentile for aged-matched men, according to ACSM Guidelines. Patients initiating ADT vary significantly in their cardio-metabolic phenotype. Although degradation of cardiopulmonary health related to ADT is being investigated and reported, it remains imperative to define objective strategies to identify men at risk of cardiopulmonary decline and metabolic complications with ADT. This data will allow the design of effective fitness interventions at the initiation of ADT that will promote healthy cancer survivorship. Supported by Pelotonia/The OSU Comprehensive Cancer Center

1242 Board #6 June 1 8:00 AM - 10:00 AM
Assessing Cardiorespiratory Fitness in Early Stage Breast Cancer: The M.D. Anderson Healthy Heart Program
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 (No relationships reported)

Purpose: Cardiovascular disease (CVD) is rapidly becoming the predominant cause of mortality in early stage breast cancer survivors. The magnitude of this problem is likely to increase with the aging US population, improvements in breast cancer-specific survival, and the continued use of adjuvant therapies with cardiovascular toxicities. Thus, novel strategies are required to predict and mitigate excess CVD risk in breast cancer survivors. **Methods:** The MD Anderson Healthy Heart Program was created to improve cardiorespiratory fitness (CRF) and reduce existing cardiovascular risk factors in cancer survivors. Patients undergo a one-time consultation with a cardiologist to discuss previous cancer treatment and CVD risk factor modification after measurement

of CVD 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 (Vo_{2peak}). 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 Vo_{2peak} was 20.9± 4.1 mL.kg⁻¹.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.

1243 Board #7 June 1 8:00 AM - 10:00 AM
Supervised Exercise as Supportive Care for Women with Breast Cancer: Improvements in Physical Fitness
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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 with adjuvant 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 adjuvant Treatment (NEXt) study within the first half of chemotherapy. Supervised aerobic and resistance exercise was performed for 60-80 min 3x/wk during adjuvant 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 (VO_{2peak}) 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 the exercise program. Baseline VO_{2peak} and LP 1RM were 26.8±0.8mL/min/kg and 186.5±6.6lbs, respectively. VO_{2peak} was not significantly different from baseline to end of treatment (+1.0mL/min/kg, p=1.0), increased from baseline to end of intervention (+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<0.01) and from end of treatment to end of intervention (+30.5±4.4lbs, p<0.01), but decreased at the 1-year follow-up relative to end of intervention (-25.6±8.6lbs, p=0.03) and remained higher than baseline (+42.1±8.5lbs, p<0.01). **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.

1244 Board #8 June 1 8:00 AM - 10:00 AM
Concurrent Aerobic and Resistance Training Prevents Physical Fatigue in Patients with Breast Cancer during Chemotherapy
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 (No relationships reported)

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-IIIa 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 VO_{2peak} 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 handgrip- (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=-0.14) 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.

C-12 Thematic Poster - Military Physiology

Thursday, June 1, 2017, 8:00 AM - 10:00 AM
 Room: 304

1245 Chair: Francis G. O'Connor, FACSM. *Uniformed Services University, Bethesda, MD.*
 (No relationships reported)

1246 Board #1 June 1 8:00 AM - 10:00 AM
Predicting Load Carriage Performance Using Physical Fitness and Anthropometric Measures in Soldiers
 Peter N. Frykman, Stephen A. Foulis, Jan E. Redmond, Bradley J. Warr, Jay R. Hydren, Edward J. Zambraski, Marilyn A. Sharp. *USARIEEM, Natick, MA.*
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 (No relationships reported)

Load carriage is one of the most physically demanding of the common soldiering tasks. The average loads carried during infantry patrol operations often exceed 45 kg. Carrying these loads increases the potential for injury while foot marching. It would be advantageous to predict load carriage performance based upon commonly available information such as anthropometry and physical fitness tests without having the soldier perform the load carriage task. **PURPOSE:** To determine if physical fitness tests and anthropometric measures predict a Soldier's physical capabilities to perform the task of marching under load. **METHODS:** While carrying a load weighing approximately 46.4 kg, 67 male and 37 female Soldiers performed a 12 mile foot march for time (FM₁₂). Soldiers provided scores from their most recent Army Physical Fitness Test which consisted of a 2 mile run for time (2m Run), maximum number of pushups (PU) and sit-ups (SU) completed in 2 min. The soldier's height in cm (HT) and body mass in kg (BM) were also measured. **RESULTS:** The average time (mean ± SD) to complete the FM₁₂ task was 239 ± 36 min. The following variables were significantly correlated with FM₁₂: HT (r=-0.64, p≤0.001), BM (r=-0.55, p≤0.001), PU (r=-0.53, p≤0.001), 2m Run (r=0.57, p≤0.001). A stepwise multiple regression was used to develop the following equation: FM₁₂=411.15-1.01(HT)+5.25(2m Run)-0.44(PU)-0.69(BM), (SEE = 23.92 min: R=0.749, p ≤ 0.01). Approximately 56 percent of the variability in the prediction (i.e. R²) of FM₁₂ performance can be explained by the combination of these 4 factors. **CONCLUSIONS:** A soldier's time to complete the FM₁₂ task can be predicted by several individual factors as well as the combination of the 4 factors in this model. These readily available data provide an easy to employ method of predicting a Soldier's physical capabilities for FM₁₂. *These views are those of the authors and are not official policy of the Department of Army, DOD, or the U.S. Government.*

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 military personnel when carrying 25 kg load ($R^2 = 0.71$; 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 yrs, 61.8 ± 8.4 kg, 1.64 ± 0.05 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 ± 4.27 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 %HRR ($r = 0.467$, $P < .001$) and daily distance ($r = 0.616$, $P < .001$). **Conclusion:** This is the first study to report external training loads (distance and speed) of British Army recruits during Phase One training using GPS which 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

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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_{kg}) for upper body strength and their height in cm (HT_{cm}) and body mass in kg (BM_{kg}) were measured. Stepwise multiple regression was used to develop separate equations for males and females. **Results:** For male Soldiers, average HT_{cm} was 177.68 ± 19.56 cm (mean ± SD), BM_{kg} 75.96 ± 12.18 kg, and they moved 7.69 ± 1.61 rounds·min⁻¹. The regression equation was $TAL = 7.03 - .011(HT_{cm}) - .012(BM_{kg}) + .079(BC_{kg})$ (SEE = 1.51 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. For women Soldiers, average HT_{cm} was 165.80 ± 6.48 cm, BM_{kg} 63.46 ± 9.23 kg, and they moved 3.32 ± 1.82 rounds·min⁻¹. The regression equation was $TAL = -9.83 + .029(HT_{cm}) + .090(BM_{kg}) + .097(BC_{kg})$ (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. **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 Recruit 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; I-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 ($r^2 = 0.097$ 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 ($r^2 = -0.514$ 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 ($r^2 = -0.676$ 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 fact, a recent review of physically demanding tasks across 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
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 (No relationships reported)

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 material 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 ($R^2 = 51.78, p < 0.001$). 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. Supported by Freddie H. Fu, MD Graduate Research Award, SHRS Research Development Fund

C-13 Thematic Poster - Muscle Basic Science

Thursday, June 1, 2017, 8:00 AM - 10:00 AM
 Room: 101

1252 Chair: Michael Roberts. Auburn University, Auburn, AL.
 (No relationships reported)

1253 Board #1 June 1 8:00 AM - 10:00 AM
Size Profile and Selective Protein Packaging of Exosomes Released from Atroaching Muscle Cells
 Matthew B. Hudson¹, Carina M. Pautz¹, Carlos A. Barrero¹, Ellen M. Kelly¹, Joshua T. Selsby², Brittany E. Wilson¹. ¹Temple University, Philadelphia, PA. ²Iowa State University, Ames, IA.
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 (No relationships reported)

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 by which muscle signals other tissues during chronic conditions in which atrophy is occurring. However, to know what signaling pathways these exosomes may potentially be involved in, it is important to know what potential signaling molecules are present in exosomes released from muscle cells during atrophy. **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 proteomic analysis was performed on proteins isolated from exosomes, and analyzed using Ingenuity Pathway Analysis software. Nanoparticle tracking analysis (Nanosight) was performed on a separate set of exomes measure vesicle size and number. **RESULTS:** Compared to control cells, the exosomes released during DEX-induced muscle atrophy contained 135 proteins increased greater than two-fold and 159 proteins decreased greater than two. Nanoparticle tracking analysis revealed no change in the number of exosomes released during atrophy (6.77×10^8 vs 7.06×10^8 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 both a selective packaging of proteins into exosomes 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.
 (Sponsor: Dr. James A. Carson, FACSM)
 (No relationships reported)

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 130 receptor (gp130) induces cellular signaling that regulate muscle metabolism and remodeling. While muscle oxidative metabolism is induced by 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 ($R^2=0.63, p=0.01$), but not in KO muscle ($R^2=0.02, p=0.65$). Exercise increased B6 and KO COX activity ($p < 0.0001$), and ablated the relationship between COX activity and total RNA content in B6 muscle ($R^2=0.01, p=0.90$).

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.

Supported by NCI R01-CA121249

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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 (No relationships reported)

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, 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 (TEST). **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 TEST 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 TEST 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

($p < 0.05$). Wnt5a/b was 26% greater at 3 versus 12 ($p < 0.05$), and 54% at 3 versus 24 months ($p < 0.05$). Additionally, Wnt5a/b was 26% greater at 6 versus 12 ($p < 0.05$), and 54% at 6 versus greater than 24 months ($p < 0.05$). Relative gastrocnemius masses and Wnt5a/b exhibited a moderate positive correlation $r = 0.397$, ($p = 0.007$). Beta-catenin was greater at 6 versus 3 and 18 months ($p < 0.05$). Additionally, beta-catenin was greater at 12 versus 3 and 18 months ($p < 0.05$), and 24 versus 3 and 18 months ($p < 0.05$). Androgen receptor (AR) was greater at 3 versus 18 and 24 months ($p < 0.05$), greater at 6 versus 18 and 24 months, and greater at 12 versus 18 and 24 months ($p < 0.05$). Furthermore, AR had a moderate positive correlation $r = 0.438$, ($p = 0.003$) with relative gastrocnemius masses. Additionally, AR had a strong positive relationship correlation $r = 0.670$, ($p < 0.001$) with Wnt5a/b. **CONCLUSIONS:** It appears that intramuscular Wnt signaling proteins, androgen receptor content, serum testosterone, and gastrocnemius masses are inter-related, and decline with aging. Androgen-sensitive mechanisms related to Wnt signaling should be further investigated in skeletal muscle in order to ascertain if these processes contribute to sarcopenia.

1256 Board #4 June 1 8:00 AM - 10:00 AM

A Single Bout Of Cryotherapy Does Not Alter The Transcriptome Or Metabolome Of Human Skeletal Muscle

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(No relationships reported)

Cryotherapy is a 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 cup massage over a 45 cm² area on each thigh for 15 min. Two hours after application, bilateral biopsies were taken at a depth of 2 cm from the vastus lateralis in the center of the ice or sham area. Muscle biopsies were from each leg were then subjected to microarray or LCMS-based metabolomics analysis. Differences between groups were tested using paired t-tests ($\alpha = 0.05$).

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 13% 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 no significant ($p < 0.05$) differences/decreases in the hexose sugars and hypoxanthine by 15% and 17% respectively in cooled skeletal muscle tissue. **CONCLUSION:** A clinically relevant administration of cryotherapy does not seem to have a significant impact on the transcriptome nor metabolome of otherwise healthy skeletal muscle. Supported by NIH grant U24-DK097153.

1257 Board #5 June 1 8:00 AM - 10:00 AM

Transcriptional Signatures of Human Skeletal Muscle in Response to Aerobic and Resistance Exercise

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(No relationships reported)

Aerobic and resistance exercise facilitate unique health- and functional-based adaptations in skeletal muscle. The precise cellular mechanisms through which these exercise-mode specific adaptations are realized remain to be completely understood.

PURPOSE: Identify the transcriptional signatures of human skeletal muscle in response to acute aerobic and resistance exercise. **METHODS:** In a counter-balanced, cross over design, six healthy, recreationally active young men (26 ± 1 yr; BMI: 24.9 ± 2.7 kg·m⁻²) completed an acute bout of aerobic (AE, 40 min stationary cycling, 60-70% heart rate max) and resistance exercise (RE, 8 sets of 10 reps, 70% 1RM), separated by ~1 week. Muscle biopsies (*vastus lateralis*) were obtained before exercise and at 1 and 4h after each exercise bout. Whole transcriptome next-generation RNA sequencing (HiSeq2500, Illumina) was performed on cDNA synthesized from skeletal

muscle RNA. Sequencing data were analyzed using HTSeq and differential expression was identified using DESeq2 software. Genes with an adjusted p-value of < 0.05 and ≥ 2 -fold change (log₂) from pre exercise were considered differentially expressed.

RESULTS: At 1h postexercise, AE and RE elicited a similar number of up- (AE, 43; RE, 57) and down-regulated genes (AE, 1; RE, 1), including 36 genes that were common to both exercise modes. However, at 4h postexercise RE elicited a larger number of up- (AE, 156; RE, 353) and down-regulated genes (AE, 27; RE, 54), of which 143 genes were common between exercise modes. Over this postexercise time course 264 genes were preferentially up- (216 genes) or down-regulated (47 genes) only by RE whereas 40 genes were preferentially up- (21 genes) or down-regulated (19 genes) only by AE. **CONCLUSION:** These preliminary data highlight mutual and unique transcriptome responses to aerobic and resistance exercise that are likely to regulate, in part, the specific adaptive responses of skeletal muscle to these exercise modes. Further work is necessary to determine how these transcriptome profiles correlate to exercise-mode specific adaptations in skeletal muscle, and how they are impacted by age, gender, and clinical disease.

Supported by intramural funds from ASU, TGen, and MU

1258 Board #6 June 1 8:00 AM - 10:00 AM

Time-dependent Expression Of Il-6, Irisin And Bdnf In Response To Exercise In Rats

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(No relationships reported)

PURPOSE: Irisin, Bdnf And Il-6 Are Exercise-Induced Myokines Which Exert Their Effects In Driving Brown-Fat-Like Development (Irisin) And Regulating Fat Oxidation. However, Their Dynamic Expression In Response To Exercise Is Not Fully Known. Here We Examined The Level Of Irisin, Bdnf And Il-6 As Well As The Activation Of Ampk And Akt At Different Time Points Following Exercise, In Order To Explore The Pattern Of Their Expression And Biological Functions.

METHODS: Sprague-Dawley Rats Were Subjected To Downhill Running At 17m/Min For 90 Minutes. Serum Creatine Kinase Activity Was Tested At Day 1, 3, 5, 7, And 14 Following Exercise To Evaluate Skeletal Muscle Injury. The Serum Level And Skeletal Expression Of Bdnf, Il-6 And Irisin Were Measured By Elisa And Real-Time Rt-Pcr, Respectively. The Activation Of Ampk And Akt Signaling Pathway 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.

RESULTS: An Increase Of Ck Activity Was Observed At Day 3 And Day 5 Following Exercise, Confirming Exercise-Related Skeletal Muscle Injury. We Didn'T Find Any Increase Of Il-6 In The Rats Following Exercise Compared To Sedentary Group, Although It Is Reported That Il-6 Level Is Elevated Dramatically During Exercise. The Level Of Irisin And Bdnf Was Increased Both In The Serum And In The Skeletal Muscle In Day 1 And Day 3 Following Downhill Running; Then, While Irisin Level Returned To The Baseline, Serum Bdnf Level Was Continuously Elevated. Besides, Ampk Activation Was Found At Day 1 And Day 3, But Akt Was Kept Activated Over All The Time Points.

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.

1259 Board #7 June 1 8:00 AM - 10:00 AM

Methylation Alters Skeletal Muscle Apoptosis Transcription and Myonuclei Morphology Following Resistance-Type Training in Old Rats

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(No relationships reported)

Previously, our lab has shown that modifying the frequency of resistance-type training using stretch-shortening contractions (SSCs) from 3 to 2 days/wk attenuates age-dependent maladaptation and restores muscle quality to a younger phenotype. Evidence suggests a link between nuclei morphology and epigenomics, but the precise mechanisms and the effects of these responses on myonuclei with aging is unknown. **PURPOSE:** To quantify gene expression and methylation for apoptosis in old versus

young skeletal muscle following training at different frequencies, and report concurrent status of nuclei morphology. **METHODS:** Tibialis anterior (TA) muscles of young (3 mo) and old (30 mo) 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 RT² 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 ± 0.004 vs $2.2\% \pm 0.02$, $p < 0.05$). For old 2 days/wk there was no difference in methylation compared to non-trained (0.70 ± 0.004 vs $1.0 \pm 0.01\%$). 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 ($7,708 \pm 181$ vs $6,695 \pm 171$ nuclei per mm^2) and myonuclei ($1,943 \pm 78$ vs $1,483 \pm 74$ nuclei per mm^2). 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 ($1,590 \pm 86$ vs $1,888 \pm 86$ vs $1,943 \pm 78$ nuclei per mm^2). **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.

1260 Board #8 June 1 8:00 AM - 10:00 AM
Effect Of Sprint Interval & Eccentric Training On Gene Expression Levels Of Caspase3 & Bax/bcl-2 In Rat Skeletal Muscle
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 (No relationships reported)

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 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 minutes rest, 6-10 sets per session on 5-6 days a week, and eccentric downhill running was included running on -16° slope with 16 m/min for 90 minutes which in both the intensity of the trainings during the nine weeks gradually increased. The evaluation of gene expression was done by Real time PCR method. **RESULTS:** Considering the low number of samples (n=8) and the normality of data rejected by Shapiro-Wilk test, Mann Whitney test for differential between training and control groups were used. Also, caspase3 expression increased in all groups. All of these differences were not significant except for soleus muscle of eccentric training group. Also Bax/bcl-2 ratio increased in all groups and all of these differences were not significant. **CONCLUSIONS:** we conclude that nine weeks of sprint interval training could lead to a small increase in caspase3 expression, Bax/bcl-2 ratio as the influential factor of apoptosis in all groups, except a large increase in caspase3 expression and ultimately strong apoptosis for soleus muscle in eccentric training group. Furthermore, it should be mentioned that the type of training and muscle could influenced the amount of gene expression levels of caspase3, bax/bcl2.

C-14 Thematic Poster - Sex Differences in Cardiovascular Physiology

Thursday, June 1, 2017, 8:00 AM - 10:00 AM
 Room: 505

- 1261 **Chair:** James H. Hull. *Royal Brompton Hospital, London, United Kingdom.*
 (No relationships reported)
- 1262 Board #1 June 1 8:00 AM - 10:00 AM
No Sex Differences in Muscle O₂ Delivery-to-Utilization Matching Before or During Contractions in Rats
 Jesse C. Craig, Michael J. Schettler, Trenton D. Colburn, Daniel M. Hirai, David C. Poole, FACSM, Timothy I. Musch, FACSM. *Kansas State University, Manhattan, KS.* (Sponsor: Timothy I. Musch, FACSM)
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 (No relationships reported)

Pre-menopausal women express a reduced arterial blood pressure and risk of cardiovascular disease relative to age-matched men. The mechanism for these outcomes purportedly relate to elevated estrogen levels increasing endothelial nitric oxide (NO) synthase activity and NO-mediated vasorelaxation. **PURPOSE:** Based on the role that NO plays in the relationship between O₂ delivery and utilization, we tested the hypothesis that females would show a fundamentally higher O₂ delivery/utilization ratio; especially during muscle contractions, compared to males. **METHODS:** To test this hypothesis, the spinotrapezius muscle of Sprague Dawley rats (14 total; female = 7, male = 7) was surgically exposed and electrically stimulated at 1 Hz. Oxyphor G4 was injected into the muscle and phosphorescence quenching employed to determine the temporal profile of muscle interstitial space O₂ partial pressure (P_{im}O₂, determined by O₂ delivery/utilization ratio). This was performed under three conditions: control (CON), 300 μM sodium nitroprusside (SNP; NO donor) superfusion, and 1.5 mM L-arginine methyl ester (L-NAME; NOS blockade) superfusion. **RESULTS:** No differences were found for baseline P_{im}O₂ (CON: 21 ± 1 vs 17 ± 2 ; SNP: 40 ± 3 vs 36 ± 3 ; L-NAME: 16 ± 2 vs 14 ± 2 mmHg (all $p > 0.05$); nor $\Delta\text{P}_{im}\text{O}_2$ during contractions (CON: 13 ± 1 vs 12 ± 2 ; SNP 20 ± 2 vs 18 ± 2 ; L-NAME: 11 ± 1 vs 9 ± 1 mmHg (all $p > 0.05$)) between males and females, respectively. The kinetics response (mean response time) to contractions did not differ in any condition (CON: 17 ± 2 vs 16 ± 3 ; SNP: 21 ± 2 vs 28 ± 5 ; L-NAME: 15 ± 2 vs 14 ± 1 seconds (all $p > 0.05$)) between males and females, respectively. **DISCUSSION:** In direct contrast to our hypothesis, no sex differences were evident at rest or during contractions under any condition. Therefore, at rest and during muscle contractions, the effect of estrogen on NO bioavailability and vascular control are either insignificant or redundant to other vasodilatory pathways.

- 1263 Board #2 June 1 8:00 AM - 10:00 AM
Sex-specific Differences In Pulse Wave Reflection 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., FACSM)
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 (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-specific 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 ± 9 bpm; recovery: 89 ± 13 bpm, $p = 0.0001$), augmentation index (rest: $12.1 \pm 7.9\%$; recovery: $19.9 \pm 10.5\%$, $p = 0.003$), augmentation index at 75 bpm (rest: $5.3 \pm 7.9\%$; recovery: $24.5 \pm 14.3\%$, $p = 0.0001$), augmentation pressure (rest: 4.9 ± 2.8 mmHg; recovery: 8.3 ± 6.0 mmHg, $p = 0.004$), and pulse wave velocity (rest: 5.3 ± 0.6 m/s; recovery: 5.9 ± 0.7 m/s, $p = 0.02$) such that they

significantly increased after the acute 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 pulse wave 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

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(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, AIx 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 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)
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(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 isokinetic knee extension and flexion (3 sets of 10 repetitions) on a force dynamometer. Central pulse wave velocity (PWV) was estimated by brachial oscillometric 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 torque ($p < 0.05$), relative flexor power ($p < 0.05$) and relative average 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.

| Leg Strength *Significant correlation: $p < 0.05$ | ΔPWV | |
|--|--------|---------------|
| | Male | Female |
| Peak Extensor Torque (ft-lbs) | 0.198 | 0.482 |
| Average Extensor Torque (ft-lbs) | 0.250 | 0.490 |
| Peak Flexor Torque (ft-lbs) | -0.016 | 0.852* |
| Average Flexor Torque (ft-lbs) | 0.170 | 0.550 |
| Relative Peak Extensor Torque (ft-lbs/kg) | 0.498 | 0.346 |
| Relative Peak Flexor Torque (ft-lbs/kg) | 0.181 | 0.887* |
| Relative Extensor Power (Watts/kg) | 0.455 | 0.599 |
| Relative Flexor Power (Watts/kg) | 0.488 | 0.712* |
| Relative Average Power (Watts/kg) | 0.492 | 0.769* |

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% $\dot{V}O_{2peak}$. Blood flow was analyzed in the brachial artery before and 30min after exercise. Retro- and ante-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, PERI showed a trend for higher antegrade 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 a non-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±0.39 vs. post: -4.17±1.87, $p=0.015$) and no change in PERI (pre: -2.02±0.45 vs. post: -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 antegrade 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)

1267 Board #6 June 1 8:00 AM - 10:00 AM
Long Term Effects of Menopausal Hormone Therapy on Cerebral Pulsatility Index

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 (No relationships reported)

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 y; BMI=28±3 kg/m²) or MHT (MHT: n=35; age=60±3 y; BMI=27±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 at each stage for three minutes. PI was calculated as (systolic MCAv-diastrolic MCAv)/mean MCAv. **RESULTS:** Baseline MAP and MCAv were similar between groups (PLA: MAP=90±2 mmHg; MCAv=60±3 cm/s; MHT: MAP=91±1 mmHg; MCAv=69±3 cm/s; p>0.05 for both). PI was greater 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 AG44170, HL118154

1268 Board #7 June 1 8:00 AM - 10:00 AM
NOS Blockade Reveals No Sex Difference in Contracting Muscle O₂ Delivery-to-Utilization Matching in Rats

Trenton D. Colburn, Jesse C. Craig, Daniel M. Hirai, K. Sue Hageman, Timothy I. Musch, FACSM, David C. Poole, FACSM. Kansas State University, Manhattan, KS. (Sponsor: David C. Poole, FACSM)
 (No relationships reported)

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 sex differences in pre-menopausal FMD, we tested the hypothesis that complete NOS blockade via L-arginine methyl ester (L-NAME) in female rats would exhibit a greater reduction in muscle O₂ delivery-to-utilization matching (assessed via PO₂ in the muscle interstitial space (P_{INT}O₂)) and speed P_{INT}O₂ kinetics following the onset of muscle contractions when compared to age-matched males. **METHODS:** In Sprague Dawley rats (n=5 male, 5 female), the spinotrapezius 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 P_{INT}O₂; P_{INT}O₂ was recorded at rest and during contractions in control (CON) and following NOS blockade (intra-arterial (IA) infusion of L-NAME (10 mg kg⁻¹)) conditions. **RESULTS:** NOS blockade revealed no differences in resting P_{INT}O₂ 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 P_{INT}O₂ or P_{INT}O₂ kinetics. These results suggest that estrogen via NO bioavailability does not play a significant role in resting P_{INT}O₂ or P_{INT}O₂ kinetics during muscle contractions in female rats.

C-15 Free Communication/Slide - Aging

Thursday, June 1, 2017, 8:00 AM - 10:00 AM
 Room: 401

1269 **Chair:** Loretta DiPietro, FACSM. *The George Washington University School of Public Health and Health Services, Washington, DC.*
 (No relationships reported)

1270 June 1 8:00 AM - 8:15 AM
Improved Strength and Balance in Older Adults Following an 8-week Eccentric Training Program

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 (No relationships reported)

PURPOSE: The purpose of the current study was to determine changes in balance and strength following an eccentric resistance training program in community-dwelling older adults.

METHODS: Participants (N = 14; 63.5 ± 2.0 years) completed 8 weeks of eccentric training on a commercially-available, seated eccentric step machine. Participants completed 2 training sessions per week, with each session consisting of 5 to 10 minutes of exercise at an intensity ranging from 30 to 50% of maximal eccentric strength. Single leg stance, 30-second repeated chair stand, timed up-and-go, and maximal eccentric strength were assessed at baseline, at week 4 of training, and within one week of the last training session. RPE was also assessed following each training session.

RESULTS: Data are presented as (baseline, week 4, week 8). Negative work completed in training increased approximately three times (20.1 ± 7.7, 52.9 ± 25.0, 79.6 ± 38.4 kJ), while the rating of perceived exertion plateaued at "somewhat hard" (10.2 ± 1.6, 11.9 ± 1.1, 13.1 ± 2.0). Significant improvements were observed in the 30-second repeated chair stand (12.1 ± 3.1, 14.3 ± 4.4, 16.2 ± 5.4 repetitions; p < .001), the timed up-and-go (6.0 ± 0.8, 5.3 ± 0.9, 5.3 ± 0.9 seconds; p < .001), and maximal eccentric strength (489.8 ± 179.4, 612.6 ± 193.6, 685.0 ± 184.7 pounds; p < .001), while there was no significant change in single leg stance time (82.9 ± 78.3, 95.72 ± 102.1, 107.4 ± 99.9 seconds).

CONCLUSIONS: The eccentric training was sufficient to yield improved performance on dynamic balance and strength tasks. These improvements, in individuals not yet classified at high fall risk, indicate eccentric training may be a viable modality for low fall risk, older individuals aiming to minimize future fall risk and prolong physical independence.

1271 June 1 8:15 AM - 8:30 AM
Improvements Following a Speed-Based Go4Life Group Exercise Intervention in Older Adults

Maria Bellumori. California State University, Monterey Bay, Seaside, CA. (Sponsor: Kent J. Adams, FACSM)
 (No relationships reported)

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>.05). Upon completion of the eight week program, there were improvements in the following tests: simple reaction time (F_(2,43) =7.5, p<.01), choice reaction time (F_(2,43) =19.8, p<.01), 10 meter walk (F_(2,43) =16.7, p<.01), number of steps taken during the 10m walk (F_(2,43) =9.01, p<.01), timed up and go (F_(2,43) =7.4, p<.01), nine hole peg test (F_(2,43) =4.1, p<.05), and SF-36 scores (t₍₁₄₎ =-2.85, p<.05). Functional reach and grip strength did not change. **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.

1272 June 1 8:30 AM - 8:45 AM

Age-related Differences in Maximal and Rapid Hamstrings to Quadriceps Strength Capacities and Vertical Jump Power

Ty B. Palmer¹, Brittany N. Followay², Brennan J. Thompson³.
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 (No relationships 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 = 1075.87 ± 376.78 W; young = 3131.07 ± 1426.22 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.

1273 June 1 8:45 AM - 9:00 AM

Supramaximal-Exercise Training Improves Fitness and Ratings of Perceived-Exertion in Adults Aged 50 Years and Over

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 (No relationships reported)

PURPOSE: Physical activity in elderly persons contributes to prevention and treatment of the negative effects of age on muscle performance and, in turn, increases physical capability and improves muscle function and condition. This pilot study evaluated the effects of six weeks of supramaximal-exercise training (SET) on fitness variables and Ratings of Perceived-Exertion (RPE) in men and women aged 50 years and over.

METHODS: Nine healthy older adults [average age 60(7) years; body mass index = 33.5(3) kg·m⁻²] completed a 6-week SET intervention comprising 18 sessions of 6 repeats of 6-second supramaximal sprints on an electromagnetically braked cycle ergometer, with 2-minute recovery between each repetition. Anthropometry, maximal power output (MPO), mechanical efficiency and RPE were obtained at baseline and at post-intervention. MPO was evaluated using a charge-velocity test. Mechanical efficiency (ME, in %) was computed across stages correspond to 25, 50 and 100% of VO₂max of an incremental maximal cycling test as follows: work produced, in watts • (total - resting energy consumption, in watts)⁻¹ • 100⁻¹. The RPE was rated five minutes following the incremental maximal cycling test. Multiple linear regression with an extended-model approach was subsequently used to document the effects of the fitness variables on RPE changes.

RESULTS: Neither anthropometric variables nor maximal oxygen uptake differed between the baseline and 6 weeks of SET. However, MPO (3.5(1.5) vs 5.5(0.5) W·Kg⁻¹; $p < 0.01$) and ME (12(1) vs 14(2) %; (15(1) vs 17(2) % and 18(3) vs 23(4) %; $p < 0.01$, respectively) increased significantly from baseline at post intervention. RPE index (8.6(0.3) vs 5.1(0.3); $p < 0.01$) were significantly lower at post-intervention than at baseline. In this study, the increases in MPO and in ME were identified as significant predictors of RPE declines over 6 weeks, accounting for 39 and 52 % respectively of the relationship.

CONCLUSIONS: Although there were no changes in the participants' anthropometric and aerobic fitness variables, six weeks of SET are beneficial for lower muscular performance and efficiency and seem to influence positively the RPE index. Consequently, SET can be recommended as a form of strategies aimed at improving muscle efficiency among older adults.

1274 June 1 9:00 AM - 9:15 AM

Maximal Strength Training-induced Neural Plasticity With Age: Cross-limb Effects

Tiril Tøien, Runar Unhjem, Thomas Øren, Ann Charlotte Kvellestad, Eivind Wang. *The Norwegian University of Science and Technology, Trondheim, Norway.*
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 (No relationships reported)

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±4 (SD) year old males 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±348Nm) and rate of force development (1973±541 to 2328±777Nm·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) (0.12±0.09 to 0.21±0.17), and increase in VA (79.5±5.1 to 83.3±5.2%) (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.

1275 June 1 9:15 AM - 9:30 AM

Using The FMSTM To Assess The Degenerative Changes Of Functional Performance In Mid-aged And Older People

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 (No relationships reported)

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 ageing. **PURPOSE:** To explore functional degeneration associated with ageing, 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. There functional performance was assessed by using the FMS™. **RESULTS:** (1) The mean (±SD) total FMS score was 13.10 (±1.83) and 45% participants an asymmetry 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.

1276 June 1 9:30 AM - 9:45 AM

Physical Activity Intervention In Older Adults: Greater Gains In Functional Performance In Older Adults At Higher Risk For Mild Cognitive Impairment

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 (No relationships reported)

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=.004). Post hoc comparison showed differences in pre to post measurements between LC and CON in Time Up to Go test (TUG; P=.002), while no differences were found between HC and CON (P=.159) as well as for LC and HC (P=.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.

1277 June 1 9:45 AM - 10:00 AM

Two-Year High-Intensity Aerobic Training Program Prevents Age-Associated Health Risk Factor Development in Sedentary Middle-Aged Adults

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 (No relationships reported)

Sedentary aging results 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 ($\text{VO}_{2\text{max}}$), 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 $\text{VO}_{2\text{max}}$ [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 $\text{VO}_{2\text{max}}$ (29.6 ± 5.2 to 28.7 ± 5.4 ml/kg/min, p=0.11) and FFM (50.8 ± 11.4 to 49.9 ± 11.6 kg, p=0.13), an increase in FM (25.3 ± 6.9 to 27.5 ± 5.9 kg, p=0.002), and a decrease in both absolute and relative BV (69.5 ± 8.5 to 66.0 ± 8.0 ml/kg, p=0.003) and PV (44.0 ± 6.4 to 40.8 ± 5.7 ml/kg, p<0.001) over two years. EX participants experienced a significant increase in $\text{VO}_{2\text{max}}$ (28.8 ± 4.8 to 34.4 ± 6.2 ml/kg/min, p<0.001) and a significant decrease in FFM (50.4 ± 11.0 to 49.4 ± 11.1 kg, p=0.01). However, exercise training prevented age-associated changes in FM (24.1 ± 5.9 to 24.4 ± 6.3 kg, p=0.51) and both absolute and relative BV (70.3 ± 8.4 to 71.2 ± 7.8 ml/kg, p=0.54) and PV (44.9 ± 5.6 to 44.0 ± 6.5 ml/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.

C-16 Free Communication/Slide - Chronic Disease and Health

Thursday, June 1, 2017, 8:00 AM - 10:00 AM
 Room: 103

1278 **Chair:** Janet Walberg-Rankin, FACSM. *Virginia Tech, Blacksburg, VT.*

(No relationships reported)

1279 June 1 8:00 AM - 8:15 AM

Water Intake And Hydration State Is Associated With Insulin Resistance In Healthy Adults: NHANES 2009-2012

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Epidemiological studies from European cohorts suggest that low water intake is associated with the risk of developing diabetes and/or hyperglycemia. Additionally, data indicate that copeptin, a surrogate marker of vasopressin and low water intake, is associated with diabetic heart disease and death. **PURPOSE:** To examine the association between water intake and hydration state with glucose regulation in healthy individuals in the U.S. **METHODS:** 2,233 adults from 2009-10 & 2011-12 NHANES (National Health and Nutrition Examination Survey) considering participants without diabetes, non-pregnant, and with normal renal function (females: 48.3%, age: 44 ± 1 y, BMI: 27.5 ± 0.2 kg·m²). Insulin resistance was assessed by homeostasis model assessment of insulin resistance (HOMA-IR; 2.77 ± 0.05) and data were divided into tertiles (≤1.77, 1.78-3.45, and >3.45). Hydration status was assessed by urine osmolality (621 ± 7 mmol·kg⁻¹) and urine flow rate (0.96 ± 0.03 ml·min⁻¹). Plain water (1,203 ± 35 mL) and total water intake (TWI; 3,190 ± 43 mL) were assessed by 24 h dietary recall. **RESULTS:** Urine osmolality was highest in the upper HOMA tertile (679 ± 9 mmol·kg⁻¹) compared to lowest tertile (583 ± 1 mmol·kg⁻¹, P<0.001), while urine flow rate was highest in the lowest HOMA-IR tertile (1.03 ± 0.04 ml·min⁻¹) compared to upper tertile (0.92 ± 0.03 ml·min⁻¹, P=0.001). Multinomial logistic regression showed healthy adults with higher levels of daily TWI (≥2,657 mL) had significantly less likely to be in the upper HOMA tertile, compared to adults with a lower level of TWI (≤1,598 mL, OR=1.17; 1.11-2.64), after adjusting for age, gender, BMI, waist circumference, race/ethnicity, education, and physical activity. Similarly, adults who consumed more plain water (≥859 mL) were half as likely to be in the upper HOMA-IR tertile, compared with those who consumed less (≤207 mL, OR=2.00; 1.37-2.93). **CONCLUSION:** Higher plain water (≥859 mL) and total water intake (≥2,657 mL), as well as better hydration state were associated with lower insulin resistance.

1280 June 1 8:15 AM - 8:30 AM

Exercise Training Lowers Postmeal Insulin Concentrations And Cancer-relevant Adipokines In Postmenopausal Breast Cancer Survivors

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Exercise-induced reductions in fasting insulin are modestly associated with lower cancer risk and improved prognosis in breast cancer survivors, however the impact of exercise training on postmeal insulin concentrations (50-80% of daily insulin exposure) and the relationship between postmeal insulin and cancer-relevant biomarkers is unclear. **Methods:** Fifteen postmenopausal breast cancer survivors underwent a supervised, progressive 12-week aerobic exercise program (60 min/day, 2-4 days/week). Baseline and post-intervention concentrations of insulin and cancer-relevant biomarkers (leptin, adiponectin, IGF-1, SHBG and 17-b Estradiol (E2)) were measured during a five-sample oral glucose tolerance test (OGTT) following 24h dietary and physical activity control. Changes in fitness and body composition were assessed by estimated $\text{VO}_{2\text{peak}}$ during a submaximal exercise test and dual energy X-ray absorptiometry (DEXA) respectively. In addition to each OGTT timepoint (30, 60, 90 and 120 minutes), postmeal insulin responses were determined by area under the

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 statistics 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 (75.55 ± 2.3 vs 74.45 ± 2.7 kg, $p < 0.05$) following the intervention. There were significant reductions in leptin (30.8 ± 5.0 vs 23.8 ± 3.4 ng/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 uU/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 ± 5.2 vs. 24 ± 8.8 , $p = 0.02$), higher body fat percentage (40.3 ± 7.77 vs. 32.4 ± 5.34 , $p = 0.05$), 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 (Age: 28 ± 8 y; 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 cardiovascular 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: 89 ± 2 vs 8wks: 83 ± 2 mmHg; $p = 0.05$), with both systolic (0wks: 122 ± 4 vs 8wks: 112 ± 3 mmHg; $p = 0.06$) and diastolic (0wks: 73 ± 2 vs 8wks: 68 ± 2 mmHg; $p = 0.07$) pressure tending to decrease. Arterial stiffness, measured by brachial-ankle pulse wave velocity, was lower (0wks: 870 ± 30 vs 8wks: 797 ± 37 cm/sec; $p = 0.04$), and FMD trended toward increasing, albeit variably (0wks: 6.9 ± 1.1 vs 8wks: $9.1 \pm 1.3\%$; $p = 0.25$). Fasting glucose was significantly reduced (0wks: 104 ± 7 to 8wks: 92 ± 7 mg·dl⁻¹; $p = 0.04$) in all subjects, and OGTT area under the curve (AUC) and glucose at the 2-hr timepoint decreased substantially in subjects who began the study with impaired glucose tolerance (2-hr glucose > 140 mg·dl⁻¹). In these three pre-diabetic individuals, 2-hr glucose decreased from 0wks: 181 ± 10 to 8wks: 139 ± 20 mg·dl⁻¹ and OGTT AUC decreased from 0wks: $21,323 \pm 2,273$ to 8wks: $17,695 \pm 2,890$ mg·dl⁻¹·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 effects 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-1 β (IL-1 β) 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-1 832/3 cells exposed to BSA ± palmitate at 5, 11 or 20 mM glucose or IL-1 β 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 ± 0.1 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-1 β completely blunted GSIS from 3.0 ± 1.1 to -0.14 ± 0.17 ng insulin · 10⁻⁴ cells ($P < 0.05$). IL-6 treatment had no effect on GSIS under normal conditions (3.4 ± 0.17 ng insulin · 10⁻⁴ cells, $P = 0.77$), and did not prevent the suppression of GSIS by 20 mM glucose ± palmitate or IL-1 β (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 Carbonylations In Adipose Tissue

Carina M. Pautz¹, Brittany E. Wilson¹, Kelli Jackson¹, Joshua T. Selsby², Carlos A. Barreiro¹, Salim Merali¹, Ellen M. Kelly¹, Matthew B. Hudson¹. ¹Temple University, Philadelphia, PA. ²Iowa State University, Ames, IA.
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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=4) were fed an overnutrition (60% high fat diet) for 14 days and then then switched 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 spectroscopy-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 caloric intake by 30% for 3 days reduced WAT GLUT4 carbonylations ~58% 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 in mouse WAT are not permanent and can be reversed by exercise or a reduced-calorie diet. Supported by NIH GM087239

1285 June 1 9:30 AM - 9:45 AM

High Intensity Interval Training Improves Endurance Performance and Increases Brown Adipose Mass in Diet-Induced Obese Mice

Kim S L Mileski, M.Sc., Luiz G G Porto, Ph.D, Sidney A. Pereira, M.Sc., Fernanda C B Oliveira, M.Sc., Francisco de Assis R. Neves, Ph.D, Michela S. Coelho, Ph.D, Adriana Lofrano-Porto, Ph.D. *University of Brasilia, Brasilia, Brazil.*
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(No relationships reported)

Inadequate diet and inactivity are associated with several metabolic diseases, mainly obesity. High intensity Interval Training (HIIT) is a promising exercise strategy for obese but its effects deserve further investigation. **PURPOSE:** To evaluate the effects of HIIT training on endurance and fat mass in diet-induced obese mice. **METHODS:** Fifteen C57BL/6 mice were randomly assigned to Control group (CC, n=5), Hipercaloric diet group (HC, n=5) and HIIT training plus Hipercaloric diet group (IH, n=5). Food and water were administered *ad libitum*. Hipercaloric diet was composed of 60%fat, 30%carbs and 10%protein. Control diet was composed of 30%fat, 60%carbs and 10%protein. Every group underwent a ramp test (RT) before and after intervention, on a mice treadmill (AVSprojects®) to determine maximal speed and maximal distance. RT initiated at 6m/min with a 2m/min increase every 2min (at 25°), until exhaustion. HIIT lasted for 8 wk, 5 days/wk. Each session lasted 45 min with 4-min high intensity bouts at 90% of the reached speed on first RT, followed by 3-min moderate intensity bouts at 70%. Animals were sacrificed after intervention and tissues were collected and weighed. One-way ANOVA (Tukey post hoc test) was used for comparison between groups, 5% level of significance. **RESULTS:** Baseline mean values of body weight before intervention were similar between groups ($p=0.57$). Hipercaloric diet groups gained more weight (IH: 26.6±3.1 g; CH: 23.9±3.2 g) than control group (CC: 15.1±4.6 g) after diet protocol/before intervention ($p=0.001$). After 8-wks intervention, CC (6.3±2.2 g) gained more weight than IH (3.7±0.9 g) ($p=0.03$). IH improved endurance performance (209.8±80.2 m), more than CH (54.8±30.3 m) and CC (118.2±28.5 m) ($p=0.002$) groups. Brown adipose tissue mass of IH (434.7±94.1 g) was higher than CC (214.5±65.6 g) ($p=0.04$). **CONCLUSIONS:** Eight-weeks HIIT improved endurance performance on diet-induced obese mice and attenuate the weight gain as compared with no exercise control diet group. The weight gain in non-exercising lean animals highlights the importance of being physically active to prevent obesity, with HIIT being a time-effective strategy. Brown adipose tissue is associated with more efficient thermogenesis and seems to mediate the effects of HIIT. Supported by CNPq/pro-centro-oeste grant 564658/2010-3

1286 June 1 9:45 AM - 10:00 AM

Short-Term Interval Training Increases Fat Utilization During Exercise in Adults With Prediabetes

Julian M. Gaitan, Natalie ZM Eichner, Jacquelyn Moxey, Nicole M. Gilbertson, Eugene J. Barrett, Arthur Weltman, FACSM, Steven K. Malin. *University of Virginia, Charlottesville, VA.*

(No relationships reported)

PURPOSE: Individuals with prediabetes have impaired fat metabolism. Interval exercise is thought to lower type 2 diabetes risk, but the mechanism is unclear. We tested the hypothesis that interval training would enhance fat oxidation during exercise and relate to lower disease risk to a greater extent than continuous exercise training. **METHODS:** Thirteen obese, sedentary adults with prediabetes (Age: 57.9±2.2y, BMI: 34.5±1.4 kg/m², VO₂max: 21.1±1.2 mL/kg/min, FPG: 100.1±2.1 mg/dL, 2-hr glucose: 147.7±8.1 mg/dL) were screened using a 75g OGTT. Subjects were randomized to 12 days of interval (INT, n=7; 3min 90%HR_{max}, 3min 50%HR_{max}) or isocaloric continuous (CONT, n=6; 70%HR_{max}) cycle ergometry exercise for 60 min/d. Body

weight, VO₂max, and substrate oxidation via indirect calorimetry during exercise at the same absolute (30W) and relative (70%HR_{max}) intensities were measured before and after training. Data were analyzed using a 2-way mixed model ANOVA and Pearson's correlation, and reported as mean±SEM. **RESULTS:** Although there was no statistical change in body weight, VO₂max increased after both INT and CONT training ($P=0.05$). Exercise training also increased fat oxidation at 30W ($P=0.02$) and 70%HR_{max} ($P=0.03$). INT training tended to increase fat oxidation more than CONT at 30W (+0.07±0.02 vs. +0.03±0.03 g/min, $P=0.22$) and 70%HR_{max} (+0.11±0.03 vs. +0.03±0.04 g/min, $P=0.17$), although these did not reach statistical significance. The rise in fat oxidation during exercise at 70%HR_{max} correlated with decreased body weight after training ($r=-0.69$, $P=0.01$). **CONCLUSIONS:** Short-term INT training increases fat oxidation during exercise in people with pre diabetes. This preliminary change in fat metabolism is associated with decreased body mass and may contribute to lower diabetes risk.

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. *Wellspan York Hospital, South Bend, IN.*
(No relationships reported)

1288 **Discussant:** Wayne E. Derman. *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)

1290 June 1 8:00 AM - 8:20 AM

Knee Pain: An Uncommon Presentation

Benjamin P. Smith, Wade M. Rankin, Kelly Evans-Rankin, J.M. McGaugh. *University of Kentucky, Lexington, KY.*
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(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 0-115°. 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 0° & 30°. 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: 6.3k/uL (ref 3.7-10.3); ESR: 39mm/hr (ref 0-20); CRP: 2.2mg/dL (ref 0-0.9); D Dimer: 0.36mg/L (ref <0.51); **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 every 2-4 weeks to manage/monitor symptoms and expectations

THURSDAY, JUNE 1, 2017



1291 June 1 8:20 AM - 8:40 AM
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 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 PPI 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.

1292 June 1 8:40 AM - 9:00 AM
Posterior Knee Pain in a Cyclist

Allison Schafer. UCONN, Hartford, CT. (Sponsor: Jeffery Anderson, M.D., FACSM)
 (No relationships reported)

HISTORY: A 51-year-old avid female cyclist presents with a 1.5 year history of right posterior knee and leg pain. This pain started following a hyper-extension type injury after a fall down multiple steps. Prior to being evaluated in our clinic a MRI was done showing a low-grade gastrocnemius strain and the patient completed physical therapy reporting 90% improvement in her pain. Unfortunately, her knee pain returned and

was easily aggravated by climbing steps and walking. At this time she was sent for an ultrasound guided injection of her distal hamstring. Initial anesthetic provided relief however, over the next few months her pain returned and localized over her distal hamstring. Another ultrasound guided injection of the semi-tendinosus sheath was ordered. Again, she experienced only temporary relief. Given her persistent pain she was referred to an orthopedic office for further evaluation. At this time her pain had become more localized to her posterior knee and was described as deep pain radiating anteriorly to her pes anserine.

PHYSICAL EXAM: Examination of the right knee was without effusion or erythema. There was considerable tenderness along the posterior proximal gastrocnemius and distal hamstring along with the pes anserine. There was no joint line tenderness. Full range of motion from 0 to 130 degrees of flexion. Special testing including Lachman, McMurray, varus and valgus stress was negative.

DIFFERENTIAL DIAGNOSIS: Distal hamstring tear, proximal gastrocnemius tear, medial collateral ligament injury, medial meniscus injury, pes anserine bursitis

TESTING/RESULTS:

-At her initial visit a repeat MRI was ordered. This showed progression of a partial tear of the medial gastrocnemius with multiple intramural cysts and a small Baker's cyst.

FINAL WORKING DIAGNOSIS: Gastrocnemius tear

TREATMENT AND OUTCOMES:

-After the new MRI showed a worsening intramural gastrocnemius tear with multiple cysts it was concluded that her pain was generated from this location deep within her posterior knee.

-She was referred to interventional radiology for a therapeutic corticosteroid injection

-Patient continues to attend spin class throughout this work up and will follow-up in clinic after the injection with interventional radiology.

1293 June 1 9:00 AM - 9:20 AM
Acute Knee Pain in a Professional Baseball Player

Ryan C. Wennell. Wellspan York Hospital, Red Lion, PA.
 (Sponsor: Mark Lavallee, MD, FACSM)
 (No relationships reported)

32 year old AA professional baseball player who hit the ball and ran towards first base. As he decelerated to touch first base, he felt his knee buckle and fell face first to the ground. He proceeded to hop on one foot around the bases as he was unable to bear weight on the affected limb. **History:** Patient is healthy other than ADHD on Adderall. No history of steroid or antibiotic usage. No surgery to affect leg. **Physical Exam:** Significant swelling and edema in the right knee compared to the contralateral side. Both his thigh compartments as well as his calf compartments were soft. There was a palpable defect directly inferior to the patella. Inability to extend knee or do straight leg raise. Ligaments were intact with good endpoints. He had 5/5 strength in dorsiflexion, plantar flexion as well as his EHL. He had 2+ dorsalis pedis and posterior tibial pulses and sensation were intact throughout the L3-S1 dermatomes. Unable to ambulate. **Broad Diagnosis:** ACL rupture, quadriceps tendon tear, patellar tendon repair, meniscal tear, collateral ligament tear, muscular strain (grade I or II), patellar subluxation/ dislocation, fracture of the patella, severe patellar tendinosis, acute sickle cell crisis, gouty arthritis, septic joint. **Studies:** Three radiographs of the right knee do not demonstrate any fracture of dislocation. There is a notable patellar alta. **Contralateral side intrasubstance calcific tendinosis.** **Consultations:** orthopedic surgery **Working Diagnosis:** Complete rupture of the right patellar tendon from anterior pole of the patella. The left knee exhibited intrasubstance patella tendinosis **Treatment:** Repair of acute right patellar tendon rupture **Outcome:** Acute inpatient rehabilitation with transition to home rehab. Expect 6-12 months to full recovery. **Author's Comments:** The question for debate is in the follow-up... This case entails a common injury with uncommon presentation. In this case, the baseball athlete was healthy without prodrome complaints when he ruptured his patellar tendon during eccentric loading as he decelerated towards first base. His sport, as well as, his lack of prodrome complaints makes this case unique. Given that the patient has tendinosis on the other side the question remains if he requires therapies given it has now been identified that he is at risk for future injury.

1294 June 1 9:20 AM - 9:40 AM
Complicated Synovial Cyst Tibiofibular Joint - Squash

Dina C. Janse van Rensburg, FACSM, Dimakatso A. Ramagole.
 University of Pretoria, Pretoria, South Africa.
 Email: christa.jansevanrensburg@up.ac.za
 (No relationships reported)

HISTORY: A 47-year old male veteran squash player presented with intermittent left knee pain and swelling below the knee joint. He also complained of back pain and reduced sensation in his left foot. He had no history of trauma and has been treated for gout for 5 months prior to consultation.

PHYSICAL EXAMINATION: He had tenderness on his medial joint line and 3 separate masses on the lateral aspect of his lower leg. The masses were soft, compressible and not tender to the touch. He also had reduced sensation in the L5 distribution, but no weakness of ankle dorsiflexion, toe extension or ankle eversion.

DIFFERENTIAL DIAGNOSIS: 1. Space occupying lesion (Benign, malignant) 2. Nodule (Gout, Rheumatoid arthritis) 3. Common peroneal nerve involvement vs L5 radiculopathy
TEST AND RESULTS: Blood investigations: Uric acid 0.33 mmol/l (previously elevated at 0.59 mmol/l). Rheumatoid Factor was negative. *Anti-citrullinated protein antibodies* was negative. Imaging: *Ultrasound lower leg:* Anterior proximal in the left lower leg a cyst of 44.5 X19.9 mm. A second synovial cyst of 59.8 x 26 mm and a third synovial cyst measuring 17.5 x 5.4 mm were also visualised. All cysts were connected with small tracts. *X-rays of the knee:* Narrowed medial tibiofemoral joint space. Erosions of the tibiofibular (TF) joint. *X-rays lumbar:* L4-S1 disc spaces narrowed. Grade 1 degenerative anterolisthesis of L4 in relation to L5. *MRI lower leg:* Cysts not in relation to peroneal nerve, well circumscribed, homogenous content with pressure effect on muscles. Intra-osseous cysts TF joint. *MRI lumbar:* Confirmed listhesis identified on X-ray. Paravertebral joint osteo-arthritis (OA) L4,5 with degenerative cyst lateral resess of L5 and pressure effect on left L5 root.
FINAL WORKING DIAGNOSIS: 1. Multi-locular synovial cyst TF joint ± peroneal nerve involvement 2. Gout 3. L5 facet joint OA with nerve root radiculopathy
TREATMENT AND OUTCOMES: This was the patient's first consultation. Keeping the possible double pathology in mind (i.e. L5 root pressure and/or peroneal nerve involvement) an EMG will shed more light on future treatment. Surgical excision of the cyst will probably be needed. In the mean time gout treatment was continued. Conservative management and re-assessment of the lumbar pathology were advised.

1295 June 1 9:40 AM - 10:00 AM
Hyperextension Knee Injury in College Football Player
 Kent P. Scheff. *University of Michigan, Ann Arbor, MI.*
 (Sponsor: Robert Kiningham, 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 paresthesia, 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. **PHYSICAL EXAMINATION:** -Swelling of the thigh, anterior compartments firm but compressible, LE compartments soft, nontender, compressible, no pain with passive ankle ROM -Large effusion -Diffusely TTP -Guarding with Lachmans test, too painful for detailed ligament exam-Sensation intact to light touch in tibial, saphenous, sural, superficial/deep peroneal nerve distributions -5/5 ankle plantar/dorsiflexion, great toe flex/extension -DP/PT pulses not palpable, faint on doppler -Toes cool, sluggish cap refill. **DIFFERENTIAL DIAGNOSIS:** 1. Knee Dislocation: Multi-ligamentous Injury. 2. Popliteal Artery Injury. 3. Common Peroneal Nerve Injury. 4. Fracture. **TEST/RESULTS:** 1. ABIs: Right Brachial Press 155; Ankle PT Press 114, Index 0.74; Ankle DP Press 114, Index 0.63. 2. XR: Moderate knee joint effusion with fluid-fluid level. Concerning for occult fracture, although no fracture identified. Normal alignment. 3. CTA: 5 cm segment of popliteal artery occlusion. Mildly depressed R anterolateral tibial plateau fracture. Vastus intermedius intramuscular hematoma. **FINAL DIAGNOSIS:** Right Popliteal Artery Occlusion. **TREATMENT AND OUTCOMES:** 1. Heparin Drip started for therapeutic anticoagulation. 2. Urgently sent to operating room for popliteal exploration. 3. Right fem-pop artery bypass using contralateral great saphenous vein. 4. Right lower extremity 4-compartment fasciotomy. 5. Ligamentous repair of knee planned 4-6 weeks post vascular repair.

C-18 Clinical Case Slide - Medical Issues I

Thursday, June 1, 2017, 8:00 AM - 9:40 AM
 Room: 402

1296 **Chair:** Steven D. Stovitz, FACSM. *University of Minnesota, Minneapolis, MN.*
 (No relationships reported)

1297 **Discussant:** Kathryn E. Ackerman, FACSM. *Children's Hospital Boston, Cambridge, MA.*
 (No relationships reported)

1298 **Discussant:** John Mark MacKnight, FACSM. *University of Virginia, Charlottesville, VA.*
 (No relationships reported)

1299 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 Sutherland, Erik Lind, Kevin Dames, Alexander Generali, Brandon Schrom, Maura Mills. *SUNY Cortland, Cortland, NY.*
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 (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. Continued eccentric lower body training
 2. Expansion and increase intensity of physical activities
 3. Continued monitoring of functional parameters
 4. Reduction in prescription use of Sinemet

1300 June 1 8:20 AM - 8:40 AM
Alcohol Addiction - Improving Brain Oxygenation and Cognition Through a Three-Month Running Program
 Daniel A. Cabral, Kell G. Costa, Adolfo M. Costa, Alexandre H. Okano, Hassan M. Elsangdy, Vanessa P. Rachetti, Eduardo B. Fontes. *Federal University of Rio Grande do Norte, NATAL, Brazil.*
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 (No relationships reported)

HISTORY: A 46-year-old male psychiatric Hospital patient, having 33 years of alcohol alcohol dependence with more than 20 hospitalizations was selected. According to the DSM-V, the patient had a chronic disorder related to alcohol consumption. In addition, he scored 37 on ASSIST questionnaire which recommends a severe therapeutic intervention.
PHYSICAL EXAMINATION: The volunteer performed psychosocial questionnaires, fitness and cognitive tests (stroop), and had pre-frontal cortex oxygenation and heart rate variability measurements pre- and post-running program.
DIFFERENTIAL DIAGNOSES:

1. Impaired cognition
2. Decreased function of the autonomic nervous system
3. Impaired quality of life and sleep
4. Decreased pre-frontal cortex oxygenation

TEST AND RESULTS
 Low prefrontal cortex oxygenation during rest and exercise
 - Low reaction time during cognitive test
 - High sympathetic activation
FINAL/WORKING DIAGNOSES
 Severe alcoholic dependence with lack of executive functions, autonomic nervous system dysfunction and pre-frontal cortex damage.

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 921% in ventilatory threshold, 604% in respiratory compensation point and 76% in VO₂peak.
9. The need for therapeutic intervention decreased from severe to moderate.

1301 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.*
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(No relationships reported)

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 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 treatment for the pharyngitis.

PMH: uncomplicated

Meds: OCP

NKDA

Physical Examination: Lower Extremities: multiple nodular lesions varying, in color from faint red to dark red to a light purple [photo documentation is available]; they ranged from just proximal to her knees to her ankles bilaterally; warm, palpable and tender to the touch. Lower extremity strength was 5/5 bilaterally, sensation to light touch was intact and equal, pulses present and equal bilaterally.

Differential Diagnosis:

1. Nodular Vasculitis
2. Erythema Mutiforme
3. Superficial Thrombophlebitis
4. Subcutaneous Bacterial Infection
5. Sarcoidosis

Test and Results:

CBC -

WBC: 10.0

Hemoglobin: 12.2

Hct: 35.8

• CRP: 11

• ASO titer: 423

• Epstein Barr VCA IgM: Positive

• Epstein Barr VCA IgG: Positive

Final/Working Diagnosis:

1. Erythema Nodosum secondary to recent mononucleosis and/or streptococcal pharyngitis

Treatment and Outcomes:

1. Pre-game NSAID administration and post-game ice bath for pain control
2. Protection of area with shin guards
3. Close monitoring of lesions for resolution to assure no other testing needed to look for source other than recent pharyngitis infection
4. Patient continued to play with moderate discomfort during contact with shins. Over an 8-week period of observation, the lesions decreased in number and tenderness, but a few non-tender palpable lesions remained through the end of season at 5 months since the original illness.

1302 June 1 9:00 AM - 9:20 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 angiomas. No JVD. Lungs were clear. Heart regular rate and rhythm, no murmur, 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, α_1 -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: hepatosplenomegaly without any masses or ascites.

FINAL WORKING DIAGNOSIS: Diclofenac induced hepatotoxicity

TREATMENT AND OUTCOMES: 1. Cessation of diclofenac. 2. In addition to inpatient GI consult 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.

1303 June 1 9:20 AM - 9:40 AM

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, FACS M)

Email: nicole.klochak@ucdenver.edu

(No relationships reported)

HISTORY: Neoadjuvant chemotherapy and radiation (NEO) is prescribed to patients with borderline-resectable 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-resectable 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:

- 400 m Walk Test (s) - Base: 211, PreOp: 188, PostOp: 195

- Grip Strength (kg) - Base: 45, PreOp: 46, PostOp: 44

- 30 s Sit-to-Stand (reps) - Base: 13, PreOp: 20, PostOp: 14

- Total Body Mass (kg) - Base: 64, PreOp: 72, PostOp: 65

- Total Lean Mass (kg) - Base: 50, PreOp: 57, PostOp: 51

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

TREATMENT AND OUTCOMES: The patient attended 28, hour-long, supervised exercise sessions during NEO. Each session consisted of a 10-min warmup followed by aerobic, resistance, and flexibility exercises. Intensity was progressed or regressed when ability was impacted by training, chemotherapy, or radiation. All physical

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 Paxton¹, Karl Pankratz².
¹Texas Tech University Health Sciences Center, Lubbock, TX.
²Covenant Medical Center, Lubbock, TX.
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(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 phalanx. 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 phalanx. No bruising. TTP over the volar aspect of the distal proximal phalanx and proximal aspect of the distal phalanx. 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 phalanx.

Ultrasound of L ring finger: tear of the flexor digitorum profundus over the distal proximal phalanx (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 tendon
4. Hand physical therapy starting with passive ROM and then strengthening exercises

1308 June 1 8:20 AM - 8:40 AM

Chronic Hand Deformity in a Boxer

Clark Madsen, Joshua Goldman. *UCLA, Los Angeles, CA.*
Email: cmadsen@mednet.ucla.edu
(No relationships reported)

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.Juncture tendinosis
- 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

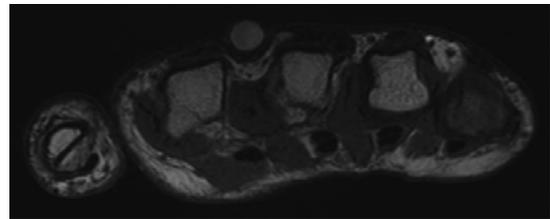
Traumatic sagittal band disruption (Boxer's Knuckle)

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



1309 June 1 8:40 AM - 9:00 AM

Wrist Injury - Go karting

Jonathan T. Napolitano, Anastasia Fischer, FACSM. *Nationwide Children's Hospital, Columbus, OH.*
(No relationships reported)

HISTORY: A 15 year old right handed female basketball player presented to the sports medicine clinic of a pediatric hospital four months after a go-karting accident. The go-kart rolled and landed on her right wrist. With no significant pain or disability after the injury she did not seek immediate medical attention. Four months later she presented with increased pain and swelling in the wrist. She was immobilized with a cock-up splint and instructed to follow up after further imaging and occupational therapy. Her pain improved with bracing and she was lost to follow-up, attending only one occupational therapy visit. She presented again eight months later with improved pain and swelling but severe loss of range of motion. **PHYSICAL EXAMINATION:** Inspection of the right upper extremity revealed atrophy of right forearm, wrist, and hand, and a volar angular deformity of the wrist. No tenderness to palpation. Active and passive range of motion was severely limited in all directions. No soft tissue swelling or effusion. No temperature or skin texture changes. **DIFFERENTIAL DIAGNOSIS:** Post-traumatic arthritis, complex regional pain syndrome, juvenile idiopathic arthritis. **TEST AND RESULTS:** X-ray attached. MRI: Diffuse infiltrative process suggestive of ongoing inflammatory process. 3 Phase Bone Scan: Increased uptake along the right wrist and carpal joints. Sedimentation Rate: 45mm/h. Anti-CCP: 160 U. Rheumatoid Factor: 250 IU/mL. X-Rays of bilateral elbows reveal possible joint effusions. Ankle x-ray with irregular dorsal contour of the navicular. **FINAL WORKING DIAGNOSIS:** Rheumatoid factor positive, polyarticular, juvenile idiopathic arthritis. **TREATMENT AND OUTCOMES:** The patient was referred to rheumatology for further workup and close follow-up, started on methotrexate,

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.



1310 June 1 9:00 AM - 9:20 AM

Decreased Thumb Rom In A Soccer Player

Robert Bogart¹, Kathryn Vidlock, FACSM². ¹*Sky Ridge Medical Center, Lone Tree, CO.* ²*Colorado Orthopaedics, Lone Tree, CO.*
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(No relationships reported)

HISTORY: A 17-year-old male presented to the office c/o inability to extend thumb after experiencing a popping sensation earlier in the morning. Past history of falling on outstretched hand while playing soccer 5 weeks prior. X-rays of left wrist at that time demonstrated a mature skeleton with a nondisplaced distal radius fracture. Patient was placed in a cast and instructed to use sling as needed. 4 weeks s/p injury, the fracture was healed and patient exhibited full range of motion and strength on exam. Subsequently, he was allowed to return to activities as tolerated. 10 days later patient presented to the office with the inability to extend his thumb.

PHYSICAL EXAMINATION: No erythema, ecchymosis, edema or gross deformities. Non-tender to palpation along 1st MCP joint, thumb IP joint or along any carpal, metacarpal or phalangeal bony prominences. No palpable masses. Inability to actively initiate or maintain extension of the thumb at the MCP and IP joints. Full passive ROM of thumb. No laxity at MCP joint at 30 degrees of flexion.

DIFFERENTIAL DIAGNOSIS

1. Ruptured extensor pollicis longus tendon
2. Ulnar collateral ligament avulsion
3. Distal intersection tenosynovitis
4. Radial nerve neuropraxia/posterior interosseous syndrome
5. Stenosing tenosynovitis

TESTS AND RESULTS

Left wrist AP, lateral, oblique, scaphoid radiographs (initial):
-Fusion of the metaphyseal-epiphyseal junction without presence of growth plate
-Non-displaced fracture of the distal radius, with intraarticular extension involving the medial dorsal epiphysis without presence of step-off

Left wrist AP, lateral, oblique (final)

-Healed, non-displaced distal radius fracture

Ultrasound left dorsal wrist (s/p thumb weakness)

-Fluid filled 3rd compartment at the level of Lister's tubercle and intact EPL tendon distally

Left wrist MRI (s/p thumb weakness)

-Torn and retracted proximal EPL tendon

-Stump of tendon seen at the level of mid trapezium

FINAL/WORKING DIAGNOSIS

-Ruptured EPL tendon s/p non-displaced distal radius fracture

TREATMENT AND OUTCOMES

1. Patient underwent tendon transfer using EIN to EPL and is recovering.

1311 June 1 9:20 AM - 9:40 AM

Wrist Pain - Fish Cutter with Acute Joint Pain and Swelling

Lauren Nadkarni. *Maine Medical Center, Portland, ME.*
(Sponsor: Heather Gillespie, FACSM)

(No relationships reported)

History:

A 52 year old male smoker presents with 3 days of left wrist pain. His past medical history is significant for hypertension, hyperlipidemia, stroke, renal calculi, gout, ganglion cyst of his left wrist, previous left wrist sprains, and left wrist fracture resulting in prior surgery without hardware. Although he works as a fish cutter, he

denied any recent injuries or puncture wounds. He reports he had started wearing a wrist brace over the past 1-2 days due to swelling and pain, but this had not improved his symptoms. He reports some possible subjective chills, but denies fever.

Physical Exam:

Office examination of his left wrist revealed erythema, warmth, tenderness, and tense edema extending from the base of his fingers to his mid forearm with a 3 cm fluctuant area on his dorsal wrist, associated with low grade fever and tachycardia. Aside from a well healed scar on his posterior wrist, no other skin lesions were present. His wrist was tender to palpation and painful with movement in all directions. Active and passive range of motion were limited by pain and swelling in all directions. Distal neurovasculature was intact.

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 allopurinol/colchicine

C-30 Free Communication/Poster - ACL Injury

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

Room: Hall F

1326 Board #1

June 1 8:00 AM - 9:30 AM

Impulsive Loading During Running Following Anterior Cruciate Ligament Reconstruction

Derek N. Pamukoff, Michael N. Vakula, Tyler J. Moffit, Kevin Choe, Melissa M. Montgomery. *California State University, Fullerton, Fullerton, CA.* (Sponsor: Lee E. Brown, FACSM)

(No relationships reported)

Individuals with anterior cruciate ligament reconstruction (ACL) 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±3.3 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=22.6±3.1 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 evaluated using a force plate. PIF, ALR, and ILR were normalized to body weight (BW) for analysis. Separate one-way ANCOVAs were used to compare each dependent variable between the injured, uninjured, and control limbs, using running speed as a covariate ($\alpha=0.05$). *Post hoc* comparisons were evaluated using a *Bonferroni* adjustment ($\alpha=0.017$). **RESULTS:** PIF ($F_{2,62}=4.55$, $p<0.01$) and ALR ($F_{2,62}=3.22$, $p=0.03$) differed between limbs, and a trend was observed towards a difference in ILR between limbs ($F_{2,62}=2.56$, $p=0.07$). *Post hoc* analyses indicated that PIF (1.84±0.48 vs. 1.45±0.34 BW, $p<0.01$), ALR (67.1±26.2 vs. 46.4±15.9 BW/sec, $p=0.01$), and ILR (90.2±18.8 vs. 73.2±16.9 BW/sec) were greater in the injured compared to control limb. PIF (1.68±0.44 vs. 1.45±0.34 BW, $p=0.01$) and ALR (60.6±25.7 vs. 46.4±15.9 BW/sec, $p=0.016$) were greater in the uninjured compared to the control limb. No differences were observed between the injured and uninjured limbs. **CONCLUSIONS:** Our findings indicate that the injured limb in individuals with unilateral ACLR experience greater PIF, ALR, and ILR compared to control limbs, and that the

uninjured 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.

been linked to cartilage degradation in individuals with knee pathologies, the current results emphasize the role of quadriceps dysfunction in KOA development following ACLR. Improving quadriceps RTD may reduce loading characteristics that negatively influence cartilage health.

1327 Board #2 June 1 8:00 AM - 9:30 AM
Aberrant Gait Biomechanics Are Not Associated with Aberrant Landing Biomechanics in Those with ACL Reconstruction
 Steven Pfeiffer, Troy Blackburn, Brittney Luc-Harkey, Matthew Harkey, Laura Stanley, Stephen Marshall, Jeffrey Spang, Brian Pietrosimone, Darin Padua. *University of North Carolina at Chapel Hill, Chapel Hill, NC.*
 Email: stevenpf@email.unc.edu
(No relationships reported)

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. Secondly, 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, 45.5±38 months post-ACLR, 22.1±3.4 years old, 169.4±10.8 cm, 73.4±17.9kg) with a 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 *a priori* at 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; ρ=0.389, P=0.021) in the uninvolved limb. All other associations between walking gait and JL kinetics and LSI were negligible (range ρ= -0.289 to 0.209) 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.

1329 Board #4 June 1 8:00 AM - 9:30 AM
Objectively Measured Physical Activity in Patients after ACL Reconstruction
 David R. Bell¹, Karin Pfeiffer, FACSM², Lisa Cadmus-Bertram¹, Stephanie M. Trigsted¹, Adam Kelly³, Eric G. Post¹, Joe Hart, FACSM⁴, Dane Cook¹, Warren Dunn¹, Chris Kuenze³.
¹University of Wisconsin-Madison, Madison, WI. ²Michigan State University, East Lansing, MI. ³Michigan State University, East Lansing, MI. ⁴University of Virginia, Charlottesville, VA.
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Return to a healthy level of physical activity is a common clinical goal for patients recovering from anterior cruciate ligament reconstruction (ACLR). Objective measures of physical activity may provide useful information regarding achievement of rehabilitation goals in patients with ACLR. **PURPOSE:** To investigate differences in the average minutes per day (min/day) spent in moderate-to-vigorous physical activity (MVPA) as well as the total number of steps per day (steps/day) between individuals with ACLR and matched controls. A second purpose was to investigate relationships between MVPA and steps/day subjective activity scales Tegner and Marx activity scales. **METHODS:** Physical activity was assessed using ActiGraph accelerometers in 33 participants (22 females; 20.3±1.8 years; 171.8±10.5cm; 69.9±11.3kg; 27.8±17.5 months from surgery) with a history of primary unilateral or bilateral ACLR as well as 33 healthy controls (CON) (20.8±1.6 years; 172.9±8.5cm; 70.2±13.5kg) (matched on age, sex, and Tegner activity level). Participants wore the accelerometer for 7 consecutive days and completed the IKDC 2000 subjective form and the Tegner and Marx activity scales. Independent t-tests were used to examine between group differences. Bivariate correlation coefficients were calculated between objective and subjective activity levels. **RESULTS:** Patients with ACLR participated in less MVPA per day (ACLR: 78.3±26.6 min/day; CON: 94.2±26.6 min/day; P=0.02) and less steps/day (ACLR: 7,982±3,020 steps/day; CON: 9,945±2,885 steps/day; P=0.02) 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 (ACLR: 10.2±4.8; CON: 10.8±3.8; P=0.63) and Tegner (ACLR: 6.2±2.1; CON: 6.7±1.7; P=0.11) 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.

1328 Board #3 June 1 8:00 AM - 9:30 AM
Quadriceps Function is Associated with Running Kinetics Post Anterior Cruciate Ligament Reconstruction
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(No relationships reported)

PURPOSE: Individuals with anterior cruciate ligament reconstruction (ACLR) are at greater risk for knee osteoarthritis (KOA), partially due to chronic quadriceps dysfunction. Impaired quadriceps function contributes to higher loading rates during gait, and may exacerbate cartilage breakdown. The purpose of this study was to examine the association between indices of quadriceps function and ground reaction forces (GRF) characteristics linked to KOA development during running in individuals with ACLR. **METHODS:** Quadriceps function and running biomechanics were assessed in 20 individuals (5 M, 15 F) with unilateral ACLR (age=22.3±3.3 years, height=1.73±0.09m; mass=71.8±15.3kg). Indices of quadriceps function included isometric peak torque (PT) and rate of torque development (RTD), and isokinetic peak torque measured at 180°/s and 240°/s. Kinetic data included peak vertical impact force (PIF), average vertical loading rate (ALR), and instantaneous vertical loading rate (ILR) acquired from the ACLR limb while running at a self-selected pace. Partial correlations were used to assess the relationship between quadriceps function and running kinetics after accounting for self-selected running speed. **RESULTS:** Quadriceps RTD was negatively correlated with PIF (r=-0.40, p=0.04) and ALR (r=-0.48, p=0.03). A trend was observed between quadriceps RTD and ILR (r=-0.36, p=0.07). Neither isometric PT nor isokinetic PT at 180°/second or 240°/second were associated with any running biomechanics variable. **CONCLUSIONS:** Slower quadriceps RTD were associated with larger PIF and ALR during running. The ability of the quadriceps to generate rapid force prior to heel contact is necessary for GRF attenuation during gait. Since larger PIF and ALR have

1330 Board #5 June 1 8:00 AM - 9:30 AM
Hop Distance Symmetry Does Not Reflect Biomechanical Symmetry in Adolescents Post-ACL Reconstruction
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(No relationships reported)

PURPOSE: To assess symmetry and biomechanics of young athletes with anterior cruciate ligament reconstruction (ACLR) during a single-leg hop. **METHODS:** 39 patients with unilateral ACLR (62% female; age 13-18 years; 5-12 months post-surgery) and 29 controls (58% female) performed a single-leg hop for distance and were classified as asymmetric if hop distance on the operative or control limb with the shorter distance was <90% of the contralateral limb. Lower extremity landing biomechanics were compared among operative, non-operative and control limbs. **RESULTS:** 10/29 controls (34%) and 12/39 patients (31%) were classified as asymmetric. Asymmetric patients hopped a shorter distance on the operative side compared with non-operative and symmetric control limbs (op: 1.3 leg lengths, non-op and control: 1.6 LL, p≤0.04). Symmetric patients tended to hop a shorter distance on both sides (1.4 LL, p=0.17) with lower peak ground reaction force (op and non-op: 2.8 body weights; control: 3.1 BW, p<0.10). Compared to controls, asymmetric patients landed more plantarflexed (op: -18°, control: -2°, p=0.002) with greater pelvic drop (op: -13°, control: -10°, p=0.06) and less knee varus (op: 0°, control: 3°, p=0.05). Operative limbs had lower knee flexion moments (p=0.004) and greater power absorption at the ankle (p=0.05) with a trend of higher dorsiflexion moments (p=0.08). Symmetric patients had greater bilateral hip flexion compared with controls

(op: 71°, non-op: 68°, control: 55°, $p \leq 0.001$) and less varus at initial contact on the operative side (op: 1°, control: 3°, $p = 0.03$). This resulted in higher hip flexion moments ($p \leq 0.002$) and power absorption ($p \leq 0.02$) and lower knee valgus moments on both sides compared with controls, as well as lower knee flexion moments on the operative side ($p < 0.001$). **CONCLUSIONS:** A similar percentage of patients and controls were classified as asymmetric based on single-leg hop distance suggesting hop distance symmetry may not reflect single leg function and return to sport readiness. Both symmetric and asymmetric patients demonstrated biomechanical differences compared with controls but employed different movement strategies. Asymmetric patients offloaded the knee to the ankle, while symmetric patients offloaded the knee to the hip and decreased task performance on the non-operative side.

1331 Board #6 June 1 8:00 AM - 9:30 AM
Contribution of the Sensorimotor System to Landing Demand and Risk Factors For ACL Injury

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The sensorimotor system is known to be important for injury prevention, however, it is unknown how these characteristics contribute to known risk factors for ACL injury. **PURPOSE:** To examine the contribution of sensorimotor characteristics on landing biomechanics related to ACL injury and how they may change with task difficulty. **METHODS:** Fifty-three healthy females (Age: 23.2±4.3 years; Height: 166.6±7.5 cm; Mass: 65.0±9.5 kg) participated. Dominant knee proprioception and strength was assessed using threshold to detect passive motion (TTDPM), time to peak torque (TTPT), and peak torque (PT) in both knee extension (ext) and flexion (flex). Kinematic and kinetic analyses were performed during a double-leg stop-jump (DLSJ) task to evaluate knee flexion and knee abduction angle at initial contact (KFIC, KABIC) and peak vertical and posterior ground reaction force (vGRF, pGRF), knee flexion angle (KF), knee abduction angle (KAB), knee abduction moment (KABm), and proximal anterior tibial shear force. Jumps were performed at distances of 20%, 40%, 60%, and 80% of their body height to assess the influence of landing demand. Multiple linear regression was used to determine the contribution of these sensorimotor characteristics to predict biomechanical risk factors. **RESULTS:** Sensorimotor characteristics did not account for a significant amount of the variance of either vGRF or pGRF. Sensorimotor characteristics accounted for little to moderate amount of variance of KFIC ($R^2 = 0.08 - 0.27$, $p = 0.038 - 0.002$), KF ($R^2 = 0.03 - 0.08$, $p = 0.196 - 0.035$), and KABm ($R^2 = 0.04 - 0.22$, $p = 0.171 - 0.007$). Regression models showed that the best sensorimotor contribution occurred at a jump distance of 40% with TTDPM and TTPT-flex accounting for 30.4% ($p < 0.001$) of the variance of the square-root of KABm. **CONCLUSIONS:** Although knee proprioception and strength do significantly contribute to some risk factors for ACL injury, more research is needed to determine other contributing features to develop more directed prevention methods. Researchers and clinicians need to be aware that proprioception and strength at the knee are most related to knee flexion at initial contact, peak knee flexion, and peak knee abduction moment and have the strongest relationship at mid-range landing demand.

1332 Board #7 June 1 8:00 AM - 9:30 AM
Comparison Of Post-ACLR Kinematics Between Landings Of A Drop Vertical Jump: Implications For Re-injury Risk

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 (No relationships reported)

The drop vertical jump (DVJ) task is used to assess functional recovery after an anterior cruciate ligament reconstruction (ACLR). A DVJ has two distinct phases, and while the 1st landing is more commonly analyzed, the 2nd landing follows a maximal jump and may better represent higher-risk sport situations. Comparing the kinematics of each landing in subjects after an ACLR would provide insights into the specific qualities of each landing to inform clinical examination and future research.

Purpose: To compare hip and knee kinematics of the reconstructed limb between the 1st and 2nd landing of a DVJ in patients after ACLR. **Methods:** 22 subjects (10 F, age 20.6±5 y, H 1.7±0.1 m, M 71±12 kg) 6 months post-ACLR performed a DVJ. Subjects were asked to step off of a 30.5 cm box, land (1st landing), maximally jump, and land once more (2nd landing) during an instrumented data collection. Visual 3D was used to calculate hip and knee kinematics at initial contact. Paired sample t-tests were used to compare between landings. **Results:** The ACLR limb demonstrated less knee flexion but greater knee abduction and internal rotation angles during the 2nd landing (Table 1). The hip exhibited less flexion and internal rotation motion. No differences were observed in frontal plane hip motion.

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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.

| Joint | Motion | First Landing | Second Landing | P-Value |
|-----------|-------------------|---------------|----------------|---------|
| ACLR Knee | Flexion | -36.7±5.8° | -31.0±9.4° | .007 |
| | Adduction | 3.0±4.8° | 0.2±3.9° | .000 |
| | External Rotation | -11.4±9.9° | -8.3±9.2° | .001 |
| ACLR Hip | Flexion | 45.5±12.9° | 27.3±12.9° | .000 |
| | Adduction | -2.9±4.2° | -3.6±4.3° | .419 |
| | Internal Rotation | 8.7±7.2° | 4.6±6.8° | .002 |

Data significant at $p < 0.05$ and presented as Mean ± SD. ACLR = anterior cruciate ligament reconstructed limb. All data reported in degrees.

1333 Board #8 June 1 8:00 AM - 9:30 AM
Kinetics and Kinematics During the Cutting Maneuver Weight Acceptance - Relevance for ACL Injury Prevention

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Purpose: Prospective studies have identified high valgus moment (VM) and vertical ground reaction forces (vGRF) as risk factors for anterior cruciate ligament (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; ($\geq 5^\circ$, 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 (44382 N/s (2724 N/s) vs 35062 N/s (2281 N/s); $p < .009$) 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.

1334 Board #9 June 1 8:00 AM - 9:30 AM
Altered Brain Activity During Joint Loading After Anterior Cruciate Ligament Reconstruction

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Following an anterior cruciate ligament rupture, many patients that undergo surgical intervention (ACLR) fail to return to pre-injury levels of physical activity due to repetitive "giving-way" episodes. This functional joint instability may result from an insufficient neural processing responsible for neuromechanical links between the ACL and central nervous system. It remains unclear how the brain of the ACLR patients perceives mechanical loading compared with healthy controls. **PURPOSE:** To examine brain activity differences between ACLR patients and healthy controls during knee loading. **METHODS:** Seventeen healthy control (CON: 26.9±5.6yrs, 69.6±1.2kg, 166.3±7.7cm) and seventeen ACLR patients (ACLR: 22.29±3.8yrs, 67.8±18.7kg,

164.5±10.4cm) volunteered. Somatosensory cortical activity was measured using event-related desynchronization (ERD: % decreased power; ERD1, ERD2, ERD3) from electroencephalography (EEG) during each second of an anterior knee loading (3sec) at constant force (45N/sec). Comparisons were made using 2-way ANOVAs with one within factor (limb, 2 levels) and one between factor (group, 2 levels). **RESULTS:** A significant limb by group interaction was observed for ERD1 ($F_{[1,32]} = 8.280, p = .007$). The reconstructed knee in the ACLR showed greater increased cortical activity than the matched limb in the CON (36.4±11.5 vs. 25.3±13.2%, $p = .013$), while the uninjured knee in the ACLR was similar to the CON's matched limb (25.1±14.2 vs. 28.0±11.5%, $p = .506$). Additionally, the ACLR showed greater increased ERD1 in the reconstructed limb when compared to the uninjured limb (36.4±11.5 vs. 25.1±14.2%, $p = .006$). No significant interactions or main effects were observed for ERD2 and ERD3. **CONCLUSION:** Following an ACL rupture, the injured leg exhibits increased brain responses during early loading compared to the uninjured knee, as well as the matched limb of healthy controls. This may indicate protective neural adaptation in the brain to compensate the altered proprioceptive input from the injured knee, such that reorganized somatosensory cortex activity can optimize neuromuscular control needed for maintaining functional joint stability. Future studies should explore whether this neural adaptation improves joint health and junction after an ACL injury.

1335 Board #10
Abstract Withdrawn

1336 Board #11 June 1 8:00 AM - 9:30 AM
Quadriceps Force Control and Motor Cortex Organization Following Anterior Cruciate Ligament Rupture

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Diminished quadriceps force control following ACL rupture may reflect quadriceps dyskinesia, which may be attributed to modulation or reorganization within the motor cortex. Reorganization within the motor cortex may be characterised by changes in the cortical motor representation of a muscle. Alterations in the cortical motor representation position is associated with dysfunctional motor control in a number of musculoskeletal conditions, but has not been examined following ACL rupture.

Purpose: To determine the association between quadriceps cortical motor representation position and accuracy of quadriceps force output following ACL rupture.

Methods: Eighteen individuals (12M/6F; 29.8 ± 8.7years; 69.5 ± 42.5 days post-injury) with a unilateral isolated ACL rupture. While seated in a dynamometer, participants performed an isometric quadriceps contraction to match a fluctuating force target between 5% to 25% body weight (BW). The root mean square error (RMSE) of participants force relative to target force was used to determine accuracy. Motor representation of the quadriceps was determined using transcranial magnetic stimulation. Four stimuli at 120% of motor threshold were given 5s apart while participant contracted their quadriceps at 10% BW, starting at the identified optimal site moving in 1cm steps in anterior, then posterior directions until a motor evoked potential could no longer be elicited. This pattern was repeated for lateral, then medial sites until all map borders had been determined. Pearson product moment correlations ($P < 0.05$) were used to assess associations between RMSE and motor representation position in the x- and y-axes.

Results: There were no significant associations between RMSE and y-axis center position of the motor representation in either limb of the ACL group ($r = 0.28, P = 0.31$ INV; $r = 0.30, P = 0.32$ UNIV). Also, no significant associations between RMSE and x-axis center position in either limb of the ACL group ($r = 0.099, P = 0.73$ INV; $r = -0.36, P = 0.27$ UNIV).

Conclusions: Quadriceps force control following ACL rupture was unrelated to cortical motor representation position. Alternatively, impaired quadriceps force control following ACL rupture may relate to alterations in spinal reflex excitability, or altered connectivity with higher brain centers.

1337 Board #12 June 1 8:00 AM - 9:30 AM
Relationship between Patient Reported and Objective Measures of Physical Activity in Individuals with ACL Reconstruction

Christopher Kuenze¹, Karin A. Pfeiffer, FACSM¹, Lisa A. Cadmus-Bertram², Adam R. Kelly¹, Stephanie M. Tristed², Warren A. Dunn², David R. Bell¹. ¹Michigan State University, East Lansing, MI. ²University of Wisconsin, Madison, WI.
(Sponsor: Karin Pfeiffer, FACSM)
(No relationships reported)

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) form to assess 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. Freedson 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 Bland Altman plot revealed an average MD of 58.9 min/day and broad LOA (Upper LOA = 110.7min/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.

1338 Board #13 June 1 8:00 AM - 9:30 AM
Quadriceps Strength is More Associated with Disability than Rate of Torque Development Following ACL Reconstruction

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(No relationships reported)

Quadriceps muscle function, specifically maximal isometric strength (MVC) has been associated with disability in individuals with an anterior cruciate ligament reconstruction (ACLR). In addition, rapid strength, or the rate of torque development (RTD), is reduced following ACLR when compared to healthy controls. It is unknown if quadriceps RTD explains unique variance in self-reported disability after accounting for MVC in individuals with an ACLR. **PURPOSE:** Determine separate associations between MVC and RTD in the ACLR limb with self-reported disability (International Knee Documentation Committee Index [IKDC]) in individuals with a unilateral ACLR. Secondly, we evaluated the unique amount of variance explained by RTD after accounting for MVC for self-reported disability. **METHODS:** Forty-one individuals (29.3% male, 22.1±3.2 years old, 25.2±3.8 kg/m² BMI, 49.5±39.6 months post ACLR) completed the IKDC, as well as a maximal and rapid knee extension MVC to determine maximal strength and RTD. All isometric assessments were performed at 90° of knee flexion on a HUMAC Norm dynamometer. MVC was determined as the highest peak torque value, and RTD was assessed at early (RTD_{0-100ms}) and late (RTD_{100-200ms}) phases over the MVC torque-time curve. Both MVC (Nm) and RTD (Nm/s) were normalized to body mass. Separate Pearson product moment correlations were conducted between outcomes of quadriceps function (MVC and RTD) and IKDC. For significant associations between RTD and IKDC, a hierarchical linear regression was used to determine the unique variance in IKDC explained by RTD after accounting for MVC. Statistical significance was set a priori ($\alpha = 0.05$). **RESULTS:** Greater RTD_{100-200ms} (4.25±1.79 Nm/s/kg; $r = 0.346, P = 0.031$) and MVC (2.04±0.67Nm/kg, $r = 0.418, P = 0.008$) of the ACLR limb significantly associated with better IKDC (87.02±9.69%). RTD_{0-100ms} (5.13±2.79 Nm/s/kg; $r = 0.170, P = 0.300$) was weakly and non-significantly associated with IKDC. MVC accounted for 17.5% of the variance in IKDC, and RTD_{100-200ms} accounted for an additional 0.5% of the variance.

CONCLUSIONS: Greater MVC and late phase RTD, but not early RTD, were related to better IKDC. Rehabilitation protocols that prioritize the improvement of quadriceps strength over RTD may be more likely to improve perceived disability following ACLR.

1339 Board #14 June 1 8:00 AM - 9:30 AM
The Relationship between Knee Related Function and Objectively Measured Physical Activity after ACL Reconstruction

Adam R. Kelly¹, David R. Bell², Karin A. Pfeiffer, FACSM¹, Lisa A. Cadmus-Bertram², Stephanie M. Trigsted², Warren A. Dunn², Christopher Kuenze¹. ¹Michigan State University, East Lansing, MI. ²University of Wisconsin, Madison, WI.
 (No relationships reported)

Persistent quadriceps weakness and knee dysfunction have been reported after ACL 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 ± 3.5kg/m², Time since surgery = 39.3 ± 18.7mo) and 17 matched controls (Sex = 10F/7M, Age = 20.5 ± 2.5 years, BMI = 23.1 ± 3.5kg/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 isokinetic 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-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 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 isokinetic 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 isokinetic 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

1340 Board #15 June 1 9:00 AM - 10:30 AM
Children's Physical Activity Cadence Measures: Video Direct Observation vs. Research and Commercial Grade Activity Trackers

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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 and 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 (6.9±0.3 vs. 6.2±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 five ATs recorded significantly higher cadence for all activities combined (range: 71±5 to 173±15 steps/min) compared to ViDO (37±4 steps/min). When activities were classified by PA intensity (moderate vs. vigorous) or type (sport, play or locomotive), one AT recorded consistently higher cadence than ViDO. Each 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 (range: *r*=0.21 to 0.31), with a stronger relationship between ViDO and AT cadence (range: *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.

1341 Board #16 June 1 9:00 AM - 10:30 AM
Accuracy Of Steps, Energy Expenditure, And Distance In Nine Activity Trackers

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 (No relationships reported)

Purpose: To evaluate the accuracy of the step counts, energy expenditure (EE), and distance measured from 9 consumer grade activity trackers. **Methods:** Twenty participants completed 1 mile of walking followed by 1 mile of running on a treadmill in the lab. Participants completed 3 sessions of exercise while wearing as many as 4 devices set up for their height, weight, and age in addition to an Actigraph GT3X (GT3X) accelerometer. Devices included in the study were (1) the Fitbit Surge (FBS), Charge (FBC), and Charge HR (FBH); (2) the Garmin Vivoactive (GVA) and Vivosmart HR (GVS); (3) the Jawbone UP2 and UP3; (4) the Polar Loop and; (5) the Microsoft Band 2 (MSB). Data from the devices were compared to the GT3X for steps and American College of Sports Medicine metabolic equations (ACSMME) for estimated EE. Distance recorded by the devices was compared to the 1-mile treadmill completed distance. **Results:** The GVA and GVS performed best with accurate measures for running steps counted, walking EE, running EE, and walking distance (*p* < .05). The FBH and UP3 performed worst with only accurate step counts for running (*p* < .05). The FBH and FBS underestimated walking steps by 370 steps (*p* < .000) and 318 steps (*p* = .002) respectively. Only the PL and UP2 were accurate for steps counted at a walking pace; however, both devices underestimated steps at 48 steps (*p* = .227) and 86 steps (*p* = .06) respectively. **Conclusion:** Few devices accurately measured steps at speeds lower than 4.5mph when compared to a validated accelerometer; however, most devices may accurately measure steps taken at speeds greater than 4.5mph. Few devices accurately measured EE for a 1-mile walk or run when compared to ACSMME. Few devices accurately measured distance for a walk, and none of the devices accurately measured distance for a run. It is recommended that accuracy should be considered when using activity tracking devices for the measurement of daily physical activity.

1342 Board #17 June 1 9:00 AM - 10:30 AM
Assessing the Feasibility of Wearable Activity Tracker with Individual vs. Group Users

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Wearable activity monitors are gaining popularity in individuals who want to track their physical activity (PA). The potential use of wearable monitor technology as a tool to facilitate behavior changes represents promising opportunities to promote healthy lifestyles, particularly the key feature of sharing individual's daily activity with others. **PURPOSE:** To compare individual and group users' PA by examining step measurement. **METHODS:** A convenience sample of 78 adults were recruited in this research across two groups: individual users (n=38) and group users, including their partners (n=32). A Jawbone UP 24 (JU) tracker was provided to track the participants' PA, and worn on their wrist for 8 weeks. Only the group users shared their PA information with their partners by using the JU application. After 8 weeks, participants' step counts recorded by the JU were evaluated to examine the change in PA. Participants' weight (WT, kg), body mass index (BMI, kg·m⁻²), waist circumference (WC, cm), blood pressure (systolic blood pressure: SBP and diastolic blood pressure: DBP, mmHg), self-efficacy (SE), and exercise motivation (EM) survey were measured before and after wearing the tracker. Repeated-measured ANOVA was performed to examine the difference of PA between the weeks, comparing individual and group users' PA. The change in WT, BMI, WC, SBP, DBP, SE, and EM were analyzed by performing dependent sample t-test. **RESULTS:** Significant differences in PA were observed at baseline (7308.6 ± 5023.5 steps/day) vs. week 1 (8558.6 ± 5128.6 steps/day, *p*=0.001), baseline vs. week 2 (8645.2 ± 5343.7 steps/day, *p*=0.001),

baseline vs. week 3 (8600.1 ± 4747.5 steps/day, p=0.001), and baseline vs. week 7 (9033.4 ± 6604.3 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. WC (p=0.01), SBP (p=0.02), and DBP (p=0.001) 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.

1343 Board #18 June 1 9:00 AM - 10:30 AM
Energy Expenditure and Step Count Analysis of the Fitbit Flex Activity Tracker

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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, N=26, female N=23; age (years) 23.43±6.57; height (m) 1.72±0.11; mass (kg) 76.15±18.46 walked protocol one and 46 (male, N=24, female N=22; age (years) 23.39±6.69; height (m) 1.72±0.11; mass (kg) 76.52±18.73 walked protocol two. 31 (male, N=18, female N=13; age (years) 24.39±7.59; height (m) 1.73±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@1.5mph (r=0.52, p<0.01; α=0.56; FF:19.43±7.12 Kcal, MOXUS:11.9±3.09 Kcal, p<0.01), 2.5mph (r=0.53, p<0.01; α=0.72; FF:25.0±7.3 Kcal, MOXUS:14.43±3.67 Kcal, p<0.01), 3.5mph (r=0.61, p<0.01; α=0.67; FF:27.2±7.55 Kcal, MOXUS:19.43±4.76 Kcal, p<0.01). SC@1.5mph (r=0.4, p<0.01; α=0.55; FF:231.05±58.75 steps, Observed:268.95±25.17 steps, p<0.01), 2.5mph (r=0.37, p<0.01, α=0.50; FF:322.64±42.74 steps, Observed:331.6±21.22 steps, p=0.03), 3.5mph (r=0.53, p<0.01; α=0.66; FF:366.02±31.35 steps, Observed:379.83±21.58 steps, 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 underestimating 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 shown to provide minimum health benefits.

1344 Board #19 June 1 9:00 AM - 10:30 AM
Accuracy of Fitbit Activity Trackers During Walking in a Controlled Setting

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 (No relationships reported)

BackgroundActivity trackers are widely used to measure daily physical activity. Many devices have been shown to measure steps more accurately at higher intensities, however, it is also important to determine accuracy at a walking pace. **Purpose**To assess 6 popular activity trackers at measuring steps while walking on a treadmill. **Methods**Twenty-six college students (Mean±SD; 22.1±3.7yrs; 25.1±4.0kg/m²; 13 male) walked 500 steps at 3mph on a treadmill while wearing 6 different activity trackers (Pedometer, Fitbit Blaze, Charge HR, Alta, Flex, Zip, One). The Charge HR was placed two fingers above the right wrist while the Flex was next to the wrist bone. The Blaze was placed two fingers above the left wrist while the Alta was next to the wrist bone. The Fitbit Zip and the One were aligned with the hip bone on the left and right waistband respectively. A trained researcher using a hand tally counter counted the steps. Missing values were replaced with the mean value for that device. Step counts were correlated between Fitbit devices and the pedometer and tally counter using Pearson correlations. Significance was set at p<0.05. Mean bias scores were calculated between the step counts for each device and the tally counter. Mean Absolute Percent Error (MAPE) values were also calculated for each device relative to the tally counter.

Results Fitbit Zip and One were significantly correlated with the tally counter (r=0.50, p<0.05; r=0.68, p<0.01, respectively) while the other devices were not significantly correlated. Mean bias and MAPE values were as follows:

| Device | Mean Bias (Mean±SD) | MAPE (Mean±SD) |
|-----------|---------------------|----------------|
| Pedometer | -0.2±39.2 | 3.8±6.8 |
| Blaze | -34.5±67.1 | 9.9±11.3 |
| Charge HR | -12.6±61.5 | 7.0±10.3 |
| Alta | -85.0±70.8 | 17.1±14.1 |
| Flex | 49.5±242.4 | 19.7±45.3 |
| Zip | 1.8±3.4 | 0.4±0.6 |
| One | 0.2±2.1 | 0.3±0.3 |

Fitbit Zip and One were within one half percent of actual steps while wrist-worn Fitbits ranged from 7.0-19.7% from 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.

1345 Board #20 June 1 9:00 AM - 10:30 AM
Accuracy And Reliability Of The Fitbit Charge™ Activity Tracker Among Older Adults

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Wearable technology, including activity trackers, remains a top fitness trend worldwide; however, the ability of individual activity trackers to accurately and consistently record physical activity remains unknown. **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 ±4.27 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 22.62 steps, respectively (p < .05). No difference in step count from the activity tracker was seen from session one to session two (151.85 steps vs. 152.54 steps, p > .05); however, the correlation between the two sessions was only moderate, r = .55, p = .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 careful study to determine their ability to accurately measure daily activity.

1346 Board #21 June 1 9:00 AM - 10:30 AM
Examination of a Wearable Activity Tracker to Assess Children's Physical Activity.

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Newer wearable activity monitors have the capability to measure heart rate (HR) from the user's wrist using an optical blood flow sensor (i.e., photoplethysmography techniques), and none of the previous studies examining children's free-living activity utilizing a newly developed wearable activity tracker which includes built-in HR sensor. **PURPOSE:** To examine PA intensity using the wearable HR monitor. **METHODS:** a total of 43 children (girls = 18, boys = 25), aged 8 - 12 years, participated in the study. Participants were asked to wear the Fitbit Charge HR (FHR) on their left (FHRL), right wrist (FHRR) and Polar HR (PHR) monitor on their chest, while completing 11 different activities lasted 48 mins, monitoring their HR. Oxygen consumption was measured throughout the routine with the Cosmed K4B² metabolic analyzer. 10 min average values of the resting metabolic rate were used as one metabolic equivalent of task (MET) to categorize children's PA intensity. Activity intensities using HR from the FHR were classified by calculating children's target HR between 50 and 75% of their maximum HR as moderate intensity activity and

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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 $208 - 0.7(\text{age})$ equation. Each intensity classified by the MET determined by HR was compared to the intensity classified 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, 407, and 120 for light, moderate, and vigorous intensity. The frequency determined by HR monitor and FHR were as follows: 1076, 394, and 58 by PHR, 1393, 127, and 9 by FHRL, 1393, 129, and 7 by FHRR. The values of weighted Kappa statistics from the McNemar's test were 0.40 (95% CL: 0.36-0.44) for the intensity by PHR, 0.21 (95% CL: 0.18-0.25) for the intensity by FHRL, 0.19 (95% CL: 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.

1347 Board #22 June 1 9:00 AM - 10:30 AM
Validation of Caloric Expenditure Using the Apple Watch and the Fitbit Zip

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 (No relationships reported)

PURPOSE: Physical activity trackers have become popular devices to monitor daily exercise and caloric expenditure. However, the validity of these devices is still being investigated. The purpose of this study is to compare estimates of caloric expenditure during exercise using an Apple Watch Sport and Fitbit Zip to values calculated from direct measurement of oxygen consumption. **METHODS:** The study included seven healthy participants (3 male and 4 female), 20 - 22 years of age. Participants completed six 6-minute bouts of sitting and treadmill walking and jogging (sitting, 2.5, 3.5, 4.2, and 5.5 mph, followed by 2.5 mph cool-down) while wearing an Apple Watch and a Fitbit Zip. Oxygen consumption (VO_2) was measured using the Cosmed Quark CPET. Data is presented as mean \pm SD. **RESULTS:** Caloric expenditure values for the Fitbit Zip were significantly higher than values calculated from VO_2 for all walking and jogging speeds ($p < 0.05$). In contrast, caloric expenditure values for the Apple Watch were not significantly different than values calculated from VO_2 for all walking and jogging speeds ($p > 0.05$). Total caloric expenditure values were also significantly higher for the Fitbit Zip (296.3 \pm 33.0 kcals) compared to estimates calculated from VO_2 (195.8 \pm 30.4 kcals) and the Apple Watch (201.1 \pm 41.5 kcals) ($p < 0.05$). **CONCLUSION:** The results of this study suggest that the Fitbit Zip may overestimate caloric expenditure compared to values calculated from VO_2 measurements. In contrast, caloric expenditure values from the Apple Watch are not different from the values calculated from VO_2 . This information may be important for exercise professionals to consider when recommending physical activity trackers to their clients.

1348 Board #23 June 1 9:00 AM - 10:30 AM
How Accurately The Smartwatch Measures Steps?
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 (No relationships reported)

Wearable activity trackers are getting popular in the fitness market to track individual's activity level and several research studies have examined the validity of popular wearable activity trackers. However, there is still limited research regarding the validity of smart watch. **PURPOSE:** The present study was to systematically examine the validity of the Apple watch for measuring steps. **METHODS:** Healthy individuals (mean \pm SD; age = 23.5 \pm 13.4 years; body mass index = 26.8 \pm 4.2 kg·m⁻²) participated in the study. The participants were asked to wear the apple watch while normal walking, fast walking and running for one lap on an indoor track (i.e., 200-meter track). The actual steps were manually tallied by researchers using a hand tally counter and the steps on the watch were recorded before and after each test, step counts from the apple watch were compared with manually counted steps. Pearson correlation was calculated to identify the measurement relationship between the counted steps and the recorded steps from the apple watch. Mean absolute percentage error (MAPE) were calculated to examine the measurement error of the Apple watch steps. A dependent t-test was performed to the significant mean differences between counted steps and recorded steps from the apple watch. **RESULTS:** Total step counts (means \pm SD) for counted steps were 222.3 \pm 82.5 for normal walking, 198.2 \pm 55.7 for fast walking, and 185.9 \pm 35.7. Recorded steps from the apple watch were 216.9 \pm 77.7 for normal walking, 198.2 \pm 55.7 for fast walking, and 188.4 \pm 37.9 for running. Pearson correlations were $r = .96$ ($p = .001$) for normal walking, $r = .83$ ($p = .000$) for fast walking, and $r = .93$ ($p = .000$) for running, respectively. Corresponding mean absolute error rates (computed as the average absolute value of the individuals' errors) were 6.1 \pm 6.6%, 8.8 \pm 11.2%, and 4.3 \pm 5.8%, for normal walking, fast walking, and running, respectively. Dependent sample t-tests indicated that there is no significant difference ($t(35) = .989$, $p = .359$) between the counted steps and the recorded steps from apple

watch. **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

1349 Board #24 June 1 9:00 AM - 10:30 AM
Validating iWatch in Measuring Energy Expenditure during Different Levels of Physical Activity

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Both consumers and researchers have become increasingly interested in using wearable fitness devices to monitor and measure physical activity (PA). iWatch 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 iWatch 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 iWatches while also being connected to indirect calorimetry. The two sets of measurement were arranged on two separate days with a randomization and > 48-hour rest in between. The three walking trials were at speeds of 54, 80, and 107 m·min⁻¹ while the running trials were at speeds of 134, 161, 188 m·min⁻¹. 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 x speed interactions ($F_{(15, 696)} = 1.113$, $p > 0.05$) between the indirect calorimetry (criterion) and iWatch. Bonferroni post hoc analysis revealed no significant differences between the criterion energy expenditure estimates (76.91 \pm 39.69 calories) and iWatch (81.53 \pm 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.

1350 Board #25 June 1 9:00 AM - 10:30 AM
"How 'bout Them Apples?" Validating Step Counts From The Apple Watch

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Purpose: To evaluate the validity of step counts detected by the Apple Watch (Series 1) during nineteen laboratory-based activities. **Methods:** Fifteen participants (mean \pm SD: age = 28.2 \pm 6.2 years; BMI = 23.6 \pm 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. 2.5 \pm 3.9 steps; $p = 0.025$), standing and stacking books (54.5 \pm 61.4 vs. 8.9 \pm 7.5 steps; $p = 0.014$), walking on the treadmill at 3 mph at a flat rate (244.5 \pm 111.1 vs. 342.4 \pm 24.4 steps; $p = 0.008$), standing and folding towels (48.3 \pm 42.5 vs. 11.9 \pm 11 steps; $p = 0.007$), riding the stationary bicycle at 600 kpm/min (47.2 \pm 54.1 vs. 0 steps; $p = 0.004$), and vacuuming (47.7 \pm 42.6 vs. 134.8 \pm 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

spuriously high step counts. Interestingly, despite gripping the handlebars, bicycling at 600 kpm/min may have generated rhythmic wrist movements that were sufficient to be detected as steps. Thus, the Apple Watch was not consistent when tracking step counts.

1351 Board #26 June 1 9:00 AM - 10:30 AM
Validation Of A Wrist Worn Consumer Physical Activity Monitor

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(No relationships reported)

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 (kcal), 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 (2 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 (kcal 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 kcal, steps, and HR from the AM and criterion measures.

RESULTS: Overall % errors for steps, kcal, and HR were 9.7%, 50.2%, and 6.6%, respectively. The AM underestimated steps during most of the slow walking activities ($\geq 11.7\%$, $p < 0.05$), whereas kcal were significantly overestimated ($\geq 9.9\%$, $p < 0.05$) 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 ($\geq 12.1\%$, $p < 0.05$) and HR ($\geq 6.9\%$, $p < 0.05$).

CONCLUSIONS: The AM had low overall error ($\leq 10\%$) for estimating steps and HR in the laboratory protocol. However, accuracy was notably worse for kcal estimates 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.

1352 Board #27 June 1 9:00 AM - 10:30 AM
Accuracy of Wrist-Worn Activity Monitors during Treadmill and Elliptical Ergometry

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(No relationships reported)

Wrist-worn activity monitors, designed to register daily activity, are used during many types of aerobic activity. **PURPOSE:** To assess the accuracy of wrist-worn activity monitors during treadmill and elliptical exercise. **METHODS:** Forty-two subjects (age=26.1±4.9 yrs, ht=166.2±9.5 cm, wt=81.6±26.7 kg) wore six wrist activity monitors (FF, FC, and PL on the right wrist, GV, MV, and LT on the left wrist, and a pedometer (HJ) on the right wrist. After walking for two minutes at 53.6 m/min (2.0 mph), 80.5 m/min (3.0 mph), and 107.3 m/min (4.0 mph), and exercising on the elliptical at 40 rpm and 60 rpm, monitor counts and actual step counts from a hand tally (AC) were recorded. Repeated measures ANOVA was used to determine significant differences between the counts. Pedometer error was calculated as [(monitor counts-actual counts)/actual counts]*100. **RESULTS:** FF, LT, PL, and FC was significantly lower ($p < .05$) than AC at 53.6 m/min (35.4±52.6, 67.6±72.5, 53.5±49.9, and 34.8±43.5 counts, respectively). FF, MV, PL, and FC was significantly lower than AC during 80.5 m/min (15.9±27.7, 29.6±32.3, 21.5±38.3, and 18.8±24.1 counts, respectively). During 107.3 m/min, FF, MV, GV, PL, and FC was significantly lower than AC ($p < .05$), 22.4±27.7, 56.7±47.9, 42.0±49.2, 44.2±44.5, and 23.9±27.9 counts, respectively. HJ was not significantly different than AC at any speed ($p > .05$). On the elliptical at 40 and 60 rpm, all monitors except HJ were significantly lower ($p < .05$) than AC. Of the wrist-worn monitors, LT had greatest error at 53.6 m/min (33.9%), followed by PL (26.6%). At 80.5 m/min, MV was highest at 12.5%, followed by PL (9.3%) and LT (8.7%). Error was greatest in MV at the fastest walking speed (21.2%), followed by PL (16.8%). While error during elliptical was high in all monitors, FF was least during 40 rpm (28.8%) and PL (14.2%) at 60 rpm. At 40 rpm, error was greatest in LT (96.3%), MV (53.1%), and FC (33.9%). At 60 rpm, MV (52.1%), FF (29.4%), and LT (24.4%) exhibited the greatest error. HJ registered the least percent error across all trials. **CONCLUSION:** The hip-worn pedometer (HJ) provides the most accurate step count across all speeds and modalities. One should account for type and intensity of activity when considering use of wrist-worn activity monitors.

1353 Board #28 June 1 9:00 AM - 10:30 AM

Fitbit And Actigraph: A Comparison Of Physical Activity And Sedentary Time In Overweight/obese Adults

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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 wore a Fitbit Flex™ on their non-dominant wrist continuously over 6 mos. They were also asked to wear an ActiGraph GTX1™ 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, $p < 0.001$; MPVA: Fitbit= 128 ±49, ActiGraph = 18 ±19 min/d, $p < 0.0001$) or 6 mos. (sedentary time: Fitbit = 459 ±168, ActiGraph = 613 ±103 min/d, $p = 0.001$; MPVA: Fitbit= 123±53, ActiGraph= 14 ±10 min/d, $p < 0.0001$). Change in both sedentary time and MVPA from baseline to 6 mos. was not statistically significant measured either with 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

1354 Board #29 June 1 9:00 AM - 10:30 AM
Sources of Error with Wearable Step Counters

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PURPOSE: To investigate sources of error with 11 wearable step counting devices, during common types of physical activities.

METHODS: 20 participants performed 15 activities for 2 min each, while wearing 11 step counters on the waist, ankle, or non-dominant wrist. Arm activities included: snacking, brushing hair, folding laundry, sweeping, brushing teeth, and meal preparation. Overground activities included: walking holding onto backpack strap, walking with umbrella, walking with hands in pockets, and pushing stroller. Treadmill activities included: walking at 1 mph, walking at 2 mph, walking at 3 mph, walking at 3 mph holding onto bars, and jogging at 6 mph. Wrist-worn devices included: Garmin Vivofit 2, Fitbit Charge, Polar A360, Withings Pulse Ox, and ActiGraph GT3X. Waist-worn devices included: Yamax Digi-Walker SW-200, Fitbit Zip, Omron HJ-322U, and ActiGraph GT3X (without low-frequency extension). Ankle-worn devices included: two StepWatch 3 devices, one with preprogrammed, default settings and one with modified cadence and sensitivity settings. A researcher hand-counted steps during each activity; this served as the criterion. The step counts reported from each device compared to the hand count using a 1-way (1x12) repeated measured ANOVA. If the overall effect for an activity was significant, the outputs from individual devices and the criterion were analyzed using planned contrasts. Devices with significant contrasts ($p \leq 0.05$) and observed power greater than 0.8 were considered to be significantly different than the criterion.

RESULTS: During arm activities, the wrist-worn devices overcounted steps while hip-worn devices slightly undercounted steps. The ActiGraph GT3X on the wrist greatly overcounted steps during arm activities, while other devices had smaller errors. During treadmill walking at 1 mph, all wrist and hip-worn devices undercounted steps. The ankle-worn device (StepWatch 3) had the smallest error across all activities, especially when programmed with the modified setting.

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.

- 1355 Board #30 June 1 9:00 AM - 10:30 AM
Step Count Filters in Wearable Step Counters
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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 various pause 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 completed for both parts. In the case of significant overall effects ($p < 0.05$), the results were further examined using planned contrasts to see which conditions differed from the criterion.

RESULTS: In Parts A and B the multivariate results for ActiGraph GT3X (AG) (without low frequency extension) worn at the wrist, StepWatch 3, and Yamax Digi-Walker SW-200 were not significantly different from the criterion, indicating absence of a step count filter. Walking bouts shorter than 4 steps (AG at the hip), 6 steps (Withings), 8 steps (Omron and Garmin Vivofit 2), and 12 steps (Polar A360), resulted in a significant decrease in the number of steps counted, indicating presence of a filter. The minimum pause needed to break up a walking bout was 1 sec (Fitbit Charge, Fitbit Zip, and Withings), and < 1 sec (Omron HJ-322U). For both the Polar and Garmin, the longer the pause, the less likely they were to record steps.

CONCLUSIONS: Devices with step count filters will contribute to error in daily step counts because steps taken during short, intermittent walking bouts (e.g., meal preparation, and housework) are not registered.

- 1356 Board #31 June 1 9:00 AM - 10:30 AM
The Effect of Wearable Devices and Tailored Engagement on Physical Activity in College Students
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Wearable devices have been used to track physical activity in clinical interventions and within the general population with an attempt to improve physical activity. The success of wearable devices that track physical activity alone is limited. The pairing of wearable devices with tailored engagement has been suggested to enhance compliance and outcomes.

PURPOSE: To measure the effect of activity tracking devices with and without tailored engagement on physical activity in college-aged students measured daily over twelve weeks. **METHODS:** Thirty-five college-aged participants (n = 11 male and n = 24 female) were recruited based upon surveyed stage of change corresponding to contemplation or preparation for physical activity who self-reported obtaining ≤ 60 min of structured physical activity per week. Participants were randomly assigned to 1 of 4 treatment groups: Actigraph GT3X accelerometer without engagement or step count (C) (n = 8), pedometer without engagement (P) (n = 9), pedometer with engagement (PE) (n = 10), or commercially-available iliac crest tracker with engagement (FBE) (n = 8). After enrollment, all groups were instructed to attempt to obtain 10,000 steps per day. Group C served as control and received no step data. Groups P, PE, and FBE reported daily steps through a digital form with all participants reminded to wear the device daily via text message. Engaged groups received additional motivational text messages. The PE and FBE groups were engaged via digitally administered self-directed SMART objectives with feedback each week. **RESULTS:** The average steps per day over twelve weeks for group C (6698 + 2870) was found to be significantly lower than all other groups. There was no significant difference in the average steps per day between group P (7201 + 3037) and group FBE (7653 + 3190). Group PE achieved the highest average steps per day (8103 + 3699) which was significantly higher than C and P, but not significantly greater than

FBE. There was no significant difference when examining group by day of the week interaction. **CONCLUSIONS:** All groups failed to meet the goal of 10,000 steps per day. However, engagement increased steps per day when administered digitally. Over twelve weeks, receiving feedback on the number of steps taken per day increases the average number of steps taken in all groups compared to control.

- 1357 Board #32 June 1 9:00 AM - 10:30 AM
Does Wearable Technology Provide Accurate Heart Rate Measures While Playing Pickleball Doubles?
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The sport of pickleball is increasing in popularity throughout the United States, especially in middle-aged, and older adults. Research investigating the physiological demands of pickleball is limited. The use of wearable technology is also gaining popularity, however, the accuracy of such devices is under question. **PURPOSE:** The purpose of this study was to determine if wearable technology provide valid heart rate (HR) measures during pickleball doubles in middle aged adults. **METHODS:** 8 female, intermediate level pickleball players (IFP = 3.0 ± 0.8 ; age = 47 ± 11 years; mass = 72.5 ± 12.8 kg; height = 1.70 ± 0.08 m) participated in this study. All subjects played pickleball doubles for 30 minutes. HR was measured using two devices (Fitbit HR, worn on the dominant wrists, and Polar HR monitor, worn at the xiphoid process level). Peak and mean HR were determined for each device. A paired sample *t*-tests was used to determine differences in HR between devices for each dependent variable (HR max and HR mean). A Pearson product-moment correlation coefficient was used 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 also nonsignificant ($p > 0.05$). **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.

- 1358 Board #33 June 1 9:00 AM - 10:30 AM
Effect of Wearable Devices With and Without Engagement on Weight and Fitness in College-Aged Students
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 (No relationships reported)

Wearable devices are rapidly growing in popularity as individuals attempt to improve their health behaviors as they become more aware of their physical activity. Even with the adoption of wearable devices, many individuals are not achieving activity guidelines. The pairing of activity monitors with tailored engagement has been suggested to enhance compliance and outcomes. **PURPOSE:** To measure the effect of activity tracking devices with and without tailored engagement on weight and YMCA 3-Minute Step Test score in college-aged students, measured before and after a 12-week intervention.

METHODS: Thirty-four college-aged participants were randomly assigned to 1 of 4 treatment groups: Actigraph GT3X accelerometer without engagement or step count (C) (n = 8), pedometer without engagement (P) (n = 9), pedometer with engagement (PE) (n = 10), or commercially-available iliac crest tracker with engagement (FBE) (n = 7). Participants were in the contemplation or preparation stage of change at recruitment and self-reported obtaining ≤ 60 min of structured physical activity per week. After baseline measurements of weight and cardiorespiratory fitness as evaluated by YMCA 3 minute step test, all groups were instructed to attempt to obtain 10,000 steps per day and how to wear the device properly. Participants were reminded to wear the device daily via text message and reported daily steps through a digital form. **RESULTS:** The overall difference in weight from baseline (171.5 ± 45.2 lbs) to post intervention (172.9 ± 44.5 lbs) was found to be not statistically significant between groups. There was no statistically significant difference regarding cardiorespiratory fitness from baseline 1 minute heart beat count 129.97 ± 14.1 BPM to post-intervention 126.15 ± 16.5 BPM. All groups produced a mean score in the 'poor' category at baseline. Group PE produced a mean score category of 'average' after the intervention.

CONCLUSIONS: The use of wearable devices with or without engagement did not have a statistically significant effect on weight or cardiorespiratory 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

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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 ($F_{(7,67)}=5.681, p<0.001$). Significant predictors were change in SE ($\beta=0.278, p=0.039$), HS ($\beta=0.296, p=0.009$), and age ($\beta=0.247, p=0.018$). **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

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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 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 mean differences. Pairwise comparisons with Bonferroni correction were used in post-hoc analysis. Pearson correlations and mean bias between polar heart rate monitor and activity monitors were also 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; -0.4 ± 6.9; -0.3 ± 7.3 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.

1361 Board #36 June 1 9:00 AM - 10:30 AM

Determining the Validity and Accuracy of Multiple Activity Tracking Devices in Controlled and Free-Walking Conditions

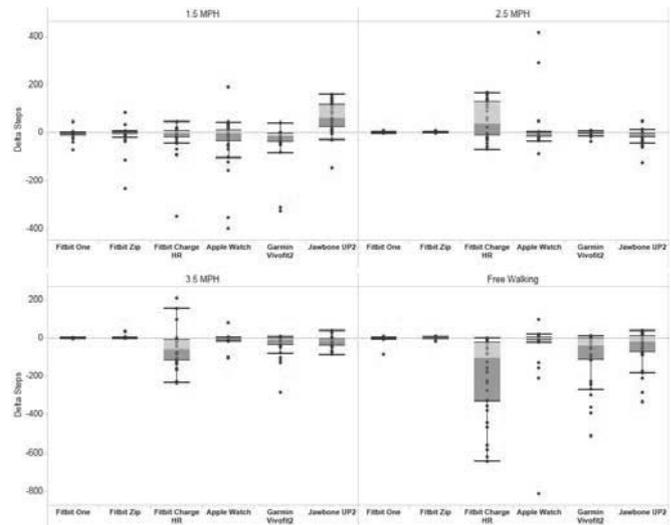
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Purpose: This study aimed to compare commercially-available activity tracking devices worn at both the hip and on the wrist for step and distance accuracy. Current research has investigated activity tracking devices for step and/or distance accuracy, but few studies have done this level of investigation with the depth and breadth of data collection found in this investigation.

Methods: Thirty-two subjects completed five trials: three treadmill, one free-walking, and one stair climbing activity. The treadmill protocols were five minutes in duration at 1.5, 2.5, and 3.5 mph, respectively. Free-walking trials consisted of a one-mile indoor or outdoor (weather-permitting) walk at a self-selected pace. Stair trials took place indoors, with subjects completing two flights of stairs. Researchers counted steps for all trials and compared hand-calculated steps to device-collected steps.

Results: Please refer to the images uploaded for detailed results.

Conclusions: Hip-based activity tracking devices perform better than their wrist-based counterparts when looking at step and distance accuracy.



| | Free Walking (N=32) | 1.5 MPH (N=32) | 2.5 MPH (N=32) | 3.5 MPH (N=32) | Stairs (N=32) |
|------------------|-----------------------------|---------------------------------|----------------------------|-----------------------------|--------------------------|
| Garmin Vivofit2 | -98.06 ± 137.493 (-513, 12) | -37.25 ± 77.726 (-328, 41) | -5.09 ± 8.383 (-38, 7) | -31.66 ± 58.788 (-286, 9) | -4.56 ± 9.069 (-22, 16) |
| Jawbone UP2 | -53.16 ± 90.928 (-332, 39) | 64 ± 66.315 (-149, 160) | -16.19 ± 29.141 (-126, 48) | -21.34 ± 27.103 (-85, 38) | -2.19 ± 19.785 (-54, 62) |
| Fitbit Charge HR | -195.06 ± 207.937 (-645, 1) | -21.81 ± 67.076 (-350, 45) | 51.84 ± 78.845 (-71, 167) | -56.28 ± 96.291 (-235, 211) | -3.66 ± 11.932 (-26, 45) |
| Apple Watch | -39.44 ± 151.813 (-815, 99) | -32.69 ± 107.731 (-401, 188.99) | 12.69 ± 93.14 (-90, 417) | -7.56 ± 29.609 (-105, 81) | -4.03 ± 17.73 (-66, 20) |
| Fitbit One | -2.53 ± 15.498 (-85, 11) | -5.44 ± 17.225 (-73, 44) | 0.03 ± 2.403 (-4, 9) | -0.13 ± 1.809 (-4, 2) | -2.09 ± 3.701 (-15, 2) |
| Fitbit Zip | 1.09 ± 5.044 (-19, 10) | -11.25 ± 49.822 (-236, 84) | 0.88 ± 2.268 (-2, 9) | 2.13 ± 6.399 (-2, 36) | -1.97 ± 4.068 (-15, 2) |

Mean difference for each Device by Condition

THURSDAY, JUNE 1, 2017

1362 Board #37 June 1 9:00 AM - 10:30 AM

Test-Retest Reliability of Smartphone Apps While Walking on a Treadmill

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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 count 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±4.3yrs; BMI 24.7±3.8kg/m²; 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 ($r=0.42$, $p < 0.01$; $r=0.507$, $p < 0.01$; $r=0.862$, $p < 0.01$; 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%; -8.02 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.

1363 Board #38 June 1 9:00 AM - 10:30 AM

<Validity of Wrist-worn Physical Activity Monitors to Measure Heart Rate>

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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. Repeated measures ANOVA [Speed x Device] were also 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 ($r=0.693$, $p=0.012$ and $r=0.592$, $p=0.043$). At 4 mph and 6 mph TT was significantly correlated with ECG ($r=0.911$, $p < 0.001$ and $r=0.853$, $p < 0.001$). Significant correlations were calculated between FB and ECG at 4 mph ($r=0.691$, $p=0.013$), 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 overestimate HR during slower walking speeds.

1364 Board #39 June 1 9:00 AM - 10:30 AM

Effect of Smartphone Carrying Location on Accuracy of Popular Pedometer Apps

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(No relationships reported)

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±4.2yrs; 24.8±4.1kg/m²; 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 significant 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's showed significant differences between apps and the step counter for all apps ($p < 0.05$ for all). Using pairwise 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: Moves, pocket (mean bias ± SD; 20.0 steps ± 107.8 steps); G-Fit, arm (40.8 ± 109.8); Runtastic, pocket (7.9 ± 36.4); Accupedo, arm (-9.3 ± 71.6); S-Health, pocket (-2.1 ± 17.3). **CONCLUSION:** Using smartphone apps to measure steps at a normal walking pace while carrying the phone in the hand or on the waist may produce significant error, while the pocket seems to be the best location with the arm as another potentially accurate position.

1365 Board #40 June 1 9:00 AM - 10:30 AM

Wristband Physical Activity Monitors Over-Report "Steps" Accumulated During Activities of Daily Living.

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(No relationships reported)

Physical activity (PA) guidelines recommend accumulating 10,000 steps/day through 30 minutes of aerobic exercise (~3,500 steps) and maintaining a physically activity 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 equal validated 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 to achieve 10,000 steps. Remaining steps were accumulated by walking on 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 (4016±138 vs. 4306±86 steps; $P < 0.01$) and treadmill walking (5211±126 vs. 5699±86 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

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.

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 Jesunathadas, Scott G. Piland, Trenton E. Gould. *University of Southern Mississippi, Hattiesburg, MS.*
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(No relationships reported)

Equipping athletes with properly fitted helmets is purported to ensure devices are performing to manufacturer's product claims. Traditional methods of verifying product safety claims are based on linear acceleration measures. A more recent measure, the Summation of Tests for the Analysis of Risk (STAR) rating system, also incorporates linear acceleration weighted at each location by on-field season exposure. However, little research is available linking the influence proper fit may have on the helmet's ability to mitigate impact energy. **PURPOSE:** To investigate whether helmet fit, adjusted by jaw pad thickness, affects an American football helmet's ability to mitigate linear acceleration measures (peak g, STAR). **METHODS:** The fit of nine, new, size large, widely used make and model helmets (3 STAR rated), was manipulated using 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 STAR 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 triaxial accelerometer mounted in the center of gravity of the headform (sampling 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 peak g accelerations ($\alpha = 0.05$). **RESULTS:** Statistical differences in resultant linear peak g by location ($F_{3,45} = 43.2, p < 0.01, f = 3.34$), drop height ($F_{1,76.60} = 2720.85, p < 0.01, f = 19.5$), and location*height ($F_{3,9.51} = 27.97, p < 0.01, f = 2.31$) were found. There were no statistical differences for thicknesses (Means \pm SD, S = 75.15 \pm 23.22, M = 76.75 \pm 22.58, L = 78.39 \pm 23.51g, $p = 0.068$), height*thickness ($p = 0.058$), or location*thickness ($p = .124$). STAR 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 set-up resulted in a reduction of the advertised STAR rating, from 3 to 2 STARS (Good, Adequate respectively).

**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 Sawada¹, Yu Okubo¹, Kiyokazu Akasaka¹. ¹Saitama Medical University, Saitama, Japan. ²Saitama Medical Center Saitama Medical University, Saitama, Japan.
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(No relationships reported)

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 \pm 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: m/s²) from the 5th to 9th throw (early phase) were 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 \pm 172.1 and 647.5 \pm 198.2, respectively. Ave-VA without a brace was 842.0 \pm 246.7 and 816.5 \pm 195.5, respectively. These differences were significant ($p < 0.05$). Ball speed with a brace was 63.5 \pm 5.3 and

63.9 \pm 5.0, while ball speed without a brace was 65.2 \pm 4.1 and 65.5 \pm 5.0, respectively which was not significantly different. Strike accuracy with a brace was 47.0 \pm 27.7 and 64.0 \pm 20.1 while with a brace was 52.0 \pm 20.9 and 50.0 \pm 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).

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

Marika A. Walker, Kathy J. Simpson, FACSM, Julia C. Dolgetta, Jeremy R. Raiford, Christine O. Samson. *University of Georgia, Athens, GA.*
(No relationships reported)

Football rib protectors could prevent and reduce the severity of injuries, such as fractured ribs, splenic lacerations or kidney injuries. However, athletes often do not wear them, possibly due to perceptions that the equipment hinders performance. It is unclear if quarterbacks' perceptions of rib protectors are consistent with actual performance, dependent on the protector's hardness and different after having worn them while throwing. **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 \pm 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 their 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 \pm 2.83 cm) compared to NO RIB (24.68 \pm 4.59) was greater; SOFT RIB throw error (26.86 \pm 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 \pm 13.9%) was less than SOFT RIB (87.25 \pm 13.06%) and NO RIB (93.39 \pm 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.

1369 Board #44 June 1 8:00 AM - 9:30 AM

Kinematic Predictors of Ball Velocity and Elbow Varus Torque in Adolescent Baseball Pitchers

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(No relationships reported)

Ulnar collateral ligament injuries in baseball pitchers may be the result of high-magnitude torques generated during the pitching motion. Maximizing ball velocity while simultaneously avoiding excessive elbow torque may improve performance and decrease injury risk in baseball pitchers. The identification of kinematic variables that predict ball velocity and peak elbow varus torque may assist in developing efficient pitching mechanics. **PURPOSE:** To identify the kinematic factors during a baseball pitch associated with ball velocity and peak elbow varus torque in adolescent male baseball pitchers. **METHODS:** Twenty male baseball pitchers (15.3 \pm 1.3 years; 78.9 \pm 21.1 kg; 177.0 \pm 21.1 cm) pitched three fastballs from the windup while undergoing three-dimensional motion analysis with a ten camera motion capture system, collected at 480 Hz. Ball velocity was simultaneously captured using a radar gun. Elbow varus torques were normalized to body weight and height. Six kinematic pitch variables were analyzed: trunk forward lean range of motion (ROM) between maximum stride leg knee height and stride foot contact (stride phase), trunk forward lean ROM between stride foot contact and maximum glenohumeral external rotation (GHER) (cocking phase), stride leg sagittal knee angle at stride foot contact, trunk rotation at stride foot contact, stride length, and contralateral trunk lean at GHER. A multivariate linear

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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 ($\beta=0.22$, 95% CI [0.02, 0.43], $p=0.04$) and stride length ($\beta=0.30$, 95% CI [0.09, 0.50], $p=0.005$). Significant predictors of peak elbow varus torque included trunk rotation at stride foot contact ($\beta=-0.01$, 95% CI [-0.02, -0.01], $p<0.001$) and stride length ($\beta=0.05$, 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.

1370 Board #45 June 1 8:00 AM - 9:30 AM

Electromyographic Analysis Of The Elbow And Forearm In The Overhead Football Throw

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(No relationships reported)

Purpose: This study was to describe the muscle activation patterns of the elbow and forearm during the overhead football throw. The hypothesis was that the unique grip and obligatory pronation upon ball release will cause the elbow and forearm muscles to have a unique activation pattern during the overhead football throw. **Methods:** IRB approval was obtained. Electromyographic (EMG) and motion capture data was collected on 8 male quarterbacks. An EMG data was collected at 1200 Hz with 9 surface electrodes. The signals were normalized to maximal voluntary contraction (MVC) values for each subject. EMG sensors were placed on the biceps, triceps, brachialis, brachioradialis, anconeus, extensor digitorum communis, flexor digitorum superficialis, pronator teres, and pronator quadratus. A 13 camera Vicon motion capture system measuring at 240 Hz with a full body marker set of 39 retro-reflective 9mm markers was used. The throwing motion was divided into four events: early cocking, late cocking, acceleration, and follow through. **Results:** All athletes had NCAA experience and were aged 18-30 years old. The anconeus (26.9%, 36.3%, 57.6%, and 105.8% MVCs), extensor digitorum communis (22.7%, 28.0%, 31.0%, and 42.8% MVCs), and flexor digitorum superficialis (19.4%, 39.3%, 22.3%, and 104.7% MVCs) had high levels of activity throughout all phases of the football throw. The brachioradialis (56.8%MVC) and anconeus (57.6%MVC) were the most active muscles during the acceleration phase. The pronator teres (78.4%MVC), pronator quadratus (90.9%MVC), and flexor digitorum superficialis (104.7% MVCs) have very high levels of activation during the follow through phase. **Conclusion:** High levels of activity of the anconeus suggest that it functions as a dynamic stabilizer during all phases of the throwing motion. High levels of activity of the extensor digitorum communis and flexor digitorum superficialis suggest that they are important for grip. The pronator teres and pronator quadratus are important at ball release to produce a spiral motion of the football. High activity of the medial sided musculature may impart dynamic stability to the elbow. These findings may explain why quarterbacks have a lower rate of UCL injury and a higher return to play without surgery.

1371 Board #46 June 1 8:00 AM - 9:30 AM

Changes In Functional Movement Patterns And Injuries For In-season Division III Women.

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(No relationships reported)

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 the competitive season with or without corrective intervention.

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 3-site % body fat (%BF) skinfold analysis were performed 1-wk prior to in-season, twice in-season, and 1-wk post season. After pre-season FMS, teams were split into matched pairs and allocated to either a corrective exercise (CE) or sham (SH) exercise group. CE groups were prescribed exercises to improve specific FMS issues after the first in-season re-test. Repeated measures ANOVA with post-hoc Tukey were run comparing differences within and between sports at each time period. Pearson correlations were run to examine the relationships between the FMS and %BF. All data were expressed as mean + se, and all significance levels were set at $\alpha=0.05$.

RESULTS: Pre-season FMS showed that S players scored significantly higher (Tukey $p < 0.05$) in Squat (Sq) 1.7 + 0.2 vs 1.2 + 0.2, Hurdle (Hd) 1.8 + 0.2 vs 1.1 + 0.18,

and leg raise (ASLR) 2.59 + 0.14 vs 1.8 + 0.16 scores, but lower in Lunge (Ln) 1.4 + 0.2 vs 2.1 + 0.2 and Push-up (PU) 1.3 + 0.1 vs 1.9 + 0.2. Total scores (S 12.9 + 0.6 vs V 12.3 + 0.6) did not differ. After 4-wk, S improved ($p < 0.05$) Ln 2.4 + 0.2, PU 2.2 + 0.1, and Total scores 15.5 + 0.5, while V scores failed to improve. %BF appears to negatively impact FMS scores ($r = -0.36$, $p=0.0447$). Injury rates were not available, but S reported engaging in a structured strength training program.

CONCLUSION: There appears to be significant disparities in FMS scores among D3 women. Initial in-season 4-wk improvement was only seen in S players with all scores trending higher. A plausible conclusion is that the structured strength training program by S, compared to no training for V, accounted for these differences. The negative relationship between %BF and lower FMS scores supports prior research that increased BF limits movement quality and increases risk for injury.

1372 Board #47 June 1 8:00 AM - 9:30 AM

Kinematics of the Handball Power Serve

Andrew Anderson, Adam Coronado, Tim R. Anderson, Mark Baldis, Jacobo Morales. CSUFresno, Fresno, CA.

(No relationships reported)

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 $\text{rad}\cdot\text{s}^{-1}$ in individual players; grand mean = 8.13 $\text{rad}\cdot\text{s}^{-1}$. SAV ranged from 10.5 to 18.4 $\text{rad}\cdot\text{s}^{-1}$ in individual players; grand mean = 13.98 $\text{rad}\cdot\text{s}^{-1}$. RVB ranged from 25.5 to 36.7 $\text{m}\cdot\text{s}^{-1}$ in individual players; grand mean = 29.4 $\text{m}\cdot\text{s}^{-1}$. 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 ($r=.205$; $p<0.05$) than was HAV ($r=.139$; $p>0.05$). 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.

1373 Board #48 June 1 8:00 AM - 9:30 AM

Agility K-test In Adolescent Soccer Players As Function Of Age

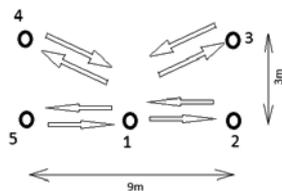
Lee Cabell¹, Frantisek Zahalka², Tomas Maly², Lucia Mala². ¹Seton Hall University, South Orange, NJ. ²Charles University, Prague, Czech Republic.

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(No relationships reported)

Performance relative to age differences in a new Agility K-test (Cabell, 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 = 19 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 pair-wise comparison Mann-Whitney U test as a post-hoc test. $P < .05$. **RESULTS:** The subjects achieved a time of $n_1 = 11.14 \pm 0.26$ s, $n_2 = 12.96 \pm 0.69$ s, $n_3 = 10.87 \pm 0.32$ s in the Agility K-test. There was an increase in agility time from 16 to 17 years of age (16.44%), and a decrease in agility time from 17 to 19 years of age (19.22%). 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, $Z = -5.16$, $p < .001$; 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.



1374 Board #49 June 1 8:00 AM - 9:30 AM
Dynamic Trunk Stability During A Step-down Task In Baseball Players
 Adam J. Barrack¹, Yunae Lee¹, Hillary A. Plummer¹, Bernard Li², Lori A. Michener¹. ¹University of Southern California, Los Angeles, CA. ²Los Angeles Angels of Anaheim, Anaheim, CA. (Sponsor: Gretchen Oliver, FACSM)
 (No relationships reported)

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 ± 9.9kg; 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).

| Trunk Stability | Ankle Dorsiflexion | Knee Flexion | Hip Flexion | Knee Valgus | Pelvic Drop |
|-----------------|--------------------|--------------|---------------|-------------|-------------|
| Good | 45.6 (3.8) | 100.5 (4.5)* | 119.9 (15.1)* | 7.4 (8.6) | 7.1 (3.4) |
| Poor | 46.9 (3.2) | 98.2 (4.8)* | 112.2 (13.5)* | 9.5 (8.0) | 6.9 (3.0) |

1375 Board #50 June 1 8:00 AM - 9:30 AM
Self-reported Measures Of Fatigue during Golf Performance
 McKenna Benson, Michael Decker, Casey Myers, Craig Simons, Kevin Shelburne, Bradley Davidson. University of Denver, Denver, CO.
 (No relationships reported)

PURPOSE: To determine the influence of directional compression core shorts on self-reported measures of pain and fatigue and maximum driving distance during repeated, maximum-effort golf drives. **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 (TotF) 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=.019), QF (p=.046) and TotF (p=.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 TotF (none, 14.9 ± 12.0%; DCP, 6.4 ± 8.7%). Maximum carry distance was not different between conditions for the 6 iron (p=.777; none, 268.6 ± 14.6 yards; DCP, 268.0 ± 17.1 yards) or driver (p=.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.

1376 Board #51 June 1 8:00 AM - 9:30 AM
Kinematic Differences Shooting Motion in Professional Lacrosse Players: Key Anatomical Sites for High Stress Risk
 Heather K. Vincent, FACSM, Trevor Leavitt, Joseph Wasser, Cong Chen. University of Florida, Gainesville, FL.
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 (No relationships reported)

PURPOSE: Lacrosse offensive players emphasize ball speed during shooting to maximize the chance for scoring. Attackmen shoot from near the goal whereas the midfielders tend to shoot from farther away from the goal. It is unclear, however, whether specific features of high-speed shooting motion of these two positions differ and place certain anatomical sites at higher risk for high tissue stresses and injury. The purpose of this study was to compare kinematics of shooting motion in men's professional midfielders and attackmen. **METHODS:** Fifteen male players (5 midfielder, 10 attackmen) from a professional team participated in this experimental study. Three dimensional motion capture system was used to collect overhead shooting motion in sagittal, frontal and transverse planes. The shot cycle was defined as the time from lead foot contact (0% of throw) to the ball release (100% of throw). Pelvis, torso, shoulder and crosse angular velocities were determined. Joint and trunk angles at FC and BR were calculated. The range of motion (ROM) during the throw cycle of the different joint and segment motions were found. The 'X-Factor', was calculated as the angle of shoulder-to-pelvis crossover. **RESULTS:** Ball speed was higher in the midfielders than attack (149.7 km/h versus 134.2 km/h; p=0.021). Maximal torso and shoulder angular velocities were greater in the midfielders than attack by 17.3%-31.8% (p<0.05). The timing of maximal angular velocity tended to be later in midfielders (maximal velocity occurred at 76% versus 60% in attackmen; =p=0.058). Pelvic anterior tilt in the sagittal plane during the shot cycle was greater in the midfielders than attackmen (p<0.05). Attackmen demonstrated less shoulder-to-pelvis crossover at follow-through than midfielders in the transverse plane (40.0 6.4 vs 58.1 14.0; p=0.004). **CONCLUSION:** Positional differences exist in shooting motion between offensive players. Midfielders shoot to generate relatively higher rotational velocities of the upper body and anterior pelvic tilt than attackmen in order to achieve the ball speed needed to score from a farther distance. The high-speed rotation and tilt differentials about the spine in midfielders may place high stress and risk for injury in the tissues surrounding the low back.

1377 Board #52 June 1 8:00 AM - 9:30 AM
Axiomatic Movement And Dynamic Balance Disparities Between Varying Competition Levels In Golfers
 Garrett S. Bullock¹, Christopher R. Harnish², Amy M. Knab³, Sean Krysak³, Ariel Blount³. ¹Duke University, Durham, NC. ²Ferrum College, Ferrum, VA. ³Queens University of Charlotte, Charlotte, NC.
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 (No relationships reported)

Deficiencies in fundamental movement patterns and dynamic balance have been shown to increase injury risk, and that movement testing is proportional to competitive skill level. Golf has a high prevalence of injuries, but little research on the relationship between movement patterns and injuries exists. **Purpose:** To examine differences in axiomatic movement patterns and dynamic stability in different competition levels in golfers. **Methods:** 72 golfers were recruited across several regional middle and high schools (SCHOL; n=40), and division I, II, and III colleges (COL; n=32). Each group performed the seven-test functional movement screen (FMS), and the upper (UQ) and lower quarter Y-balance tests (YBT-LQ). Limb lengths were normalized to percent limb length (%LL). Statistical analyses were run using students T-tests comparing test results with competition level (p<.05).

Abstracts were prepared by the authors and printed as submitted.

THURSDAY, JUNE 1, 2017

Results: COL golfers exhibited greater UQ (medial: 95.2 vs. 86.6 %LL, $p < .0001$; inferolateral: 94.8 vs. 88.6 %LL, $p = .0007$; superolateral: 72.1 vs. 64.5 %LL, $p < .001$); and LQ (anterior: 77.0 vs. 68.6 %LL, $p < .001$; posteromedial: 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 ; $p = .0163$), hurdle step (COL: 1.88 ± 0.09 , SCHOL: 1.59 ± 0.10 ; $p = .0167$) and active straight leg raise (COL: 2.38 ± 0.10 , SCHOL: 2.07 ± 0.11 ; $p = .0207$), and a greater composite score (COL: 13.7 ± 0.54 ; SCHOL: 12.44 ± 0.52 ; $p = .0293$) compared to SCHOL.

Conclusions: COL level golfers had better proficiency in UQ 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.

1378 Board #53 June 1 8:00 AM - 9:30 AM

Are Indian Cricket Fast Bowlers At Risk Of Injury? - A 3d Biomechanical Investigation

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(No relationships reported)

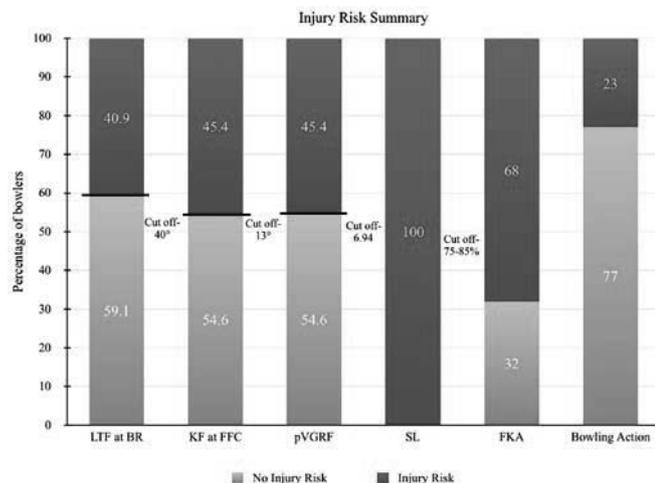
Cricket is the most commonly played and followed sport in India. Modern day Cricket demands a high level of performance from the fast bowler who obviously carries the highest risk for injury. 3D motion analysis could be used to prevent injuries by identifying incorrect techniques. Researchers have identified certain key biomechanical variables as predictors of injury in fast bowlers apart from other factors like bowling workload and on-field injuries. Very little such information is available with respect to Indian Cricket fast bowlers despite the huge popularity of the sport here.

PURPOSE: To identify injury risks in Indian fast bowlers with respect to key biomechanical variables, using 3D motion analysis.

METHODS: 22 male fast bowlers from state & division level Cricket teams between ages 18-30 years underwent 3D motion analysis in a Cricket Biomechanics testing facility. The bowling action was captured with a set of 3D cameras (250fps) and 2D video cameras (125fps). Key biomechanical variables including Delivery Stride Length (SL), Lateral Trunk Flexion at Ball Release (LTF at BR) and Knee Flexion at Front Foot Contact (KF at FFC) were measured. Peak Vertical Ground Reaction Forces (pVGRF) were recorded simultaneously using Force Plates. Data processing & analysis was done with proprietary software using a standard model. Descriptive statistical analysis of results was done.

RESULTS: A large proportion of the study population were at risk of injuries (100% had less than optimum SL, 41% had high LTF at BR, 45% had high pVGRF and 45% had lower KF at FFC). Bowling Action Type was found ideal or acceptable in 77%.

CONCLUSION: Indian Fast Bowlers, in spite of possessing ideal to acceptable bowling action types, are vulnerable to injury with respect to key biomechanical variables.



C-33 Free Communication/Poster - Biomechanics of Cycling

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

Room: Hall F

1379 Board #54 June 1 9:00 AM - 10:30 AM

Front Suspension Does Not Increase Mechanical or Metabolic Power Requirements during Uphill Bicycling

Todd M. Carver¹, Asher H. Straw², Jesse H. Frank², Tyler S. Kraus³, Wouter Hoogkamer². ¹Specialized Bicycle Components Inc., Boulder, CO. ²University of Colorado Boulder, Boulder, CO. ³Specialized Bicycle Components Inc., Morgan Hill, CA. (Sponsor: William Byrnes, FACSM)

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) = $k \Delta L^2 2f$, where, f = cadence in rev/s. We averaged $\dot{V}O_2$, and $\dot{V}CO_2$ 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 ± 0.56 W/kg rigid vs. 13.21 ± 0.57 W/kg compliant ($p = 0.23$). For standing, metabolic power was 14.23 ± 0.76 W/kg and 14.15 ± 0.84 W/kg respectively ($p = 0.45$). Power losses in the suspension while sitting 0.01 ± 0.004 W/kg, and standing 0.03 ± 0.01 W/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.

1380 Board #55 June 1 9:00 AM - 10:30 AM

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

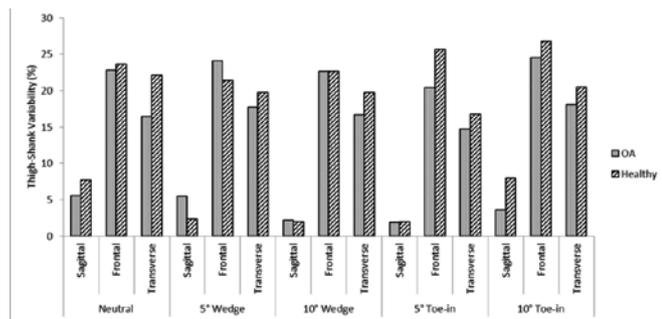
Jacob K. Gardner¹, Kristyne Wiegand², Julia Freedman Silvernail². ¹Biola University, La Mirada, CA. ²University of Nevada, Las Vegas, NV.

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(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 2 minutes at 60 rpm and 80 Watts in 5 testing conditions: neutral, 5° and 10° of toe-in foot progression angle, and 5° and 10° of eversion angle. Five consecutive crank cycles in each condition was recorded. A custom vector coding program was used to calculate thigh-shank coupling variability during two phases: 0-50% 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.

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.



1381 Board #56 June 1 9:00 AM - 10:30 AM

Are Frontal Plane Knee, Hip And Trunk Kinematics Associated With Cycling Power In Trained Cyclists?

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(No relationships reported)

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 maximal-effort sprint at 90-110rpm (4). During these bouts, knee, hip, and trunk 3D kinematics were collected using a motion capture system (240Hz, Qualisys, Sweden). Average and peak pedal power (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 ($p \leq 0.05$). **RESULTS:** Seated average and peak powers were 701±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 ($r = 0.53, p = 0.028$). No other frontal plane kinematic variables were significantly correlated with peak or average power during seated (range $r = 0.029$ 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.

1382 Board #57 June 1 9:00 AM - 10:30 AM

Fatigue Induced Changes of the EMG Profile of Select Lower Extremity Muscles in Competitive Cyclists

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(No relationships reported)

PURPOSE: To determine the effect of fatigue on the median frequency (MF) and amplitude (AMP) of select lower extremity muscles in competitive cyclists. **METHODS:** Five category 4 or above cyclists (29.6 yrs ± 16.0) were recruited for this pilot study. Data collection consisted of 2 sessions. At session one, the subject's maximum work load (MWL) was determined during an incremental cycling test. At session two, EMG activity of the rectus femoris (RF), vastus medialis (VM) and lateralis (VL), semitendinosus (ST), biceps femoris (BF), gastrocnemius (GS), tibialis anterior (TA) and gluteus maximus (GM) were recorded bilaterally at 2400 Hz using surface electrodes during a fatigue protocol. The fatigue protocol consisted of a 4-minute warm-up at 55% of their MWL followed by 5, alternating efforts at

90% and 55% of their MWL for 1 and 2-minutes respectively. This was followed by a continuous cycling effort at 90% of their MWL until fatigue (pedaling rate < 80 RPM). For each muscle, the EMG data were band pass filtered and the MF was determined using a time-frequency analysis based on power spectra estimation (short-time Fourier transform). The average MF and average peak AMP was calculated for each trial. The average change in MF and average peak AMP from the 1st trial to the fatigue trial for each muscle were calculated. **RESULTS:** The average MF for the RF, VM, VL, ST, BF, and TA increased by 3.0, 3.4, 5.8, 4.2, 1.2, and 0.6 %, respectively from trial 1 to the fatigue trial while the MF for the GM and GS decreased by 7.3 and 5.8%, respectively. The average peak AMP for the RF, VM, VL, ST, BF, and GM increased by 44.9, 27.5, 23.4, 18.6, 38.3, and 51.6%, respectively while the average peak AMP for the TA and GS decreased by 2.0 and 6.3%, respectively. **CONCLUSION:** According to Luttmann et al's (1996) joint analysis of EMG spectrum and amplitude theory, the quadriceps (RF, VM, VL) and hamstring (BF, ST) muscles demonstrated an increase in force production, while the GS and TA exhibited a decrease force production during fatigue. Only the GM exhibited a classical fatigue pattern of activity (decrease MF, increase AMP). These results suggest that in the current testing paradigm both central and peripheral fatigue may be contributing to the inability to maintain pedaling rate. Funding was provided in part by the 2016 NEACSM Undergraduate Research Experience Grant.

1383 Board #58 June 1 9:00 AM - 10:30 AM

Measuring Mechanical and Metabolic Power during Uphill Treadmill Cycling

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Reported Relationships: A.H. Straw: Contracted Research - Including Principle Investigator; Specialized Bicycle Components Inc.

Stationary cycle ergometers are useful, but they do not accurately mimic riding uphill, nor the balance or lateral rocking movements involved in overground bicycling. It is possible to study overground bicycling, however, variations in wind (air resistance), velocity, incline, and road surface (rolling resistance) can be confounding. Bicycling on an inclined treadmill may offer a realistic and controlled simulation of overground conditions, albeit without air resistance. **Purpose:** To compare and verify mechanical and metabolic power measurements during uphill treadmill bicycling in both sitting and standing positions.

Methods: 11 males (74.93 ± 2.16 kg) rode six 5-min trials of uphill (4.0°/7.0%) bicycling on a large motorized treadmill (3.2m x 0.9m), in both sitting and standing positions at a velocity of 3.35 m/s (7.5MPH). Subjects used their preferred gear ratio/cadence combination. All subjects wore a helmet and metabolic mouthpiece (1.05kg combined) and rode the same rigid-framed road bicycle (9.02kg) equipped with a crank-based power meter and a pedal-based power meter. We calculated gravitational power from $m \cdot g \cdot v \cdot \sin(\text{incline angle})$ where m = mass of rider + bicycle in kg, g = 9.81m/s², v = treadmill velocity in m/s. We empirically measured rolling resistance power, summed the gravitational and rolling resistance powers and assumed 2% transmission loss. We averaged $\dot{V}O_2$, and $\dot{V}CO_2$ for the last 2 minutes of each trial and calculated metabolic power. **Results:** Calculated mechanical power output was 2.85±0.03 W/kg body mass for sitting trials, which was not different from the crank-based (2.85±0.05 W/kg) or pedal-based (2.83±0.06 W/kg) values ($p = 0.72$). Metabolic power was 13.11±0.57 W/kg for sitting and 14.23±0.77 W/kg for standing, i.e. standing was 8.27% more expensive ($p < 0.001$).

Conclusion: Calculation-based, crank-based and pedal-based methods of measuring mechanical power output give very similar results. Treadmill cycling appears to be a valid method for studying rider and bicycle performance. Independent of air resistance, standing up while cycling uphill is substantially more metabolically costly than the sitting position.

Supported by a gift from Specialized Bicycle Components Inc.

THURSDAY, JUNE 1, 2017

1384 Board #59 June 1 9:00 AM - 10:30 AM
Kinematic Measures Of The Knee While Cycling: A Comparison Of Vicon And Retül 3d Motion Analysis Systems
 Sinéad A. FitzGibbon¹, Bill Vicenzino², Mitchell J. Rauh³, Jeanne F. Nichols⁴, Sue Ann Sisto⁵. ¹Rocky Mountain University of Health Professions, Provo., Provo, UT. ²University of Queensland, Brisbane, Australia. ³San Diego State University, San Diego, CA. ⁴University of California San Diego, San Diego, CA. ⁵Stony Brook University, Stony Brook, NY.
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 (No relationships reported)

Factors contributing to knee pain in cyclists include deviations from optimal pedaling patterns and poor bike fit. Accurate measurement of kinematics is essential to obtain optimal positioning, but motion analysis equipment cost is an obstacle for many clinicians.

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 eleven 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 Velotron cycle ergometer.

RESULTS: MANOVA demonstrated no significant difference between systems for knee range of motion (ROM) (mean difference (MD)=0.12°, p=0.96), knee extension (MD=0.12°, p=0.10), knee frontal plane knee angles (MD=2.7°, p=0.15), ankle dorsiflexion (DF) (MD=-1.45°, p=0.46) and plantarflexion (PF) (MD=4.51°). However, knee flexion (MD=1.42°, p=0.02), hip flexion (MD=32.83°, p<0.001), hip ROM (MD=3.8°, p<0.001), ankle ROM (MD=3.7°, 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_(2,5)=0.52, p<0.001). Linear regression of difference scores on mean scores demonstrate 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

1

1385 Board #60 June 1 9:00 AM - 10:30 AM
Effect Of Cadence And Gender On Pedaling Technique of Youth Cyclists At Constant Power Output
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 (No relationships reported)

Changing pedal cadence would affect resultant forces (RF), effective force (EF), index of effectiveness (IE), we could observe these with the biomechanics measurement. Which could supply evidence from research to coaches to improve youth cyclists performance. **Purpose:** This study aimed to compare the effects of gender and cadence in pedaling cadence (65 and 115 RPM) on RF, EF, and IE during power and recovery phase. **Methods:** A total of 16 youth cyclists (8 males, 15.0 ± 0.8 years, 8 females, 15.1 ± 1.0 years) were divided into two groups based on gender. Left pedal forces and lower limb kinematics of participants were measured at 250 W power output, for two pedaling cadences (65 and 115 RPM). The integral RF, EF and IE during power and recovery phase (IE_{pow} and IE_{rec}) were calculated. A two-way MANOVA with repeated measures was conducted to determine the effect of intervention to measure of integral RF, EF, IE, IE_{pow} and IE_{rec}. Group (male versus female group) was used as the between subject factor, and cadences (65 and 115 RPM) as a within-subjects. All data were analyzed using SPSS 20.0. **Results:** There was a significance between two cadence on integral IE_{rec} (-30±7% and -54±8%, p<0.05), but we did not observed this phenomenon on IE_{pow} (79±7% and 77±10%). Female youth cyclists' integral IE_{rec} was higher than male for all cadences (-19±7% vs. -40±12% and -39±17% vs. -60±17%, p<0.05). For RPM65 there was no significance between female and male youth cyclists on integral IE_{pow} (79±5% and 78±4%). There was a significance between female and male youth cyclists on integral IE_{pow} (81±6% and 73±8%, p<0.05) for RPM115. However, the male youth cyclists' RF and EF was higher female's during power phase (p<0.05). **Conclusion:** The results suggest that cycling at lower cadences were more effective during the recovery phase for both male and female youth cyclists. The coaches should pay attention to youth cyclists' pedaling technique especially during recovery phase in order to improve cycling efficiency.

1386 Board #61 June 1 9:00 AM - 10:30 AM
Age Effects on Sagittal Plane Joint Powers during Submaximal Cycling
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 (No relationships reported)

During walking, older adults generate more power about the hip and less power about the ankle compared to young adults. Cycling is another cyclic task and a popular mode of exercise. No research has examined whether older compared to young adults demonstrate a similar lower extremity motor pattern characterized by distal-to-proximal redistribution of effort during cycling. **PURPOSE:** To investigate the effects of age on lower limb motor patterns during submaximal cycling. **METHODS:** Thirteen young (22.9±3.4 years) and 13 older (69.7±4.5 years) male recreational cyclists completed a 6-minute pedaling trial at 125W and 90 rpm on a Lode bicycle ergometer. Reflective markers (n=21) were attached to the left pedal and on the subject's pelvis and left lower limb. Marker positions and pedal reaction forces were sampled synchronously at 100 Hz and 2000 Hz, respectively. A three-segment sagittal plane inverse dynamics model was used to compute net joint forces, moments, and powers. Lower limb motor patterns were characterized by examining the distribution of total absolute lower limb power about ankle, knee, and hip. Independent t-tests were used to examine the effects of age on total and average absolute joint powers. **RESULTS:** Absolute total and average joint powers were not significantly different between young and older participants (Table 1). The net ankle, knee, and hip joint power profiles were similar for older and young participants showing a higher reliance on knee and hip power and lower reliance on ankle power when pedaling. These results can be explained by the high level of control in our experimental design. To examine age effects on lower limb motor patterns, we controlled external power output, cadence, posture, and cycling experience in our study. Many of these factors have been shown to affect lower limb kinetic and kinematic variables. **CONCLUSION:** Older and younger adults employ similar patterns of distributed effort in the lower extremity during submaximal cycling.

| | Total power (W) | Ankle power (W) | Knee power (W) | Hip power (W) |
|-------|-----------------|-----------------|----------------|---------------|
| Older | 107.8±16.1 | 14.0±3.6 | 56.0±7.6 | 37.8±9.9 |
| Young | 111.8±15.2 | 15.1±5.4 | 51.6±8.0 | 45.1±9.1 |

C-34 Free Communication/Poster - Biomechanics of Jumping, Landing, and Cutting

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

1387 Board #62 June 1 8:00 AM - 9:30 AM
A Comparison of Different Methods for Assessing Plyometric Ability During Jumps
 Brandon W. Snyder¹, Gavin L. Moir¹, Chris Connaboy², Hugh S. Lamont³, Shala E. Davis, FACSM¹. ¹East Stroudsburg University, East Stroudsburg, PA. ²University of Pittsburgh, Pittsburgh, PA. ³Coastal Carolina University, Conway, SC.
 (Sponsor: Shala Davis, FACSM)
 (No relationships reported)

ABSTRACT

Purpose: To compare different methods for assessing plyometric ability during countermovement (CMJ) and drop jumps (DJ) from different heights. **Methods:** Twelve resistance-trained men (age: 21.8 ± 1.7 years; height: 1.81 ± 0.06 m; mass: 85.1 ± 8.6 kg) performed CMJ and DJ from heights of 0.40 m, 0.60 m, and 0.80 m. Force plates recorded the ground reaction force from which the descent (absorption phase) and ascent (propulsive phase) of the center of mass during ground contact was determined. Jump height (JH), vertical stiffness (V_{STIFF}) and normalized work (W_{NORM}), power output (PO_{NORM}), and impulse (I_{NORM}) during the absorption and propulsion phases were calculated. Plyometric ability was assessed using the modified reactive strength index (RSI_{MOD}) and four indices using propulsion time (PTI), propulsive work (PWI), propulsive power (PPI), and propulsive impulse (PII). Analysis of variance was used to assess 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 JH. **Results:** JH (mean differences: 0.03 – 0.06 m; p=0.007) and V_{STIFF} (mean differences: 0.69 – 0.93 kN/m, p<0.001) were greater during CMJ compared to the DJ conditions. The mechanical variables during the absorption phase were greatest during the highest DJ (W_{NORM} mean differences: 1.6 –

10.0 J/kg, $p < 0.001$; PO_{NORM} mean differences: $4.9 - 31.3$ W/kg, $p < 0.001$; I_{NORM} mean differences: $0.36 - 2.52$ m/s, $p < 0.001$, while W_{NORM} and I_{NORM} during the propulsive phase were greatest during the CMJ (W_{NORM} mean differences: $0.2 - 1.1$ J/kg, $p = 0.020$; I_{NORM} mean differences: $0.09 - 0.21$ m/s, $p < 0.001$) with no differences in PO_{NORM} ($p > 0.05$). RSI_{MOD} increased across the four jumps and was greatest at the highest DJ condition (mean differences: $0.003 - 0.150$, $p < 0.001$). The greatest values for the other indices were reported for the CMJ ($p < 0.001$). The largest correlations with JH were found for PII ($r = 0.958 - 0.993$). **Conclusion:** RSI_{MOD} does not reflect the changes in mechanical variables during the propulsion phases of CMJ and DJ and may not therefore provide an accurate assessment of the ability to utilize the stretch-shortening cycle during different jumps. Practitioners should consider using PII as a measure of plyometric ability.

1388 Board #63 June 1 8:00 AM - 9:30 AM
The Influence Of The Number Of Jumps On Eccentric And Concentric Force-Velocity Characteristics
 Gavin L. Moir¹, Brandon W. Snyder¹, Chris Connaboy², Hugh S. Lamont³, Shala E. Davis, FACSM¹. ¹East Stroudsburg University of Pennsylvania, East Stroudsburg, PA. ²University of Pittsburgh, Pittsburgh, PA. ³Coastal Carolina University, Conway, SC. (Sponsor: Shala E. Davis, FACSM)
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 (No relationships reported)

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% (SJ_0), 27% (SJ_{27}), 56% (SJ_{56}), and 85% (SJ_{85}) 1-RM and DJ from heights of 0.40 m (DJ_{40}), 0.60 m (DJ_{60}), and 0.80 m (DJ_{80}). 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: $SJ_0, SJ_{27}, SJ_{56}, SJ_{85}$; model 2: SJ_0, SJ_{27}, SJ_{56} ; model 3: SJ_0, SJ_{27}) and eccentric Fv (model 1: $SJ_0, DJ_{40}, DJ_{60}, DJ_{80}$; model 2: SJ_0, DJ_{40}, DJ_{60} ; model 3: SJ_0, DJ_{40}).
RESULTS: Model 3 for the eccentric Fv characteristics produced a significantly greater y-intercept (mean difference: 1.2 N/kg, $p = 0.043$) and lower slope (mean difference: 1.2 Ns/m, $p = 0.020$) than model 1. There were no significant differences in the y-intercept (range of differences: $1.7 - 3.7$ N/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.

1389 Board #64 June 1 8:00 AM - 9:30 AM
Squat Jump Performance Is Not Related to Bilateral Asymmetry or Training State in College-aged Men
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 (No relationships reported)

Bilateral asymmetry has been observed in muscular strength/power movements and has been linked to poor performance and/or risk of injury. **PURPOSE:** to investigate bilateral asymmetry during jumping. **METHODS:** Athletes (A, intercollegiate sports; $n = 13$) and active (C, $n = 11$) men gave informed consent to participate in this approved study. Subjects completed repeat trials of 2-leg (2L) and single-leg (1L; left and right leg) squat jump without countermovement; data averaged across trials. Jumps were conducted on individual force plates (2L) or singularly for 1L. Jump height (JHt) was calculated from jump impulse (IMP) determined from ground reaction force and from flight time (Δt). Asymmetry index was calculated; $(L-R)/(0.5*(L+R))$. Bilateral facilitation/deficit was determined from JHt; $(1L+1R)/2L$. Data were analysed by ANOVA and significant differences were accepted with $p < 0.05$. **RESULTS:** 2L (A: 36.7 ± 0.4 cm; C: 33.7 ± 0.8 cm) and 1L (left & right: A: 17.5 ± 0.4 & 16.7 ± 0.3 cm; C:

15.9 ± 0.4 & 16.8 ± 0.6 cm, respectively) JHt was similar between groups. An extreme bilateral asymmetry (AI range 37 to -58%) was noted in IMP_J during 2L; individual leg IMP_J was not related to JHt ($r = 0.13$ left; $r = 0.14$ right). To accomplish similar 2L JHt both groups produced a greater jump impulse in one leg (A: 135.1 ± 25.4 N; C: 108.3 ± 24.1 N) vs the other (A: 111.6 ± 19.7 N; C: 89.1 ± 14.1 N); accounting for asymmetry. 2L performance was associated with a bilateral deficit ($n = 4$) or facilitation ($n = 15$); yet, neither bilateral asymmetry nor deficit/facilitation impacted performance directly. The top 5 jumps (> 40 cm) were recorded from 2 A and 3 C with bilateral asymmetry (10-40%) and bilateral deficit (2-19%) or facilitation (5-12%). 1L jump performance was asymmetric (-35 to 28%). 1L JHt was also poorly related to IMP_J ($r = 0.58$ left and 0.50 right). **CONCLUSION:** Performance of 2-leg squat jump is associated with extreme IMP, bilateral asymmetry ($\pm 45\%$) and is independent of training status. Expression of bilateral facilitation or deficit does not appear to impact jump effectiveness. 1L jump performance is limited in its ability to explain 2L jump performance, bilateral asymmetry, or neural strategy (bilateral deficit/facilitation) likely due to balance issues indicated by pattern (slope, appearance of plateaus, flat peak, etc.) of force expression.

1390 Board #65 June 1 8:00 AM - 9:30 AM
Biomechanical Comparison of Loaded Countermovement Jumps on Land and in Water
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 (No relationships reported)

Compared with land-based exercise, researchers have observed that when individuals undergo aquatic exercise and rehabilitation programs, they achieve similar, if not greater, improvements in physical function. **PURPOSE:** To evaluate the mechanical specificity of jumping movements performed in partial water immersion versus land using conditions of light external load, with a combined kinetic and kinematic analysis. **METHODS:** Twenty young males and twenty-four NCAA division I women's soccer and gymnastics athletes were asked to perform unloaded and loaded (adding 10, 20, and 30% BW with weighted vest) countermovement jumps on land and in partial water immersion. Kinetic and kinematic measures of jump performance were obtained using a tri-axial force platform and two dimensional videography, respectively. **RESULTS:** Compared to land, peak and mean mechanical power outputs (W), on average, were 88% (8919 ± 3744 W vs. 4734 ± 1418 W) and 81% (3640 ± 1807 W vs. 2011 ± 736 W) greater for jumps performed in water, respectively. While most kinematic differences were small, peak dorsiflexion velocity was, on average, 688% faster ($44 \pm 39^\circ/s$ vs. $5.6 \pm 5.4^\circ/s$; $p < 0.001$) for jumps performed in the water and tended to model similarly with measures of mechanical power and amortization rate. In water, the addition of light, external loading was associated with an average decrease in bodyweight normalized peak and mean mechanical power of $23.6 \pm 2.7\%$ and $23.8 \pm 1.9\%$, respectively. On land, the addition of load was associated with an $8.7 \pm 2.3\%$ and $10.5 \pm 4.4\%$ decrease in bodyweight normalized peak and mean mechanical power, respectively. **CONCLUSIONS:** Buoyancy appears to alters movement strategies at amortization, which may provide a unique stimulus for training the stretch-shortening cycle contribution to jump performance. The combination of fluid resistance and buoyancy are likely responsible for previously reported improvements in athletic performance and functional mobility.

1391 Board #66 June 1 8:00 AM - 9:30 AM
Strength and Biomechanical Contributions to Vertical Ground Reaction Forces in a Single Limb Landing Task
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 (No relationships reported)

Reducing dynamic joint loading is a key strategy included in injury prevention landing mechanics programs. Previous research has noted the importance of increased knee flexion to reduce vertical ground reaction forces (vGRF), and the relationship between strength asymmetry and asymmetrical landing mechanics following injury. **PURPOSE:** To determine if and how landing kinematics at the hip, knee, and ankle, as well as quadriceps strength contribute to vGRF in a single limb landing task. **METHODS:** Thirty-four physically active males (Age: 27.6 ± 4.6 yrs; Height: 177.74 ± 7.15 cm; Mass: 84.31 ± 11.83 kg) completed a single limb drop landing off a 45.7 cm box onto a force plate. A 3D motion system was used to collect dominant (DOM) and non-dominant (NON) hip flexion at initial contact, peak knee flexion (PKF), knee flexion at initial contact (KFIC), peak ankle flexion, ankle flexion at initial contact and, peak vGRF. DOM and NON quadriceps strength (IKQS) was collected using an isokinetic dynamometer at $60^\circ/s$. Simple linear regression models were run for each limb to detect independent contributions to vGRF. Backward stepwise multiple linear regression was used to determine the best model to predict vGRF. **RESULTS:**

KFIC independently accounted for 11.8% ($p=0.047$) of the variance in DOM vGRF. No DOM limb multiple linear regression model was significant. KFIC and PKF independently accounted for 15.7% ($p=0.021$) and 16.5% ($p=0.017$) of the variance in NON vGRF, respectively. KFIC and IKQS as a multiple linear regression model accounted for 18.9% ($p=0.043$) of variance in NON vGRF. **CONCLUSION:** KFIC, 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 IKQS not being an independent significant predictor on either limb, it improved KFIC 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.

1392 Board #67 June 1 8:00 AM - 9:30 AM
Influence of Trunk Angle on Joint Mechanics During the Vertical Jump

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 (No relationships reported)

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 during this movement. **PURPOSE:** The aim of the current study is to identify the alterations in lower extremity joint mechanics when participants jump with a more upright trunk position. **METHODS:** 15 participants (age 23 ± 3 , weight 160 ± 33 lbs, height 68.6 ± 4.3 in) performed body weight squats, side lunges, and leg swings as a warm-up. Reflective markers were placed on the lower extremities. Participants performed 3 vertical jumps with a self-selected trunk angle (SS) and 3 vertical jumps after being instructed to keep trunk angle as vertical as possible (UR). Arm swing was limited by placing hands on the hips. Force data were collected with a force plate (Bertec, Inc.; Columbus, OH). Motion capture data were collected with Vicon Nexus (Vicon, Inc.; Oxford, UK). All data were processed with Visual 3D (C-Motion, Inc.; Germantown, MD) and analyzed using a paired t-test ($\alpha=0.05$). **RESULTS:** The results showed that hip extension moment was significantly reduced in the SS trials ($M=1.44$ Nm/kg and 1.26 Nm/kg for SS and UR, respectively, $p=0.006$). Knee and ankle moments did not show a significant difference and jump height was significantly decreased ($p<0.001$), although 3 participants jumped higher in the UR position. **CONCLUSIONS:** Hip extension moment alone was significantly influenced by trunk angle. Data did not show evidence that knee and ankle moments compensated 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 to repeat this study with athletes who are trained to jump with a vertical trunk i.e. volleyball players, basketball players.

1393 Board #68 June 1 8:00 AM - 9:30 AM
Effects of Athletic Floor Surfaces on Cutting and Jumping Ground Reaction Forces in Female Athletes

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Purpose: To assess ground reaction forces in female athletes performing sport-specific movements (drop vertical jump and cut) on two athletic flooring surfaces: Smartcells® [SM] and Sport Court® [SP], as compared with a control [CO] surface. **Methods:** After providing informed consent, sixteen NCAA female athletes (age 20 ± 1.3 yrs; height 175.8 ± 7.3 cm; weight 71.5 ± 7.1 kg) were instrumented with a standard lower extremity plug-in-gait marker set, after which ground reaction forces were assessed during performance of two movement types (drop vertical jump and 45 degree cut) on each surface using a 6 camera MOCAP system (Vicon, Denver, CO, USA) and two force platforms (AMTI, Watertown, MA, USA). Test order was randomized. Subjects performed 3 successful trials for each movement on each surface. Data were normalized by participant weight before comparison via paired t tests ($p<0.05$) between conditions for right-side peak and mean medial/lateral [ML], anterior/posterior [AP], and vertical [VERT] ground reaction forces [GRF].

Results: During cutting, peak ML GRF for SM (42.62 ± 15.31 Nkg⁻¹) and SP (41.11 ± 12.32 Nkg⁻¹) were reduced as compared with CO (51.99 ± 13.25 Nkg⁻¹) ($p=0.039$ and $p=0.002$, respectively). Mean ML GRF for SM (4.14 ± 4.28 Nkg⁻¹) and SP (3.81 ± 3.76 Nkg⁻¹) were also reduced as compared with CO (6.58 ± 5.18 Nkg⁻¹) during cutting movements ($p=0.009$ and $p=0.004$, respectively). During drop vertical jump performance, mean AP GRF for both SM (-1.88 ± 0.90 Nkg⁻¹) and SP (-1.13 ± 0.52 Nkg⁻¹) were reduced as compared with CO (-4.02 ± 1.33 Nkg⁻¹) ($p<0.0001$ & $p<0.0001$, respectively). Peak ML GRF for SM (25.09 ± 4.43 Nkg⁻¹) was less than both CO (32.70 ± 8.45 Nkg⁻¹) ($p=0.0009$) and SP (29.67 ± 5.36 Nkg⁻¹) ($p=0.0008$). Mean ML GRF for SM (1.71 ± 0.33 Nkg⁻¹) was less than CO (2.04 ± 0.40 Nkg⁻¹) ($p=0.0012$). Mean AP GRF for SP (-1.13 ± 0.52) was reduced compared to SM (-1.88 ± 0.90) ($p=0.0011$). A trend for peak VERT GRF between SM (151.99 ± 5.28 Nkg⁻¹) and both CO (156.91 ± 10.71 Nkg⁻¹) and SP (156.52 ± 8.53 Nkg⁻¹) during drop vertical jump was noted.

Conclusion: SP and SM athletic flooring may reduce selected peak and mean GRF. SM mitigated GRF to a greater extent. Data trends also demonstrated reductions in VERT GRF during drop vertical jump for SM that may be further elucidated with a greater sample size in future efforts.

1394 Board #69 June 1 8:00 AM - 9:30 AM
Relationship Between Functional Movement Patterns And Performance Between Division Iii Women's Soccer And Volleyball

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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 ± 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 $\alpha=0.05$.

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 ($28.6\pm 1.4\%$ vs $22.2\pm 1.3\%$), which resulted in 5.8 kg greater fat free mass (FFM) 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 (3888.1 ± 105.8 W) than SOC (3094.6 ± 92.6 W). The FMS lunge score was moderately related to both mean ($r=-0.46$, $p=0.0140$) 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 FFM. 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.

1395 Board #70 June 1 8:00 AM - 9:30 AM
Lower Limb Kinetic And Kinematic Effects Of An Arm Swing During Counter-movement Vertical Jumps

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PURPOSES: This study determined the effects of an arm swing on lower limb kinematics (joint ranges of motion; ROM) and kinetics (peak joint torques; Nm) during a CMVJ. **METHODS:** Fourteen healthy, recreationally active men (\pm SD; age= 24.1 ± 3.9 yrs, height= 1.76 ± 0.05 m, weight= 82.6 ± 10.6 kg) performed 6 CMVJ, 3 with an arm swing (AS) and 3 with no arm swing (NAS), in random order. The AS CMVJ began with the participant standing upright with arms fully raised above the

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 kinetic 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 (3.0±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 AS 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.

Table 1. Kinetic and kinematic comparison of joint flexion and peak joint torques during eccentric (ECC) and concentric (CON) phases of counter-movement vertical jumps with arm swing (AS) and no arm swing (NAS) (X±SD).

| | AS | NAS |
|----------------------------|----------------|-----------------|
| Jump Height (m) | 0.55 ± 0.09 | 0.48 ± 0.07* |
| ECC Duration (s) | 0.62 ± 0.15 | 0.59 ± 0.07 |
| CON Duration (s) | 0.30 ± 0.06 | 0.27 ± 0.05* |
| Hip Flexion (°) | 102.45 ± 19.14 | 92.65 ± 15.48* |
| Knee Flexion (°) | 101.36 ± 15.08 | 103.58 ± 11.86 |
| Ankle Flexion (°) | 27.43 ± 4.84 | 27.36 ± 4.33 |
| ECC Hip Peak Torque (Nm) | 28.54 ± 6.52 | 23.15 ± 8.05* |
| ECC Knee Peak Torque (Nm) | 15.21 ± 3.56 | 10.71 ± 4.21 |
| ECC Ankle Peak Torque (Nm) | 7.60 ± 2.37 | 4.15 ± 1.72* |
| CON Hip Peak Torque (Nm) | 50.43 ± 11.24 | 37.43 ± 13.42*† |
| CON Knee Peak Torque (Nm) | 17.48 ± 2.96 | 16.30 ± 6.40† |
| CON Ankle Peak Torque (Nm) | 7.78 ± 1.55 | 6.86 ± 2.81*† |

*AS vs. NAS, †ECC vs. CON

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

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BACKGROUND: Sports injuries remain a major concern for athletes despite ongoing efforts to improve screening and prevention methods. Recent research suggests that neurocognition 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 has yet to be investigated.

PURPOSE: To determine the relationship between neurocognition 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 yr; 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' C_p were further evaluated for significance (α=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.

1397 Board #72 June 1 8:00 AM - 9:30 AM

Landing Kinetics and Time to Stabilization for Loaded Countermovement Jumps Performed on Land and in Water

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(No relationships reported)

Competitive sports require athletes to focus on several aspects of human performance, especially training techniques that maximize muscle power. This type of training may pose risk of injury, and performing these exercises in water appears to reduce risk due to lower impact forces, yet the influence of adding external loads in water has not been investigated. **PURPOSE:** Compare landing kinetics of weighted countermovement jumps performed in water versus land. **METHODS:** Twenty-four NCAA DI female athletes (19.9±1.1 yr, 12 soccer, 12 gymnasts) performed three countermovement 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 weighted vest. Landing kinetic measures were peak force (PF), rate of force development (RFD), impulse (Imp), and time-to-stabilization (TTS). Results were analyzed 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 produced significant (p<0.001) increases in 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<.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 increase 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.

1398 Board #73 June 1 8:00 AM - 9:30 AM

Pre-landing Lower Extremity Kinematics and Muscle Activation in Chronic Ankle Instability Patients Following Rehabilitation Intervention

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(No relationships reported)

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±8 cm, 76±9 kg, 83±7% FAAM ADL, 56±10% FAAM Sports, 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, 5.9±3.3 sprains). Subjects performed 10 jumps consisting of a max vertical jump plus a side cut. EMG data were normalized to a 3-sec squat position. Functional analyses (α=.05) were used to detect group x treatment interactions. If 95% CI did not cross the zero, significant differences existed.

RESULTS: Figure 1. The rehab intervention resulted in up to (i) 32% less VL activation at 55-42 ms pre-, 39-24 ms pre-, and 6 ms pre-contact to initial-contact and (ii) 8.5% less GX activation at 150-81 ms pre-contact. No changes were detected in sagittal ankle, knee and hip kinematics, and MG activation.

CONCLUSIONS: As knee and hip extensors act as a shock absorber during landing, reduced VL and GX preactivation could reduce the ability to attenuate the high impact loads at initial landing. While no corresponding kinematic differences were observed, these EMG alterations could have a delayed effect on kinematics at or following impact.

THURSDAY, JUNE 1, 2017

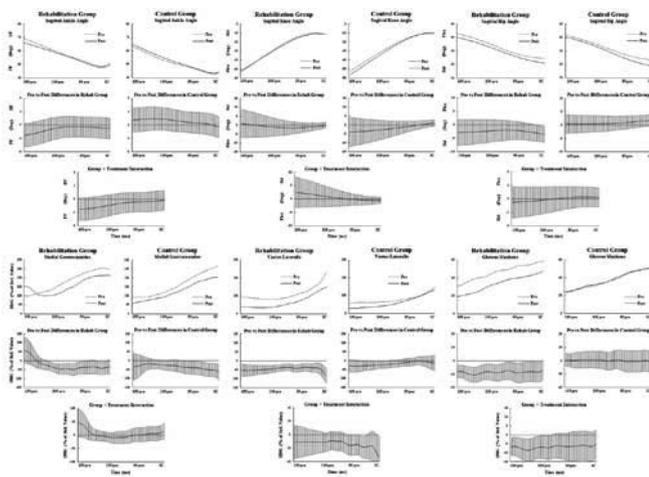


Figure 1. Ground reaction forces for eight subjects. Each row and column represents a different subject. A grey line indicates a subject in the stabilization group, and a black line indicates a subject in the control group. The top row shows vertical force, the middle row shows medial-lateral force, and the bottom row shows anterior-posterior force. The x-axis represents time from 0 to 2 seconds. The y-axis represents force in Newtons (N).

1399 Board #74 June 1 8:00 AM - 9:30 AM
Effects of Jump Landing on Achilles Tendon Loading

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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. **Purpose:** Compare AT loading during JUMP and LAND in a F/B and M/L directions. **Methods:** 16 physically active, healthy males (age 21.6: ±1.8years, height: 178.4 ±6.4cm, weight: 76.4±11.2kg) were fitted with 47 markers and performed dominant 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 for each LAND and JUMP). Kinematic and force data sampled by 15 motion analysis cameras (180 Hz) and force platforms (1800 Hz), respectively. Inverse dynamics and then static optimization was used to estimate muscle force. AT cross sectional area (CSA) was measured by ultrasound. AT force was divided by each subject's AT CSA for stress estimation and strain from an average Young's modulus. Body center of 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 ($\alpha=0.05$) 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.

1400 Board #75 June 1 8:00 AM - 9:30 AM
Test-retest Reliability Of The Kinetic Time To Stabilization Measurement During A Single-legged Jump Landing

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Biomechanical deficits during jump landings often contribute to common lower extremity musculoskeletal (MSK) injuries in athletes. Time to stabilization (TTS) measurements have recently been used to assess MSK injury risk. Greater TTS values represent a diminished dynamic postural stability. **PURPOSE:** To determine the reliability of TTS during a single-legged jump-landing task. We hypothesized that reliability would be good for both within- and between-day measures. **METHODS:** Eight physically active male participants (16.8 ± 0.7 yr) completed three trials of a single-legged jump landing in a non-fatigued state, on two days, separated by about one week. Subjects jumped on their dominant leg from a distance equal to 60% of their maximum, single-legged forward jump distance and landed on the same leg in the middle of a force platform. Subjects were instructed to stabilize and remain as still as possible upon landing. TTS was quantified as the time required for the vertical force component to reach and remain within $\pm 5\%$ of the subject's body weight for one second after landing. The first attempt served as a familiarization trial, while the mean TTS of the remaining two attempts were used for between-day comparisons. Intraclass correlation coefficients (ICC) and standard error of measurement (SEM) were calculated for TTS between Day 1 and Day 2, and between attempts 2 and 3 on each day. **RESULTS:** Mean TTS was 0.87 [95% CI 0.54-1.20] and 0.81 [95% CI 0.47-1.14] seconds for Day 1 and Day 2, respectively. Within-day reliability for Day 1 (ICC = 0.84 [95% CI 0.28-0.97]) and between-day reliability (ICC = 0.98 [95% CI 0.92-0.99]) were excellent, while within-day reliability for Day 2 (ICC = 0.49 [95% CI 0.0-0.90]) was fair. The SEM was 0.17, 0.34, and 0.05 seconds for Day 1, Day 2, and between-day measures, respectively. **CONCLUSIONS:** Between-day reliability of TTS was excellent, yet within-day reliability was inconsistent. Thus, a single measurement may not be a reliable indicator of jump-landing TTS. These results support the use of TTS as a test-retest assessment of neuromuscular control following a bout of exercise or a MSK injury risk reduction training program. The reliability of TTS using additional jump variations and calculation methods, and its efficacy as a MSK injury prediction tool should be examined further.

1401 Board #76 June 1 8:00 AM - 9:30 AM
Effect of Ankle and Hip Rehabilitation Intervention on Knee Landing Mechanics in Chronic Ankle Instability

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 (No relationships reported)

Sensorimotor deficits due to lateral ankle sprains can result in altered landing mechanics in the lower extremity. The ankle and hip have been a focus of interventions in patients with chronic ankle instability (CAI), however, knee landing mechanics may also be affected by the intervention. **PURPOSE:** To examine the effect of a 6-week ankle and hip intervention program on knee landing mechanics in patients with CAI. **METHODS:** 15 CAI subjects in a rehab group (23 ± 2 yrs, 178 ± 8 cm, 76 ± 9 kg, $83 \pm 7\%$ FAAM ADL, $56 \pm 10\%$ 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, $81 \pm 9\%$ FAAM ADL, $56 \pm 12\%$ 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 ($\alpha=0.05$) 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 rehabilitation intervention resulted in up to (i) 2 deg less knee flexion at 13-18% of stance, (ii) 0.23 Nm/kg more knee extension moment at 21-27% and 35-69% of stance, and (iii) 1.6 deg more knee valgus at 0-8% and 48-64% of stance. No changes were detected in frontal knee moment over time between groups. **CONCLUSIONS:** Relative to the control group, CAI patients in the rehabilitation group tend to land more aggressively using more knee extensor moment with less flexion and more valgus positions of the knee. These positions and moments, due to the ankle and hip exercises in CAI patients, could be a risk factor for knee injury in this CAI population.

THURSDAY, JUNE 1, 2017

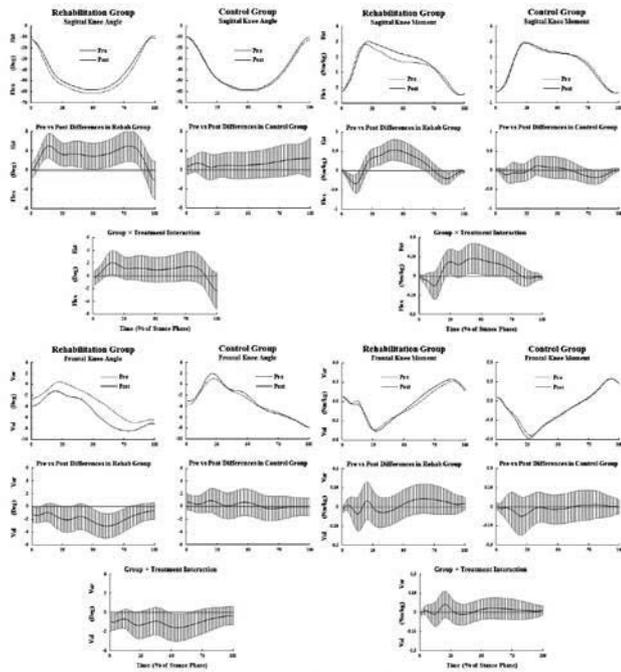


Figure 1. Grand ensembles for sagittal and frontal knee kinematics and kinetics during the stance phase of a cutting task. A group x treatment interaction was detected subtracting "Pre vs Post Differences in Rehab Group" from "Pre vs Post Differences in Control Group". When 95% confidence intervals (shaded area) did not overlap the zero (horizontal red line), significant differences existed. Abbreviations: Pre vs Post, extension; Vari, variance; Y-axis, Y-axis values.

1402 Board #77 June 1 8:00 AM - 9:30 AM
The Effect of a Single Bout of Exercise on the Motor Learning of a Drop Vertical Jump Landing Strategy
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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.

1403 Board #78 June 1 8:00 AM - 9:30 AM
Association Between Rate of Torque Development, Strength, Landing Biomechanics, And Dynamic Postural Stability In Physically Active Males
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 (No relationships reported)

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 (Hip@IC, Knee@IC, ANK@IC) and peak flexion angles (KneePkFlex, ANKPkFlex) 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 ANKPkFlex (p=0.033) but not asymmetrical KES or RTD (p>0.05). Increased KneePkFlex and ANKPkFlex correlated with an improved DPSI (r=-0.519, p=0.016 and r=-0.466, p=0.033) on the DOM limb while KneePkFlex and HIP@IC 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 DPSI or 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 ANKPkFlex, 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.

1404 Board #79 June 1 8:00 AM - 9:30 AM
Biomechanical Correlates of Vertical Jump Height in Children
 Rebecca S. Angles, Adam E. Jagodinsky, Jeffrey Cowley, FACSM, Steve MCaw, Michael Torry. *Illinois State University, Normal, IL.* (Sponsor: David Q. Thomas, FACSM)
 (No relationships reported)

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 (JH) 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 bodyweight. 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 (.21 ± .08 Nm/kg) and JH (18.05 ± 2.40 cm) (r=.51; p<.01), peak knee moment (.07 ± .04 Nm/kg) and JH (r=.50; p<.01) as well as peak hip moment (.15 ± .06 Nm/kg) and JH (r=.61; p<.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.

1405 Board #80 June 1 8:00 AM - 9:30 AM
Net Peak Power and Hip Moment Predict Vertical Jump Height in Children
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(No relationships reported)

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] 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 [$R^2 = .716$, $R^2_{adj} = .70$, $F(2, 35) = 44.158$, $p < .001$], and accounts for 71.6% of the variance in JH when net peak power (14.43 ± 3.95 W/kg) and peak hip moment ($.15 \pm .06$ 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.

1406 Board #81 June 1 8:00 AM - 9:30 AM
Joint Loading While Jumping on a Pilates Reformer
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(No relationships reported)

Exercising on a Pilates reformer has been successfully used as an exercise intervention for numerous pathologies. One area where this type of exercise has not been applied is for maintenance of bone health. Currently, it is unknown whether the forces experienced when jumping on a Pilates reformer reach recommended thresholds for osteogenic exercises. **PURPOSE:** Develop an instrumented Pilates reformer capable of measuring the ground reaction forces during Pilates jumping activities and use this device to compare joint loading when jumping on a Pilates reformer and during activities recommended for maintaining bone health. **METHODS:** An instrumented Pilates reformer (INST) was built with a strain gauge force plate mounted to the base and used as the foot board. To validate the device behaved like a commercially available reformer (COMM), a tri-axial accelerometer was used to measure tibial acceleration and a 3D motion capture system was used to measure knee kinematics while jumping on both the COMM and INST reformers. Subsequent to validation, loading rates, peak resultant hip joint reaction forces, and peak sagittal plane hip moments were evaluated while jumping on the INST reformer and during brisk walking (W) and low amplitude hopping (HOP). **RESULTS:** There were no differences between COMM and INST reformers in peak tibial acceleration (23.8 ± 3.5 m/s² vs. 24.1 ± 4.8 m/s², $p = 0.95$) or peak knee flexion ($110.1 \pm 5.9^\circ$ vs. $113.4 \pm 6.1^\circ$, $p = .54$) during jumping, suggesting the INST reformer behaved similarly to the COMM reformer. Vertical loading rates were lower in the INST condition (20.3 ± 3.5 BW/s) than in either W (95.1 ± 9.4 BW/s, $p = .026$) or HOP (109.5 ± 7.7 BW/s, $p = .007$) conditions. Peak hip joint reaction forces were not different between INST (1.2 ± 0.1 BW) and W (1.3 ± 0.1 BW, $p = .136$), but both were lower than HOP (2.9 ± 0.3 BW). Peak hip moments were not different between the INST (2.3 ± 0.2 Nm/kg), W (2.1 ± 0.5 Nm/kg, $p = .936$), or HOP (2.4 ± 0.7 Nm/kg, $p = .886$) conditions. **CONCLUSION:** Jumping on a Pilates reformer results in hip joint reaction forces similar to those experienced during brisk walking, and similar joint moments to both walking and hopping. Additional work is required to quantify bone stresses and strains during Pilates activities to determine if they reach sufficient thresholds to be classified as osteogenic exercise.

1407 Board #82 June 1 8:00 AM - 9:30 AM
Joint Stiffness and Energy Contribution during Drop Jump in Fatigued and Non-fatigued Conditions
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Repetitive movements in training or competitions will inevitably lead to neuromuscular fatigue. It is still unclear about the specific influence of induced fatigue on drop jump biomechanics, e.g., joint energy contribution and stiffness. **PURPOSE:** To examine the differences in joint energy contribution and stiffness before and after fatigue, further exploring how fatigue affects drop jump performance. **METHODS:** 15 male participants were required to complete 5 consecutive countermovement jumps (CMJs) and a group of shuttle running in order to induce fatigue. Subjects repeated the above procedure until the average height of 5 consecutive CMJs was below the 70% of the maximum height. Vicon system and Kistler force plates were employed to collect the kinematics and GRF data. The variables included: 1) Leg stiffness: $K_{leg} = F_i/\Delta y$, F_i was the GRF at the transition from the eccentric to concentric phase, Δy was the maximum vertical displacement of the body gravity from touchdown to the lowest position of squatting. 2) Joint stiffness: $K_{joint} = \Delta M/\Delta \theta$, ΔM and $\Delta \theta$ were the amount of change in moment and joint angle respectively. 3) Hip joint energy contribution: $C_{hip} = W_{hip} / (W_{hip} + W_{knee} + W_{ankle})$, the same as knee and ankle. W_{hip} , W_{knee} and W_{ankle} were joint work which calculated by the integration of net joint powers respectively. Paired sample *t*-tests were used to determine the statistical differences. **RESULTS:** The maximum height (0.53 ± 0.03 vs. 0.51 ± 0.04 m, $P < .05$) of drop jump in fatigued condition was decreased compared to non-fatigue. Only energy absorbed contribution of knee joint (58.36 ± 8.51 vs. 55.00 ± 8.00 %, $P < .05$) in fatigued condition was decreased during the eccentric phase of drop jump. Meanwhile, the leg stiffness (2.01 ± 0.46 vs. 1.73 ± 0.4 kN/m, $P < .01$) and ankle joint stiffness (0.018 ± 0.005 vs. 0.015 ± 0.003 Nm/kg⁰, $P < .05$) were reduced after fatigue. **CONCLUSIONS:** Drop jump in fatigued condition affected joint energy contribution and stiffness. The reduction of leg stiffness, ankle joint stiffness and energy absorbed contribution of knee joint in fatigued condition may be considered as the major factors leading to the decrease of jump height. These variables may be sensitive in indicating the performance of drop jump after fatigue, which might be helpful in monitoring the training effect. Supported by NSFC (11302131).

1408 Board #83 June 1 8:00 AM - 9:30 AM
The Relationship Between A New Test Of Trunk Control To Cutting Mechanics
 Chelsey Roe, Hayley Reed, Amanda Hickey, Kathryn Lucas, Brian Noehren, FACSM. *University of Kentucky, Lexington, KY.*
(No relationships reported)

Poor neuromuscular control of the trunk in laboratory studies has been identified as a significant risk factor for lower extremity injuries in females. To date few clinical tests have been developed that capture trunk control which have been compared to trunk and lower extremity control. Establishing the relationship between multidirectional trunk control and lower extremity control during a cutting task would serve as the first step in establishing a measure to identify females at risk for injury in a clinical setting. **PURPOSE:** To determine the association between a new seated trunk test and trunk and lower extremity kinematics during an unanticipated cutting task. **METHODS:** 8 female subjects (20.9 ± 1.6 ages, 20.6 ± 2.0 BMI) with no prior lower extremity injuries performed an instrumented three dimensional assessment of an unanticipated cutting task. Visual 3D was used to analyze frontal plane trunk, hip, and knee kinematics at initial contact (IC). Subjects were asked to sit on a wobble board placed on a solid surface on a plinth with their feet approximately 0.1 m off the ground with their eyes closed. Errors were counted and averaged during the two 30 second trials. Errors included uncrossing the arms, opening eyes, or if the wobble board touched the plinth. Pearson Product Moment Correlations were calculated between kinematics at IC and the mean number of trunk errors. **RESULTS:** Mean frontal plane angles were trunk $-1.1 \pm 1.8^\circ$, hip, $-4.7 \pm 3.5^\circ$, knee $2.9 \pm 4.1^\circ$ and the numbers of trunk errors were 1.7 ± 1.5 . A significant relationship was observed with errors and hip adduction ($r = 0.84$, $p = 0.009$). Significant associations were not observed at the trunk ($r = 0.23$, $p = 0.578$) and knee ($r = -0.59$, $p = 0.126$). **CONCLUSIONS:** There was a significant relationship between greater hip adduction which is associated with numerous injuries to the errors on the seated trunk test. While not significant the relationship to the frontal plane knee motion did have a high *r* value indicating a strong relationship that may become significant with additional subjects. The lack of relationship to trunk mechanics could be due to a greater contribution of trunk rotation than frontal plane motion during cutting from the trunk. Future analysis will further assess this possibility.

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

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 (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 ($\alpha=.05$) 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.

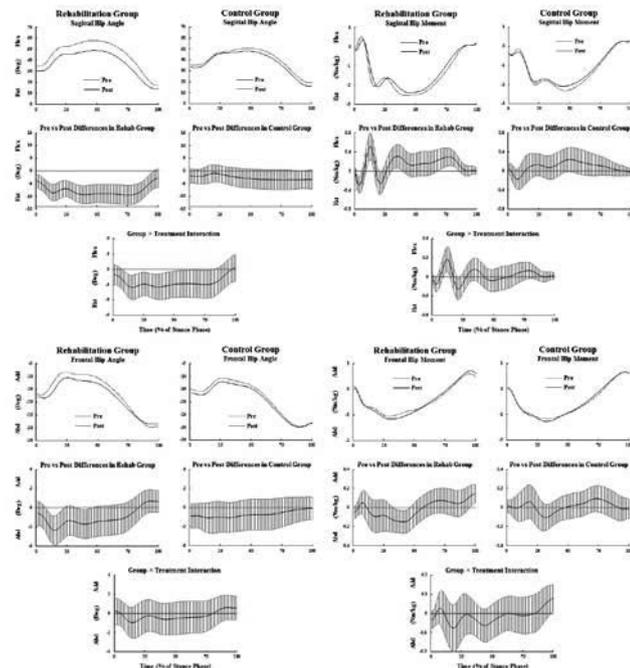


Figure 1. Grand ensembles for sagittal and frontal hip kinematics and kinetics during the stance phase of a cutting task. A group x treatment interaction was defined subtracting "Pre vs Post Differences in Rehab Group" from "Pre vs Post Differences in Control Group". When 95% confidence intervals (shaded areas) did not overlap the zero (horizontal red line), significant differences existed. Abbreviations: Flex: flexion, Ext: extension, Add: adduction, Abd: abduction.

1410 Board #85 June 1 8:00 AM - 9:30 AM
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 ($\alpha=.05$) 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.

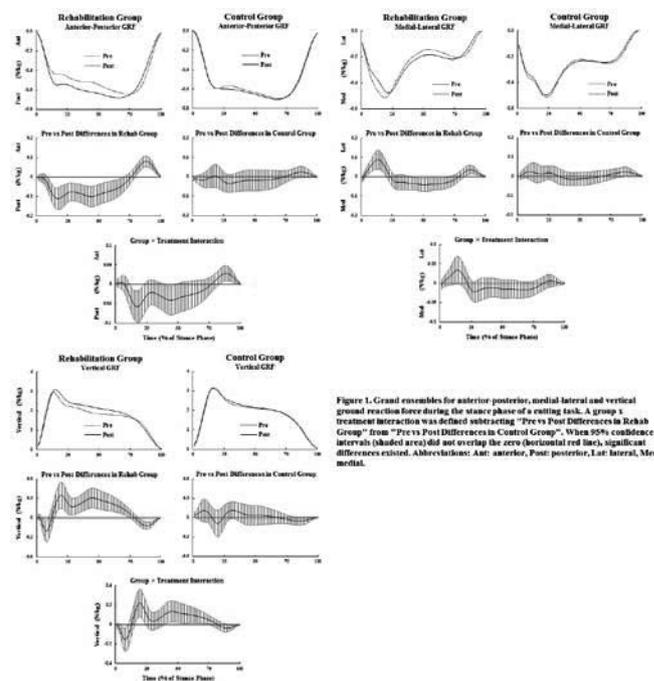


Figure 1. Grand ensembles for anterior-posterior, medial-lateral and vertical ground reaction force during the stance phase of a cutting task. A group x treatment interaction was defined subtracting "Pre vs Post Differences in Rehab Group" from "Pre vs Post Differences in Control Group". When 95% confidence intervals (shaded areas) did not overlap the zero (horizontal red line), significant differences existed. Abbreviations: Ant: anterior, Post: posterior, Lat: lateral, Med: medial.

1411 Board #86 June 1 8:00 AM - 9:30 AM

Changes in Lower Extremity Energetics during Cutting in Chronic Ankle Instability Patients Following Rehabilitation Intervention

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Energetic redistribution from the distal to proximal joints may be linked to sensorimotor deficits at the ankle in patients with chronic ankle instability (CAI). Little 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 ($\alpha=.05$) 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 generation at 89-98% of stance, (ii) 2.9 W/kg more knee power absorption at 19-26% and 41-49% of stance, and 0.9 W/kg more knee power generation at 64-76% and 94-100% of stance, and (iii) 2.7 W/kg more hip power absorption at 2-5% and 17-25% 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 knee during push-off. Proximal joints play a key role in landing energetics in patients with CAI following the intervention.

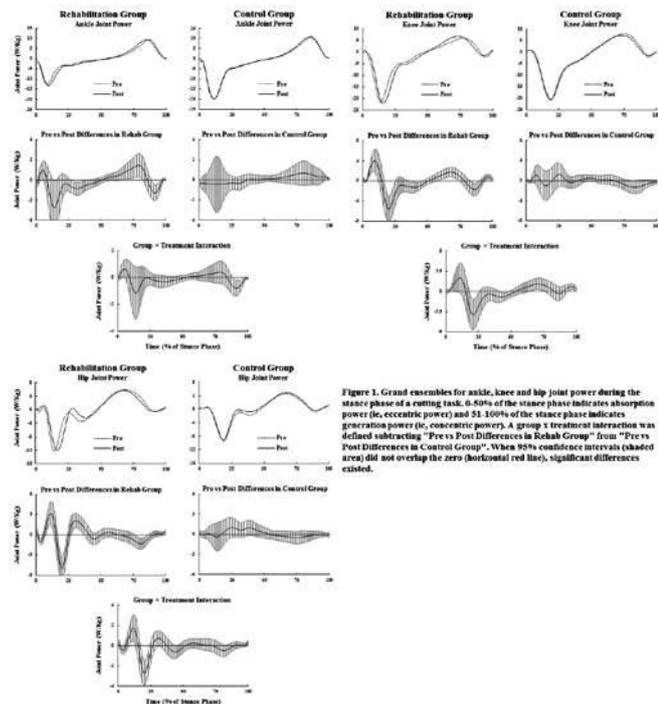


Figure 1. Grand ensembles for ankle, knee and hip joint power during the stance phase of a cutting task. 0-50% of the stance phase indicates absorption power (i.e. eccentric power) and 51-100% of the stance phase indicates generation power (i.e. concentric power). A group x treatment interaction was defined subtracting "Pre vs Post Differences in Rehab Group" from "Pre vs Post Differences in Control Group". When 95% confidence intervals (shaded area) did not overlap the zero (horizontal red line), significant differences existed.

C-35 Free Communication/Poster - Biomechanics of Resistance Training

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

1412 Board #87 June 1 9:00 AM - 10:30 AM

Back Squat Performance Characteristics of Resistance Trained Males Are Affected by Wearing Knee Wraps

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 (No relationships reported)

Knee wraps have been used to improve back squat performance characteristics during free weight resistance training. **PURPOSE:** To investigate the effects of using knee wraps on back squat performance characteristics (force, velocity, power). **METHODS:** Twelve resistance-trained males (mean±SD; Age: 25±4yrs, Height: 1.78±0.06m, Mass: 86.6±13.3kg, 1RM: 152±21kg) volunteered to participate in a 2-week back squat training study. Subjects performed a back squat training protocol (5 sets of 5 repetitions with 5 min rest between sets) without (UW) and with knee wraps (KW) on separate days in a randomized order. A linear position transducer was used to measure average concentric/eccentric velocity (AV/EV), peak concentric velocity (PV), peak concentric force (PF) and average/peak concentric power (AP/PP). Repeated measures ANOVAs were used to determine differences in back squat performance across treatment (UW, KW) and set (1-5). Paired t-tests were used with a Bonferroni correction for post-hoc analysis of significant ANOVAs. **RESULTS:** Significant ($p<0.001$) treatment by set interactions were observed such that wearing knee wraps during the back squat increased AV (Set1: 14.3%, Set2: 25%, Set3: 25%, Set4: 26.7%, Set5: 22.6%, $p<0.001$), decreased EV (Set1: 18.9%, Set2: 13.3%, $p<0.001$), increased PV (Set4: 7.5%, Set5: 13.8%, $p<0.001$), and increased AP (Set1: 12.1%, Set2: 23.2%, Set3: 23.9%, Set4: 26.7%, Set5: 24.5%, $p<0.001$). In addition, significant ($p<0.001$) main effects of treatment were observed such that wearing knee wraps during the back squat increased AV (UW: 0.32 ± 0.08 m/s, KW: 0.39 ± 0.10 m/s, $p<0.001$), decreased EV (UW: 0.38 ± 0.10 m/s, KW: 0.34 ± 0.12 m/s, $p<0.001$), increased PV (UW: 0.72 ± 0.19 m/s, KW: 0.77 ± 0.18 m/s, $p<0.001$), increased PF (UW: 2671 ± 411 N, KW: 2745 ± 308 N, $p<0.001$), increased AP (UW: 671 ± 172 W, KW: 817 ± 192 W, $p<0.001$), and increased PP (UW: 1760 ± 524 W, KW: 1899 ± 585 W, $p<0.001$). **CONCLUSIONS:** These data demonstrate that knee wrap treatment can be used to improve back squat performance characteristics in resistance-trained men. Future studies should measure the effects of knee wraps treatment at near maximal intensities (>85%1RM) and submaximal intensities (<85%1RM) in order to further evaluate velocity, force, and power characteristics of the back squat.

1413 Board #88 June 1 9:00 AM - 10:30 AM

Comparison Of Peak Ground Reaction Forces Of Flexible Barbell And Steel Olympic Barbell At Various Lifting Speeds

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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. No studies have shown that the same trend is true for other lifting speeds (LS). **PURPOSE:** The purpose of this study was to compare maximum and minimum ground reaction force production (GRFmax, GRFmin) of the FB and the SB at various physiologically relevant LSs. **METHODS:** Using a bar-lifting machine, an SB and FB were lifted at various speeds between 1.87 ft/s and 3.57 ft/sec. The weight of each bar was set to 63lbs. The GRFmax and the GRFmin of FB and SB were compared with independent-samples t-tests. **RESULTS:** The FB had significantly higher GRFmax for all speeds excluding 3.06 ft/s (LS=1.87 ft/s: 4619 ± 11 N vs. 4609 ± 19 N, $p<0.001$; LS=2.04 ft/s: 4834 ± 11 N vs. 4662 ± 23 N, $p<0.001$; LS=2.21 ft/s: 5202 ± 29 N vs. 4731 ± 16 N, $p<0.001$; LS=2.38 ft/s: 5345 ± 11 N vs. 4911 ± 28 N, $p<0.001$; LS=3.23 ft/s: 5433 ± 15 N vs. 5233 ± 35 N, $p<0.001$; LS=3.40 ft/s: 5701 ± 19 N vs. 5293 ± 21 N, $p<0.001$; LS=3.57 ft/s: 5897 ± 55 N vs. 5430 ± 43 N, $p<0.001$). The FB also had significantly lower GRFmin for all speeds excluding 3.06 ft/s, 3.40 ft/s and 3.57 ft/s (LS=1.87 ft/s: 4055 ± 7 N vs. 4131 ± 10 N, $p<0.001$; LS=2.04 ft/s: 3861 ± 16 N vs. 4076 ± 11 N, $p<0.001$; LS=2.21 ft/s: 3520 ± 17 N vs. 4025 ± 10 N, $p<0.001$; LS=2.38 ft/s: 3604 ± 26 N vs. 3932 ± 21 N, $p<0.001$; LS=3.23 ft/s: 3325 ± 23 N vs. 3417 ± 25 N, $p<0.001$). **CONCLUSIONS:**

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These results may provide a physiological mechanism to recruit more type IIx 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.

1414 Board #89 June 1 9:00 AM - 10:30 AM
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 at 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/sec. The weight of each bar was set to 63lbs and placed at an inner-most (in) and outer-most (out) 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 IIx 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 | | |
|--|----------------|-----------------|
| Speed (ft/s) | FB in position | FB out position |
| 2.04 | 4743+/-15.5 | 4877+/-25.1 |
| 2.21 | 4852+/-20.3 | 5178+/-21.8 |
| 2.38 | 5001+/-24.2 | 5397+/-32.0 |

1415 Board #90 June 1 9:00 AM - 10:30 AM
Ground Reaction Force Asymmetries in the Bodyweight Squat: An Examination of Phases
 Raoul F. Reiser, II, FACSM, Steven D. Medberry, Grant V. Overmoyer. *Colorado State University, Fort Collins, CO.*
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(No relationships reported)

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 = 21.9 ± 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 (NKL) 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 1.4 ± 4.9% NKL-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 most asymmetric 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 were found to be highly repeatable (Chronbach's α ≥ 0.715 except in the second half of the up phase where 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.

1416 Board #91 June 1 9:00 AM - 10:30 AM
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 (14.4° ± 3.6°, p < 0.001) and sagittal plane range of motion (15.3° ± 3.6°, p < 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 cushioned zero-drop condition was reduced compared to the standard condition (0.80 Nm/kg ± 0.36 Nm/kg, p = 0.008). A decrease of the peak ankle inversion 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.

1417 Board #92 June 1 9:00 AM - 10:30 AM
A Kinematic and Kinetic Analysis Of The Partial And Conventional Deadlift In Resistance-trained Males
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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 (22.50 ± 2.12 years; 165.50 ± 6.57 cm; 93.69 ± 12.51 kg) with a minimum of two years of resistance training experience that included frequent use of the barbell squat and CDL volunteered for this study. Subjects attended a familiarization session before beginning the study. They were tested on three visits separated by no less than 48 hours. One repetition maximum (1RM) CDL strength was determined in visit 1. In visits 2 and 3, each subject completed the CDL or PDL at 80% of 1RM of the CDL. Whichever lift was not completed in visit 2 was completed in visit 3 in a randomized and balanced fashion. Data was collected using 3D motion analysis and two force plates. Data was compared between the PDL and CDL by beginning the capture at the liftoff point of the PDL for each lift. Joint angles of the ankle, knee, hip, and thorax as well as joint moments of the ankle, knee, and waist were compared. Separate 1 factor (group) MANOVAs were performed to determine if a significant difference exists between the PDL and CDL in these variables. **RESULTS:** The PDL exhibited significantly greater knee flexion (37.32 ± 5.18° to 27.61 ± 6.83°, p £ 0.05), less hip extension at near significance (104.04 ± 7.94° to 112.67 ± 11.35°, p = 0.064), a significantly smaller NJM at the knee (764.19 ± 393.33 Nm to 1225.74 ± 279.09 Nm, p £ 0.05), and a significantly smaller NJM at the waist (3901.63 ± 386.85 Nm to 4527.82 ± 712.62 Nm, p £ 0.05) at liftoff of the PDL. **CONCLUSION:** The form used, and forces at the knee and trunk extensors

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.

- 1418 Board #93 June 1 9:00 AM - 10:30 AM
Validity Of Using The Microsoft Kinect™ To Automatically Assess Deep Squat Performance
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 (No relationships reported)

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±7.5 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) automatic scoring methods. For prototype (V2), the intraclass 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) (Kw = 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.

- 1419 Board #94 June 1 9:00 AM - 10:30 AM
The Effects of Squats and Jump Squats on Mechanical Work and Energy Expenditure
 Shawn N. Munford, Michael L. Rossetti, Gavin L. Moir, Brandon W. Snyder, Shala E. Davis, FACSM. *East Stroudsburg, East Stroudsburg, PA.* (Sponsor: Shala E. Davis, FACSM)
 (No relationships reported)

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 (30PN-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 (30PB). Force plates and a 3-D 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 30PN-B (MD: 7,749 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 30PN-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 30PN-B (MD: 11,326 J, p=0.001, ES: 0.92). Energy expenditure during 30PB was also significantly greater than that during 30N-B (MD: 12,615 J, p=0.001, ES: 1.04) and 30PN-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.

- 1420 Board #95 June 1 9:00 AM - 10:30 AM
Electromyographic Analysis Of The Two Parts Of The Gluteus Maximus During Squat Exercises
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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 gluteus medius (GMED) 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 (MVIC). 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 MVIC 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.

- 1421 Board #96 June 1 9:00 AM - 10:30 AM
A Consecutive Loop Elastic Band Placed Around the Distal End of the Thighs During an Overhead Barbell Squat Increases Medial Knee Collapse
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 (No relationships reported)

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 thorax. 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 with the band condition for the concentric phase (band: 0.96 ± 0.6 ; 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 ± 0.06 , $P < 0.05$).

DISCUSSION: KWI during the overhead 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.

1422 Board #97 June 1 9:00 AM - 10:30 AM
Internal and External Focus of Attention During Bench Press Results in Increased EMG Amplitudes

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It is generally acknowledged that performance in various motor skills can be significantly affected by the participant's focus of attention, induced by instructions for instance. However, the effect of focus of attention in relation to strength training exercises remains to be investigated. **PURPOSE:** To address the effect of internal and external focus of attention on the surface electromyography (EMG) amplitude during bench press. **METHODS:** Twenty-one young male individuals (age 25 ± 2 years) with at least two years of strength training experience (3 repetition maximum (3RM) in bench press 109 ± 25 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 EXT than NOI for pectoralis major (PM) 44 ± 16 vs. $40 \pm 16\%$, anterior deltoid (DA) 43 ± 18 vs. $38 \pm 17\%$, triceps brachii medial head (TBM) 40 ± 19 vs. $35 \pm 17\%$, latissimus dorsi (LD) 40 ± 17 vs. $36 \pm 16\%$, and erector spinae (ES) 24 ± 15 vs. $22 \pm 14\%$ ($p \leq 0.05$ for all). The average normalized EMG amplitude values were significantly higher for INT than NOI for DA 43 ± 18 vs. $38 \pm 17\%$, biceps brachii (BB) 30 ± 18 vs. $28 \pm 16\%$, TBM 40 ± 19 vs. $35 \pm 17\%$, LD 43 ± 18 vs. $36 \pm 16\%$, and ES 27 ± 17 vs. $22 \pm 14\%$ ($p \leq 0.05$ 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.

1423 Board #98 June 1 9:00 AM - 10:30 AM
External Mechanical Indices of Resistance Exercise and the O₂ Cost

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 (No relationships reported)

PURPOSE: (1) To measure external mechanical indices of Work & Power during bouts of resistance exercise (RE) completed at 3 relative intensities (RI). (2) To determine the relationship between external measures of Work & Power during RE & O₂ uptake (VO₂) & CO₂ production (VCO₂). **METHODS:** 9Ss, 7 female, who were RE untrained volunteered. Ss underwent assessments to determine VO_{2max}, body composition (BodPod), & 1-RM for Chest Press (CP) & Leg Press (LP). RI were set at 33, 50, & 75% 1-RM; 22, 15, & 10 reps were performed, respectively, in an attempt to control for volume of work during RE. Experimental procedures consisted of: 5min Rest, followed by RE, & 10min Post RE Rest; RE & Post RE Rest were repeated for LP & CP at each RI. RE-RI combinations were counterbalanced. VO₂, VCO₂ & HR were recorded using a Cosmed K4b². Work (W), Work Integral (IntW), Power (P), & Total RE Time (T) was measured with an ultrasound sensor (used to measure Distance & Time of weight stack movement) and NI's Labview software platform. **RESULTS:** Age=21.5±0.5yrs, Ht=166.5±6.2cm, Mass=65.4±11.7kg, BMI=23.5±3.7, BodyFat%=20.7±7.5, FM=13.8±7.5kg, LM=51.5±7.7kg, VO_{2max}=46.4±8.4ml/kg/min, RERmax=1.13±0.03, & HRmax=200±6.2. Total O₂ cost (TVO₂) was measured

as the O₂ used during RE & 10min Post RE Rest using Integral estimation of breath-by-breath intervals. W, IntW & P during LP & CP was not significantly different (sd) by RI. T during LP & CP was sd by RI [LP75<LP50<LP33 & CP75<CP50<CP33; $p < 0.005$]. W, IntW & P for LP compared to CP at each RI was significantly greater ($p < 0.01$). T during LP75 vs CP75 was not sd while T for LP vs CP was significantly greater at 50% & 33% RI ($p < 0.005$). W & IntW for Rep1 vs last Rep were not sd for LP or CP by RI. P for Rep1 vs last Rep was sd for LP75 & CP75 ($p < 0.05$). W, IntW & P were significantly, positively correlated with VO₂ & VCO₂ during RE for CP at each RI & for LP50. W, IntW & P for LP or CP were not correlated with TVO₂. **CONCLUSIONS:** Measurement of W & P was actually held constant during RE bouts at each RI, but W & P during LP was greater at each RI. Only during CP were W & P related to VO₂ & VCO₂ at each RI; however, TVO₂ was not related to W & P during either LP or CP. This suggests a disassociation between W & P and the dynamics of VO₂, VCO₂ & TVO₂ and ultimately the O₂ deficit & debt incurred during & following RE.

C-36 Free Communication/Poster - Body Composition

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

1424 Board #99 June 1 9:00 AM - 10:30 AM
Polyphenol Supplementation Attenuates Apoptotic Signaling Following Acute Resistance Exercise in Untrained Males

Jeremy R. Townsend¹, Jeffrey R. Stout, FACSM², Adam R. Jajtner³, David D. Church², Kyle S. Beyer², Michael B. La Monica², Joshua J. Riffe², Tyler W.D. Muddle², Leonardo P. Oliveira², Kelli A. Herrlinger⁴, David H. Fukuda², Jay R. Hoffman, FACSM². 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) were randomized to PPB ($n=14$), placebo (PL; $n=14$) or control (CON; $n=10$). Participants completed a lower-body muscle-damaging resistance exercise protocol comprised of 10 repetitions at 70% of 1-RM for the squat (6 sets), leg press (4 sets) and leg extension (4 sets), with 90 seconds of rest between sets. Skeletal muscle microbiopsies were obtained from the vastus lateralis pre-exercise (PRE), 1-hour (1HR), 5-hour (5HR), and 48-hours (48HR) post-resistance exercise. Apoptotic signaling pathways were quantified using multiplex signaling assay kits to quantify total proteins (Caspase 3, 8, 9) and markers of phosphorylation status (JNK, FADD, p53, BAD, Bcl-2). Change scores from PRE were calculated for each group (PPB, PL, CON) and analyzed by magnitude based inferences to compare the effects of each condition on intramuscular signaling following resistance exercise. The precision of the magnitude inference was set at 90% confidence limits using the p value corresponding to the t-statistic. **RESULTS:** Magnitude based inferences indicated a "likely" decrease in total Caspase 3 and "possibly" decreased total Caspase 9 in PPB compared to PL from PRE-5H. JNK phosphorylation was "likely" decreased from PRE-5H in PPB compared to PL. BAD was "very likely" decreased from PRE-5H in PPB when compared to PL and Bcl-2 was "likely" decreased from PRE-1H and PRE-5H in PPB compared to PL. Phosphorylation of p53 was "likely increased" in PPB compared to PL from PRE-1H and PRE-48H. **CONCLUSION:** These data indicate that chronic supplementation with PPB may attenuate or delay indices of apoptosis in skeletal muscle following an acute muscle-damaging resistance exercise. Supported by Kemin Foods L.C.

1425 Board #100 June 1 9:00 AM - 10:30 AM

Body Composition Of Italian Soccer RefereesCristian Petri¹, Gabriele Mascherini¹, Carlo Castagna², Angelo Pizzi², Pierluigi Collina³, Giorgio Galanti¹. ¹*Sport Medicine Center, Florence, Italy.* ²*FIGC, Florence, Italy.* ³*UEFA, Florence, Italy.*

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(No relationships reported)

PURPOSE Soccer is a sport in which players perform different kind of activities at different level of effort over a 90-min match. Referee is so important for this sport that without him there is no match. The objective of the present study was determined the body composition of official Italian soccer referees and compare their changes through a regular season (T1, October; T2, December; T3, May) with a team of the first Italian league. **METHODS** 22 elite soccer referees (SR) from the Italian Association of Soccer and 18 elite Soccer players (SP) were enroll in this study. The variables of body mass, height, skinfold thicknesses, body circumferences (waist, hip and biceps) were collected with the purpose of estimating Sum of skinfold thicknesses (Fat Mass (FM %), Fat Mass (FM kg), Fat Mass index (FMI kg/h) and Free-fat mass (FFM kg). **RESULTS** We observed statistical differences in age (SR= 39.0 ± 3.6; SP= 27.0 ± 3.5; p= ≤ 0.005). In T1, T2 and T3 evaluation are been detected statistical differences if we compare the 2 groups (Table 1). During the season in referees group are been observed statistical difference in body mass (T1, 77.4 ± 4.2; T2 78.1 ± 4.4; T3 78.3 ± 4.2 kg; p= < 0.005), waist circumference (T1, 76.5 ± 2.3; T2 78.1 ± 2.9; T3 77.4 ± 2.6 cm; p= < 0.005) and free-fat mass (T1, 66.7 ± 3.8 T2 67.6 ± 4.0; T3 67.1 ± 4.0 kg; p= < 0.005). In elite soccer players don't are been found statistical differences. **CONCLUSION** Considering the results of the present study we may conclude that official football referees presented an amount of body fat higher of that observed in football players. Therefore, the nutritional habits must be adapted to their daily physical activities, short training periods and moderate energy intensity physical activity, on average, during match refereeing, to obtain better performance.

| | Soccer Referees T1 | Soccer Players T1 | P value | Soccer Referees T2 | Soccer Players T2 | P value | Soccer Referees T3 | Soccer Players T3 | P value |
|---------------------|--------------------|-------------------|---------|--------------------|-------------------|---------|--------------------|-------------------|---------|
| Sum of thick-nesses | 78.0 ± 19.4 | 48.9 ± 7.9 | < 0.005 | 74.4 ± 17.1 | 47.8 ± 2.8 | < 0.005 | 80.0 ± 17.0 | 47.9 ± 3.3 | < 0.005 |
| FM % | 13.6 ± 3.0 | 8.8 ± 1.7 | < 0.005 | 13.2 ± 2.7 | 9.0 ± 1.8 | < 0.005 | 13.9 ± 2.9 | 8.8 ± 1.6 | < 0.005 |
| FM Kg | 10.7 ± 2.2 | 7.2 ± 1.5 | < 0.005 | 10.6 ± 2.0 | 7.5 ± 1.6 | < 0.005 | 11.1 ± 2.1 | 7.3 ± 1.2 | < 0.005 |
| FM/h | 5.8 ± 1.2 | 3.9 ± 0.8 | < 0.005 | 5.7 ± 1.1 | 4.1 ± 0.9 | < 0.005 | 6.0 ± 1.1 | 3.9 ± 0.6 | < 0.005 |
| FFM Kg | 66.7 ± 3.8 | 72.7 ± 4.7 | < 0.005 | 67.6 ± 4.0 | 72.7 ± 4.6 | < 0.005 | 67.1 ± 4.0 | 72.9 ± 5.2 | < 0.005 |

1426 Board #101 June 1 9:00 AM - 10:30 AM

High-intensity Interval Training Vs. Moderate-intensity Continuous Training For Body Composition. A Systematic Review And Meta-analysis.Michael A. Weege, Roanna van den Berg, Rachel E. Ward, Andrew Keech. *University of New South Wales, Sydney, Australia.*

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(No relationships reported)

Physical activity is an important component of weight management, but the optimal exercise characteristics for body fat loss and weight reduction are not clear. High-intensity interval training (HIIT) is becoming increasingly popular as an alternative to moderate-intensity continuous training (MICT), with robust evidence for its efficacy to improve maximal aerobic fitness and vascular function in healthy and clinical populations. However, there are no systematic reviews exploring the relative merits of HIIT and MICT on body composition outcomes. **PURPOSE:** To conduct a systematic review and meta-analysis comparing the effects of HIIT and MICT protocols on body composition outcomes in overweight or obese, healthy adults. **METHODS:** Data was systematically sourced from controlled trials (randomised or matched) found on electronic search engines (MEDLINE, Scopus, Embase, SportDiscus, Web of Science, CINAHL and PEDro) up to September 2016. Trials directly compared HIIT and MICT intervention in healthy but overweight or obese patients aged 18-45 years. Outcome measures included body mass, body fat, lean mass and trunk fat. Data was analysed using RevMan 5.3 and SPSS. **RESULTS:** From 1330 articles, 15 studies were included, involving 455 participants (mean age = 33years; BMI = 29.6; 53% male). HIIT (N=231) and MICT (N=224) interventions duration averaged nearly 11 weeks (3.5 sessions/week), and the majority of studies applied matched exercise modes and work outputs. Weekly exercise time was significantly lower in HIIT than MICT (95.5 vs. 158.54 minutes; p = 0.002). Both HIIT and MICT appear to induce modest improvements (effect sizes ranging 0.2-0.3) in body mass, BMI, body fat %

and fat mass (kg), and waist circumference. There was no significant difference in effectiveness of HIIT and MICT on any of these outcome measures, with no significant heterogeneity in any of the 32 analyses conducted. **CONCLUSION:** Exercise training involving either HIIT or MICT can induce mild improvements in body composition. HIIT is just as efficacious as MICT for improving body composition, however HIIT requires ~40% less time commitment. More studies are required to analyse regional-specific changes in body fat, especially central adiposity and visceral fat.

1427 Board #102 June 1 9:00 AM - 10:30 AM

Impact of Acute Dietary Manipulations on Dual-Energy X-ray Absorptiometry Estimates of Visceral Adipose TissueJeffrey S. Forsse¹, Grant M. Tinsley², Flor E. Morales Marroquín¹, Peter W. Grandjean, FACSM¹. ¹*Baylor University, Waco, TX.* ²*Texas Tech University, Lubbock, TX.* (Sponsor: Peter Grandjean, FACSM)

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(No relationships reported)

Purpose

Dual-energy x-ray absorptiometry (DXA) is viewed as a superior method of body composition assessment, but whole-body DXA scans are impacted by variation in pre-assessment activities, such as eating and drinking. DXA software now allows for estimation of visceral adipose tissue (VAT), which has been implicated in a number of diseases. It is unknown to what extent food and fluid intake affect VAT estimates. In the present analysis, the effects of acute high-carbohydrate (HC) and very low-carbohydrate (VLC) diets on DXA estimates of VAT were examined.

Methods

Male and female adults completed two one-day dietary conditions in random order: a VLC diet (1 - 1.5 g CHO/kg) and a HC diet (9 g CHO/kg). The diets were isocaloric to each other, and all food items were provided to participants. DXA scans were conducted in the morning after an overnight fast and in the afternoon soon after the third standardized meal. VAT volume, mass, and area were obtained, and paired samples t-tests were performed to compare the changes in VAT measures between diets.

Results

Fifteen males (age 22 ± 3, BF% 21 ± 5%) and eighteen females (age 21 ± 2, BF% 31 ± 5%) were included in the analysis. The change in VAT volume between the fasted and fed visits was different between diets (HC: +1.6%; VLC: -9.2%, p=.047). There were also trends for differences in VAT mass (p=.089) and area (p=.096) changes between diets.

Conclusions

Within a single day, VAT estimates are differentially affected by isocaloric HC and VLC diets, with VLC consumption leading to reductions in VAT estimates. The content of the diet on the day of a DXA scan can affect estimates of VAT, which could spuriously influence the categorization of an individual's health risk by DXA VAT estimates. Standardization of food intake prior to scans, preferably in the form of an overnight fast, should be employed to eliminate this important source of error.

1428 Board #103 June 1 9:00 AM - 10:30 AM

Utility of Skinfold Measures and Lifestyle Questionnaires in Prenatal CareKidana Kidane, Anna Magee Morris, Katherine H. Ingram. *Kennesaw State University, Kennesaw, GA.*

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(No relationships reported)

Gestational diabetes is a serious condition, affecting up to 12% of pregnancies, and is associated with obesity and inactivity. During late pregnancy, women generally become insulin resistant and many develop diabetes, however a late diagnosis leads to late intervention. **PURPOSE:** To test the hypothesis that body fat and physical activity can be used as early predictors of gestational insulin resistance. **METHODS:** At approximately 19 weeks gestation, 32 nulliparous pregnant women (71% white; aged 27.2 ± 4.5 years) received body composition measures, including 8 skinfolds, bioimpedance (InBody 720), and abdominal adipose tissue via ultrasound, in addition to surveys and 7-day accelerometry (Actigraph GT3x). Sedentary time was computed from accelerometry, while 3 survey questions about time spent sedentary (TV, computer time, sitting time), were summed to create a dichotomous (sedentary Y/N) score. Homeostasis assessment model of insulin resistance (HOMA-IR) was calculated from fasting glucose and insulin at 24-26 weeks. HOMA-IR required log-transformation for normality. **RESULTS:** Adjusting for age and race, HOMA-IR correlated with subcutaneous (SAT; $r = .627, p = .003$) and intra-abdominal (IAAT; $r = .671, p = .002$) ultrasound measures, as well as 5 skinfold measures in the trunk region, but most strongly the suprailliac ($r = .684, p = .001$) and abdominal ($r = .681, p < .001$) measures. These relationships persisted after further controlling for percent body fat. HOMA-IR correlated with sedentary Y/N from surveys ($\rho = .523, p = .015$), but not accelerometer measures of activity ($r = .034, p = ns$) or sedentary time ($r = .147,$

$p=ns$). Stepwise linear regression revealed the suprailiac skinfold as the strongest independent predictor of HOMA-IR ($R^2=.474, p=.001$) and excluded IAAT, SAT, and abdominal fold. A model including suprailiac and sedentary Y/N was stronger ($R^2=.557, p<.001$). **CONCLUSION:** Subcutaneous abdominal fat distribution is a strong, independent predictor of gestational insulin resistance. Moreover, skinfolds and a brief activity questionnaire may be effective early predictors of gestational insulin resistance, thus making earlier prenatal intervention feasible. Supported by the Office of the Vice President of Research and Center for Excellence in Teaching and Leadership, Kennesaw State University.

1429 Board #104 June 1 9:00 AM - 10:30 AM
Change in Body Mass from Kindergarten to 5th Grade as a Predictor for Body Mass in 5th Grade
 Alexis Malmkar, Kate Heelan, FACSM. *University of Nebraska at Kearney, Kearney, NE.*
(No relationships reported)

Childhood obesity impacts approximately 12.7 million children in the US (Ogden, et.al., 2015). Prevalence of obesity among 6-11 year (17.5%) is more than double of toddler-aged children 2-5 year olds (8.9%). Identifying excessive weight gain among school-aged children and implementing healthy living programs in schools may assist the attenuation of excessive weight gain. **PURPOSE:**The purpose of this study was to evaluate changes in body mass (BM) from K through 5th grade and determine its impact on BM in 5th grade. **METHODS:**BM and stature were measured on a single population of 199 elementary school children in 2010 (K) and again in 2015 (5th grade). BMI was calculated by (kg/m^2). BMI percentiles (BMI %tile) were determined using the CDC age-and gender-specific BMI %tiles. Weight status in both K and 5th grade were determined as Normal Weight (5th -84.9th BMI %tile), Overweight (85th -94.9th BMI %tile) and Obese ($\geq 95^{th}$ BMI %tile). Stepwise multiple regression analysis was computed to determine if change in BM from K to 5th grade, BM, or BMI in K predicted BM in 5th grade. **RESULTS:**64.77% of students remained in the normal weight classification from K to 5th grade and gained 36.58 \pm 10.67 lbs. 18.13% of students moved into or remained in the overweight weight classification between K and 5th grade and gained 50.55 \pm 7.49 lbs. 13.47% of students moved into or remained in the obese weight classification and gained 73.98 \pm 14.71 lbs. 3.63% of students moved from unhealthy to a healthier weight classification and gained 34.84 \pm 11.13 lbs ($p<0.05$). Change in BM from K-5th grade ($R^2=0.82, p<0.05$), K BM ($R^2=0.02, p<0.05$), and K BMI ($R^2=0.12, p<0.05$) significantly predicted 5th grade BM accounting for 95% the variance ($p<0.05$). **CONCLUSIONS:**Those that remained in an unhealthy weight classification from K to 5th grade gained 50.55% more weight in 5 years, an average of approximately 7.5 more lbs per year compared to a normal weight gain. More alarming is the weight gain among students who moved into an overweight or obese weight classification and gained 73.98 \pm 14.71 lbs in 5 years; more than double of the normal weight gain for growth and maturation. Programs that focus on prevention of excessive weight gain are warranted to assist student in elementary school to avoid unnecessary weight gain and assist obese children to grow into their body mass over time.

C-37 Free Communication/Poster - Bone, Bone Mineral Density, and Microarchitecture

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

1430 Board #105 June 1 8:00 AM - 9:30 AM
Local Adaptations of Osteocyte Proteins to Increased and Decreased Mechanical Forces Correlate with Osteoblast Levels
 Corinne E. Metzger, Michael J.M. Junior, Jessica E. Brezicha, Harry A. Hogan, Susan A. Bloomfield, FACSM. *TEXAS A&M UNIVERSITY, College Station, TX.* (Sponsor: Susan A. Bloomfield, FACSM)
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(No relationships reported)

Osteocytes, cells embedded in the mineralized matrix of bone, 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-mo old) were subjected to HU ($n=7$) for 28 days. Age-matched controls (CON; $n=7$) had normal weight-bearing activity on all four limbs 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 (by 29% and 25%, respectively), but higher at the PH by 94% and 48%. Staining for osterix, a marker of osteoblasts, showed 60% lower %osterix+ cancellous bone surface in HU in the DF; however, the PH had 48% more %osterix+ 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.

1431 Board #106 June 1 8:00 AM - 9:30 AM
Influence Of 25(OH)D, Parathyroid Hormone And Cytokines On Bone Resorption During Acute Vigorous Running
 Aoi Ikedo, Marin Imai, Satoshi Fujita. *Ritsumeikan University, shiga, Japan.*
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(No relationships reported)

Athletes who undergo intense exercise routinely have been reported to demonstrate significant decrease in bone mineral density (BMD). Training-induced repeated exposures to increased bone resorption after a vigorous aerobic exercise may lead to decreased BMD. Parathyroid hormone (PTH) has been shown to be associated with increased bone resorption during exercise. In addition, low level of basal serum vitamin D (25(OH)D) has been reported to increase PTH. Furthermore, in differentiation / activation of osteoclasts (increase in bone resorption), cytokines have been reported to be involved. Thus, although various factors are associated, the mechanisms for exercise-induced increase in bone resorption are still unclear. **PURPOSE:** The purpose of this study was to examine relationship between basal 25(OH)D status, PTH and cytokine responses on exercise-induced bone resorption. **METHODS:** Seven healthy male subjects (age: 22.7 ± 1.8 years old, BMI: 21.4 ± 1.9 kg/m^2 , VO_{2max} : 56.1 ± 3.5 $ml/kg/min$) participated in this study. Subjects performed treadmill running for 90-min at 75% of VO_{2max} . Blood samples were collected pre, post, 1hr-post and 1day-post exercise for measurement of glucose, lactate, PTH, CTX (bone resorption marker), M-CSF, TNF- α . Serum 25(OH)D level was assessed at baseline before exercise. **RESULTS:** Serum 25(OH)D at baseline was 27.9 ± 4.8 ng/ml . Although CTX was increased by $5.9 \pm 23.7\%$ at post-exercise, it was not statistically significant. PTH was significantly increased post-exercise ($P = 0.05$), but it was reduced below pre level at 1hr-post ($P = 0.05$). Correlations between cytokines (M-CSF and TNF- α) and CTX were not statistically significant. PTH and 25(OH)D at baseline showed a negative correlation ($r = -0.81, P = 0.03$). However, basal 25(OH)D and PTH at either post, 1hr-post, or 1day-post was not correlated significantly. On the contrary, there were significant correlations between PTH and CTX at pre ($r = -0.76, P = 0.05$), post ($r = 0.81, P = 0.03$) and 1day-post ($r = 0.82, P = 0.04$). Furthermore, post PTH and 1hr-post CTX showed a positive correlation ($r = 0.77, P = 0.04$). **CONCLUSION:** Exercise-induced bone resorption demonstrated a strong relationship with PTH response. However, basal 25(OH)D and cytokines were not associated with exercise-induced bone resorption.

1432 Board #107 June 1 8:00 AM - 9:30 AM
Associations Between Vitamin D and Tibial Density and Trabecular Microarchitecture in Army Infantry Recruits
 Julie P. Greeves¹, Thomas J. O'Leary², Jonathan C.Y. Tang³, William D. Fraser³, Neil P. Walsh, FACSM⁴, Samuel J. Oliver⁴, Laurel M. Wentz⁴, Rachel M. Izard². ¹HQ Army, UK Ministry of Defence, Andover, United Kingdom. ²HQ Army Recruiting and Training Division, UK Ministry of Defence, Upavon, United Kingdom. ³University of East Anglia, Norwich, United Kingdom. ⁴Bangor University, Bangor, United Kingdom.
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(No relationships reported)

Serum 25-hydroxyvitamin D (25(OH)D) concentrations ≥ 50 nmol/L are advocated for optimal bone health. In military recruits, low 25(OH)D concentrations have been associated with increased stress fracture risk during initial training, but little is known

of the effect of vitamin D status on bone density and microarchitecture in young healthy men. **PURPOSE:** To investigate the relationship between total serum 25(OH) D and bone density, structure and trabecular (Tb) microarchitecture of the distal tibia using high-resolution peripheral quantitative computed tomography (HR-pQCT) in young male British Army recruits. **METHODS:** 324 healthy British Army infantry recruits (age, 22 ± 3 years; height, 1.77 ± 0.06 m; body mass, 75.5 ± 10.2 kg) provided informed consent. In week one of training, scans were performed at the distal tibia of the non-dominant leg using HR-pQCT (Xtreme CT, Scanco Medical, Switzerland), and a blood sample was drawn for measurement of total serum 25(OH)D and intact parathyroid hormone (iPTH). Participants were enrolled onto the study across all seasons. Participants were stratified into two groups based on their total serum 25(OH) D concentrations: Sufficient (≥50 nmol/L) and Deficient (<50 nmol/L), and were also assessed with total serum 25(OH)D as a continuous variable. **RESULTS:** 39.5% of participants were classified Deficient (*n* = 128) and 60.5% as Sufficient (*n* = 196). There were no significant differences between groups in bone density, structure or Tb microarchitectural parameters (*P* > 0.05). Cortical area (151 ± 28 vs 145 ± 26 mm², *P* = 0.057, ES = 0.22) and sub-endocortical Tb density (301 ± 34 vs 294 ± 29 mg HA/mm³, *P* = 0.058, ES = 0.22) tended to be higher in the Sufficient than the Deficient group. Serum 25(OH)D was negatively associated with iPTH (*r* = -0.271; *P* < 0.0001), and positively associated with cortical area (*r* = 0.183; *P* < 0.01), cortical thickness (*r* = 0.147; *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 microarchitecture of the distal tibia in young healthy men. These findings suggest that vitamin D status is not a key factor influencing bone strength. The role of vitamin D in stress fracture risk warrants further investigation.

Supported by UK MoD (Army)

1433 Board #108 June 1 8:00 AM - 9:30 AM
Bone-specific Physical Activity Questionnaire (BPAQ) Score Associations with Proximal Femur Geometry from DXA-derived 3D Analysis

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The bone-specific physical activity questionnaire (BPAQ) was developed to account for the lifetime influence of habitual mechanical loading on the skeleton. It has been previously shown that BPAQ scores predict DXA-derived bone mass at clinically important sites and exhibit high inter- and intra-rater reliability. Recently, software was developed to determine three dimensional (3D) parameters of the proximal femur from standard DXA scans, from which the influence of physical activity on bone geometry can be examined. **PURPOSE:** The aim of the current study was to determine the relationship of lifetime bone-relevant physical activity to morphometric parameters of the proximal femur from novel 3D analysis of standard DXA scans. **METHODS:** Healthy men and women from the local community underwent proximal femur DXA scans (Medix DR, Medilink) and completed the BPAQ. Scans were analysed using the novel 3D software (DMS Group, France) to derive cortical and trabecular volume and cortical thickness at the femoral neck (FN) and total hip (TH). Lifetime bone-relevant physical activity was determined from the BPAQ and group tertiles were compared using one-way ANOVA. **RESULTS:** A total of 234 participants were recruited (53.6 ± 19.1 yrs, 167.7 ± 9.3 cm, 71.5 ± 15.2 kg), of whom 33.3% were men (*n* = 78). Participants in the highest BPAQ tertile exhibited more robust parameters of bone geometry than the lowest BPAQ tertile for trabecular volume (FN = 12.78 ± 3.38 cm³ vs. 10.95 ± 2.46 cm³; TH = 75.36 ± 18.66 cm³ vs. 63.43 ± 14.43 cm³, *p* < 0.001), cortical volume (FN = 2.14 ± 0.58 cm³ vs. 1.73 ± 0.44 cm³; TH = 13.57 ± 3.42 cm³ vs. 11.06 ± 2.54 cm³, *p* < 0.001), total volume (FN = 14.90 ± 3.85 cm³ vs. 12.69 ± 2.77 cm³; TH = 88.92 ± 21.60 cm³ vs. 74.63 ± 16.55 cm³, *p* < 0.001) and total cortical thickness (FN = 1.11 ± 0.20 mm vs. 0.99 ± 0.19 mm, *p* < 0.001). **CONCLUSIONS:** Lifetime bone-relevant physical activity is associated with more robust bone geometry at the proximal femur; in particular, bone volume and cortical thickness. Those properties are typically associated with greater bone strength, and thereby reduced fracture risk. These findings emphasize the importance of lifelong bone-relevant exercise for maintaining a healthy skeleton and confirm the sensitivity of the BPAQ to exercise-related geometric adaptation.

1434 Board #109 June 1 8:00 AM - 9:30 AM
Skeletal Characteristics of Competitive Female Rowers

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Weight-supported activities, such as rowing, are not commonly prescribed for fracture prevention. However, rowing requires large magnitudes of internal loading, thus it has

potential to induce positive skeletal adaptations, especially in the hip and radius, two common fracture sites. **PURPOSE:** To examine skeletal health and body composition in college aged competitive female rowers. **METHODS:** In this cross-sectional study, 24 rowers and 24 age and body mass (±2yrs and 5lbs) matched physically active controls were compared. DXA was used to measure body composition and areal BMD (aBMD) of the total body, lumbar spine, hips and forearms, and hip structural analysis variables. pQCT was used to assess bone characteristics and bone strength of the tibiae (4%, 38%, 66%) and radii (4%, 66%) sites. **RESULTS:** Age- and height-adjusted aBMDs were not significantly different between groups (*p* > 0.05), but rowers had greater hip cross-sectional moment of inertia (*p* ≤ 0.05). Rowers had greater tibiae 4% total area, trabecular area, and periosteal circumference (PeriC) (*p* ≤ 0.05). Also, total bone content and area, cortical area, PeriC, iPolar and SSI were greater at the tibiae 38% and 66% sites for rowers (*p* ≤ 0.05). Controls had significantly greater 38% tibiae cortical density than rowers (*p* ≤ 0.05). Rowers had significantly greater forearm muscle cross sectional area (*p* ≤ 0.01) at the 66% radial site, and greater PeriC at the 4% radial site (*p* ≤ 0.05). **CONCLUSIONS:** Rowers had greater tibiae bone area and strength compared to controls, but there were no group differences in aBMD or most radial bone variables. Our findings suggest that competitive rowing has osteogenic potential and may be particularly beneficial for improving bone quality at the tibiae even when compared to physically active controls.

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

| | Rowers (n=24) | Controls (n=24) |
|--|----------------|-----------------|
| Hip Cross-sectional moment of inertia (mm ⁴) | 13256±495.6* | 11841.5±409.8 |
| 38% Tibia Strength-Strain Index (mm ³) | 1887.8±61.9* | 1705.1±44.8 |
| 38% Cortical Density (mg/cm ³) | 1153.9±4.3 | 1168.1±3.2* |
| 66% Tibia Strength-Strain Index (mm ³) | 2852.5±109.4* | 2587.3±69.9 |
| 4% Radial Periosteal Circumference (mm) | 63.7±0.9* | 60.8±1.0 |
| 66% Radial muscle CSA (mm ²) | 3557.0±106.3** | 3108.1±88.3 |

* *p* < 0.05 and ** *p* < 0.01 significant differences between groups.

1435 Board #110 June 1 8:00 AM - 9:30 AM
Bone Mineral Monitoring with Dual-energy X-ray Absorptiometry (DEXA) in University Female Soccer Players

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Soccer practice usually has high intensity movements involving sprints and change of direction; these implicate great strength over the bone structure having influence in the bone mineral since they facilitate bone stimulation, getting the appropriate parameters. Several studies show soccer practice or training, amateur as well as professional, lead to effective adaptations in the bone mass, as well as increases in bone mineral content (BMC) and bone mineral density (BMD). **PURPOSE:** The evaluation of changes in BMC and BMD during 4-month period, competition training of university, female, soccer players.

METHODS: Body measurements were made at the beginning and at the end of 4-month training to 19 soccer players (20.87 ± 1.88 years old), through DEXA where BMC and BMD of arm, leg, trunk and total body were obtained. They were evaluated fasting at the morning, where every subject used a minimum of clothes for measurement. They also received informed consent explaining the test protocol, after that their height was measured. For the statistical analysis, the software SPSS version 21.0 was used. The Pearson product-moment correlation coefficient method was used. **RESULTS:** Meaningful increases were found from the initial take to the final take of BMC of arms and legs (*p* < 0.01), and meaningful decrease on trunk and total body (*p* < 0.01). Regarding BMD, significant increases were seen in legs and trunk (*p* < 0.01), however in total body obtained a significant decrease (*p* < 0.01) and not significant in arms (*p* = 0.252), all of this during a 4-month study.

CONCLUSIONS: Significant changes of lower limbs BMC and BMD are associated to the impact of kicking the ball, the sprints and the jumps that exist in soccer practice.

1436 Board #111 June 1 8:00 AM - 9:30 AM
The Feature of Bone Mineral Density Between High Altitude And Sea Level In Inhabitants

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PURPOSE: The main purpose of this study was to investigate the characterise of high altitude (HA) and sea level (SL) habitation on body composition (BC) and bone mineral density (BMD). **METHODS:** Total of 799 subjects aged from 20-69

years were included in this study. Three hundred sixty one healthy subjects including 129 males and 232 females were living in Qinghai-Tibet Plateau (QHTP) 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 $\alpha=0.05$. All data were expressed as mean \pm SD. **RESULTS:** BMD of the HA residents was significantly higher than that of the SL residents regardless of gender (Males: HA 103.7 ± 10.98 g/cm² > SL 99.4 ± 11.14 g/cm², $p < 0.01$) (Females: HA 108.5 ± 11.06 g/cm² > SL 104.1 ± 12.43 g/cm², $p < 0.01$). There was no significant difference in BMD of young males aged 20-29 in different living altitude. However, in 30-39 and 40-49 age groups, male HA residents showed higher BMD than SL folks (30-39: HA 102.5 ± 9.29 g/cm² > SL 96.7 ± 10.68 g/cm², $p < 0.05$) (40-49: 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 ± 12.41 g/cm² > SL 101.3 ± 11.37 g/cm², $p < 0.01$). Body fat percentage (BFP) of the HA residents was significantly higher than that of the SL residents regardless of gender (Males: HA $25.6 \pm 6.65\%$ > SL $22.2 \pm 7.01\%$, $p < 0.01$) (Females: HA $32.3 \pm 5.86\%$ > SL $28.7 \pm 6.77\%$, $p < 0.01$). There was significant 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 $26.4 \pm 6.80\%$ > SL $20.9 \pm 7.00\%$, $p < 0.01$) (50-59: HA $27.2 \pm 5.81\%$ > SL $24.2 \pm 5.76\%$, $p < 0.05$). **CONCLUSIONS:** 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 June 1 8:00 AM - 9:30 AM

Bone Quality in Weight and Non-Weight Bearing Sports in Male Collegiate Athletes

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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 weight bearing and non-weight bearing sports on bone quality in male collegiate athletes. **METHODS:** Ten male collegiate athletes (20.8 \pm 1.2yrs), with no history of musculoskeletal injuries within the last 12 months, were selected from each NCAA Division II men's soccer, football, cross country, swimming, and USA cycling Division I teams (n=50). For analyses, men's soccer, football, and cross country were considered WB, and swimming and USA cycling were considered NWB. A bone specific physical activity questionnaire (BPAQ) and a general demographic health questionnaire were collected for each athlete to determine eligibility for the study, as well as their history of physical activity and general demographic information that was relative to bone health. Using the Achilles InSight Ultrasonometer, broadband ultrasound attenuation (BUA), speed of sound (SOS), and stiffness index (SI) were measured on both heels for each athlete. The BUA, SOS, and SI were compared between sport, WB vs. NWB activities, and foot dominance using a two-way ANOVA with repeated measures. **RESULTS:** No significant differences were found between dominant and non-dominant foot for sports or WB vs. NWB activities. There were significant differences between BUA scores for sports and WB vs. NWB activities $p=0.026$ and $p=0.015$, respectively. The SOS scores were significant for sports and WB vs. NWB activities ($p<0.001$). SI scores were found to have a significant difference between sports type and WB vs. NWB activities ($p<0.001$). **CONCLUSION:** Weight bearing vs. non-weight bearing sports have significant effects on bone health in male collegiate athletes.

1438 Board #113 June 1 8:00 AM - 9:30 AM

Bone Mineral Density - Is It Lower In Synchronized Swimmers Compared To Competitive Swimmers?

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In female athletes bone mineral density (BMD) is typically 5-15% higher than in the non-athletic population, depending on the type and amount of impact on the bones. 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 questionnaires. **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·cm⁻², $p = 0.012$). SS were significantly leaner at puberty than CS (BMI 18.7 ± 1.3 and 21.5 ± 2.1 kg·m⁻², 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 and CS = 13.1 years) or in prevalence of menstrual irregularities. Average training hours per week for both groups was 24, but SS spend significantly ($p = 0.024$) more time in "out of water" training compared to CS (8 ± 3.5 and 5 ± 2.5 h·week⁻¹, 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 higher than CS. 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.

1439 Board #114 June 1 8:00 AM - 9:30 AM

The Effect of Soccer Training on Tibia Bone Properties in Healthy Young Females

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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 multi-axial loading (e.g. soccer) could help improve tibia 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 \pm 1 yr) and 20 mass and height matched sedentary women (21 \pm 1 yr) 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. **Results:** 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 those of 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 modeling 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-15-1-0006.

1440 Board #115 June 1 8:00 AM - 9:30 AM

Serum Sclerostin Levels Are Positively Correlated with Bone Mineral Density in Chinese Young Adults

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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 \leq 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 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 \pm SE)

| | Men (n=28) | Women (n=25) | Total (n=53) |
|--|----------------------|-------------------|-------------------|
| Total BMD (g/cm ²) | 1.249 \pm 0.017*** | 1.134 \pm 0.023 | 1.195 \pm 0.016 |
| Lumbar Spine BMD (g/cm ²) | 1.218 \pm 0.084 | 1.183 \pm 0.146 | 1.202 \pm 0.016 |
| Left Proximal Femur BMD (g/cm ²) | 1.119 \pm 0.133 ** | 0.979 \pm 0.183 | 1.053 \pm 0.024 |
| Bone Strength Index at 4% Tibia (mm ³) | 143.7 \pm 4.9*** | 88.0 \pm 7.3 | 117.4 \pm 5.8 |
| Sclerostin (ng/mL) | 0.442 \pm 0.021** | 0.353 \pm 0.019 | 0.400 \pm 0.015 |

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

1441 Board #116
Abstract Withdrawn

1442 Board #117 June 1 8:00 AM - 9:30 AM
Physical Activity During Youth is Associated with Adult Bone Microarchitecture
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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 \pm SD] 24.6 \pm 3.0 years) Caucasian men (n=50) and women (n=50). Cortical (Ct) and trabecular (Tb) volumetric bone density (vBMD), microarchitecture, and estimated bone strength (by micro-finite element analysis) were assessed at the distal tibia (4% of tibial length) using high-resolution pQCT (82 μ m³ voxel size). Physical activity questionnaires were administered and a SKL index derived based on the effective load stimuli associated with each activity and the duration the subject participated in the activity during ages 11 to 14. We used generalized linear regression to determine associations between SKL score and bone outcomes, adjusting for age in addition to BMI, weight, and their interaction. **RESULTS:** We found that the SKL score in adolescence was significantly associated with Ct.vBMD and Tb.vBMD in men and women respectively (M: $r^2 = 0.33$, $p = 0.045$; W: $r^2 = 0.33$, $p = 0.036$). 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 adolescent 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.

1443 Board #118 June 1 8:00 AM - 9:30 AM
Effect Of Low-magnitude Different-frequency Whole-body Vibration On Subchondral
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PURPOSE: To investigate the effects of different vibration frequencies of low-magnitude whole-body vibration (WBV) on subchondral trabecular bone microarchitecture, cartilage degradation and metabolism of the tibia and femoral condyle bone, and joint pain in an anterior cruciate ligament transection (ACLT)-induced knee osteoarthritis(OA) rabbit model. **METHODS:** Ninety adult rabbits subjected to unilateral ACLT were divided into six groups: Group 1, ACLT control group; Group 2, WBV (5 Hz) + ACLT; Group 3, WBV (10 Hz) + ACLT; Group 4, WBV (20 Hz) + ACLT; Group 5, WBV (30 Hz); and Group 6, WBV (40 Hz). Pain was tested via weight-bearing asymmetry. Subchondral trabecular bone microarchitecture was examined using *in vivo* micro-computed tomography. Knee joint cartilage was evaluated by gross morphology, histology, and ECM gene expression level (aggrecan and type II collagen [CTX-II]). Serum bone-specific alkaline phosphatase, N-mid OC, cartilage oligomeric protein, CPII, type I collagen, PIIANP, G1/G2 aggrecan levels, and urinary CTX-II were analyzed. **RESULTS:** After 8 weeks of low-magnitude WBV, the lower frequency (10 Hz and 20 Hz) WBV treatment decreased joint pain and cartilage resorption, accelerated cartilage formation, delayed cartilage degradation especially at the 20 Hz regimen. However, the higher frequencies (30 Hz and 40 Hz) had worse effects, with worse limb function and cartilage volume as well as higher histological scores and cartilage resorption. In contrast, both prevented loss of trabeculae and increased bone turnover. No significant change was observed in the 5 Hz group. **CONCLUSIONS:** 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.

1444 Board #119 June 1 8:00 AM - 9:30 AM
Tibial Density and Trabecular Microarchitecture in Army Recruit Stress Fracture Cases and Matched Uninjured Controls
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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 Army infantry recruits. **METHODS:** 324 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 \pm 3 years, 73.3 \pm 8.3 kg, 1.78 \pm 0.06 m, 593 \pm 68 s 1.5 km run time), and matched to 21 non-injured controls (22 \pm 3 years, 74.2 \pm 10.0 kg, 1.77 \pm 0.06 kg, 588 \pm 58s 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 volunteers using HR-pQCT (Xtreme CT, Scanco Medical, Switzerland) in week one of training. **RESULTS:** No significant differences were observed in bone density or Tb microarchitecture between stress fracture cases and uninjured controls ($P > 0.05$). A subgroup of seven cases suffering stress fractures to the tibia had higher Tb bone density (245 \pm 32 vs 209 \pm 28 mg HA/cm³, $P = 0.042$), higher sub-endocortical Tb density (320 \pm 21 vs 282 \pm 32 mg HA/cm³, $P = 0.047$) and higher Tb volume to tissue volume ratio (0.204 \pm 0.027 vs 0.174 \pm 0.023, $P = 0.042$) than uninjured controls. **CONCLUSION:** Young healthy men suffering stress fracture in training do not differ in their bone structure or Tb microarchitecture at the distal tibia from uninjured matched counterparts. Our understanding of bone microarchitecture in the development of stress fractures is limited by the utility of high resolution techniques to distal sites. Future studies should explore phenotypic characteristics in stress fracture cases at specific sites of injury, which typically develop at the distal third of the tibia in military recruits.
Supported by UK MoD (Army)

- 1445 Board #120 June 1 8:00 AM - 9:30 AM
Vertical Jump Test as a Health-Promotion Screening Tool for Predicting Bone Strength in Young Adults
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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, 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 strength-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 height-adjusted FN aBMD decreased 5.4% for females and 3.6% for males per 50 Watts of power. ROC analysis showed the best cut point to identify individuals with below-average aBMD was 5,038 Watts in males (sensitivity = 73.7%; specificity = 62.4%; AUC = 0.709, 95%CI = 0.572-0.847) and 3,261 Watts in females (sensitivity = 71.4%; specificity = 58.9%; AUC = 0.708, 95%CI = 0.586-0.829). These values correspond to vertical jump heights of 54.4 cm and 36.2 cm for males and females. **CONCLUSION:** We found acceptable sensitivity and specificity and moderate discriminate ability for muscle power, assessed with a peak vertical jump test, to identify young adults with below-average aBMD.

- 1446 Board #121 June 1 8:00 AM - 9:30 AM
RANK Gene Polymorphism Is Associated With Incidence Of Stress Fractures In Japanese Female Endurance Athletes
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 (No relationships reported)

In female endurance athletes, stress fractures are induced by repeated mechanical loading and various factors are involved in the development of stress fracture. The receptor activator of nuclear factor-kappa B (RANK) and its ligand (RANKL) are a member of the tumour necrosis factor superfamily and stimulate mature osteoclasts to resorb bone. However, effect of development of stress fractures on RANK and RANKL gene polymorphisms remains unclear in Japanese female endurance athletes. **PURPOSE:** This study aimed to clarify whether single nucleotide polymorphisms (SNPs) within the RANK and RANKL genes were associated with the incidence of stress fracture in Japanese female endurance athletes. **METHODS:** Twenty-four Japanese elite female long-distance runners (20 \pm 1 years, 160 \pm 4 cm, 48 \pm 4 kg, 15 \pm 4 %fat, Mean \pm SD) participated in a cross-sectional study. All subjects were investigated the onset number of stress fractures and medial tibial stress syndrome in the student period of the university from high school by using a questionnaire. SNPs of rs3018362 in RANK gene and rs1021188 in RANKL gene were determined by real-time PCR with Taqman probe. **RESULTS:** The onset number of stress fractures in the student period of the university from high school was significantly higher in the AA genotype of rs3018362 in RANK gene compared with the GA and GG genotype individuals (P<0.05). Moreover, the onset number of stress fractures and medial tibial stress syndrome in a student period of a university was significantly higher in the AA genotype of rs3018362 in RANK gene compared with other genotype individuals (each P<0.05). However, the rs1021188 in RANKL gene polymorphism had no impact on differences of the onset number of stress fractures and medial tibial stress syndrome. **CONCLUSION:** These results suggest the association between SNPs of rs3018362 in the RANK gene polymorphism and the incidence of stress fracture in Japanese female endurance athletes. Supported by Grants-in-Aid for Scientific Research (#26282199 and 16K13059, M. Iemitsu)

- 1447 Board #122
Abstract Withdrawn
- 1448 Board #123 June 1 8:00 AM - 9:30 AM
Measurement of Radial Bone Strength as Related to Common Muscle Function Tests in College Athletes
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The functional muscle-bone unit, described by the mechanostat theory, illustrates a dependence of bone strength on muscle size and strength. A recent study reported significant correlations between muscle power and both SSIP and cortical area ($r=.69-.78$) (Janz, 2015). Bone adaptation in response to mechanical loading is site specific. A loading stimulus to the lower limbs should not have an effect on the bones of the upper limbs.

PURPOSE: To investigate the relationship between common muscle function tests (Relative Grip Strength, 1 Rep Max of Leg Extensors, Peak Power-vertical jump) and bone strength in the radial diaphysis of Division II athletes.

METHODS: Eighty-six Division II athletes, 56 females and 30 males (age 20.2 \pm 1.7, height (m) 1.7 \pm 0.1, body fat % 17 \pm 7.4) performed a relative grip strength (RGS) test using a hand dynamometer, a one repetition maximum leg extension test (1RM), and a peak power vertical jump test (PP) using a Vertec. Moment of inertia (J), cortical area (Ct.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.

RESULTS: RGS, 1RM, and PP were all significantly correlated with Ct.Ar., J, and SSI. However, none of the muscle function measures were correlated with cBMD. Both RGS and 1RM were significantly correlated with SSI but RGS had a larger R2 value for all measurements: SSI (RGS [R2=0.3333, p<0.0001], 1RM [R2=0.2332, p<0.0001]), Ct. Ar. (RGS [R2=0.2638, p<0.0001]), 1RM (R2=0.2142, p<0.0001), J (RGS [R2=0.3609, p<0.0001]), 1RM (R2=0.1733, p=0.0008). Peak Power had the largest R2 values of all 3 measurements SSI (R2=0.5338, p<0.0001), Ct. Ar. (R2=0.4156, p<0.0001) J (R2=0.4802, p<0.0001).

CONCLUSIONS: The muscle-bone unit can be measured using functional muscle measurements; RGS, 1RM and PP all strongly correlated with bone strength. Interestingly PP, a lower limb measurement explained the most variance in the bone strength of the upper limb. Muscle function seems to have the greatest effect on the geometry of the bone and little influence on cBMD. Lower limb muscle power calculated by vertical jump assessment could provide a means to monitor and assess bone health.

- 1449 Board #124 June 1 8:00 AM - 9:30 AM
Changes In Tibial Bone Microarchitecture Following 8 Weeks Of U.S. Army Basic Combat Training
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BACKGROUND: Stress fractures affect up to 5% of men and 20% of women undergoing basic combat training (BCT), a physically demanding program that involves repetitive loading of the lower extremities. Animal studies have demonstrated adaptive microarchitectural bone formation following repetitive loading. This adaptive response may reduce the risk of injury. However, no studies have evaluated changes in bone microarchitecture following BCT, due to limitations with *in vivo* measurement techniques. Recent development of high-resolution peripheral quantitative computed tomography (HRpQCT) allows for assessment of bone microarchitecture *in vivo*, in humans. **PURPOSE:** To determine if changes in bone microarchitecture, indicative of adaptive bone formation, occur in female recruits following U.S. Army BCT.

METHODS: HRpQCT (XtremeCT II, Scanco Med) images of the distal tibia (4% of tibia length) were collected before and after 8 weeks of BCT. We used linear mixed models for each outcome of interest to estimate the mean difference and its 95% confidence interval (CI) in each microarchitectural bone measurement from pre- to post-BCT. Covariates were decided *a priori* and included race/ethnicity, age, and body mass index. **RESULTS:** Data were collected on 91 female recruits (37 African American, 40 Caucasian, 14 Other) with baseline age = 21.5 \pm 3.3 yrs and BMI = 23.7

± 2.8 kg/m². Mean total volumetric bone mineral density (Tt.vBMD) [1.79% (95% CI: 1.32, 2.25); $p < 0.001$], trabecular vBMD [2.01% (1.44, 2.58); $p < 0.001$], trabecular number [1.21% (0.48, 1.94); $p < 0.05$], trabecular thickness [1.13% (0.76, 1.50); $p < 0.001$], and trabecular bone volume/total volume [1.87% (1.31, 2.43); $p < 0.001$] all increased significantly with BCT, whereas trabecular spacing decreased significantly [-1.09% (-1.61, -0.56); $p < 0.001$]. **CONCLUSIONS:** We observed modest but statistically significant improvements in trabecular bone microarchitecture at the distal tibia after 8 weeks of Army BCT. The changes we observed are consistent 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.

1450 Board #125 June 1 8:00 AM - 9:30 AM

Higher Occurrence Rates Of Foot Sesamoids And Accessory Bones In Wrestlers By Ct And 3d-reconstruction

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(No relationships reported)

The sesamoids and accessory bones of feet are complicated and small but important in regulating pressure, frictions and direction of muscular traction. Multi-slice CT and 3D reconstruction becomes available for exhibiting bones' morphology. **PURPOSE:** To investigate the morphological features of podalic sesamoids and accessory bones in professional wrestlers by CT and 3D reconstruction. **METHODS:** 9 male Guangdong wrestlers served as subjects (height: 168.2 \pm 2.1 cm; weight: 66.8 \pm 4.2 kg; age: 18.3 \pm 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, 0.656mm 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 bones are below the first metatarsal bones while 17 in the great toe joints, with 2 to 3 sesamoids per foot. In 89% 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 298.8294m², 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 417.41 m². In all accessory bones, the triquetral bone in the right foot is biggest with volume 941.21 mm³, while the interphalangeal bone is smallest with 45.98 mm³. **CONCLUSIONS:** CT and 3D reconstruction may be effective for investigating the small bones. The sesamoids and accessory bones in feet of wrestlers could be common than no sportsmen, which is related to the acquired influence of Professional training.

1451 Board #126 June 1 8:00 AM - 9:30 AM

Calcium Lost Through Sweat: Is There Evidence of Bone Remodeling Due to Cutaneous Calcium Loss during Bikram Hot Yoga?

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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 (\pm 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. Nude body weight was measured before 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 were obtained. **RESULTS:** Participants mean age was 47.4 (3.7) years. Mean estimated sweat loss was 1.6 (.6) L eliciting a -1.5% to -3.8% ($M = -2.3 \pm .92\%$) decrease in participants' body weight. Mean Ca²⁺ in sweat was 3.78 \pm 1.8 mg/dl and the mean total calcium lost was 63.1 \pm 32.8 mg. PTH did not increase from pre (17.0 \pm 1.7) pg/ml to post (16.7 \pm 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.

1452 Board #127 June 1 8:00 AM - 9:30 AM

Predictors of Bone Mineral Density Among Intercollegiate Female Athletes

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PURPOSE: The purpose of this investigation was to determine the degree to which the confirmation of an eating disorder (ED), body mass index (BMI), percent body fat (PBF), and episodes of amenorrhea (EA) influence the bone mineral density (BMD) status of Division I-A female athletes. **METHODS:** Fifty National Collegiate Amateur Athletes (NCAA) females from a variety of intercollegiate sports (volleyball, soccer, track, tennis, golf, cheerleading, and softball) volunteered to participate. The athletes ranged in age from 18 to 35 ($M = 20.4$; $SD = 3.07$). All participants completed a demographic questionnaire, the Eating Attitudes Test-26 (Garner, Olmsted, Bohr, & Garfinkel, 1982), and signed an informed consent to participate. Following the written exercises, the subjects succumbed to anthropometric measurements (height, weight, and BMI), PBF determined by Lange calipers at three locations (abdomen, supraillium and triceps), and endured four regional scans (right/left radius and ulna and right/left femoral neck) on a Hologic QDR 4500W (S/N 49865) software version 11.2.5 dual x-ray absorptiometry. Four independent regression analyses were executed to determine the effect of BMI, PBF, EA, and ED scores on each of the four BMD measurements. **RESULTS:** The BMD of the dominant and non-dominant arm were significantly related to PBF and BMI ($p < .05$), whilst only BMI was significantly related to the BMD of the dominant and non-dominant femoral neck ($p < .05$). **CONCLUSIONS:** Only BMI was found to be a significant predictor of BMD for all four BMD sites. Although, BMI is not a consistent parameter from which body composition can be ascertained in athletes. PBF was a significant predictor for the forearms but not for each femoral neck. PBF was negatively correlated with the BMD at all four sites. Lean mass was not measured in this investigation to contrast the PBF results. It is therefore difficult to determine if PBF was significant due to increased lean mass or if this phenomena was due to a chronic energy deficit which could compromise PBF. The International Olympic Committee consensus group (De Souza, et al., 2014) called this chronic energy deficit RED-S (relative energy deficit in sport).

1453 Board #128 June 1 8:00 AM - 9:30 AM

Reduced Lean Mass and Fat Mass Exacerbate Effects of Estrogen Deficiency on Bone

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Lean mass is a stronger predictor of bone geometry in loaded limbs than fat mass in exercising women; however, estrogen exposure likely modulates the relationship between lean/fat mass and bone. We recently demonstrated that energy and estrogen status interact to impact vBMD, bone geometry and estimated bone strength (eBS) but that energy deficiency was often only detrimental in the presence of estrogen deficiency. This suggests that estrogen deficiency increases the vulnerability of bone to metabolic disruptions that accompany energy deficiency. We hypothesize that the impact of lean/fat mass on bone is dependent on estrogen status. **PURPOSE:** To compare the predictive value of lean mass index (LMI, kg*m⁻²) and fat mass index (FMI, kg*m⁻²) on vBMD, geometry, and eBS in the tibia in estrogen replete and estrogen deficient women. **METHODS:** Exercising women ($n = 60$, 18-30 yrs) were grouped by 1) Estrogen deficient (E_D, $n = 27$): oligo/amenorrheic <6 cycles/12 mo, and 2) Estrogen replete (E_R, $n = 33$): eu/oligomenorrheic ≥ 6 cycles/12 mo. Body

composition was assessed via DXA. vBMD, bone geometry, and eBS were assessed at the 4% (distal) and 66% (proximal) tibia via pQCT. Multivariate stepwise regression determined predictors of bone outcomes. **RESULTS:** LMI was a positive predictor of distal tibia total, trabecular, and cortical vBMD in E₂D women only, accounting for 28-36% of the variance (p<0.004). LMI was a positive predictor of distal tibia cortical area in E₂R women (R²=0.137, p=0.037). FMI was not predictive of bone outcomes in E₂R women but was a positive predictor of cortical area at the distal tibia in E₂D women (R²=0.162, p=0.038). At the proximal tibia, FMI and LMI were positive predictors of total vBMD (R²=0.494) and cortical thickness (R²=0.571) in E₂D women only (p<0.015). LMI was a positive predictor of total area (R²=0.353) and negative predictor of cortical vBMD (R²=0.141) in E₂R women only (p<0.044). FMI and LMI were positive predictors of distal tibia BSI in E₂D women (R²=0.435, p<0.029). LMI positively predicted BSI in E₂R 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

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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 (tBPAQ), aBMD, volumetric BMD (vBMD, mg/cm³), and bone markers in middle-aged premenopausal women. **METHODS:** Thirty-four premenopausal women (44.4 ± 4.1 years; 161.7 ± 5.4 cm; 69.9 ± 11.1 kg) were recruited for this study. aBMD of L1-L4 and dual proximal femur (TH; total hip, FN; femoral neck) were measured using Dual Energy X-ray Absorptiometry. We assessed vBMD of tibia 4% (ToD; total vBMD, trabecular vBMD), 38% (ToD, CoD; cortical vBMD, SSI; strength strain index), and 66% (ToD, CoD, SSI) by peripheral quantitative computed tomography. Bone formation (Bone ALP) and bone resorption (TRAP5b) markers were assessed. The tBPAQ was used to obtain a comprehensive account of lifetime physical activity related to bone health. **RESULTS:** Spearman's correlation showed significant (p<0.05) positive relationships between tBPAQ and aBMD of right FN(r=.370) and left femur (TH, r=.373; FN, r=.372) and L1-L4 (r=.371), but no significant relationship was found for the right TH (p>0.05). There were no significant correlations between vBMD variables and tBPAQ. Also, no relationships were found between tBPAQ and bone ALP and TRAP5b (p>0.05). When tBPAQ, bone free lean body mass (BFLBM), calcium intake, and age were included in a stepwise multiple linear regression analysis, BFLBM was the only predictor of tibia 38% and 66% SSI, accounting for 16% (p=0.012) and 27% of the variance (p=0.001), respectively. **CONCLUSION:** The tBPAQ score-derived physical activity had positive relationships with FN, TH, and L1-L4 aBMD in healthy middle-aged premenopausal women, but no significant associations were found between tBPAQ and both vBMD and bone markers. Table 1. tBPAQ and aBMD (g/cm²)

| Variables | Mean ± SD | Range |
|-----------|--------------|------------|
| tBPAQ | 24.3 ± 24.8 | 1.1 - 75.5 |
| L1-L4 | 1.222 ± .129 | .97 - 1.50 |
| R_TH | 1.015 ± .112 | .8 - 1.2 |
| R_FN | .988 ± .107 | .73 - 1.22 |
| L_TH | 1.015 ± .102 | .77 - 1.21 |
| L_FN | .984 ± .096 | .74 - 1.14 |

R, right; L, left

1455 Board #130 June 1 8:00 AM - 9:30 AM
Bone Mechanical Strength Deficits Following a Contusion Spinal Cord Injury in Rats

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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 surgery or T9 laminectomy 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 scale 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 (N) 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 SPIRE 1121RX001373-01 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

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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 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 μm³ voxel size) was used to assess bone microarchitecture and strength by micro-finite 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 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)

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 strength in Blacks appears attributable to denser, less porous, 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

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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 (EEP-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 ($F_{(8-160)} = 7.72$, $P < 0.01$, $\eta^2 = .279$) from (11.5 ± 4.3 to 5.7 ± 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 ($F_{(8-160)} = 4.3$, $P = 0.016$, $\eta^2 = .178$) 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 to 3.1 ± 3.8, $P = .010$). Vigor increased ($F_{(8-160)} = 7.1$, $P = 0.0019$, $\eta^2 = .263$) from (12.2 ± 4.6 to 16.0 ± 3.6, score), 31% more post CR. The improvement in vigor was observed until week 5 from (12.2 ± 4.6 to 3.6 ± 16.1, $P = 0.009$) and it was maintained afterward. Tension decreased ($F_{(8-160)} = 7.8$, $P = 0.005$, $\eta^2 = .281$) from (6.0 ± 4.5 to 2.4 ± 2.8 score), 60% less post CR. The decrease in tension was observed at week 3 from (6.0 ± 4.5 to 3.2 ± 3.1, $P = 0.037$) and it was remained at week 5, 6 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 to 17.1 ± 2.7, $P = 0.015$). In addition, VO₂max improved 21.7% from (12.4 ± 3.7 to 15.1 ± 3.9 ml/kg/min, ES = 0.68, $P < 0.01$) after CR. Similarly, the 6MWT distance improved 26% from (444 ± 86 to 559 ± 88 m, ES = 1.2, $P < 0.01$). **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

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(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±2.04 vs 60.41±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 significant 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.

1459 Board #134 June 1 9:00 AM - 10:30 AM Performance and Physiological Improvements in Treadmill Walking after 12 Sessions of Phase Two Cardiac Rehabilitation

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(Sponsor: Ann L. Gibson, FACSM)
(No relationships reported)

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 $p < .05$. **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 ($p=.03$) as was diastolic BP in the 12th session ($p=.04$).

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.

1460 Board #135 June 1 9:00 AM - 10:30 AM

Impact Of Depression Or Anxiety On Enrollment In Cardiac Rehabilitation In Veterans

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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 FB-CR. Future studies are indicated 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.

1461 Board #136 June 1 9:00 AM - 10:30 AM

Effect Of Aqua-walking On Cad Risk Factors And Fitness In Older Adults

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Effect of Aqua-Walking on CAD Risk Factors and Fitness in Older Adults.
 Kee-Chan Joo, Peter H. Brubaker, Hyun-Tae Ok.
 Seowon 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 problems (n= 40) were randomly assigned to either 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 -22.9 + 40.6 mg/dL, AW -27.2 + 37.3 mg/dL, Con 14.0+44.5 mg/dL, p<0.05) and cardiorespiratory fitness expressed as VO_{2peak} (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.

1462 Board #137 June 1 9:00 AM - 10:30 AM

Facility- and Home-Based Cardiac Rehabilitation Achieve Similar Magnitude of Functional Improvements

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Background: Cardiac rehabilitation (CR) has been demonstrated to increase functional capacity in patients with cardiovascular disease (CVD). However, research has found only 14 to 31% of eligible patients participate in facility-based (FB) CR; participation appears to be even lower within the Veteran Administration (VA) with only 8 to 10% of eligible Veterans participating. Home-based (HB) CR may be a viable alternative to expand CR utilization. In a VA quality improvement project, we compared functional gains achieved in FB-CR versus HB-CR for Veterans with CVD.
Methods: Veterans diagnosed with CVD were assessed pre- and post- CR including medical and functional assessment [6 Minute Walk Distance (6MWD), Gait Speed (GS) and Timed Up and Go (TUG)]. Low risk patients were given the option to participate in the FB- or HB-CR program. Moderate and high risk patients participated only in FB-CR. FB-CR entailed standardized exercise training and education; 1 to 3 hospital-based sessions per week over 12 weeks (range of 24-36 sessions). HB-CR entailed an initial onsite exercise education session and then verbal exercise review/reinforcement and education over the phone, one session per week for 12 weeks. After 12 weeks, patients in both groups were reassessed.
Results: As shown in the Table, significant improvements in 6MWD, GS, and TUG were evident for both FB- and HB-CR. Similar magnitude of changes were achieved in both CR groups.

| TEST | FB-CR | | | P-Value Pre vs Post | HB-CR | | | P-Value Pre vs Post | P-Value (BETWEEN GROUPS) |
|------|-------------|-------------|-------------|---------------------|-------------|-------------|-------------|---------------------|--------------------------|
| | PRE | POST | Change | | PRE | POST | Change | | |
| 6MWD | 296 ± 103 | 337 ± 88 | 41 ± 75 | 0.02 | 362 ± 70 | 408 ± 74 | 46 ± 73 | 0.02 | 0.94 |
| GS | 1.19 ± 0.28 | 1.25 ± 0.29 | 0.06 ± 0.27 | 0.29 | 1.35 ± 0.23 | 1.45 ± 0.26 | 0.09 ± 0.19 | 0.08 | 0.24 |
| TUG | 11.4 ± 3.6 | 10.6 ± 3.6 | 0.8 ± 2.6 | 0.19 | 9.1 ± 2.4 | 8.3 ± 2.1 | 0.8 ± 1.9 | 0.096 | 0.22 |

Conclusion: FB- and HB-CR were associated with similar improvements in key functional metrics, suggesting that both programs achieve valuable functional gains in patients that ranged in CVD severity. This extends the promise of HB-CR as a format of CR that not only has the potential to increase participation, especially for the many eligible patients who are curtailed by logistics, but to achieve similar efficacy. Functional recovery after a cardiovascular event is a critical step towards improved quality of life and reduced disability.

THURSDAY, JUNE 1, 2017

1463 Board #138 June 1 9:00 AM - 10:30 AM

Anthracycline Chemotherapy and Cardiovascular Function and Fitness in Breast Cancer PatientsSaowalak Siripanya¹, Napa Parinyanitikul¹, Hirofumi Tanaka, FACSM², Daroonwan Suksum¹. ¹Chulalongkorn University, Bangkok, Thailand. ²The University of Texas at Austin, Austin, TX.

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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 diseases. 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 fourteen age-, sex-, and body composition-matched healthy females. The anthracycline chemotherapy treatment consisted of 4 cycles of doxorubicin (60 mg/m²) and cyclophosphamide (600 mg/m²) repeated every 3 weeks. Breast cancer patients had been undergoing 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). Ankle-brachial 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 (1325±48 vs. 1158±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.

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1464 Board #139 June 1 9:00 AM - 10:30 AM

Effects Of Different Types Of Chemotherapy On Cardiopulmonary Fitness In Patients With Breast CancerChing-Ying Tseng¹, Hsin-Fu Lin², Chiao-Nan (Joyce) Chen³, Yi-Ching Huang⁴, Jui-Chi Lin⁵, Yi-Hung Liao⁶. ¹Koo Foundation Sun Yat-Sen Cancer Center, Taipei, Taiwan. ²Department of Athletics, National Taiwan University, Taipei, Taiwan. ³Department of Physical Therapy, Chang Gung University, Taoyuan, Taiwan. ⁴Taipei College of Maritime Technology, New Taipei, Taiwan. ⁵Taipei Medical University-Shuang Ho Hospital, Ministry of Health and Welfare, New Taipei, Taiwan. ⁶Department of Exercise and Health Sciences, National Taipei University of Nursing and Health Sciences, Taipei, Taiwan.

(No relationships reported)

Two most popular adjuvant chemotherapeutic regimens, including cyclophosphamide, doxorubicin, and fluorouracil (CAF) and doxorubicin plus cyclophosphamide followed by taxanes (AC→T), are currently used for treating the early stages breast cancer. However, it has not been clear whether the cardiopulmonary fitness and cardiovascular responses would be perturbed by the administrations of these chemotherapeutic regimens. **PURPOSE:** To investigate the effects of the administrations of CAF and AC→T on cardiopulmonary fitness and cardiovascular responses in patients with early stage breast cancer. **METHODS:** Twenty-seven patients with early stages of breast cancer (age: 45.0±1.5 yrs; Stage I-II) voluntarily participated in this study, and they were assigned to either CAF (n=12) or AC→T (n=15) group depending on oncological specialists' clinical decisions. Their cardiopulmonary fitness (measured by resting heart rate and six-minute walking test) and cardiovascular response (measured by pulse wave velocity - PWV) were assessed at before and after receiving adjuvant chemotherapy. **RESULTS:** There were no differences in all measurements between CAF and AC→T groups at baseline. In the completion of adjuvant chemotherapy, the participants in AC→T group showed significantly higher resting heart rate by ~14.9% than CAF group. Although the walking speed, distance, and metabolic equivalent of task (MET) during six-minute walking test were not different between groups, the AC→T group exhibited a remarkably higher relative stress in response to exercise test (measured by the % of maximal heart rate - %MHR; AC→T: 68.8%MHR vs. CAF: 59.4%MHR, p<0.05) in compared with those with CAF treatment. There was no difference in PWV between CAF and AC→T groups at the end of chemotherapy. **CONCLUSION:** We demonstrated that doxorubicin plus cyclophosphamide followed by taxanes (AC→T) increased resting heart rate and relative stress to the 6-minute

walking test at the end of chemotherapy. However, the PWV was not different between two adjuvant chemotherapeutic groups. Our data suggest that, in compared to CAF, AC→T might cause greater adverse effects on cardiopulmonary fitness but not cardiovascular functions in patients with early stage breast cancer.

1465 Board #140 June 1 9:00 AM - 10:30 AM

Rating of Perceived Exertion As A Tool For Prescribing And Self-regulating High-intensity Interval Exercise In Type 2 Diabetes: A Pilot Study

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(No relationships reported)

PURPOSE: Rating of perceived exertion (RPE) scale is an inexpensive tool for prescribing and self-regulating moderate exercise in different populations. However, its use for prescribing and self-regulating high-intensity interval training (HIIT) in type 2 diabetes mellitus (T2DM) patients has not been studied. Our purpose was to investigate the usefulness of 6-20 RPE scale for prescribing and self-regulating HIIT in individuals with T2DM. **METHODS:** Ten (2 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 (HIIT_{HR}: 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 (HIIT_{RPE}: 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 interventions). Exercise HR, speed and distance throughout the 25 min were compared between HIIT_{RPE} and HIIT_{HR} sessions. **RESULTS:** No significant differences were observed in HR during low- and high-intensity intervals between HIIT_{RPE} and HIIT_{HR} sessions (Figure 1.A). Exercise speed during low- and high-intensity intervals (Figure 1.B), as well as exercise distance also did not differ between HIIT_{RPE} (1.4 ± 0.1 km) and HIIT_{HR} (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.

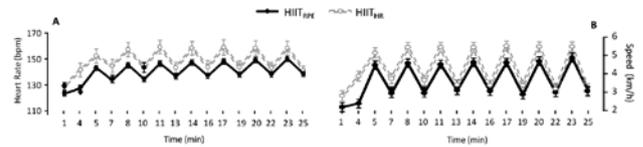


Figure 1: Exercise heart rate (A) and speed (B) during high-intensity interval exercise session prescribed and regulated by rate of perceived exertion (HIIT_{RPE}) and heart rate (HIIT_{HR}). No significant differences were observed between sessions.

1466 Board #141 June 1 9:00 AM - 10:30 AM

Blood Pressure Responses To Isometric Exercise; Safety Considerations For Exercise PrescriptionJim Wiles¹, Katrina A. Taylor¹, Damian Coleman¹, Rajan Sharma², Jamie M. O'Driscoll¹. ¹Canterbury Christ Church University, Canterbury, United Kingdom. ²St George's Healthcare NHS Trust, London, United Kingdom.

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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 80-90 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 exercise test in continuous stages, starting at 135° of knee flexion, decreasing by 10° every 2 minutes until 95° (final stage). Exercise was terminated upon completion 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 knee joint angle required to elicit a target HR of 95% HR_{peak}. 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 limits of agreement of $0.99 \times \pm 1.107$.

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 reach the upper limit 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.

1467 Board #142 June 1 9:00 AM - 10:30 AM

Impaired Critical Speed in Mice with Sickle Cell Anemia: Implications for Therapeutic Development

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Sickle cell anemia results in impaired cardiorespiratory 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 valid and reproducible 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 (WT: $r^2 = 0.98 \pm 0.01$, BERK: $r^2 = 0.98 \pm 0.02$, $p > 0.05$) which corresponded to a linear 1/time function (WT: $r^2 = 0.97 \pm 0.02$, BERK: $r^2 = 0.94 \pm 0.03$, $P > 0.05$). CS was significantly lower in BERK mice when compared to the WT control (WT: 34.8 ± 1.3 , BERK: 23.2 ± 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 relative to WT.

Conclusions: Exercise tolerance, as measured via CS, was severely reduced in BERK mice when compared to WT. Considering that CS represents the highest sustainable rate of aerobic metabolism and the lower CS in BERK mice, 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.

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1468 Board #143 June 1 9:00 AM - 10:30 AM

Algorithm For Predicting Disease Likelihood From Noninvasive Submaximal Cardiopulmonary Exercise Testing

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(No relationships reported)

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:** The purpose of the study was 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, HR 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 disease group ($p < 0.05$) 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.

1469 Board #144 June 1 9:00 AM - 10:30 AM

Water Depth Affects Energy Expenditure of Aquatic Walking in People Post-Stroke

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(No relationships reported)

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 compare 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 ($p = .16$), VO₂ ($p = .14$), and VE ($p = .08$). However, a systematic trend was found among four walking conditions. A trend of 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 l/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.

1470 Board #145 June 1 9:00 AM - 10:30 AM

Blunted Autonomic Response To Orthostasis In Individuals With Intellectual Disabilities Compared To Controls: Preliminary Results

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Individuals with intellectual disabilities (ID) have limited cardiorespiratory capacity, not explained by lack of motivation or lack of understanding the testing procedures. Previous research suggests these limits in cardiorespiratory 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 (sBRS) and power in the low frequency of blood pressure variability (SAP LF) ($p < 0.05$; Table).

Conclusions: 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.

1471 Board #146 June 1 9:00 AM - 10:30 AM
Ambulatory Blood Pressure Responses To Home-based Isometric Exercise Training In Pre-hypertensive Males

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 (No relationships reported)

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 resting and ABP. The impact these responses have on long-term cardiovascular events, end organ damage and mortality requires further research.

1472 Board #147 June 1 9:00 AM - 10:30 AM
Association of Six Minute Push Test Distance and Measures of Cardiorespiratory Fitness in Spinal Cord Injury

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 (No relationships reported)

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 function obtained during cardiopulmonary exercise tests (CPET) in people with 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; paraplegic: N=12, tetraplegia: N=3, incomplete injury: N=5, complete injury: N=10). Each subject performed a CPET to volitional exhaustion using a Monark arm ergometer during 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, VO_{2peak} was 17.5 ± 6.3 ml/kg/min and RER was 1.15 ± 0.16. CPET duration averaged 450.6 ± 200.6 seconds and relative peak workload reached at the end of exercise was 0.96 ± 0.48 Watts/kg. The 6MPD correlated significantly with VO_{2peak} (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:** CPET is currently accepted as the gold standard for measuring cardiorespiratory fitness. The strong correlation between cardiorespiratory fitness measured by CPET 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

1473 Board #148 June 1 9:00 AM - 10:30 AM
Physiological, Perceptual And Affective Responses During Community-Based Cardiac Rehabilitation
 Nicola R. Hurley. Dublin City University, Dublin, Ireland.
 (No relationships reported)

Physiological, perceptual, and affective responses during community-based cardiac rehabilitation

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BACKGROUND: Cardiac rehabilitation (CR) is a multifaceted intervention that aims to optimise cardiovascular disease (CVD) risk reduction. International guidelines identify exercise as an integral component of CR and recommend that CR participants exercise at an intensity corresponding to 50- 80% VO₂max to achieve maximal health benefits.

PURPOSE: To characterize the physiological, perceptual, and affective responses during self-regulated exercise in a community-based CR (CBCR) program.

METHODS: Twenty-six men (mean ± SD; age 67.6 ± 6.2 years, BMI 28.8 ± 3.2 kg·m⁻²; VO_{2peak} 25.3 ± 5.8 ml·kg⁻¹·min⁻¹) with stable CVD, who were attending a community based CR program for at least 6 months, were recruited. Participants performed a graded treadmill exercise test with a 12-lead ECG to measure VO_{2peak} and heart rate (HR)peak. Participants subsequently undertook two CR classes, separated by ≥ 7 days, during which expiratory gases and HR were continuously measured using a portable open circuit spirometry and telemetry system, respectively. Rating of perceived exertion (RPE) was recorded during and affective state (AS) recorded after the 60min exercise class. Classes involved a combination of aerobic exercises and resistance training. Exercise intensity was self-regulated during each CR class. **RESULTS:** During the CR class participants exercised at an exercise intensity corresponding to 62.6 ± 8.4% VO_{2peak} and 75.8 ± 10.5% HRpeak. The mean affect score was +3 (good) and the mean RPE was 13 (somewhat hard). **CONCLUSION:** When allowed to self-regulate their exercise intensity during CBCR, participants select an intensity that they perceive to be somewhat hard and that provides a high level of positive affect. The self-regulated exercise intensity is within the physiological range considered safe and effective to optimise CVD risk reduction.

1474 Board #149 June 1 9:00 AM - 10:30 AM
Stratification of Patients in Cardiac Rehabilitation as Novel Programs Develop

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(No relationships reported)

Purpose: While cardiac rehabilitation (CR) programs such as home-based (HB) and hybrid (H) are widely touted for convenience and adherence, it remains unclear which patients are best suited for these models. Current standards of risk stratification are modeled for traditional facility-based (FB) CR and based primarily on cardiovascular (CV) risk. We evaluated baseline differences between patients enrolling in HB vs. H vs. FB vs. No-CR.

Methods: In a retrospective quality improvement analysis of 295 Veterans assessed for CR we evaluated comorbidities, distance to facility, physical function (6 minute walk distance [6MWD], gait speed [GS], tandem stand [TS]), and health literacy (Rapid Estimate of Adult Literacy in Medicine [REALM]) to compare Veterans enrolled in HB, H, FB, and no CR.

Results: Patients enrolling in HB care tended to reside farther from facilities. FB-CR was highly preferred by HF patients, while post-CABG patients were more likely to enroll in HB or H- CR. Patients enrolling in HB/H CR had better physical function than patients in FB-CR. Patients that did not enroll in any CR exhibited significantly poorer health literacy. HF, depression, and T2DM differed in their distribution of CR programs, but other comorbidities had little impact on treatment pathways.

| | HB | H | FB | No-CR | Global P-Value | HB vs. H | HB vs. FB | H vs. FB | FB vs. No-CR | HB/H vs. No-CR |
|---------------------|-------------|--------------|--------------|-------------|----------------|----------|-----------|----------|--------------|----------------|
| # Patients | 53 | 51 | 168 | 23 | | | | | | |
| Age | 66 (45-80) | 66.0 (44-85) | 67.0 (40-92) | 68 (60-91) | 0.24 | 0.92 | 0.23 | 0.15 | 0.45 | 0.11 |
| Miles From Facility | 86 (6-197) | 16 (3-95) | 26 (1-228) | 70 (1-235) | <0.01 | <0.01 | <0.01 | 0.04 | 0.04 | 0.17 |
| HF | 1 (1.9%) | 4 (7.8%) | 37 (22.0%) | 2 (8.7%) | <0.01 | 0.02 | <0.01 | <0.01 | 0.98 | <0.01 |
| CABG | 30 (56.6%) | 23 (45.1%) | 54 (32.1%) | 10 (43.5%) | 0.16 | 0.70 | 0.06 | 0.17 | 0.16 | 0.74 |
| Depression | 6 (11.3%) | 18 (35.3%) | 38 (22.6%) | 5 (21.7%) | 0.03 | <0.01 | 0.02 | 0.26 | 0.97 | 0.73 |
| T2DM | 14 (26.4%) | 26 (51.0%) | 72 (42.9%) | 8 (34.8%) | 0.01 | 0.01 | <0.01 | 0.97 | 0.48 | 0.72 |
| HTN | 39 (73.6%) | 41 (80.4%) | 114 (67.9%) | 16 (69.6%) | 0.53 | 0.37 | 0.20 | 0.90 | 0.62 | 0.37 |
| CKD | 5 (9.4%) | 6 (11.8%) | 26 (15.5%) | 3 (13.0%) | 0.38 | 0.70 | 0.12 | 0.27 | 0.79 | 0.49 |
| CAD | 41 (77.4%) | 42 (82.4%) | 108 (64.3%) | 15 (65.2%) | 0.83 | 0.48 | 0.95 | 0.38 | 0.74 | 0.97 |
| COPD | 10 (18.9%) | 7 (13.7%) | 33 (19.6%) | 4 (17.4%) | 0.50 | 0.48 | 0.49 | 0.14 | 0.84 | 0.59 |
| 6MWD | 354 ± 77.7 | 334 ± 76.9 | 275 ± 94.3 | 251 ± 123 | <0.01 | 0.20 | <0.01 | <0.01 | 0.43 | <0.01 |
| GS | 1.31 ± 0.22 | 1.27 ± 0.24 | 1.09 ± 0.31 | 1.00 ± 0.32 | <0.01 | 0.31 | <0.01 | <0.01 | 0.40 | <0.01 |
| TS | 26.0 ± 8.05 | 26.3 ± 7.89 | 20.7 ± 10.8 | 15.9 ± 13.9 | <0.01 | 0.84 | <0.01 | <0.01 | 0.22 | <0.01 |
| REALM | 6.22 ± 1.58 | 6.22 ± 1.53 | 5.82 ± 1.94 | 3.84 ± 3.40 | <0.01 | 0.99 | 0.19 | 0.19 | <0.01 | <0.01 |

Conclusion: Functional metrics constituted the most significant differences between patients who attended HB/H vs. FB, whereas CV risk is the more significant factor between HB vs H. These data suggest that further refinement of risk assessment for HB/H-CR may be warranted to determine minimum thresholds of functional capacity that enable HB/H-CR to be feasible and successful.

C-39 Free Communication/Poster - Concussion I

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

1475 Board #150 June 1 9:00 AM - 10:30 AM
Proposing A New Method Of Administering The King-devick Test For Concussion Assessment
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(No relationships reported)

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

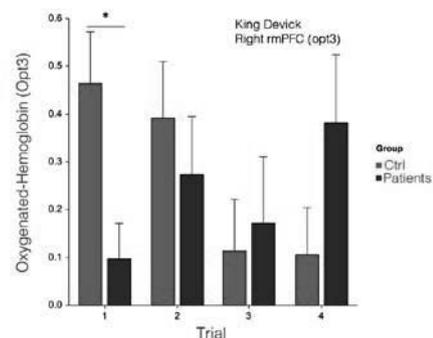
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(No relationships reported)

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 pathophysiological 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 ($F_{1,26} = 9.906, p < 0.005$) and right prefrontal cortex ($F_{1,25} = 7.965, p < 0.01$). Among this pilot cohort, healthy controls showed significantly higher levels of oxygenation changes upon initiation of the King-Devick test compared to concussed subjects, but had decreased oxygenation changes over each successive test card. This pattern was not mirrored in concussed subjects who maintained consistent levels of oxygenation changes in the left prefrontal cortex and increasing levels in the right prefrontal cortex over the course of the 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.

Figure 1. Comparison of oxygenation changes in the right prefrontal cortex between concussed subjects and healthy controls during trials of the King-Devick test ($F_{1,25} = 7.965, p < 0.01$).



1477 Board #152 June 1 9:00 AM - 10:30 AM

Test-Retest Reliability of a Clinical Cognitive Assessment over Varying Time Intervals

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(No relationships reported)

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 (ICC_{2,k}) for each cognitive domain's standard score was analyzed. **RESULTS:** CNS Vital Signs scores ranged from low to high reliability (0.338-ICC_{2,k} < 0.971). Using a cutoff of ICC_{2,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 ICC_{2,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 (ICC > 0.70) 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

| Domain | 4-Month Interval (n=38) | | 1-Year Interval (n=31) | |
|-----------------------|-------------------------|--------|------------------------|--------|
| | ICC _{2,k} | SEM | ICC _{2,k} | SEM |
| Neurocognitive Index | 0.678 | 5.469 | 0.949 | 4.451 |
| Composite Memory | 0.508 | 9.446 | 0.742 | 8.243 |
| Verbal Memory | 0.506 | 11.582 | 0.633 | 12.238 |
| Visual Memory | 0.598 | 7.996 | 0.586 | 9.411 |
| Psychomotor Speed | 0.715 | 6.930 | 0.661 | 6.566 |
| Reaction Time | 0.756 | 5.933 | 0.809 | 5.729 |
| Complex Attention | 0.659 | 12.093 | 0.971 | 14.247 |
| Cognitive Flexibility | 0.719 | 8.207 | 0.539 | 8.295 |
| Processing Speed | 0.599 | 8.833 | 0.527 | 9.105 |
| Executive Function | 0.489 | 15.074 | 0.569 | 7.632 |
| Reasoning | 0.621 | 9.318 | 0.732 | 7.763 |
| Simple Attention | 0.338 | 16.859 | 0.971 | 47.889 |
| Motor Speed | 0.808 | 6.093 | 0.662 | 5.647 |

1478 Board #153 June 1 9:00 AM - 10:30 AM

Impact of Diagnosed Sleep Disorder on Baseline Concussion Assessments in Collegiate Athletes

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Research suggests at least 27% of college students are at risk for at least one sleep disorder. Adolescents with sleep-related symptoms and reduced sleep duration perform worse on baseline neurocognitive testing, although this effect size is small and samples have not included older or collegiate-level athletes. Previous research has not taken into consideration the effects of previously diagnosed sleep disorders on performance of preinjury baseline assessment. **PURPOSE:** The purpose of the current study was to compare athletes with and without a history of diagnosed sleep disorders on commonly used baseline concussion assessments. **METHODS:** All participants completed

baseline testing including: the Balance Error Scoring System (BESS), Brief Symptom Inventory (BSI), Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT), Post-Concussion Symptom Score (PCSS), Standardized Assessment of Concussion (SAC) and Vestibular/Ocular Motor Screening (VOMS). A total of 632 NCAA student-athletes participated in the study including 316 with previously diagnosed sleep disorders and 316 with no history of sleep disorder, matched for age, sex, sport, concussion history and race. Both groups were 19.87 years old (SD = 1.36), consisted of 176 males (55.7%), with 119 athletes (37.7%) previously having sustained a concussion, and represented a multitude of sports. **RESULTS:** A series of one-way ANOVAs with Bonferroni corrections revealed significant differences between groups on BESS (F(1, 535) = 4.02, p = .045), BSI somatization (F(1,623) = 11.41, p < .01), BSI depression (F(1, 623) = 13.59, p < .01), BSI anxiety (F(1, 623) = 20.97, p < .01), BSI global severity index (F(1, 623), p < .01) and PCSS (F(1, 396) = 22.86, p < .01). Specifically, the diagnosed sleep disorder group scored worse on the BESS and reported higher BSI and PCSS symptoms. No differences were noted between groups on VOMS, ImPACT neurocognitive measures, and SAC. **CONCLUSION:** Collegiate student-athletes with sleep disorders may have elevated affective and concussion symptoms at baseline that could affect interpretation of post-injury impairment and symptoms. Clinicians should assess diagnosed sleep disorders during pre-participation sport physicals and consider them when interpreting post-injury assessments.

1479 Board #154 June 1 9:00 AM - 10:30 AM

Quantitative Electroencephalography in the Evaluation of Concussive Head Injury in Adolescents

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(No relationships reported)

PURPOSE: Reliable quantitative methods are needed to evaluate concussion-related morbidity. Electroencephalographic event-related potentials (ERPs) are being investigated for documentation of post-brain injury changes in the acute and chronic setting. Previous studies demonstrated attenuation of ERPs in the setting of concussion; however, no investigation of an exclusively adolescent population has been performed. The p300 ERP is related to decision-making, specifically evaluation and categorization of external stimuli. This study evaluated reliability and utility of p300 ERP in adolescent concussion.

METHODS: Control subjects were recruited from local soccer clubs. Subjects with concussion were recruited from our institution's concussion program. Data collection included medical history, symptom inventory (Health and Behavior Inventory - HBI), and qEEG (p300 latency and amplitude, auditory reaction time). Data was collected pre- and post-season for controls and at each clinic visit for concussion subjects. **RESULTS:** Control subjects did not demonstrate changes in p300 amplitude or HBI scores from pre- to post-season testing. Auditory reaction time was slower at post-season testing in females (311ms vs 384ms, p=0.0003), but faster in males (401ms vs 365ms, p=0.043). Concussion subjects demonstrated significantly lower p300 amplitude (14.5 µV vs 19.4 µV, p=0.024) and auditory reaction time (456ms vs 374ms, p=0.0005) relative to controls. HBI scores in concussion subjects were significantly elevated relative to controls (27 vs 8, p < 0.0001).

CONCLUSIONS: p300 ERP amplitude demonstrated stability in adolescents over a sports season. Sex differences existed for controls for p300 amplitude and auditory RT, which need further exploration to establish normative values. Concussion subjects had significant differences in p300 amplitude, auditory reaction time, and HBI scores compared to controls. Additional study is needed to describe recovery of p300 amplitude and auditory reaction time in adolescent concussion. **ACKNOWLEDGEMENTS:** Supported by University of Colorado Department of Orthopedics internal grant award and AAPM&R Foundation for Research Molinar Pediatric Research Award.

1480 Board #155 June 1 9:00 AM - 10:30 AM

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

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(No relationships reported)

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. **PURPOSE:** To examine the relationship between sex, concussion hx, and the presence of ADHD with recovery from 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 progressions. **RESULTS:** ADHD was present in 18.3% (n = 40). A greater proportion of males reported ADHD (males, 82.5%; females, 17.5%; $\chi^2 = 0.014$). Average recovery time was 20.9±14.3 days. A significant difference in recovery was observed by sex (males, 19.3±14.4 days; females, 23.9±13.8 days; p = 0.035). No significant difference was observed for recovery based on concussion hx (- hx, 21.0±14.7; +hx, 20.9 ± 13.6 days; p = 0.993). Furthermore, no significant difference was observed for recovery based on ADHD status (+ADHD, 21.3±13.3; -ADHD, 20.8±14.6 days; p = 0.864). **CONCLUSION:** These data support an effect of sex on recovery duration, but suggest that concussion hx or ADHD alone do not contribute to prolonged recovery following SRC. Given that patients in this study were managed by medical professionals, it is possible that early intervention and management of the injury in a clinical setting can minimize effects of prior history or ADHD on recovery. Further study is warranted to determine if clinical management may alleviate effects of modifying factors.

1481 Board #156 June 1 9:00 AM - 10:30 AM
Clinical Reaction Time Performance in a Concussed Pediatric Population
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Purpose: The puck-drop (PD) test has been used to assess clinical reaction time (CRT) and has been proposed as a tool to aid in the diagnosis and management of sports concussion. The simplicity of the test and low cost make it an attractive tool in the management of these injuries; however, it is not known whether the test discriminates between concussed and non-concussed patients. The purpose of this study is to determine the discriminatory utility of the PD test to differentiate acutely concussed pediatric athletes relative to an uninjured cohort. **Methods:** Patients (ages 8-18) who remained symptomatic on presentation to a sports medicine clinic and diagnosed with a concussion were eligible for study inclusion. Patients with concomitant injuries that precluded completion of the PD test were excluded. Testing was conducted in accordance with protocols established in the literature. Two practice trials were conducted. The distance of stick transversal was recorded as well as the number of drops and failed attempts. Eight successful trials were completed for each hand. Children with hands too small to circumvent the puck diameter were accommodated by starting at 10 cm above the puck base. **Results:** 196 concussed (m-103, f-93) and 463 healthy (m-178, f-285) subjects were included in this study. The average CRT for right/left hands for healthy and injured subjects were 229.7±21.6ms/229.6±21.8ms, and 243.4±29.4ms/242.3±29.8ms, respectively. Injured patients were categorized by age and compared to healthy controls. Although significant associations were noted between age and CRT among healthy and concussed subjects overall (both hands), no statistical difference was found between control and concussed groups by age. **Conclusion:** This study demonstrated the association of age on CRT in both concussed and healthy subjects; however, the CRT of injured subjects did not differ from age matched healthy controls for either hand. Thus, CRT measured at the time of clinic presentation did not appear to have a discriminatory effect for diagnostic purposes. Future studies will need to examine the time point of CRT measurement, larger sample size, and longitudinal follow up to evaluate associations with recovery.

1482 Board #157 June 1 9:00 AM - 10:30 AM
Association Between Concussion History, Demographic Characteristics, and Sensory Organization in Collegiate Athletes
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Sensory organization is affected following sport-related concussion (SRC) and may be affected as a result of previous concussions and key demographic factors, such as football participation, where subconcussive impacts are prevalent. **PURPOSE:** The primary purpose of this cross-sectional study was to examine the association between previous concussion history, other key demographics such as football participation, and sensory organization during a dynamic posturography task.

METHODS: Collegiate varsity athletes (n=227) participating from a single NCAA Division I university between 2014 and 2016 (mean age: 19.3±1.0) were enrolled in our study. During standardized baseline testing, participants completed a demographic questionnaire and the Sensory Organization Test (SOT; Natus Inc, Clackamas, OR). Primary outcomes were the SOT composite equilibrium score (COMP) and the three SOT ratio scores (Vestibular, Visual, Somatosensory). Separate multivariable linear regression models were run for each outcome. Concussion history (no/yes), football participation (no/yes), 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=0.003); and 2) football athletes also had statistically, but not clinically higher 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 SOT outcomes (p>0.017). **CONCLUSION:** Football athletes have worse overall balance when compared to non-football 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.

1483 Board #158 June 1 9:00 AM - 10:30 AM
Hurt or Injured?: Adolescent Athlete Decision-Making Post Sport Related Concussion
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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 within 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 conversation with a trusted person to weigh options about concussion reporting. 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 athletics, whereas an athlete 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).

1484 Board #159 June 1 9:00 AM - 10:30 AM
Comparison Of Concussion Outcomes In College Students
 Natalie A. Kramer¹, Prakash Jayabalan², Kelly Iwanaga Becker¹, Kristin E. Abbott¹. ¹Northwestern University, Evanston, IL. ²Rehabilitation Institute of Chicago, Chicago, IL. (Sponsor: Jeffrey Mjannes, FACSM)
 (No relationships reported)

PURPOSE: The aims of our study were to investigate the time to symptom resolution in students with a concussion at a collegiate institution and identify 'at-risk' subsets of the population. **METHODS:** Retrospective chart review of students who presented to the college health service and were diagnosed with a concussion during the

2014-2015 academic year. For analyses, descriptive statistics, independent samples t-tests, linear and binary regression were utilized. **RESULTS:** The average duration of symptoms for all subjects was 17.89 days (SD 17.05). Subjects who were playing varsity-level sports had significantly shorter duration of concussion-related symptoms (mean 11.5 days) compared to club (18.61 days, $p < 0.001$) and recreational level (22.59 days, $p < 0.001$) athletes. Female students had a longer duration of symptoms compared to male students (20.79 days vs. 14.60 days, $p < 0.001$) and graduate students had more than two weeks longer duration of symptoms compared to undergraduates (16.12 vs. 31.20). Linear regression analyses showed that a history of a seizure disorder was associated with longer time to symptom resolution by 32 days compared to those without a similar history. In binary regression analysis, those with a prior history of concussion were twice as likely to have symptoms for longer than 28 days than those without. An interaction variable between subjects with a history of concussion and club sport participation demonstrates that this population's odds of having symptoms lasting longer than 28 days increases by a factor of 25 compared to their counterparts. **CONCLUSION:** The findings in our study highlight the difficulty in treating subjects with concussions at a high level academic institution, due to both the academic rigors of the institution and the differing needs of the student population. The study also provides insight into 'at-risk' subsets of the student population. Factors such as level of sport, year in school, athlete vs non-athlete, pre-morbid conditions and sex may affect outcome and this needs to be an important consideration for the physician managing the concussed college student. Our study also suggests the potential need for improved resources for the general population of university students who suffer a concussion.

1485 Board #160 June 1 9:00 AM - 10:30 AM
Relationship Between Initial Post-concussion Presentation And Health-related Quality Of Life At One Month Post-injury In Pediatric Concussion Patients

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 (No relationships reported)

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 univariable 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.

1486 Board #161 June 1 9:00 AM - 10:30 AM
Lower Neck Strength Among Youth Soccer Players Is Associated With An Increased Prevalence Of Concussion

Hugo Paquin, David R. Howell, William P. Meehan III. *Boston Children's Hospital, Boston, MA.* (Sponsor: Pierre D'Hemecourt, FACSM)

Reported Relationships: H. Paquin: *Royalty; ABC-Clio publishing, Wolters Kluwer. Contracted Research - Including Principle Investigator; National Football League Players Association, National Hockey League Alumni Association.*

Previous studies suggest that neck strength is associated with concussion incidence, but few studies investigate other athletic skills as a risk factor for sports concussion.

PURPOSE: Determine the association between concussion history and sex with neck strength, agility, and cardiovascular function among soccer players.

METHODS: We conducted a cross-sectional study of soccer players who underwent an injury prevention evaluation at a sports injury prevention center between April 2013 and June 2016. We compared normalized neck strength, vertical jump height, front plank time, pro-agility test time, and estimated VO2 max between soccer players with and without a history of concussion. For normalized neck strength, we used the ratio of neck strength (assessed via dynamometry) to mass (n/kg) as our primary outcome variable in each direction to adjust for body size. We performed 2-way MANOVAs investigating the main effects and interaction of concussion history and sex on each set of outcome variables (neck strength in 4 directions; physical ability measurements).

RESULTS: A total of 243 soccer players participated in the study, 167 (69%) of which reported no concussion history and 76 (31%) who reported a prior history of diagnosed concussion. The mean age was 13.9 (SD = 2.3) years of age, ranging from 8 to 18, and consisted of 153 (63%) females. Females had lower neck cervical flexion strength (1.51±0.4 n/kg vs. 1.71±0.4 n/kg; $p = .001$), cervical extension strength (1.73±0.6 n/kg vs. 1.99±0.6 n/kg; $p = .017$), dominant side cervical rotation strength (1.25±0.5 n/kg vs. 1.46±0.5 n/kg; $p = .011$), and non-dominant side cervical rotation strength (1.20±0.4 n/kg vs. 1.42±0.4 n/kg; $p = .007$) than males. Those with a history of concussion had lower neck cervical extension strength (1.67±0.5 n/kg vs. 1.88±0.6 n/kg; $p = .026$) and lower dominant side cervical rotation strength (1.19±0.4 n/kg vs. 1.37±0.5 n/kg; $p = .026$) than those without a history of concussion. No significant differences were observed for vertical jump height, pro-agility test time, front plank time, or estimated VO2 max.

CONCLUSIONS: Youth soccer players with a history of concussion exhibit significantly lower normalized neck strength than those without a history of concussion. This represents a potential target for concussion prevention strategies.

1487 Board #162 June 1 9:00 AM - 10:30 AM
Concussions and Vestibular Changes: Concussion Mechanism and Neurocognitive Performance

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(No relationships reported)

It is estimated that 5-10% of athletes will experience a concussion during any given sport season. Athletes experience concussions actively (making a tackle) or statically (being hit by a baseball pitch). Research has shown that vestibular impairments, such as dizziness or postural instability, are common symptoms following concussion.

However, research has not explored whether the mechanism of concussion is a determinant of whether an athlete does or does not experience vestibular deficits.

PURPOSE: The purpose of this study is to examine both mechanism and history of concussions in relation to vestibular symptoms following injury and neurocognitive performance. **METHODS:** ImPACT™ was used to determine neurocognitive performance and surveys to determine concussion history, vestibular symptoms following a concussion and mechanism of concussion in 95 club athletes. Of the athletes tested, 22 were previously concussed with 9 having vestibular symptoms (VS) and 13 having no vestibular symptoms (NVS) in a previous concussion. Of the previously concussed athletes 5 occurred stationary and 14 occurred during various activity levels (active, moderately active, highly active). **RESULTS:** Significant differences in visual memory were found between the concussion groups with the VS group having lower visual memory than the NVS ($p < 0.05$). Significant differences were also found in mechanism of concussion with the stationary group having lower visual memory scores than the comparison groups ($p < 0.05$). **CONCLUSIONS:** History of concussion with vestibular symptoms and mechanism of concussion is related to lower scores in visual memory. Further research on concussion mechanism and vestibular symptoms is needed as it may influence concussion management.

1488 Board #163 June 1 9:00 AM - 10:30 AM
Utility of the Vestibular/Ocular Motor Screening (VOMS) Tool During High School Sport Participation
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Reported Relationships: P.R. Worts: Contracted Research - Including Principle Investigator; Florida State University's Institute of Sports Sciences and Medicine.

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 of ≥5 centimeters greatly increases the rate of false positive.

C-40 Free Communication/Poster - Epidemiology of Injury and Illness
 Thursday, June 1, 2017, 7:30 AM - 12:30 PM
 Room: Hall F

1489 Board #164 June 1 8:00 AM - 9:30 AM
The Financial Cost of Obesity in Thoracic Trauma
 Alexis C. King¹, Lewis E. Jacobson², Jonathan M. Saxe², Courtney D. Jensen¹. ¹University of the Pacific, Stockton, CA. ²St. Vincent Hospital, Indianapolis, IN.
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 (No relationships reported)

Obesity affects 34% of Americans over the age of 20 and contributes to more than \$200 billion per year in healthcare costs. Trauma medicine is a large contributor to annual expenditure. Each year, between 150,000 and 300,000 rib fracture patients are admitted to U.S. trauma centers. Obesity increases risks of morbidity and mortality in these patients but information concerning the effect of obesity on individual patient billing in this population is limited. **PURPOSE:** We examined the effect of obesity on medical costs in rib fracture patients. **METHODS:** We analyzed the patient registry and financial records of a Level 2 trauma center. All patients with ≥1 rib fracture admitted between 2010 and 2014 (n=1,007) were included. Dependent variables were cost to the patient (patient billing) and cost to the hospital (hospital expense). Independent variables were whether patients were obese and the characteristics of injury, measured by injury severity score, whether fractures were unilateral or bilateral, the presence of a pulmonary contusion, and the presence of a pneumothorax. Linear regressions tested the effect of obesity and injury severity on patient billing and hospital expense. **RESULTS:** Obese and non-obese patients were similar in age and injury severity. When controlling for severity, obesity predicted an increase of \$29,725 (35%) in patient billing (95% CI: \$10,983 to \$48,467, p=0.002) and \$3,963 (36%) in hospital expense (95% CI: \$960 to \$6,965, p=0.010). These models explained 31% (p<0.001) and 28% (p<0.001) of the variance in cost respectively. **CONCLUSIONS:** Among rib fracture patients admitted to a Level 2 trauma center, obesity predicted an increase of about 35% in the cost of delivering care, both to the patient and to

the hospital. While the prophylactic benefits of exercise are well documented in minimizing risk of preventable conditions such as cardiovascular disease and diabetes, these benefits may also minimize financial stress in unexpected conditions such as thoracic trauma.

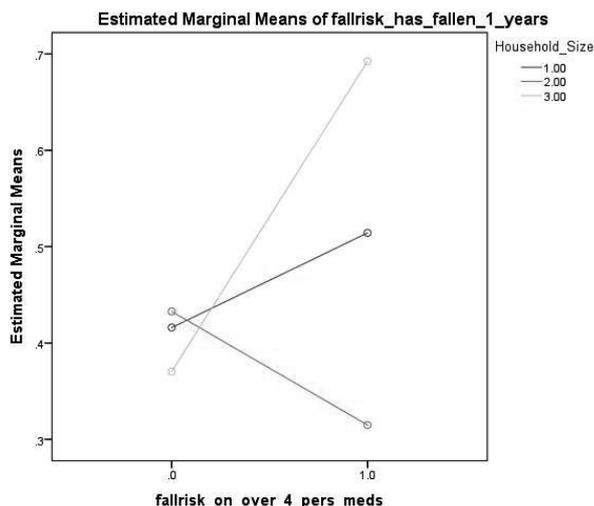
1490 Board #165 June 1 8:00 AM - 9:30 AM
The American Experience with an Emerging Adolescent Collision Sport: Rugby-7s
 Richard Ma¹, Victor Lopez, Jr², Meryle G. Weinstein³, Patria A. Hume⁴, Robert C. Cantu, FACSM⁵, Christian Victoria⁶, Sophie C. Queler⁷, Khalil J.A. Webb⁸, Answorth A. Allen⁹. ¹Missouri Orthopaedic Institute & Thompson Laboratory for Regenerative Orthopaedics, Columbia, MO. ²Rugby Research and Injury Prevention Group, Inc, Hospital for Special Surgery, New York, NY. ³New York University, Steinhardt School of Culture, Education and Human Development, New York, NY. ⁴Auckland University of Technology, Sports Performance Research Institute New Zealand, Rugby Codes Interdisciplinary Research Group, Auckland, New Zealand. ⁵Emerson Hospital, Concord, MA. ⁶New York University's College of Global Public Health, New York, NY. ⁷Tulane University, New Orleans, LA. ⁸Loyola University, Baltimore, MD. ⁹Hospital for Special Surgery, New York, NY.
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Reported Relationships: R. Ma: Contracted Research - Including Principle Investigator; USAR New England and Empire GU RFU's and National Operating Committee on Standards for Athletic Equipment.

Purpose: Rugby-7s is a popular global collision sport known to have a high injury incidence. There is a lack of data on the youths involved in the new Olympic format particularly in the United States (USA). Rugby-7's growth in the USA has occurred mainly in the amateur population. An understanding of how playing injuries occur will help develop prevention programs and promote safe growth of youth Rugby-7s. **Methods:** A prospective epidemiology study of 3, 804 Under-19 USA Rugby-7s players (13-19 years of age; injured male 256; and female 61) in USA Rugby sanctioned tournaments (2010-2014). Incidence (per 1000 player-hour (ph)), severity (days absence) and biomechanism of injuries were captured via the Rugby Injury Survey & Evaluation (RISE) Report methodology. **Results:** Overall injuries (medical attention and time-loss) among the U19 population were found at 81.9/1000ph (n=172), with time-loss injuries at 33.3/1000ph (n=70; 95% CI: 25.9-42.1) and medical attention injuries at 48.6/1000ph (n=102, 95% CI: 39.6-58.9) (P=0.013). Males experienced higher rates of injuries (backs 81.8/1000ph, n=77; forwards 56.7/1000ph, n=40; RR: 1.16, P=0.053) than females (backs 65.6/1000ph, n=17; forwards 77.1/1000ph, n=15; RR: 0.93, P=0.642) (RR: 0.96, P=0.332). Time-loss injuries resulted in a mean severity of 35.4 days (females 29.6 days; males 37.6 days; P=0.494). Most injuries were acute (93%; RR: 2.3, P<0.001) and in the tackle (80.3%; RR: 1.6, P<0.001). Injuries most commonly involved the joints or ligaments (40%) and the lower extremities (39%). High incidences of head and neck injuries including concussions (overall 26%) and upper extremity injuries (29%) were seen among the USA youth population. **Conclusions:** USA youths playing Rugby-7s tournaments had lower rates of injury (33.3/1000ph) than USA amateur adult Rugby-7s (49.2-55.4/1000ph) and international adolescent boys' Rugby-15s (35-57.2/1000ph). The majority of match injuries occurred during the tackle (80.3%), and rates of head, neck, and upper extremity injuries were elevated, which emphasizes the need for proper safe tackling techniques in USA youth. This study establishes the need for continued epidemiological research to document age-based injury rates and patterns that will help develop evidence-based injury prevention initiatives.

1491 Board #166 June 1 8:00 AM - 9:30 AM
Interaction Between Household Size And Fall Injury Status In Aged Individuals As It Relates To Fall History
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 (No relationships reported)

Falls in the elderly are a significant problem in developed countries and numerous risk factors have been linked to falls. Two such risk factors include poly-pharmacology and household size. **PURPOSE:** To investigate both pharmacology status and household size as it related to history of falls in individuals over the age of 65 years. **METHODS:** The Comprehensive Falls Risk Screening Instrument (CFRSI) and brief a self-report medical history questionnaire were completed by 403 individuals over the age of 60 (71.2 ± 5.7 yrs) at 26 testing sites across the United States. Three data points of interest were collected from these instruments and included: 1) the number of individuals currently living in the household; 2) the current number of prescribed medications being taken by the individual; and 3) history of falls in both the last year. Data were analyzed using a 2x3 ANOVA with fall history as the dependent variable

and medication status and household size as the independent variables. **RESULTS:** Although ANOVA results indicated no main effect for either household size ($F_{2,387} = 2.102$, $p = 0.124$) or medication status ($F_{1,387} = 2.287$, $p = 0.131$), a means cross-over interaction for household size and medication status was observed ($F_{2,387} = 3.563$; $p = 0.029$) 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.



1492 Board #167 June 1 8:00 AM - 9:30 AM

The Relationship between Experience Level and Age on Perception of Injury Risk in Golf

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(No relationships reported)

INTRODUCTION: In golf, each hole varies in difficulty and distance, which can change how a player approaches each shot. Depending on a player's age, experience level, or injury risk perception, the approach may vary, and a player's score can benefit or suffer due to these perceptions. **PURPOSE:** To examine the relationship between experience level, age, and perception of injury risk in golf. **METHODS:** 1170 subjects (804 women, 366 men; age: 48.8 ± 14.7 years; experience level: 17.85 ± 10.18 years) completed a questionnaire assessing demographic information, golf-specific variables, and golf-specific risk perceptions. **RESULTS:** For all analyses, handicap (low, mid, high), age (young, middle, older), and years of experience (few, mid, high) were divided into three categories, whilst gender (male, female) and injury history (injured, not injured) were divided into two categories. Younger golfers tended to have lower handicaps, and sustained significantly more injuries than other age groups ($p \leq 0.05$). Older golfers tended to play more hours per week, whereas middle-aged golfers tended to practice more hours per week compared to other age groups (both $p \leq 0.01$). With respect to gender, males had lower handicaps ($p \leq 0.05$), more years of experience ($p \leq 0.05$), and both played and practiced more hours per week than females ($p \leq 0.01$). Injured golfers tended to be younger and have higher handicaps than non-injured golfers ($p \leq 0.05$), and tended to both play and practice more often than non-injured golfers ($p \leq 0.05$). There were also significant differences between groups in risk perceptions. Higher handicap golfers had different thoughts on the level of golfer, and which age group, was more at risk of injury compared to other groups ($p \leq 0.05$). There was also a significant difference between younger and older golfers, and injured and non-injured golfers with respect to the age group most at risk of injury ($p \leq 0.01$). Finally, there was a significant difference between injured and non-injured golfers in the perception of injury risk in golf ($p \leq 0.01$). **CONCLUSIONS:** The results from this study highlight how different groups of golfers have differing injury risk perceptions, which are seemingly a result of their golfing experiences. Further, this suggests that diverse educational strategies may be necessary to help reduce injury risk to golfers.

1493 Board #168 June 1 8:00 AM - 9:30 AM

Description of Wrist Fractures in Recreational Snowboarding: Implications for Wrist Guard Design

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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 χ^2 test.

RESULTS: We identified 379 wrist injuries over the two winter seasons (age = 22.7 ± 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 ($n = 224$ for distal radius fracture, $n = 27$ for ulnar fracture, and $n = 27$ for concomitant radial/ulnar fractures). Snowboarders had a significantly higher percentage of wrist fractures than did skiers (69.1% for snowboarders vs. 46.2% for skiers, $\chi^2 = 12.376$, $p < 0.001$). 71% of all distal radius fractures were AO classification A2; 16% were C1 or C2. 33% of 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.

1494 Board #169 June 1 8:00 AM - 9:30 AM

Irritable Bowel Syndrome and Gastrointestinal Issues in Endurance Athletes: Prevalence and Management Strategies

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(No relationships reported)

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 ($p = .007$ or $< .001$ for Rome III and Manning, respectively). Only 10.9% of athletes reported seeing a medical professional due to GI issues, while 17.1% 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.

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1495 Board #170 June 1 8:00 AM - 9:30 AM

Comparison Of High School Girls' And College Women's Softball Injury Incidence, 2004/05-2013/14

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Few studies have reported sport injury incidence across age continuums. High School Reporting Information Online (HS RIO) and the National Collegiate Athletic Association Injury Surveillance Program (NCAA-ISP) and have each tracked sports injuries for over 10 years.

PURPOSE: Compare injury incidence in high school (HS) girls' and college women's softball.

METHODS: Athletic trainers (ATs) from an annual average of 100 high schools and 50 NCAA member institutions participated in online injury surveillance from 2005/06 (HS RIO) or 2004/05 (NCAA-ISP) through 2013/14, reporting injury and athlete-exposure (AE) data. Time loss injuries were injuries occurring during a school-sanctioned practice or competition, requiring medical attention, and resulting in participation restriction at least 24 hours. Injury frequencies and rates were calculated. Rate ratios (RR) compared rates between HS and college by event type (competition vs. practice). RRs with 95% confidence intervals (CI) not including 1.00 were considered significant.

RESULTS: ATs reported 1,357 softball injuries in HS and 1,848 in college. Injury rates were higher in college women than HS girls (3.19 vs. 1.16/1000 AE; RR=2.76; 95% CI: 2.57-2.96). Although a nearly even split, the majority injuries occurred during competitions in HS (51.5%) and practices in college (50.7%). Injury rates were higher in college than HS in both competitions (3.82 vs. 1.73/1000 AE; RR=2.21; 95% CI: 2.00-2.44) and practices (2.75 vs. 0.86/1000 AE; RR=3.21; 95% CI: 2.91-3.55). The competition injury rate was higher than the practice injury rate in HS (RR=2.02; 95%CI: 1.82-2.25) and college (RR=1.39; 95%CI: 1.27-1.52). Injury rates for HS practices and competitions remained stable over time. Injury rates for college practices decreased 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 identify injury prevention initiatives.

1496 Board #171 June 1 8:00 AM - 9:30 AM

Prevalence of Low Back Pain of South Korean Baseball Players in Childhood and Adolescence

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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 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 age showed the most development increased height.

RESULTS: Among all participants, 60.4% (total 177; 13.5 ± 1.9 yrs) of participants had experience of the LBP. In each school group, the prevalence of LBP followed has point LBP, lifetime LBP, and recurrence of LBP; 20.0%, 40.0%, and 23.7% in ES; 50.0%, 73.5%, and 44.1% in JHS; 65.2%, 82.6%, and 73.9% in SHS, respectively. The most frequent onset of LBP was 12 and 13 years old 22.0% respectively. 22.3% of the LBP occurred at the PHV age, and 23.2% occurred in over 1 year of PHV age (total number of occurrence 112; 14.6 ± 1.4 yrs).

CONCLUSIONS: LBP of the young baseball players occurred in early age compared to previous research. Simultaneously, a great number of LBP onsets was observed at age of PHV were within 1 year. These findings suggested that it is important to clarify the timing of PHV age to prevent the LBP for young baseball players.

1497 Board #172 June 1 8:00 AM - 9:30 AM

Describing the Epidemiology of Golfing Injuries

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Golf is a popular sport worldwide, yet injuries sustained during golf rarely receive the same recognition as sports perceived as violent or strenuous. However, golf injuries have been shown to occur with a high incidence. **PURPOSE:** To examine the injury profile of golfers and describe the epidemiology of the injuries sustained, as well as determining factors associated with injury risk. **METHODS:** Amateur golfers aged 18 years and older who played golf on a regular basis completed a questionnaire documenting their previous 12-month injury status and associated golfing demographics. **RESULTS:** This study consisted of 1170 golfers (804 women, 366 men) with a median age of 51 years, and median handicap of 15. Of the 423 injuries (36.5%), 72.8% impacted the golfers' performance or participation. The lower back was the most frequently injured region (27.6%), with strains, the most frequent type of injury (49.5%). There was a significant association between sustaining an injury and the number of hours of golf practice/week ($\chi^2 = 14.819$, $p = 0.003$). Age, hours of play/week, hours of practice/week, and total golf participation hours/week were all significant, independent predictors of injury. The Hosmer and Lemeshow test indicated an acceptable goodness of fit of the model ($p = 0.878$). Odds ratio (OR) analysis showed that golfers who accumulated more hours of play or practice were 4.37 and 1.96 times more likely to report sustaining a golfing injury ($p \leq 0.001$ and $p = 0.004$, respectively). Whereas golfers who accumulated less than eight, or between eight and 12 hours of golf participation/week were 0.517, and 0.813, times less likely to sustain an injury compared to those who accumulated more than 18 hours/week ($p = 0.007$ and $p = 0.009$, respectively). Finally, older golfers were less likely to report sustaining an injury than younger golfers (OR: 0.745, $p = 0.029$). **CONCLUSIONS:** Injuries occur to golfers of all ages and ability levels, and the injuries sustained have a significant impact upon golfers' lives. Before suggesting that golfers limit their golf participation, other injury prevention avenues must be investigated to ensure that participation in physical activity is not viewed as harmful. Further, prevention strategies need to be investigated in relation to specific characteristics of golfers to attempt to reduce the injury risk.

1498 Board #173 June 1 8:00 AM - 9:30 AM

Association between Body Mass Index and Disability in Individuals with Unilateral Anterior Cruciate Ligament Reconstruction

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Individuals with an anterior cruciate ligament reconstruction (ACL) are susceptible to persistent disability and weight gain following surgery, which may increase the risk of developing osteoarthritis. It is unclear if body mass index (BMI) influences disability following unilateral ACLR. **PURPOSE:** Primarily, we determined the association between BMI and self-reported disability using a subjective knee evaluation form (IKDC) in a cross-section of individuals with a unilateral ACLR. Secondly, we determined if those with low to normal BMI (<25) demonstrated different odds of achieving patient-specific age and gender-matched healthy population average IKDC cutoff scores compared to those with high BMI (≥25). **METHODS:** Height, mass and self-reported disability were measured in 668 individuals (60.9% female, BMI 24.39±3.71 kg/m², IKDC 84.68±11.91%, 21.73±6.17 years old, 30.51±35.45 months post unilateral ACLR). Bivariate Pearson product moment correlations were calculated between BMI and IKDC for the entire sample. Multiple regression analyses were used to determine the impact of covariates (Tegner score, age and months since ACLR) on the observed associations between BMI and IKDC, and the change in R² (ΔR^2) attributed to BMI after accounting for the covariates was determined. We calculated the odds (odds ratios and 95% confidence intervals) for achieving published age and gender-matched healthy population average IKDC scores for those with low (<25; i.e. underweight and normal BMI) versus high BMI (≥25; i.e. overweight and obese).

RESULTS: Lower BMI associated with higher IKDC score ($r=-0.08$, $P=0.04$), but BMI did not uniquely explain variance in IKDC ($\Delta R^2>0.001$, $P=0.57$) 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 cutoff 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.

1499 Board #174 June 1 8:00 AM - 9:30 AM

Prevalence Of Injuries During Brazilian Jiu-jitsu Training

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Background: Brazilian jiu-jitsu (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, weight class, 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 knee ($n=26$) and foot and toes ($n=19$). The most common non-medically diagnosed injuries occurred to the hand and fingers ($n=56$), arm and elbow ($n=40$), and foot and toes ($n=33$). **Conclusion:** Athletes reported more frequent medically diagnosed 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.

1500 Board #175 June 1 8:00 AM - 9:30 AM

Start, Middle Or End: When Do Concussions Occur During Practices And Competitions Among Athletes?

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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 (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. Certified athletic trainers, school athletic administrators, and coaches from MSHAA high schools reported head injury data and overall participation for 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 for each concussive injury. An injury rate (IR) was calculated by dividing the number of SRCs in a particular category by the number of participants in that category. IRs were presented with 95% confidence intervals (CI). **Results:** A total of 4,452 SRCs were reported for all sports. Male athletes had a greater risk for an SRC during the middle of practices and competitions ($IR=10.21/1,000$ AEs, 95% CI: 9.5-10.5), followed by the end of practices and competitions ($IR=6.63/1,000$ AE, CI: 6.2-7.0) and start of practices and competitions ($IR=1.92/1,000$ AE, CI: 1.7-2.1). Females also had a greater risk for SRCs during the middle of practices and competitions ($IR=6.50/1,000$ AE, 95% CI: 6.0-7.0), followed by the end of practices and competitions ($IR=4.35/1,000$ AE, CI: 4.0-4.7) and start of practices and competitions ($IR=1.68/1,000$ AE, CI: 1.4-1.9). **Conclusions:** The majority of SRCs occur during the middle of practices and competitions compared to the end and start of practices and competitions. Future research should concentrate on ways to prevent SRCs during the middle of events.

1501 Board #176 June 1 8:00 AM - 9:30 AM

U.S. Rugby-7s Injuries in Levels Of Play: A 5-year Epidemiological Prospective Study Of An Emerging Olympic Collision Sport In A Developing Market

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Purpose: Rugby-7s is an emerging collision sport in the U.S. Due to the sport's high incidence of injury, evidence-based data on competition levels and ages will help guide injury prevention in the U.S. market. **Methods:** 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-elite, 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, $n=502$; 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/Colt 80%, college 68%, senior 70%, sub-elite 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 21d vs. 41d; $P=0.045$; elite 11d vs. 25d, $P=0.026$, 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; $P=0.035$). **Conclusions:** Injury surveillance on U.S. Rugby-7s among playing 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.

1502 Board #177 June 1 8:00 AM - 9:30 AM

Epidemiology of Middle School Sports Injuries in the Mid-atlantic Region Of The United States

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Participation in scholastic sport has increased. Yet, limited research describes the incidence of injury at the middle school level. **PURPOSE:** Describe the incidence of injury among middle school sports. **METHODS:** Athletic trainers (AT) attended practices and games at 9 middle schools with 1194 boys and 1008 girls (age 11 to 14 years) participating in 12 sports during 2015-2016. The ATs collected injury and athlete-exposure (AE) data at all events. No-time-loss (NLT) and Time-loss (TL) injuries requiring medical attention were examined. TL injuries resulted in ≥ 24 hours participation restriction. Injury frequencies and rates (IR) were calculated. Rate ratios (RR) compared IR by sex. RRs with 95% confidence intervals (CI) not including 1.0 were considered statistically significant. **RESULTS:** 1270 NLT and TL injuries were reported with an overall IR of 16.6/1000AE; 95% CI: 15.7-17.5. Of these, 62.2% and 37.8% were NLT (10.3/1000AE; 95%CI: 9.6-11.0) and TL (6.3/1000AE; 95%CI: 5.7-6.8), respectively. Overall, girls' basketball (32.0/1000AE) had the highest rate of NLT and TL injuries combined followed by football (23.8/1000AE), wrestling (22.9/1000AE) and girls'

soccer (20.1/1000AE). Sports with the lowest IR were girls' volleyball (6.1/1000AE), cheerleading (7.9/1000AE), baseball (8.8/1000AE), and boys' soccer (11.6/1000AE). Boys and girls IR did not differ (17.8 vs. 16.3/1000AE; RR=1.1; 95%CI: 1.0-1.2); findings were retained when restricted to TL injuries (6.9 vs. 5.6/1000AE; RR=1.3; 95%CI: 1.0-1.5). Games had a higher IR than practices (22.3 vs. 15.5/1000AE; 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 abrasions (13%). Most were due to direct impact (38%), abrasion (10%) and overuse (10%).

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.

1503 Board #178 June 1 8:00 AM - 9:30 AM

Seasonal Incidence of Game-Related NCAA Football Injuries on Artificial Turf and Natural Grass

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It is commonly surmised that environmental conditions and concomitant sport use dictate the quality and degree of decline of natural grass over a season of competitive football. Although artificial turf infill systems have been purported to duplicate the playing characteristics of natural grass 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 = 46.065; p<0.0001) between surfaces by month. Subsequent post hoc analyses indicated a significant lower seasonal incidence of injury while competing on artificial turf (p<0.05) in August/September [37.4 (95% CI, 36.2-37.9) vs 47.3 (45.9-47.9)], October [41.9 (95% CI, 40.6-42.5) vs 61.7 (59.3-62.4)], and November [37.0 (95% CI, 35.7-37.6) vs 60.2 (58.9-60.5)] when compared to injuries reported on natural grass, respectively. No significant seasonal injury incidence by surface, however, was observed post season, December/January [34.0 (95% CI, 29.6-35.6) vs 37.5 (33.7-38.5)] on artificial and natural grass, respectively. **CONCLUSION:** With significant seasonal IIR differences existing 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.

1504 Board #179 June 1 8:00 AM - 9:30 AM

An Epidemiological Injury Profile Of Sub-elite U.S. Rugby-7s (USA Rugby National Club Championships)

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Reported Relationships: V. Lopez Jr: Contracted Research - Including Principle Investigator; Grant Support from USA Rugby Empire and New England RFU, and National Operating Committee on Standards for Athletic Equipment (NOCSAE).

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 USA 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; 74.3/1000ph) 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% (12.6/1000ph). **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 cohort (12.6/1000ph) than elite international Rugby-7s (8.3/1000ph) or Rugby-15s (5.4/1000ph). Furthermore, education on return to play protocols and post-tournament injury care would decrease recurrent injury rates seen in the U.S. amateur population.

1505 Board #180 June 1 8:00 AM - 9:30 AM

A 4-year Epidemiological Analysis Of Tournament Match Injuries In Men's Collegiate Rugby-7s

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Reported Relationships: L.S. Myers: Contracted Research - Including Principle Investigator; USAR New England and Empire GU RFU's and National Operating Committee on Standards for Athletic Equipment.

Purpose: Rugby-7s, an Olympic collision sport, is played with a high incidence of injury. U.S. collegiate Rugby-7s, due to its club status, has a lack of data to support the development of prevention protocols. **Methods:** This is a prospective epidemiology study using the Rugby Injury Survey & Evaluation (RISE) Report methodology to 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 31.4/1000ph, 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=0.040). 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: 2.62), including concussions at 12% of all injuries (16.7/1000ph; RR: 1.3 P=0.148). **Conclusions:** One concern with the expansion of U.S. Rugby-7s was the increasing risk of head and neck injuries in collegiate Rugby-7s between 2012 and 2014, 2015 and 2016 (RR: 2.17, 4.7, 3.3, respectively). Elevated head/neck injury rates in the current study have been found to be higher than the literature in international elite males Rugby-7s (5%) and U-20 Rugby-15s (12%). The largest injury increase was seen in running/open play, possibly due to the variability of training regimens among programs. Developing institutional support as other collegiate sanctioned sports can help guide instruction on tackling, and a standardized conditioning program, which may decrease injury rates at the collegiate playing level.

1506 Board #181 June 1 8:00 AM - 9:30 AM

Statin Use Predicts Fall Risk Among Older Adults

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(No relationships reported)

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 had been previously admitted for falls and many were later readmitted for falls. We analyzed predictors of both prior admission and readmission with linear regressions. 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 this population, the use of statins predicted more previous admissions for fall-related injuries (95% CI: 0.07–0.50, p=0.010). This same model maintained its significance when predicting admissions for future falls (p<0.001) and the use of statins continued to predict a greater number of readmissions (95% CI: 0.04–0.36,

p=0.015). **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, our data support 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.

1507 Board #182 June 1 8:00 AM - 9:30 AM

Age At First Energy Drink Use As A Predictor of College Student High-Risk Driving Behaviors

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(No relationships reported)

Age at first use has been studied extensively as a predictor for issues with substances, but remains relatively unexplored in energy drinks. **PURPOSE:** To examine the relationship of age at first energy drink use and high-risk motor vehicle driving behaviors among college students (n=552). **METHODS:** Age at first energy drink use was measured using a standard continuous scale self-reported question. Logistic and bivariate regressions were used to examine the relationship of age at first energy drink use to past 30-day alcohol-related high-risk driving behaviors. Participants responded to the following: 1) I have driven a motor vehicle when I knew I was over the .08 blood alcohol concentration (BAC) driving limit; 2) I have driven a car when I knew I had too much alcohol to drink to drive safely; 3) I have been a passenger when I knew the driver had consumed too much alcohol to drive safely. **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=.89; p=.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=.92; p=.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=.88; p=.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=-.041; p=.036; R²=0.008), and driving while perceiving a BAC over .08 (B=-.10; p=.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.

1508 Board #183 June 1 8:00 AM - 9:30 AM

A Comparison of Injury Rates In Boys' And Girls' Youth Lacrosse

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Participation in youth lacrosse is increasing. To date, limited research has compared the incidence and severity of injuries among boys' and girls' youth lacrosse players. **PURPOSE:** Compare the incidence and severity of injury in boys' and girls' youth lacrosse. **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. Injury frequencies and rates were calculated. Rate ratios (RR) compared rates by sex. RRs with 95% confidence intervals (CI) not including 1.00 were considered statistically significant. **RESULTS:** A total of 241 and 59 total injuries were reported in boys' and girls' youth lacrosse, respectively. Of these, 17.0% and 18.6% were TL, respectively. Boys had a higher injury rate than girls (10.3 vs. 7.9/1000AE; RR=1.4; 95%CI: 1.1-1.9); findings were retained when restricted to TL injuries (1.9 vs. 1.5/1000AE; RR=1.5; 95%CI: 1.0-2.3). Most injuries were to the lower extremity (boys: 48.9%; girls: 44.1%) and diagnosed as contusions (boys: 52.3%; girls: 40.7%) and sprains (boys: 12.9%; girls: 16.9%). Most injuries were due to contact with equipment, particularly stick contact (boys: 36.1%; girls: 22.0%) and ball contact (boys: 14.5%; girls: 23.7%). Player contact was also common in boys (18.3%). Checking comprised a low proportion

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 reiterate 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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(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 SIS were identified using International Classification of Diseases 9th Revision (ICD-9) codes 726.10 and 726.2. A 10-year incidence rate (IR) was calculated. A Cox Regression Model was used to calculate Hazard Ratios (HR) and 95% confidence intervals (CI) for factors associated with SIS using the variables of age, race, education level, sex, length of military service, and occupational physical demands rating. Surgical cases were identified using Current Procedural Terminology (CPT) codes, and the most common surgical codes were reported. **RESULTS:** 67,341 cases of SIS were identified in 1,261,297 Soldiers, for a 10-year IR of 15.73 per 1,000 person years. Risk increased with age in years (<20 reference; 20-25 HR=1.36, 95% CI [1.29, 1.43]; 26-30 HR=2.07, 95% CI [1.95, 2.19]; 31-35 HR=2.83 95% CI [2.67, 3.00]; 36-40 HR=4.32, 95% CI [4.08, 4.59]; >40 HR=6.31, 95% CI [5.95, 6.71]) and years of military service (<1 as reference; 3-5 years HR=1.13, 95% CI [1.09, 1.18]; >5 years HR=1.06, 95% CI [1.02, 1.10]). Of the SIS cases, 3686 were identified as surgical cases with the most common procedures being claviclelectomy (85%), biceps tenodesis (40%), chronic rotator cuff tear repair (37%), acromioplasty (28%), capsulorrhaphy with labral repair (22%), and coracoclavicular ligament release (20%). **CONCLUSIONS:** Increasing risk for SIS with increasing age and longer occupational exposure are consistent with previously identified factors related to SIS. This study shows that the most common shoulder surgical procedures in Soldiers with a diagnosis of SIS were associated with anatomy thought to contribute to compression of subacromial structures, while surgical management of instability may also be a factor for some cases. The views expressed are those of the authors and do not reflect the policy of the Department of Army, Department of Defense, or the U.S. Government.

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: 60-min key informant interviews (KI) with six HIFT coaches (67% male, age = 39 ± 8y, 4 ± 3y experience), six 90-min focus groups (FG) with 48 HIFT exercisers (56% male, age = 34 ± 9y, 40% > 1y 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 participating in HIFT?" Data were audio recorded and transcribed verbatim. Member checking was used for interviews. Data were thematically 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 or lessened intensity to avoid injury (KI = 50%, FG = 67%, IN = 20%). Accordingly, participants reported feeling pain and soreness "during workouts" (KI = 33%, FG = 83%, IN = 20%), although some liked this. Some "started HIFT because of injury"

(KI = 33%, FG = 67%, IN = 10%) and utilized HIFT for "therapy/prevention of other health problems" (KI = 17%, FG = 50%, IN = 67%) while others "stopped HIFT due to injury" (KI = 33%, FG = 50%). Even though "perceived injury risk" was a participation barrier (FG = 67%, IN = 10%), "scaling or modifying" workouts helped avoid injuries or continue HIFT when injured (KI = 50%, FG = 17%, IN = 10%). "Good coaching" (KI = 50%, FG = 50%), "improved fitness" (KI = 17%, FG = 33%, IN = 30%), and "knowledge, technique, and goals" (KI = 33%, FG = 83%, IN = 10%) were injury prevention tools.

CONCLUSIONS: Data illuminate the range of participants' experiences with HIFT regarding injury, including how to modify workouts, prevent/recover from injuries, and improve health. Prospective studies should be designed to prevent and/or better track HIFT injuries.

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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PURPOSE: Low back pain (LBP) is often cited as one of the most common musculoskeletal conditions experienced by pre-professional and professional dancers, although there is a dearth of evidence to support this. The purpose of this study was: 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.

1512 Board #187 June 1 8:00 AM - 9:30 AM

Injuries Reported During a Pre-participation Examination in Division 1 Collegiate Athletes: A Prospective Cohort Study

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Introduction

Understanding the influence of sport and gender on prior injury is important for providing rehabilitation and prevent future injury. The purpose of this study was to examine injury prevalence in Division 1 collegiate athletes prior to participation and report injury risk.

Methods

856 pre-participation questionnaires were collected between 2012 and 2016 in 32 varsity sports. Data reviewed was gender, sport, and injury in: neck, shoulder, elbow, hand, spine, hip, knee, lower leg, and foot. Top 5 sports were identified by percent total injuries and injuries per team. Odds of injury were reported by gender and matched sport.

Results

Football was 12% of the cohort. Injuries were highest in hand (26.6%), knee (24.5%), and lower leg (22.9%). Top 5 sports by number of injuries and total of team are summarized in table 1. Overall, males have a 1.8 times greater odds of shoulder injury compare to females (p<0.01). No difference in injury was found between genders in any other area (p>0.05).

In sports with corresponding male and female teams, gymnastics had 3.0 and ice hockey 2.8 times greater odds of shoulder injury (p=0.03 & 0.04). Gymnastics had 2.5 times greater odds and track & field 3.8 times lesser odds of elbow injury (p=0.05 & 0.03). Golf had 4.9 times greater odds of spine injury (p=0.03). Gymnastics had 7.1, golf 4.6, and track & field 4.3 times greater odds of foot injury (p<0.01, p=0.05, & 0.01). Gender was not a confounder (p>0.05).

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.

Table 1. Top 5 sports for each area by percent total number of injuries and percent total of team

| | First | | Second | | Third | | Fourth | | Fifth | |
|-----------|--------------|---------|-----------------|---------|-----------------|---------|--------------|---------|-----------------------------|---------|
| | Sport | % total | Sport | % total | Sport | % total | Sport | % total | Sport | % total |
| Neck | M Swim/Dive | 16.7 | W Ice Hockey | 11.1 | M Lacrosse | 11.1 | Multisport | 5.6 | M Lacrosse | 5.6 |
| Shoulder | Football | 21.2 | M Gymnastics | 9.8 | M Ice Hockey | 9.1 | W Swim/Dive | 8.3 | Wrestling | 5.3 |
| Elbow | W Gymnastics | 9.3 | Wrestling | 9.3 | Baseball | 8.2 | W Gymnastics | 8.2 | M Swim/Dive | 6.2 |
| Hand | Football | 14.5 | M Gymnastics | 5.7 | M Ice Hockey | 5.7 | M Lacrosse | 5.3 | Wrestling | 4.9 |
| Spine | Football | 12.7 | Wrestling | 9.8 | Rowing | 8.8 | M Swim/Dive | 6.9 | W Gymnastics | 6.3 |
| Hip | Football | 15.6 | W Track & Field | 11.0 | W Gymnastics | 7.3 | M Soccer | 7.3 | W Soccer & M Track & Field | 5.5 |
| Knee | Football | 15.2 | Wrestling | 9.5 | W Soccer | 5.2 | W Gymnastics | 4.8 | W Basketball & M Gymnastics | 4.3 |
| Lower leg | Football | 15.6 | W Soccer | 6.1 | W Track & Field | 6.1 | M Lacrosse | 5.6 | M Gymnastics | 5.1 |
| Foot | Football | 16.2 | M Gymnastics | 7.7 | W Track & Field | 7.7 | Cherleading | 5.6 | M Lacrosse & W Lacrosse | 4.9 |

| | Sport | | % team | | Sport | | % team | | Sport | | % team | |
|-----------|--------------|--------|--------------|--------|-----------------|--------|--------------|--------|-----------------------------|--------|--------|--------|
| | Sport | % team | Sport | % team | Sport | % team | Sport | % team | Sport | % team | Sport | % team |
| Neck | W Ice Hockey | 6.5 | M Basketball | 7.7 | M Swim/Dive | 6.4 | W Gymnastics | 5.0 | M Lacrosse | 4.5 | | |
| Shoulder | M Gymnastics | 46.1 | M Ice Hockey | 42.9 | M Volleyball | 33.3 | W Swim/Dive | 32.4 | W Volleyball | 26.7 | | |
| Elbow | W Gymnastics | 40.0 | M Gymnastics | 33.3 | W Tennis | 37.3 | Field Hockey | 29.3 | Baseball | 25.0 | | |
| Hand | M Volleyball | 53.3 | M Gymnastics | 48.1 | M Ice Hockey | 46.4 | W Soccer | 43.5 | W Golf | 42.9 | | |
| Spine | M Golf | 37.5 | W Gymnastics | 30.0 | W Golf | 28.6 | W Tennis | 27.3 | Rowing | 25.7 | | |
| Hip | W Gymnastics | 40.0 | W Tennis | 39.4 | W Track & Field | 31.6 | M Soccer | 27.6 | W Soccer | 26.1 | | |
| Knee | W Basketball | 60.0 | M Volleyball | 53.3 | W Gymnastics | 50.0 | Wrestling | 50.0 | W Soccer | 47.8 | | |
| Lower leg | W Soccer | 52.2 | W Soccer | 49.7 | M Volleyball | 40.0 | M Gymnastics | 37.0 | W Gymnastics | 35.0 | | |
| Foot | M Gymnastics | 40.7 | W Gymnastics | 30.0 | W Track & Field | 28.9 | W Golf | 28.6 | W Basketball & W Volleyball | 26.7 | | |

(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 the 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.

1513 Board #188 June 1 8:00 AM - 9:30 AM

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

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(No relationships reported)

Patients with anterior cruciate ligament reconstructed (ACLR) knees are at high risk for early development of tibiofemoral osteoarthritis(OA)w. 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, meniscus 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 ACL 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 for those with 4year follow up, 8.4%OA in patients with 3 years follow up, 6.2%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, OR 1.5, P = 0.006), Tobacco Use (OR 1.3, P = 0.001), Partial Meniscectomy (OR 1.2, P = 0.005), 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 ACL reconstruction.

1515 Board #190 June 1 8:00 AM - 9:30 AM

Head Coaches' Return To Play Decision Making After Injuries In Semi-professional Team Sport Athletes

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(Sponsor: Winfried Banzer, FACSM)

(No relationships reported)

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) physiotherapist and the strength and conditioning coach based on general RTP decision-making models and specific criteria related to injury type, sports type, level and playing position. The development of awareness and implementation strategies of RTP models should be subject to further research.

1514 Board #189 June 1 8:00 AM - 9:30 AM

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

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(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 lifelong 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

1516 Board #191 June 1 8:00 AM - 9:30 AM

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

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PURPOSE: The long-term neurological effects of exposure to repetitive subconcussive impacts, such as those 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 are 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 hours over the course of an athlete's playing career. However, the test-retest reliability of the HIEE is unknown. **METHODS:** We examined the test-retest 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 1 was 3423.76 +/- 1406.02hrs while at assessment 2, the mean was 2627.68 +/- 819.56hrs ($t_{10}=1.75$, $P=0.11$). 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 0.111 ($P=0.36$; 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.

1517 Board #192 June 1 8:00 AM - 9:30 AM

Boxing Exposure in a Representative Cohort of Modern Era Professional Boxers

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(No relationships reported)

PURPOSE: To determine the boxing exposure of a representative cohort of retired professional boxers who competed in modern era boxing.

METHODS: Boxing records of a previously studied cohort of 338 professional boxers who were applying for license to box professionally in New York State in the 1980's were reviewed. Boxing exposure was extracted from boxing records provided by BoxRec.

RESULTS: Of the 338 boxers previously studied, boxing records of 282 professional boxers were located and reviewed. The mean age of the boxers at the time of extraction was 51.9 years (range 31-66). All boxers were presumed to be retired. The mean age at the time of first professional bout was 21.6 years (range 16-30). The mean duration of the professional boxing career was 8.1 years (range 1-38). The mean number of total professional bouts was 22.1 (range 1-129) with an average of 12 wins (range 0-79) and 9.3 losses (range 0-102). The average number of wins and losses by technical knockout/knockout (TKO/KO) was 7.3 (range 0-84) and 4.5 (range 0-35), respectively. The average number of total rounds boxed was 113 (range 1-735). The mean number of annual bouts and rounds was 3.2 (range 0-27) and 14.5 (range 0-165), respectively. **CONCLUSION:** The range of exposure to boxing among a representative sample of retired professional boxers is highly varied. To the best of our knowledge this is the only documentation of professional boxing exposure in modern era (late 20th century) boxing. Follow-up of this cohort may serve as a representative sample of retired professional boxers to study the chronic effects of repetitive brain trauma, such as chronic traumatic encephalopathy (CTE).

1518 Board #193 June 1 8:00 AM - 9:30 AM

Comparison of Online and Onsite Health Education Intervention in Preventing Sports Injury among College Students

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(No relationships reported)

PURPOSE: To determine the effect and the superiority of online and onsite education intervention designed to improve perception and basic knowledge and skills of sports injury prevention among college students.

METHODS: 2,088 college students were recruited from a cluster random sampling of 51 classes to acquire sports injuries epidemiology for the further intervention. 321 collected participations were randomly allocated to the online (n=157) and onsite (n=164) group. 4 educational sessions led by specialists were designed with the same topics in both groups. The components engaged in health awareness, basic knowledge, and enrichment activities targeting skills training. Students received prospective surveys incorporated 12 Likert scale questions. Differences within and between groups were compared using independent and paired T-test, respectively. SPSS18.0 was used for the statistical analyses and a significant level was set at $P \leq 0.05$.

RESULTS: The rate of sports injuries was 15.4% (321/2088 students) on the retrospective survey. There were no differences between groups in awareness (online: 2.40 ± 0.06 vs onsite 2.34 ± 0.06 , $p=0.509$) and knowledge and skills (online: 1.87 ± 0.07 vs onsite 1.86 ± 0.09 , $p=0.891$) on the pre-intervention survey. Pre- and post-intervention data revealed improved awareness (online: pre- 2.40 ± 0.06 vs post- 3.25 ± 0.07 , $p=0.000$; onsite: pre- 2.34 ± 0.06 vs post- 3.45 ± 0.07 , $p=0.000$) and knowledge and skills (online: pre- 1.87 ± 0.07 vs post- 2.37 ± 0.07 , $p=0.000$; onsite: pre- 1.86 ± 0.09 vs post- 3.94 ± 0.06 , $p=0.000$) within both groups. Statistical tests indicated significantly difference between groups in knowledge and skills (online: 2.37 ± 0.07 vs onsite 3.94 ± 0.06 , $p=0.000$), particularly with higher scores in onsite group, while no difference in awareness (online: 3.25 ± 0.07 vs onsite 3.45 ± 0.07 , $p=0.000$).

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, 7:30 AM - 12:30 PM

Room: Hall F

1519 Board #194 June 1 9:00 AM - 10:30 AM

Preliminary Results for Test-Retest Reliability of a New Screening Tool: The Get Active Questionnaire

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PURPOSE: The Get Active Questionnaire (GAQ), developed by the Canadian Society of Exercise Physiology, is a new physical activity (PA) readiness assessment tool that seeks to safely encourage and 'screen-in' as many people as possible to participate in regular PA.

To evaluate the test-retest reliability of items from the GAQ in a sample of community-dwelling older adults.

METHODS: Older adults (≥ 50 years) were recruited from a research laboratory routinely conducting PA screening for community-based referrals. Study participants [$n=86$; mean age (SD): 75.7 ± 7.7 years; xx% female] completed 2 study visits, one-week apart, where participants self-completed the GAQ that was provided in paper form. The first page of the GAQ includes 9 yes/no questions designed to ensure individuals have a safe PA experience. Questions ask about: specific diagnoses/symptoms in the past 6 months; whether pain/other conditions affect ability to do PA; and whether a provider advised avoidance of PA/take precautions. Test-retest reliability was assessed using kappa statistics (κ) and 95% CIs.

RESULTS: Test-retest reliability could not be examined for 2 of the questions (loss of consciousness/fainting for any reason; concussion) because all participants responded "no" at 1 of the 2 visits. Of the 7 questions evaluated, the question that asked whether other medical conditions affected ability to be physically active showed almost perfect agreement between testing occasions [κ (95% CI): 0.84 (0.63-1.00)]. Most questions (diagnosis of heart disease or stroke or pain/discomfort in chest in daily activities or during PA; diagnosis of high blood pressure (BP) or resting BP $\geq 160/90$ mmHg; pain or swelling in any part of body affecting ability to do PA; provider advised avoidance of PA/take precautions) showed substantial agreement with results ranging from 0.65 (0.28-1.00) to 0.74 (0.39-1.00). The remaining 2 questions showed either moderate agreement [i.e., dizziness during physical activity: 0.58 (0.25-0.91)] or fair agreement [i.e., shortness of breath at rest: 0.32 (-0.16-0.80)].

CONCLUSION: Preliminary results from this study indicate that key GAQ screening questions demonstrate acceptable test-retest reliability over a 1-week period. Future research will further examine reliability, as well as validity of the GAQ.

1520 Board #195 June 1 9:00 AM - 10:30 AM

Development of Trait-Tailored Physical Activity Promotion Messages for Use in Community and Clinic Settings

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(No relationships reported)

Physical inactivity is a risk factor for many chronic disorders. Evidence suggests that health promotion message content interacts with personality to influence message effectiveness, such that certain messages are more effective for certain types of people than they are for others, but this effect has not been tested in the context of physical activity (PA) promotion. **PURPOSE:** To develop a set of physical activity promotion messages designed to target approach (BAS) and avoidance (BIS) motivational traits for potential use in typical community or clinical settings. **METHODS:** A set of 75 messages about physical activity were developed across five message conditions: (1) gain-framed desirable outcome, (2) gain-framed undesirable outcome, (3) neutral, (4) loss-framed desirable outcome, and (5) loss-framed undesirable outcome. Two

samples (n=800 undergrads, and n=400 primary care patients) rated the messages on three semantic differential scales (gain/loss, cost/benefit, positive/negative outcomes), and completed a PA self-report measure. Motivational traits were assessed in the undergrad sample. **RESULTS:** Content ratings conformed to the expected linear pattern according to message condition on all three ratings scales in both samples while controlling for age, race and PA ($F(df)>302.5(4); p<.001$). Bivariate associations supported expectations that BAS trait would be significantly related to ratings of gain-framed messages (r range=.17 to .30; $p<.01$) and that BIS trait would be significantly related to ratings of loss-framed messages (r range= -.09 to -.13; $p<.05$). Further, BAS was significantly related to rating of neutral messages (r range= .18 to .23; $p<.01$). Structural equation modeling supported the influence of BAS on ratings of gain-framed and neutral messages ($\beta(SE)> .26(.05); p<.001$), but the relationships between BIS and loss-framed message ratings were reduced to non-significant values ($\beta(SE)< -.24(.13); p>.06$), while controlling for self-reported PA. **CONCLUSIONS:** Approach motivation may be particularly important in the perception of message content when messages are gain-framed. More work is needed to understand how personality interacts with message content to influence the degree of message processing in the context of physical activity promotion.

1521 Board #196 June 1 9:00 AM - 10:30 AM
Promoting Physical Activity among African Americans through Policy Level Intervention
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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 underused, evidence-based approach to prevent obesity, diabetes, and heart disease. These conditions are extremely frequent 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 of PA and whether a policy level intervention can increase the frequency of those 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 discussions, 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. **Preliminary Results** 1) No policies to encourage PA discussions by HCPs were found in policy manuals of the clinic; 2) 39 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.

1522 Board #197 June 1 9:00 AM - 10:30 AM
Physical Activity Mode and Survival in U.S. Adults
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PURPOSE: Physical activity (PA) is a preventive health behavior that protects against chronic disease as well as premature mortality. Many studies have shown the necessary amounts of PA needed to produce positive health outcomes. However, less is known about the specific modes of PA and health outcomes. Therefore, the purpose of this study was to examine the protective effects of different modes of PA on all-cause mortality in adults. **METHODS:** Data for this research came from the 2001-2002 National Health and Nutrition Examination Survey (NHANES). Participants 18+ years of age who were eligible for mortality linkage were used in the analysis. Different modes of PA were determined from a series of questions asking respondents if they participated in transportation (TPA), home/yard (HPA), moderate recreational (MPA), vigorous recreational (VPA), or muscle strengthening (MSPA) physical activity. Those

respondents answering "yes" to either question were considered participating in that PA mode. Cox proportional hazards regression was used to model the effects of PA mode on mortality while controlling for age, sex, race, and income. **RESULTS:** A total of 5,985 adults were included in this analysis with a mean (median) person-year follow-up of 9.24 (9.83) and 965 deaths. Weighted prevalence estimates for TPA, HPA, VPA, MPA, and MSPA were 24.1% (SE=1.7), 64.0% (1.1), 38.4% (1.5), 52.1% (1.6), and 29.7% (1.7), respectively. Adults were at less risk of mortality if they participated in TPA (Hazard Ratio (HR)=0.72, 95% CI: 0.57, 0.90), HPA (HR=0.43, 95% CI: 0.33-0.55), VPA (HR=0.30, 95% CI: 0.23-0.38), MPA (HR=0.53, 95% CI: 0.45-0.62), and MSPA (HR=0.44, 95% CI: 0.32-0.60). In the unadjusted model, a 37.0% decrease in mortality (HR=0.63, 95% CI: 0.56-0.70) was seen for each additional PA mode adopted. The adjusted model showed a 24.0% decrease in mortality (HR=0.76, 95% CI: 0.67-0.85) for each additional PA mode adopted. **CONCLUSIONS:** Results from this study indicate that various types of PA protect adults from all-cause mortality. Additionally, a dose-response relationship exists between the number of PA modes adopted and risk of mortality.

1523 Board #198 June 1 9:00 AM - 10:30 AM
Physical Activity and Health-Related Quality of Life in Rural U.S. Adults with Chronic Disease
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 (No relationships reported)

PURPOSE: Physical activity (PA) is known to increase health-related quality of life (HRQOL) in adults. However, little is known regarding this association in rural adults suffering from chronic illness. Therefore, the purpose of this study was to examine the relationship between PA and HRQOL in a large-scale population of rural adults with chronic disease. **METHODS:** Data for this study came from the CDC's 2015 Behavioral Risk Factor Surveillance System (BRFSS). A total of N=65,492 rural adults 20+ years of age were included in the analysis. The main outcome variable was HRQOL as assessed by the CDC Healthy Days Index. Adults reporting 13 or fewer unhealthy days were considered to have "good" HRQOL and those reporting 14 or more unhealthy days were considered to have "poor" HRQOL. Adults were categorized as "meeting" PA guidelines if they reported 150+ minutes of moderate-intensity PA per week and "not meeting" PA guidelines if they reported less than 150 minutes. Participants were considered having a chronic disease if they reported ever being told by a health professional that they had diabetes, COPD, cancer, heart disease, a stroke or a heart attack. Multiple logistic regression was used to compute odds ratios (ORs) and 95% confidence intervals (CIs) while adjusting for age, sex, race, and income. SPSS Complex Sampling 24 was used to account for the sampling design. **RESULTS:** Rural adults with at least one chronic disease and meeting recommended levels of PA were significantly more likely to report good HRQOL (72.5%; 70.7-74.3) than their less active counterparts (58.1%; 56.4-59.7, $p<.001$). Those meeting recommended levels of PA had greater odds of good HRQOL regardless of reporting diabetes (OR=1.58; 95% CI: 1.31-1.91), COPD (1.49; 1.20-1.85), cancer (1.79; 1.43-2.22), stroke (1.73; 1.30-2.31), heart disease (1.52; 1.18-1.96), or heart attack (1.68; 1.32-2.15). Additionally, the same increased odds were seen across rural adults reporting 1 (1.59; 1.34-1.88), 2 (1.64; 1.28-2.11), and 3+ (1.52; 1.13-2.05) chronic diseases. **CONCLUSIONS:** Results from this study indicate that meeting recommended levels of PA is strongly associated with optimal levels of HRQOL among rural adults with chronic disease. Health promotion programs should market interventions to rural adults with such diseases to improve HRQOL.

1524 Board #199 June 1 9:00 AM - 10:30 AM
Lifestyle And Socio-Demographic Factors Determining The Coronary-Arterial Disease Risks In Brazilian Free-Living Adults
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PURPOSE: Coronary heart disease(CHD) continues to be a leading cause of morbidity and mortality among adults worldwide. The risk factors include complications of Metabolic Syndrome(MetS) and environmental factors. The Framingham score(FS) is a predictive algorithm developed using categorical variables, allowing the 10-yr prediction of multivariate CHD risk in patients without overt CHD. The purpose is to determine the intrinsic and the involved environmental factors of CHD in free-living adults. **METHODS:** A lifestyle modification program(LSM) involving dietary counseling and regularly supervised physical activity("Move for Health") has been used here, since 1991 for NCDs primary care. In a cross-sectional study we used the baseline data from 709 subjects(2005-2016), older than 35 yrs. The FS distribution was used as main variable and, as co-variables socio-demographic, behavioral(dietetic and physical fitness)anthropometric and clinical-biochemistry. For

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(hs-CRP) and oxidative(MDA and uric acid) states. Statistical comparisons were defined by $p=0.05$. **RESULTS:** The top quartile of FS was found as $\geq 10\%$ for females(F) and $\geq 15\%$ for males(M) and, they differed from the lower quartile ($\leq 3\%$ and $\leq 5\%$, respectively), by presenting 1.81x higher either HOMA-IR, 1.61x hs-CRP and 1.6x MDA values. Prevalence of MetS was 2.6x higher in p75(71.9% F and 73.1%M) than p25(28.1%F and 26.9%M) with p75 being fatter(higher 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.

1525 Board #200 June 1 9:00 AM - 10:30 AM
Is Grip Strength Related to Metabolic Risk Factors and Cardiorespiratory Fitness?

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PURPOSE: Grip strength is very easy to be measured, and is an index to reflect people's muscle strength. This study aimed at detecting if there are relationships between grip strength and metabolic risk factors and cardiorespiratory fitness.

METHODS: The 1925 people were recruited (men: 1425, female: 490; average age 41.33 \pm 9.35 yrs) and finished grip test and 835 of them finished VO_{2max} 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) \times 100), and VO_{2max} (n=835) was measured by YMCA cycle test. The relationship among grip strength, metabolic risk factors and VO_{2max} 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 \pm 7.38kg, women: 22.43 \pm 4.68 kg; relative grip strength: men: 54.35 \pm 11.55, women: 39.87 \pm 8.64), and are negatively related to age (P < 0.01). Men's VO_{2max} 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 40-49 yrs ($r=-0.129$, P < 0.05). No relationships in women. 3) In men, VO_{2max} is related to TC and LDC-C ($r=-0.211$, P < 0.05; $r=-0.287$, P < 0.01) in 20-29yrs, and related to TG in 30-39yrs ($r=-0.296$, P < 0.01); in women, VO_{2max} 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 VO_{2max} 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 predicted factor of metabolic risk and cardiorespiratory fitness (VO_{2max}) for men. 3) VO_{2max} may be a predicted factor of metabolic risk for adults. Supported by Chinese Health Promotion Foundation (CHPF2014-FITEX)

1526 Board #201 June 1 9:00 AM - 10:30 AM
Sedentary Time Adversely Influences the Mental Health of Adolescent Males Residing in a Treatment Facility

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(No relationships reported)

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 PA. The purpose of our study was to explore whether increased access to 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 \pm 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 BDBI-Y (Disruptive Behavior). Recreational therapy free time allotted in the warmer months (16.4 \pm 2.6hr-wk⁻¹) was higher than the cooler months (8.2 \pm 2.8 hr-wk⁻¹) ($t=52.7$, $p<0.01$); however most participants chose to be sedentary. There was a significant inverse correlation ($r=-0.71$, $p<0.01$) between the change in recreational therapy time and BSCI-Y (Self-Concept). 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⁻¹) 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

1527 Board #202 June 1 9:00 AM - 10:30 AM

Effect of High Intensity Intermittent Games-Based Activity on Adolescent Cardio-Metabolic Health

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In adults emerging evidence suggests that games-based activity acutely stimulates anti-inflammatory and inhibits pro-inflammatory cytokine production, proposed 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 \pm 0.6 y) completed an exercise (E) and resting (R) trial in a counter-balanced, randomised crossover design. Following a standardised breakfast (1.5 g kg⁻¹ bm 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 g kg⁻¹ bm 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-1 β , 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 \pm 0.7 mmol L⁻¹, R: 6.3 \pm 1.4 mmol L⁻¹, $p=0.070$). Similarly, the plasma insulin response was attenuated (trial*time interaction, $p=0.002$), with a lower peak plasma insulin concentration on the exercise trial (E: 217.2 \pm 29.2 pmol L⁻¹, R: 366.1 \pm 45.3 pmol L⁻¹, $p<0.001$). IL-6 concentration was higher (E: 4.22 \pm 0.80 pg mL⁻¹, R: 3.46 \pm 0.69 pg mL⁻¹, $p=0.005$) and there was a tendency for TNF- α to be attenuated (E: 1.24 \pm 0.22 pg mL⁻¹, R: 1.34 \pm 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.

1528 Board #203 June 1 9:00 AM - 10:30 AM

Associations of Aerobic and Strength Exercise with Clinical Laboratory Test Values

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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,

globulin, and C-reactive protein, and significantly higher levels of HDL cholesterol, creatinine, iron, and percent saturation (all $p < .05$). Exercise frequency had no significant effect on thyroid stimulating hormone levels in men or women. Type of exercise or gender influenced the observed relationships with exercise frequency for total cholesterol, aspartate aminotransferase, gamma-glutamyl transferase, alkaline phosphatase uric acid, bilirubin, and iron binding capacity. **CONCLUSIONS:** Physical exercise participation is associated with levels of many common biomarkers. Both forms of exercise shifted the distribution of results into the direction suggestive of better health, yet the majority of results still tended to fall within reference intervals. Reported relationships may help clinicians and patients to better understand and interpret laboratory results in athletic populations and possibly re-evaluate interpretation of reference intervals for physically active populations.

1529 Board #204 June 1 9:00 AM - 10:30 AM
The Effect Of Acute Muscular Exercise and Training Status On Hepatorenal Functions
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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 students-t-tests were used to compare values within and between the two groups. **Results:** The baseline serum urea (2.90 ± 0.1 vs 3.77 ± 0.2), and creatinine (70.05 ± 2.3 vs 81.90 ± 3.0) significantly ($P < 0.05$) increase with a significant decrease ($P < 0.05$) in potassium (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 2.56 ± 0.1), 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 (22.40 ± 1.2 vs 31.84 ± 2.0) and sodium (137.15 ± 3.0 vs 141.78 ± 0.7) was significantly lower ($p < 0.05$) in the athletic compared to the non-athletic group. However, the post-acute muscular exercise serum ALP, TBIL, CBIL, and bicarbonate showed no significant ($p > 0.05$) difference within and between the groups. **Conclusions:** Acute muscular exercise of same intensity altered hepatorenal function indices of athletes differently from the non-athletes and adaptive response seems to explain this finding.

Key words: Acute muscular exercise - athletic - hepatorenal function

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1530 Board #205 June 1 9:00 AM - 10:30 AM
Effect Of Exercise On Patients With Concussion
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PURPOSE: To examine the effect of exercise prescription on days from injury to symptom resolution and on days from first clinic visit to symptom resolution among youth with sports-related concussions presenting to a concussion clinic. **METHODS:** Data were retrospectively analyzed using electronic health records from seven concussion clinics at a pediatric hospital in the Midwest. Patients aged 10-17 years with a sports-related concussion (SRC) who presented to the clinics within 30 days post-injury, from May 2015 to May 2016 were included in the study. Youth in the exercise prescription group were prescribed non-contact exercise before symptom resolution while youth in the comparison group were prescribed exercise at or after symptom resolution. Unadjusted and adjusted generalized linear regression models were used to model the effect of active exercise prescription on days to symptom resolution, adjusting for age, sex, history of previous concussion, days from injury to initial visit, and symptom score at time of injury. **RESULTS:** Of 357 (male=229, female=128) concussed youth included, 204 (57.1%) were in the exercise prescription group and 153 (42.9%) were in the comparison group. The median symptom score (SS) at injury was 37 [interquartile range (IQR): 29.5] for the exercise prescription group and 36 (IQR: 32.0) for the comparison group. No statistically significant differences were observed in SS at injury ($p=0.4719$), SS at

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, which was statistically significantly longer than youth in the comparison group (median=12 days, $p=0.0192$) after adjusting for other covariates. However, no statistically significant difference was found in days from first clinic visit to symptom resolution between the two groups ($p=0.1118$). **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.

1531 Board #206 June 1 9:00 AM - 10:30 AM
Mechanisms for Balance Improvement in Tai Chi Intervention Trials: A Systematic Review
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 (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 mechanoreceptor 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. Neuromuscular 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 measurements 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
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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 Walking Test (6MWT), 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

unsupervised exercise (T1), we observed improvement of all analyzed parameters with statistical significance in waist circumference (T0=92.4±8.5 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 rep, T1=16.3±4.9 rep; 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

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 (No relationships reported)

Aquatic 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 based exercise. **PURPOSE:** To validate 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=.010549), 1.79 inch decrease in abdominal circumference (p=.02823), 15% reduction in systolic blood pressure (p=.00411), 12% reduction in diastolic blood pressure (p=.008556), 2.047 sec. improvement on gait speed via 10 meter walk (p=.000239), 6.72 rep improvement for 30 sec. chair stand (p=.01899), 1.698 sec. improvement on 8-foot up and go (p=.000396), 28.6% improvement in reported falls from baseline, 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

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 (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:** 5/9 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 (VO_{2submax}) 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 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 VO_{2max} of 29.61(6.01). Across both groups, there was a decrease in depressive symptoms over 12-weeks (t= 6.60, p< 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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1536 Board #211 June 1 9:00 AM - 10:30 AM

Cardiovascular Disease Risk Profile in Patients with Schizophrenia

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Poor physical health is a growing concern in patients with schizophrenia. Peak oxygen uptake ($\dot{V}O_{2peak}$) is recognized as a strong predictor of cardiovascular mortality, but cardiovascular risk profiles including $\dot{V}O_{2peak}$ are scarce in this population.

PURPOSE: To assess a risk profile from several key variables for development of 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 or delusional disorders; F20-F-29). Measurements included included state of the art direct assessment of peak oxygen uptake on a treadmill, physical activity assessment from accelerometers, BMI, waist circumference, blood pressure, as well as lipid profiles obtained from blood samples.

RESULTS: $\dot{V}O_{2peak}$ 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 waist circumference (111.8±17.4) 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 $\dot{V}O_{2peak}$. 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 $\dot{V}O_{2peak}$.

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 $\dot{V}O_{2peak}$ 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.

1537 Board #212 June 1 9:00 AM - 10:30 AM

Moderators Of Exercise Training Effects On Depressive Symptoms In Multiple Sclerosis: A Meta-regression Analysis

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Depressive symptoms are prevalent and debilitating among people with MS (PwMS). Though exercise training has demonstrated small-to-moderate antidepressant effects among PwMS, less is known about factors which influence the positive effects of exercise.

Purpose: To examine the extent patient and trial characteristics moderate the antidepressant effects of exercise among PwMS.

Methods: Twenty-four effects were derived from 14 articles published before August 2016 located using Google Scholar, MEDLINE, PsycINFO, PubMed, and Web of Science. Trials involved 624 PwMS and included randomization to exercise training or a control condition that lacked exercise and measurement of depressive symptoms at baseline and at mid- and/or post-intervention. Hedges' *d* effect sizes were computed, study quality was assessed, and random effects models were used for all analyses. Meta-regression quantified the extent to which patient and trial characteristics moderated the estimated population effect.

Results: Twenty-one effects (87.5%) were larger than zero. PEDRO scores ranged from 4-7 with a mean of 5.79±0.80. Exercise training significantly reduced depressive symptoms by a heterogeneous mean effect delta (Δ) of 0.55 (95%CI: 0.31-0.78; $p<0.001$). The effect was moderately consistent across studies ($I^2=59.9\%$, 95%CI: 49.6%-68.1%). Significant improvement in fatigue moderated the overall mean effect ($\beta=0.37$; $p<0.03$). Significantly larger antidepressant effects resulted from trials in which exercise significantly improved fatigue ($\Delta=1.04$, 0.53-1.55; $k=8$) compared to trials in which fatigue was not significantly improved ($\Delta=0.41$, 0.21-0.60; $k=14$; $z=2.91$, $p<0.004$). Age ($\beta=0.32$), disease severity ($\beta=0.05$), exercise program length ($\beta=0.26$), and exercise session duration ($\beta=0.13$) were not significantly related to effect size (all $p>0.15$).

Conclusions: Exercise significantly improves depressive symptoms among PwMS. Exercise-induced improvements in fatigue significantly moderated exercise effects on depression. Future trials may benefit from focusing on using exercise to concurrently improve depression and fatigue as a symptom cluster.

1538 Board #213 June 1 9:00 AM - 10:30 AM

Effect Of 24-weeks Low Vs High Intensity On Anxiety, Depression And Self-esteem In Obese Adolescents

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Purpose: To compare the effects of low vs. high intensity training on symptoms of anxiety and depression as well as on self-esteem in obese adolescents. **Methods:** Sixty-two obese adolescents (age=15.03±1.48; BMI=34.87±4.22 kg/m²) were randomized into high intensity training (HIT, n = 31) or low intensity (LIT, n = 31) groups for 24 weeks. All participants also received the same nutritional, psychological and clinical counseling. Pre- and post-intervention symptoms of depression, anxiety and self-esteem were assessed by questionnaires and body composition by DXA. Statistical analysis was conducted using mixed models for repeated measures and effect size (Cohen's *d*). **Results:** Depressive symptoms were reduced in both groups ($p = 0.006$) with higher effect size to HIT ($d = 1.16$) compared to LIT ($d = 0.45$). Trait anxiety were reduced in HIT ($p = 0.002$; $d = 0.81$) and LIT ($p = 0.002$; $d = 0.31$). No changes were observed for self-esteem and anxiety state.

Table 1. Effect of low vs high intensity training on self-esteem, depressive and anxiety symptoms in obese adolescents.

| | Baseline (n=28) | 24 weeks (n=28) | P values | | |
|-------------------|-----------------|-----------------|----------|-------|------|
| | | | G | T | GXT |
| BDI | | | | | |
| HIT | 19.86±7.75 | 12.29±5.69* | 0.77 | <0.01 | 0.40 |
| LIT | 18.86±8.44 | 14.85±10.14* | | | |
| RSES | | | | | |
| HIT | 19.79±6.25 | 21.69±4.33 | 0.82 | 0.11 | 0.60 |
| LIT | 20.71±5.05 | 21.46±4.54 | | | |
| STAI-State | | | | | |
| HIT | 41.07±11.26 | 38.00±13.26 | 0.85 | 0.21 | 0.81 |
| LIT | 39.79±10.48 | 38.54±13.16 | | | |
| STAI-Trait | | | | | |
| HIT | 45.71±9.49 | 37.43±11.37* | 0.92 | <0.01 | 0.21 |
| LIT | 43.86±8.34 | 40.92±11.12* | | | |

BDI: Beck Depression Inventory; STAI: Spielberger State-Trait Anxiety Inventory; RSES: Rosenberg Self-Esteem Scale; HIT: High Intensity Training group; LIT: Low Intensity Training group; *vs baseline ($p<0.05$); G: group; T: time.

Conclusion: The results from the present study suggested that in obese adolescents the positive changes in psychological outcomes are independent of the intensity of exercise training. Supported by CNPq (grant 477955/2009-6) and FACEPE (grant 0928-4.9/08)

1539 Board #214 June 1 9:00 AM - 10:30 AM

Social And Environmental Determinants Of Physical Activity And Dietary Choices In Adolescents With Intellectual Disabilities.

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(No relationships reported)

Purpose: The prevalence of obesity is higher in those with intellectual disabilities than the general population. The aim of the study was to understand the determinants of physical activity and dietary patterns in this population during their final year of school.

Methods: Participants were recruited from four additional support needs (ASN) schools in the Greater Glasgow and South Lanarkshire area of Scotland. Qualitative data were generated from 10 interviews with adolescents with mild-moderate intellectual disabilities. A phenomenological approach was utilised to explore their perceptions of factors influencing their lifestyle behaviours. Transcripts were analysed

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) situatedness (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 facilitate 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 Baily Thomas 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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PURPOSE: To quantify the relationship between adipose mass (absolute and relative) and bone mineral density (BMD) in over-weight 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 cm⁻²) of the total body, lumbar spine, total femur or femoral neck from overweight and obese individuals. A multi-level meta-regression model was used to obtain pooled estimates of the magnitude and direction of reported correlations, whilst investigating the effect of potential moderators (sex, age and BMI class). The protocol was prospectively registered in PROSPERO (CRD42015024313).

RESULTS: Sixteen studies, including 2587 participants and 75 correlation coefficients were included. Opposing relationships between 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 *per se*, which is particularly relevant in men and younger individuals. In order to protect bone mass in overweight and obese populations, exercise and nutrition based interventions that focus on a controlled reduction of adipose mass with concomitant preservation of lean mass are required.

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 $P \leq 0.05$.

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.

1542 Board #217 June 1 9:00 AM - 10:30 AM
Copenhagen Sarcopenia Study - Time To Implement Assessment Of Muscle Mass And Muscle Function As A Clinical Target

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Copenhagen Sarcopenia Study - Time to implement muscle mass and muscle function as a clinical target

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Purpose:

Despite the lack of consensus on the diagnostic criteria for sarcopenia, the combination of low muscle mass, muscle strength and function are important risk factors for disability, frailty and mortality in older individuals, as well as a wide range of patients with muscle loss. Consequently, reliable methods are therefore needed to implement routine clinical evaluation tools that allow for effective diagnostics and treatment of sarcopenia.

Methods

Participants from the Copenhagen City Heart Study were included to establish a Danish reference material (Copenhagen Sarcopenia Study) on muscle mass characteristics (Appendicular Skeletal Muscle (ASM), iDXA, GE Lunar), muscle strength, (hand grip strength, Jamar dynamometer and Leg extension power, Nottingham Power Rig) and functional ability (30 sec Chair Rise Test (CRT) and 10 m maximal walking speed).

Results

1305 subjects, (732 women and 573 men) 20-89 years were included. Compared to women, men had larger ASM (26,5 kg vs 18,2 kg; $p < 0.05$), BMI (26,9 kg/m² vs 24,8 kg/m²; $p < 0.05$), ASM/BMI (1,02 vs 0,75; $p < 0.05$), muscle power (3393 w vs 2535 w; $p < 0.05$) and HGS (46,8 kg vs 29,5 kg $p < 0.05$). In contrast there was no difference in CRT (21,2 vs 20,4; $p < 0.05$) and WS (4,5 s vs 5,0 s; $p < 0.05$). With increasing age, ASM ($r=-0.306$ and $r=-0.432$; $p < 0.05$), leg extension power ($r=-0.186$ and $r=-0.423$; $p < 0.05$) and CRT ($r=-0.405$ and $r=-0.414$; $p < 0.05$) declined in both women and men, respectively.

Conclusions

Adequate reference materials are needed to identify individuals with low muscle mass, reduced muscle strength and impaired functional capacity, in line with the current assessment of bone mineral density. Effective diagnosis of low muscle mass and parallel impairments in muscle function will enable early targeted treatments to be initiated guided by relevant diagnostic tools.

1543 Board #218 June 1 9:00 AM - 10:30 AM
Effects of Well-Rounded Exercise Training on Cartilage Metabolism in Females without Radiologically Knee Osteoarthritis

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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 preosteoarthritic 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 \leq 1) for 90 minutes once a week during 12 weeks under supervision. The subjects were followed up 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 carboxy-propeptide (CPII) and cartilage oligomeric matrix protein (COMP) were measured using serum by enzyme-linked immunosorbent assay (ELISA), collagenase-generated neopeptide of type II collagen (C2C) and carboxy-telopeptide of type II collagen (CTX-II) were evaluated using urine by ELISA.

RESULTS: One week after the initiation of the training, type II collagen degradation evaluated by CTX-II dropped down to lower levels, and thereafter maintained the levels by the final follow-up. Compared with the baseline, a significant decrease in CTX-II levels was found at 1, 2, 4, 8, and 24 weeks. Similarly, type II collagen cleavage 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 CPII and a cartilage degradation marker COMP had no appreciable changes during the whole period of intervention and the subsequent follow-up.

CONCLUSIONS: Well-rounded exercise training could decrease type II collagen degradation in females without radiologically knee OA.

C-43 Free Communication/Poster - Fat Metabolism and Exercise

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

1544 Board #219 June 1 8:00 AM - 9:30 AM
Fat Oxidation and Aerobic Fitness in Postmenopausal Women: Comparing an Exercise Intervention to Long-Term Exercise

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Menopause is related to reduced fat oxidation capacity, limiting energy for submaximal activity, contributing to earlier fatigue, reducing aerobic performance and making physical activity more difficult. Exercise interventions can increase fat oxidation in sedentary postmenopausal women, but the degree to which this enhances aerobic performance is unknown. It is also unclear if postmenopausal interventions generate fat oxidation and fitness levels similar to women who are physically active before, during, and after menopause. **PURPOSE:** To evaluate the effects of exercise on fat oxidation and aerobic fitness in postmenopausal women by comparing a short-term intervention in sedentary women to long-term exercisers. **METHODS:** Two cohorts were studied for 16 weeks: 1) Active cohort (N = 13), exercised > 5 hr/wk for \geq 10 years; 2) Training cohort (N = 14), sedentary, completed 16-week, 1000 MET-min-week⁻¹ intervention. Gas exchange was measured at rest and during cycle ergometer maximal exercise

tests. Fat oxidation was calculated from RER at rest and during warmup and exercise phases of the cycle test. Fitness variables were workloads and oxygen consumption at ventilatory threshold (workload_{VT}, VO_{2VT}) and maximal exertion (workload_{MAX}, VO_{2MAX}). Body composition was measured with DXA to normalize O₂. **RESULTS:** At baseline, compared to the Active cohort, the Training cohort had less fat-free mass (P = 0.04), used 15.7% less fat energy at rest (P = 0.02) and 9.7% less fat energy during warmup (P = 0.02), had a 46 W lower workload_{MAX} (P < 0.01), 3.6 ml O₂·kg_{FEM}⁻¹·min⁻¹ lower VO_{2VT} (P < 0.01), and 8.2 ml O₂·kg_{FEM}⁻¹·min⁻¹ lower VO_{2MAX} (P < 0.01). At 16-weeks the Active cohort's values did not change, but the Training cohort increased fat energy during warmup (+12%; P = 0.02), workload_{VT} (+9 W; P < 0.01), workload_{MAX} (+16 W; P < 0.01), and VO_{2MAX} (+2.6 ml O₂·kg_{FEM}⁻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 interventions improve 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.

1545 Board #220 June 1 8:00 AM - 9:30 AM
Change in Maximal Fat Oxidation in Individuals in Response to Different Regimes of High Intensity Interval Training (HIIT)

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INTRODUCTION: Increased capacity for fat oxidation (FatOx) is widely reported (Talanian et al. 2007; Burgomaster et al. 2008) in response to high intensity interval training (HIIT). However, most of these data was obtained in studies in which a non-exercising control group (CON) was not used. Based on the widespread variability in FatOx reported (Crocini et al. 2014), it is unknown if these previously-reported increases in FatOx are real or a product of day-to-day variability in the measure.

OBJECTIVE: To examine changes in FatOx and maximal fat oxidation (MFO) in response to 20 sessions of HIIT varying in structure in active men and women.

METHODS: Thirty-nine active men and women (age and VO_{2max} = 22.5 ± 4.4 yr and 40.0 ± 5.6 mL/kg/min) completed progressive HIIT, and 34 men and women matched for body fat and VO_{2max} served as a non-exercising control group (CON). Ten sessions of low volume HIIT (8 – 10 1 min bouts at 90 – 110 % peak power output separated by 75 s recovery) were performed on a cycle ergometer after which subjects were randomly assigned to complete 10 additional HIIT sessions consisting of sprint interval training (SIT), high-volume HIIT, or periodized HIIT. After an overnight fast and 24 h dietary standardization, individuals underwent progressive cycling to exhaustion before, midway, and post-training to assess MFO, FatOx and carbohydrate oxidation (CHOOx).

RESULTS: Results showed no effect of training on MFO (p = 0.11) although small increases in FatOx equal to an additional 4.3 g of fat were evident (p = 0.03). Individual responses in MFO occurred as 33 % of participants revealed meaningful increases in MFO from pre- to post-HIIT, and there was a significant inverse association between baseline MFO and the training-induced change, r = -0.46, p = 0.004. There was no time X training interaction for CHOOx (p = 0.31) suggesting a similar response of CHOOx to HIIT versus CON.

CONCLUSIONS: Data refute previously-reported increases in MFO in response to HIIT (Astorino et al. 2013), although participants with low initial MFO tended to show meaningful increases in MFO with training. We recommend that scientists use a non-exercising control group to certify that the frequently-reported increase in FatOx attributed to HIIT is indeed a result of training and not due to marked variability in the measure.

1546 Board #221 June 1 8:00 AM - 9:30 AM
Effects of Exercise on FGF-21 Pathway Functions in Hepatic Lipid Metabolism

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Fibroblast growth factor 21 (FGF-21) is recently known as an important factor controlling lipid metabolism in liver. Regular exercise is helpful to fat loss in obese individuals, however, whether exercise can promote fat oxidation by activating FGF-21 pathway functions has not been clearly explained.

PURPOSE: To investigate the effects of aerobic and resistant exercise on blood lipid profiles and the functions of hepatic FGF-21 pathway in obese mouse.

METHODS: Thirty male obese mice were randomly assigned into control group (CON, n=10), aerobic exercise group (AE, n=10), and resistant exercise group (RE, n=10). AE group ran on a treadmill for 8 weeks, 5 days/week, the running speed was started at 15 m/min in week 1 and increased by 1.5 m/min per week until 25 m/min in week 8. The exercise time was increased from 20 to 60 min accordingly. RE group completed an 8-week resistant exercise program by climbing on a ladder. The mice were trained once in every two days, and the load was adjusted according to their exercise capacity in each time. Blood samples and liver tissues (right lobe) were collected after the last training session for 24 hours.

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 PPAR α 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 1.59±0.38, $p < 0.05$). Moreover, the PGC-1 α 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.

(Supported by NSFC 31471139 and CISSFRF 16-18)

1547 Board #222 June 1 8:00 AM - 9:30 AM
Effects of Isoflavone and Exercise on Regulation of Energy Homeostasis in Ovariectomized Female Rats

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(No relationships reported)

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 m/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 55%) groups ($p < 0.05$). ISO supplementation showed only significant reduction effect on leptin level (35%, $p < 0.05$). OVX significantly reduced PPAR δ and FAS 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 PPAR δ 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 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 (PPAR δ) and lipogenesis (SREBP-1c and FAS). ISO diet showed effects only on reducing leptin level and SREBP-1c gene expression. Supported by DFG Di 716/12-1

1548 Board #223 June 1 8:00 AM - 9:30 AM
Effects of Endurance Exercise and Rapamycin on Hepatic Energy Metabolism Gene Expression in Rats Fed a High-Fat Diet

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(No relationships reported)

Objective The mammalian target of rapamycin(mTOR) pathway is a critical 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 was to investigate the role of the rapamycin (inhibitor of mTOR) on exercise-induced improvement of hepatic gene involved in energy metabolism in HFD rats.

METHODS: 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 satining was used to determine the hepatic triglyceride(TG)content.

Result Oil-red staining indicated that the 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 succinodehydrogenase(SDH), but reduced the activity of cytochrome C oxidase (COX) in liver of HFD rats. The exercise significantly up-regulated the gene expression level of PGC-1 β mRNAs, but Rapamycin had no effects on the gene mRNAs expression level of PGC-1 α , PGC-1 β , PPAR α , PPAR β , CPT1 α and PDK4.

Conclusion Chronic rapamycin administration does not affect exercise-induced reduction of hepatic TG content and mitochondrial metabolic gene in HFD rats.

1549 Board #224 June 1 8:00 AM - 9:30 AM
Effects of Hypoxic Living and Exercise Training on the miR-27/PPAR γ Pathway in Obese Rat Liver

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(No relationships reported)

PURPOSE: To examine the effects of hypoxic living and exercise training on the miR-27/PPAR γ pathway in the liver of obese rats.

METHODS: Forty 13-week-old male diet-induced obesity rats were randomly divided into four groups (n=10 each): normoxic group(N), exercise group(E), hypoxia group(L), hypoxia and exercise group(LE). Rats in the hypoxia groups were exposed to an oxygen concentration of 13.6%, for 24h/day. Rats in the exercise groups were exercised on a treadmill at a speed of 25m/min, 1 hour/day, 5 days/week for a total of 4 weeks. MicroRNA-27(miR-27) expression level in the liver were determined by real-time PCR. Protein and mRNA expression levels of PPAR γ , ABCA1, CYP7A1, CD36, ATGL, LPL, L-FABP, SREBP1 were tested in the obesity rat liver.

RESULTS: After the 4-week intervention period, adipose tissue around the kidney weight was significantly lower in the E(2.18±0.26g), L(2.30±0.29g), and LE(1.49±0.36g) than in the N(2.80±0.83g)($p < 0.05$), and epididymal adipose tissue weight was significantly lower in the E(6.84±1.11g), L(7.13±0.86g), and LE(6.13±1.60g) than in the N(8.44±1.63g)($p < 0.05$). Liver miR-27 levels were significantly lower in the LE(0.16±0.09) than in the N(0.26±0.09) ($p < 0.05$). N(1.11±0.26) rats' PPAR γ mRNA level is lower than E(1.81±0.28), L(1.45±0.29) and LE(1.52±0.44) ($p < 0.05$), and N(0.61±0.12) rats' protein expression level of PPAR γ is lower than E(0.80±0.16), L(0.78±0.14) and LE(0.84±0.14) ($p < 0.05$). N(1.08±0.60) rats' CYP7A1 mRNA level is lower than L(2.51±1.13) and LE(3.48±2.36) ($p < 0.05$), and N(0.46±0.13) rats' protein expression level of CYP7A1 is lower than L(0.66±0.12) and LE(0.65±0.12) ($p < 0.05$). N(0.80±0.25) rats' CD36 mRNA level is lower than E(1.45±0.80) ($p < 0.05$), and N(0.49±0.17) rats' protein expression level of CD36 is lower than E(0.73±0.13) and LE(0.18±0.06) ($p < 0.05$). N(1.03±0.23) rats' SREBP1 mRNA level is lower than L(1.37±0.41) ($p < 0.05$). Rats' mRNA and protein expression level of ABCA1, ATGL, LPL, L-FABP is no significant difference each other.

CONCLUSIONS: Hypoxic exercise may decrease the miR-27 level in the liver of obese rats, and negatively regulate the expression of PPAR γ , and affects the dynamic balance of fat metabolism in the obese rats' liver, then leads to the decrease of visceral fat of obese rats.

Project 31471139 supported by NSFC.

1550 Board #225 June 1 8:00 AM - 9:30 AM
"It Takes Two To Tango"; Exercise Modifies Skeletal Muscle Mitochondria And Lipid Droplets Closeness

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(No relationships reported)

PURPOSE: Intramyocellular lipids (IMCL), stored in lipid droplets (LD), are known to be a hallmark of skeletal muscle insulin resistance. Chronic exercise (training) increases IMCL while also increasing insulin sensitivity (IS), a paradigm known as the athlete's paradox. Mitochondria (M), the powerhouse of the cells, are responsible to transform LD content into energy. The closeness of these 2 organelles in the different subcellular compartments (intramyofibrillar (IMF) and subsarcolemmal (SSL)) and

how they change with training are not yet known. The purpose of this study was to examine exercise induced changes in LD and M closeness in insulin resistant non-diabetic subjects.

METHODS: In a nested case-control study, 12 cases (6F/6M) underwent a 4-months supervised endurance exercise intervention. 12 insulin sensitive subjects matched by age and gender served as controls (C). LD, M and the surface in contact with each other, were assessed in muscle biopsies with electron microscopy. IS was measured by hyperinsulinemic euglycemic clamp. VO_{2peak} was measured by GXT and body composition by DEXA.

RESULTS: Although training improved IS by 45±8% ($P<0.05$), increased VO_{2peak} by 13.2±4.4% ($P<0.05$), reduced body fat by 3.9±1.2% ($P<0.05$), cases remained significantly different from C. M increased in IMF and SSL (54.7±15.1% and 78.2±20.5% respectively, $P<0.05$). LD increased in IMF (51.8±18.1%) and decreased in (SSL 20.7±8.3%, both $P<0.05$). Contact between M and LD increased significantly only in IMF (65.1±26.3%, $P<0.05$). While SSL LD were negatively correlated with IS at baseline, changes in overall LD with intervention were related with improvements in IS. SSL LD correlated with body adiposity, but not IMF LD.

CONCLUSIONS: With endurance training, the closeness of M and LD increased only in the contractile region, i.e. the IMF compartment. At the same time, the amount of M and LD increased in this compartment. This observation confirms what is observed in healthy and athletic individuals, which suggests that IMCL are used for fuel. At the contrary, LD decreased in the SSL region while M increased in this compartment. Our observations are of interest, as IMCL are known to be involved in the mechanisms leading to insulin resistance in sedentary muscle, possibly explaining the observation in the SSL region.

1551 Board #226 June 1 8:00 AM - 9:30 AM

Metabolic Flexibility In Lean Children: Effect Of Parental BMI

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(No relationships reported)

Metabolic flexibility is defined as the ability of the body to switch fuel preferences after some form of stimulation. Metabolic inflexibility is associated with metabolic disorders, including obesity and diabetes. Because obesity has been determined to be the result of an interaction between environmental and genetic factors, it is possible that the influence of parental weight status may influence the child's metabolic tendencies, even in lean children. **PURPOSE:** This study examined the effect of parental weight status on the child's metabolic flexibility, expressed via fat oxidation. **METHODS:** Subjects were separated into groups based on parental BMI: those with two lean parents (LL, n=5, 10.5±1.3 years old, 31.5±4.6 kg, BMI of 16.9±1.0, 17.9±3.1 % body fat) and those with at least one overweight or obese parent (LO, n=7, 10.2±1.6 years old, 35.6±6.7 kg, 16.9±1.7, 17.6±4.3 % body fat). The experimental visit occurred in the morning, preceded by a standardized breakfast. The child performed two 20-minute exercise bouts, separated by a 10-minute rest. The first bout consisted of 10 minutes at 50% VO_{2max} and 10 minutes at 75% VO_{2max} . The second bout consisted of 20 minutes at 50% VO_{2max} . A two-way (group x time) ANOVA was used to compare the relative contribution of fat (fat use %) and fat oxidation rate (FOX) between the 10-minute time point of the first bout and the 5-, 10-, 15-, and 20-minute time points of the second bout. Significance was set at $p\leq 0.05$. **RESULTS:** There were no significant differences in age, body mass, BMI, or body fat percentage between groups. VO_{2max} was 43.5±6.8 and 44.0±8.1 ml/kg/min in the LL and LO groups, respectively ($p>0.05$). Fat use % across the five time points ranged from 32.8±20.8 to 48.8±14.9% and from 32.1±7.3 to 40.2±8.4% in the LL and LO groups, respectively. FOX across the five time points ranged from 0.11±0.07 to 0.16±0.06 g/min and from 0.12±0.04 to 0.16±0.05 g/min in the LL and LO groups, respectively. Fat use % and FOX were significantly greater at each time point of the second bout versus the 10-minute time point of the first bout. No significant group or interaction effects were noted. **CONCLUSION:** This study suggests that parental weight status may not have an effect on the metabolic flexibility in fat metabolism of lean children in the early stages of puberty.

1552 Board #227 June 1 8:00 AM - 9:30 AM

Postprandial Triglyceride Responses in Younger versus Older Active Adults

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BACKGROUND: A large post-meal triglyceride (TG) response (postprandial lipemia) is linked to increased cardiovascular disease risk. Exercise lowers postprandial lipemia, although this has been primarily shown in young adults. Studies have reported an

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 active younger 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 having 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.

1553 Board #228 June 1 8:00 AM - 9:30 AM

Effect Of 2-week Cold-water Swimming On White Adipose Tissue Browning In Mice

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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 synergic 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 synergic 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 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±1.0 vs. 35.3±1.4 & 37.2±1.1g, both $p<0.05$). And the relative cell size of white adipose tissue in the cold-swimming and warm-swimming groups decreased in compared with the control group (142±41 & 168±68 vs. 328±59%, both $p<0.05$). The expression of uncoupling protein-1 (UCP-1) in white adipose tissue in the cold-swimming group was higher significantly than in the warm-swimming and control groups (147±8 vs. 112±6 & 123±2%, both $p<0.01$), while peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1-alpha) in the warm-swimming group was higher than 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 (323±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.

1554 Board #229 June 1 8:00 AM - 9:30 AM
High Intensity Versus Low Volume Resistance Exercise On Postprandial Triglycerides In Healthy College Students

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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 minute 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 (milkshake, 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 four 30 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=0.699). **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.

1555 Board #230 June 1 8:00 AM - 9:30 AM
The Effects of Isointensive Endurance Exercise on Postprandial Lipemia

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 (No relationships reported)

The ability to alter postprandial metabolism in favor of elevated fat metabolism could help attenuate the plasma lipid excursion, leading to decreased CVD risk. **PURPOSE:** We compared two isoenergetic exercise modalities (run, walk) on subsequent postprandial lipemia in males. **METHODS:** Active, college-aged males (n=7; weight = 72.5 ± 3.9 kg; BP% = 17.9 ± 1.2; VO_{2max} = 51.5 ± 1.36 mL/kg/min) participated in a crossover-designed study, and studied on each of 3 occasions: Walk, Run, and Control. Subjects completed a body composition and VO_{2max} test. (Run) was 60-min on a treadmill at 0% grade and speed equal to 60% VO_{2max} (694.4 ± 26.1 kcal). (Walk) was 60-min at 3.3mph and a steep incline equal to 60% VO_{2max} (677.9 ± 20.9 kcal). A post-exercise meal of 11.5 kcal/kg FFM (CHO-48%, Fat-36%, Protein-16%; 672.7 ± 31.6 kcal) was given 30-min post-exercise. Pulmonary gas exchange and plasma TG was assessed at baseline (0), post-exercise (60) then at 90, 120, 180, 240, and 300 min to assess TG, metabolic rate, FATox, and CHOox. RM ANOVAs were used for statistical analysis. Values were calculated as either time weighted average over the 300 min or incremental AUC. **RESULTS:** There was no significant difference in TG tm wtd avg (Run, 77.9 ± 2.6; Walk, 86.7 ± 15.4; Con, 89.3 ± 15.2 mg/dL, P>0.05) or incremental AUC (Run, 7157 ± 695; Walk, 7954 ± 3120; Con, 6559 ± 1010 mg/dL) between the three groups. In comparison to Con, both Run and Walk led to increased incremental AUC for FATox (Run, 110.9 ± 29.4; Walk, 87.5 ± 24.5; Con, 9.8 ± 29.4 kcal, P<0.05) with no significant difference between Run and Walk. There was no significant difference in CHOox, TEE, or RER between any conditions (P>0.05). **CONCLUSION:** Running and walking at 60% VO_{2max} for 60-min enhances the rate of fat oxidation in the postprandial period in active males, when compared to a time-matched sedentary control, without a significant attenuation in the postprandial plasma TG excursion. These results indicate the effects of 60% VO_{2max} may not be potent enough in this population to elicit an attenuation in the postprandial plasma TG concentration, especially when consuming a post-exercise meal equivalent to the caloric expenditure of the exercise bout. So, greater intensity or duration may be needed to provide a beneficial effect within this population.

1556 Board #231 June 1 8:00 AM - 9:30 AM
Effect Of Acute Exercise Without Energy Replacement On Fat Oxidation And Hormone Profiles During Sleep

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Purpose: Performing exercise without energy replacement increases 24-h fat oxidation, primarily by increasing fat oxidation during sleep. This study investigated potential mechanisms to explain how daytime exercise without energy replacement increases nocturnal fat oxidation. **Methods:** Twelve healthy adults (7F/5M; age= 27±5 y; BMI=23±3 kg/m²) completed a randomized crossover study that included sedentary-energy balanced (BAL) and exercise-energy deficit (DEF) visits. 24-h energy expenditure (EE) and substrate oxidation were measured using whole room indirect calorimetry. During BAL, subjects consumed an energy-balanced diet and remained primarily sedentary. During DEF, subjects performed 2 bouts of treadmill exercise (~60% VO_{2max}) in the morning and afternoon. Total exercise EE was ~20% of daily energy requirements, which was not replaced in the diet. Room calorimeter data were divided into (1) 24-h, (2) wake (0800h-2200h), and (3) sleep (2200h-0700h) segments for analysis. Metabolites [glucose, free fatty acids (FFA), and triglycerides] and hormones (insulin, growth hormone, norepinephrine, and cortisol) thought to influence diurnal changes in fat oxidation were measured every 90-min during sleep. **Results:** 24-h EE (2483±458 vs. 1995±401 kcal, mean±SD) and waking EE (2173±428 vs. 1580±361 kcal) were higher during DEF than BAL, respectively (p<0.001), but there was no difference in sleep EE (495±83 vs. 504±76 kcal, p=0.35). Sleeping fat oxidation trended towards being higher during DEF (7.1±13.0% higher, p=0.09). DEF decreased nocturnal plasma glucose (p=0.008) and insulin (p=0.02) concentrations and increased FFA (p=0.001), but had no effect on nocturnal growth hormone (p=0.50), norepinephrine (p=0.26), or cortisol (p=0.92). Sleeping fat oxidation during DEF was associated with greater nocturnal FFA availability (R²=0.33, p=0.06), and was modestly related to lower insulin concentrations (R²=0.21, p=0.15). **Conclusion:** Daytime exercise without energy replacement increased nocturnal fat oxidation. This appeared to be driven by lower insulin concentrations, which may have facilitated a higher rate of free fatty acid release (lipolysis) during sleeping hours compared to a sedentary, energy balanced state.

1557 Board #232 June 1 8:00 AM - 9:30 AM
A High-Fat Diet Rich In Polyunsaturated Fatty Acids Downregulates Glut4, But Not Skeletal Muscle Glycogen.

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High fat diets (HFD) are linked to the development of obesity and type 2 diabetes (T2D), characterized by defects in glycogen storage and increased lipid accumulation in skeletal muscle. Replacement of saturated fatty acids in high fat diets, with unsaturated (mono- and poly-unsaturated) fatty acids has been shown to reduce risks for insulin resistance, obesity and T2D.

PURPOSE: The purpose of this study was to determine the effects of HFD differing in fatty acid composition, on skeletal muscle glycogen, mitochondrial, GLUT4, and lipid contents.

METHODS: Male Sprague Dawley rats were fed a Western-style (21% fat by weight; 41% total energy) HFD for 9 weeks to induce obesity and then were divided into one of three HFD groups for an additional 6 weeks; a control chow group followed a 15-week low fat diet. Animals consumed either a) low fat Chow diet (CD) (4.8 % fat; 0.74% saturated; 2% mono; 1.77% poly; n=6), b) mixed fat Western diet (WD) (21% fat; 9.76% saturated; 7.68% mono; 3.48% poly; n=6), c) HFD rich in monounsaturated fatty acids (MUFA) (21% fat; 2.82% saturated; 16.01% mono; 2.18% poly; n=6), d) HFD rich in polyunsaturated fatty acids (PUFA) (21% fat; 2% fat; 2.97% mono; 16% poly; n=7). After 15 weeks, glycogen (periodic acid-schiff staining) mitochondria, GLUT4, and lipid content were measured in extensor digitorum longus muscle using immunohistochemical staining techniques and quantified with imageJ software. **RESULTS:** Following the 6-week treatment period, body weight (g) in the WD group was significantly greater compared to MUFA (p=0.0006), PUFA (p=0.02), and CD (p<0.0001). Glycogen content was significantly greater (p=0.04) in animals fed a WD compared to CD. (AU±SEM; CD: 4.41±0.04; WD: 4.74±0.13; MUFA: 4.54±0.08; PUFA: 4.54±0.11; one-way ANOVA p=0.11). A HFD rich in PUFA resulted in

impaired GLUT4 content ($p=0.02$) compared to a CD ($AU\pm SEM$; CD: 77.38 ± 2.22 ; WD: 63.46 ± 3.80 ; MUFA: 61.49 ± 8.46 ; PUFA: 52.84 ± 5.13 ; one-way ANOVA $p=0.03$). There were no significant effects on mitochondrial or lipid content.

CONCLUSION: A high fat diet rich in polyunsaturated fatty acids results in significantly lower GLUT4 content without negatively impacting skeletal muscle glycogen storage in high fat diet induced obese rats. A high fat diet rich in saturated fat resulted in greater muscle glycogen content compared to low fat fed rats.

1558 Board #233 June 1 8:00 AM - 9:30 AM
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, 9.6% carbohydrate, and 65.3% fat, $n=10$) or SC (3.1 kcal/g, 24% protein, 58% carbohydrate, 18% fat; $n=30$) for 7 days. The SC rats were split into sub-groups whereby one group was provided a moderate amount of KS in their 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 pad FASN mRNA was down regulated in KD and both KS groups ($p=0.001$). HSL and CEBP α mRNAs were not differentially expressed ($p=0.16$ and $p=0.51$, respectively). ACC α 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.

1559 Board #234 June 1 8:00 AM - 9:30 AM
Introduction Of A High-fat/sucrose Diet Modulates Voluntary Wheel Running Activity In Adult Female Rats

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Food intake and spontaneous physical activity have been attributed to a common hypothalamic pathway although the specific mechanisms involved in this relationship, and how it is influenced, have yet to be elucidated. **PURPOSE:** To determine how alternating low- and high-fat/sucrose diets affect voluntary wheel running in rats and its relationship with food/energy consumption. **METHODS:** An interrupted time series model was used to examine voluntary running and *ad libitum* food consumption characteristics over a 9-week period in adult female (~40 days old; ~120-140 g) Sprague Dawley rats ($n=8$ /group). Low- (L; 4%) or high- (H; 25%) fat/sucrose diets were provided in 3-week intervals: LLL and HHH control groups received only low- or high-fat/sucrose diets, respectively, whereas alternating diet groups (HLH and LHL) were switched every 3 weeks. Resistance-free running wheels recorded distances automatically and food consumption was measured manually daily; body mass was recorded every two weeks. **RESULTS:** Each diet group increased mean running distance (meters/day) that peaked at Week 3 followed by a gradual decrease in activity through Week 9. Compared to other groups, LLL rats maintained a higher percentage of peak activity between Weeks 4-8. Daily distances were highly variable (range: 633 – 40,079 m/day) depending on the specific rat and day. Although daily food consumption ranged from 42-69 kcal / day, no relationship existed between daily running distances and absolute (grams) or relative (kcal) food consumption for the LHL, HLH, or HHH groups (R^2 range: 0.0006 – 0.15); a significant correlation existed between these variables in LLL rats (R^2 : 0.58; $p<0.05$). Body mass increased from 61-80% from

starting values and final body masses were similar in all groups (range: 225-240 g; $P>0.05$). **CONCLUSION:** Adult female rats demonstrate a high propensity for voluntary physical activity in the first three weeks of wheel access followed by 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 (LLL), suggesting that diet composition, rather than intake alone, impacts spontaneous physical activity.

1560 Board #235 June 1 8:00 AM - 9:30 AM
Effects of High-Fat Diet and Exercise on Endoplasmic Reticulum Stress Mediated Apoptosis in Rat Liver

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(No relationships reported)

PURPOSE: To examine the effects of 16 weeks of high-fat diet feeding and swimming exercise on liver steatosis and endoplasmic reticulum stress mediated apoptosis in rats. **METHODS:** Male Sprague-Dawley Rats were randomly divided into 3 groups (each $n=10$): a control group (C), a high-fat diet group (D) and a high-fat diet plus exercise group (DE). Rats in the C group were fed with standard diet, and those in the D and DE groups were fed with high-fat diet for 16 weeks. Rats in the DE group were exercised in a swimming pool for 60 min/day, 6 days/week for 16 weeks. Liver pathological changes were determined by hematoxylin and eosin staining. Hepatocyte apoptosis was measured by terminal deoxynucleotidyl transferase-mediated dUTP nick end labeling assays. Western blots were used to measure expression levels of proteins related to endoplasmic reticulum stress mediated apoptosis, including the CCAAT enhancer-binding protein homologous protein (CHOP), the c-Jun N-terminal kinase (JNK) and the caspase-12 gene. The ABC Immunohistochemical staining was used to detect the positive expression rates of CHOP, JNK, caspase-12. One-way ANOVAs were used for data analysis. **RESULTS:** all rats in the D group obtained NAFLD (C group: 0% vs. D group: 100%). the DE group had a lower incidence of NAFLD (DE group: 20% vs D group: 100%). Compared to the C group, the D group had a higher number of liver lipid droplets (0.483 ± 0.068 vs 0.185 ± 0.041 , $P<0.01$) and a higher liver cell apoptosis index (1.110 ± 0.250 vs 0.350 ± 0.160 , $P<0.05$) and significantly higher expression levels of chop (2.465 ± 0.312 vs 0.858 ± 0.079 , $P<0.01$), caspase12 (1.430 ± 0.136 vs 0.372 ± 0.064 , $P<0.01$), and JNK (1.361 ± 0.114 vs 0.358 ± 0.048 , $P<0.01$) in liver cell. Compared to the D group, the DE group had a lower number of liver lipid droplets (0.306 ± 0.059 , $P<0.01$) and a significantly lower liver cell apoptosis index (0.860 ± 0.270 , $P<0.05$) and significantly lower expression levels of chop (1.110 ± 0.116 , $P<0.01$), caspase12 (0.609 ± 0.052 , $P<0.01$), and JNK (0.645 ± 0.087 , $P<0.01$) in liver cell. **CONCLUSIONS:** Sixteen weeks of high-fat diet feeding caused NAFLD in all rats. Exercise training could improve symptoms related to NAFLD, possibly by lowering the protein expression levels of CHOP, JNK and Caspase12, and reducing liver cell apoptosis.

C-44 Free Communication/Poster - Functional Strength and Fitness

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

1561 Board #236 June 1 8:00 AM - 9:30 AM
Core Strength as a Predictor of Performance During Three Functional Movement Screens

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(No relationships reported)

Current measures of core stability utilized by clinicians and researchers suffer from a number of shortcomings. Three functional movement screens appear, at face-value, to be dependent on the ability to activate and control core musculature. As a whole, these three screens may present a viable alternative to current measures of core stability. **PURPOSE:** To determine the relationship of core strength and muscle activation to performance on these three screens. **METHODS:** Thirty-nine subjects completed a deep squat (DS), trunk stability push-up (TSP), and rotary stability (RS) screen. Scores on the three screens were summed to form a composite score (COMP). During the screens, muscle activity was collected to determine the length of time that the bilateral erector spinae, rectus abdominus, external oblique, and gluteus medius muscles were active during the screens. Strength was assessed for core muscles (trunk flexion/extension, trunk rotation, hip abduction/adduction) and accessory muscles (knee flexion/extension, and pectoralis major). Strength variables were eliminated due to multicollinearity and two ordinal logistic regression equations were calculated with COMP as the outcome variable. The first equation included both core strength

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 COMP ($p=.004$) (Pearson's Chi-Square=149.132, $p=.435$; Nagelkerke's R-Squared=.369). The second model was significant in predicting COMP ($p=.001$) (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%-86%. **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 DS, TSP, and RS, collectively, appear to be a good assessment of core strength. Supported by the Freddie Fu, MD Graduate Research Award

1562 Board #237 June 1 8:00 AM - 9:30 AM
Functional Movement Screen Performance on Baseball Players of Different Positions

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 (No relationships reported)

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), infielder (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 year were reported to provide injury category of the shoulder, elbow, wrist, hip, knee, and ankle. A One-way ANOVA test was performed to compare among these groups (α 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±2.3, 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 OF showed better in push-up but worse in rotary stability than PC group. It suggests that the designing training program for core strength need to consider the direction of rotation axis and static/ dynamics for different position. Besides, high shoulder ratio injury cases on both PC and OF may due to high demand than IF in the pitching speed or distance. Thus, the training program should adjust content based on playing specific positions to prevent injury. Supported by MOST Grant 102-2410-H-179-007.

1563 Board #238 June 1 8:00 AM - 9:30 AM
Functional Movement Characteristics of US Navy Explosive Ordnance Disposal Technicians

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Explosive Ordnance Disposal (EOD) technicians experience high levels of physical stress due to their job demands, and physical conditioning is essential for operational readiness and mission success. Proper functional movement may help maintain physical health, optimize training and performance, and decrease injury risk.

PURPOSE: To describe functional movement characteristics of U.S. Navy EOD technicians.

METHODS: Forty-nine male U.S. Navy EOD technicians (age: 36.18±6.61 yr; height: 176.38±6.13 cm; weight: 88.29±11.04 kg) participated in this study. Subjects self-reported current and past musculoskeletal injuries (MSKI) and underwent a series of functional movement assessments, including center of pressure total sway (CoP_{TS}), functional movement screen (FMS), Y-Balance Test - Lower Quarter (YBT-

LQ), spatial-temporal gait assessment, and counter movement vertical jump with hands on hips. Sample statistics were compared with healthy, age-matched normative populations when available.

RESULTS: This sample reported 35% current and 80% past MSKI with the following functional movement measures (normative values in parentheses): CoP_{TS}: 23.53±11.44 cm (24); FMS: 15.55±2.01 points (15.6±2.3); YBT-LQ: 98.46±7.52 % leg length (95.2±8.8); walking speed: 1.20±0.13 m/s (1.31±0.16); jump height: 37.23±6.05 cm (N/A).

CONCLUSIONS: This study described the functional movement characteristics of U.S. Navy EOD technicians. Functional movement measures were comparable to healthy individuals, even with the high incidence of current and past MSKI. Further analyses evaluating performance relative to conventional standards and specific differences associated with the EOD community may provide insight on how to achieve optimal performance beyond that of the average healthy individual in order to attain the high level of functioning that the job demands of EOD personnel. With this goal in mind, our future studies will evaluate predictors and correlates of functional movement in EOD technicians with implications for training programs designed to improve functional movement, promote peak physical performance, and decrease injury risk.

1564 Board #239 June 1 8:00 AM - 9:30 AM
Effectiveness of a Functional Strength Training Program on Fitness Performance among Boys Aged 13-14 Years

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 (No relationships reported)

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±7.18, BMI 20.19±2.99) 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±8.33, BMI 20.55±2.01) did 10 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)±0.31 vs. 7.40 (after) ± 0.30. $p<.01$; Control 8.72 (before)±0.91 vs. 8.03(after) ± 0.34), Long Jump (Exp 1.86 (before)±0.12 vs. 2.20 (after)±0.65. $p<.05$; Control 1.85 (before)±0.17 vs. 1.87 (after)±0.29), Sit and Reach (Exp 5.71 (before)±3.51 vs. 11.05 (after)±2.24. $p<.01$; Control 5.76 (before)±3.17 vs. 5.93 (after)±2.86), 1000m Run (Exp 4.59 (before)±0.52 vs. 4.02 (after)±0.55. $p<.01$; Control 4.51 (before)±0.63 vs. 4.27 (after)±0.64 $p<.05$), Pull-Ups (Exp 4.00 (before)±1.32 vs. 10.66 (after)±1.22. $p<.01$; Control 4.04 (before)±1.13 vs. 7.10 (after)±1.77 $p<.05$), respectively after the intervention.**CONCLUSION:** Functional strength training is more effective than traditional resistance training to improve fitness performance among boys aged 13-14 yrs.

1565 Board #240 June 1 8:00 AM - 9:30 AM
Assessing the Relationship Between Vertical Jump Performance and FMS in Young Adult Males

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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 exercise. 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.

Specifically, the relationship between FMS and vertical jump performance has not yet been addressed. **PURPOSE:** To determine the correlation between Functional Movement Screening 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 8 min was performed followed by a 4 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 jump trials, excluding the first jump, was utilized for data analysis. Pearson Correlations were utilized to assess the relationship maximum vertical jump height and total FMS score, squat FMS score, and inline lunge 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 lunge 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.

1566 Board #241 June 1 8:00 AM - 9:30 AM

A Functional Resistance Training Design Elicits Greater Exercise and Excess Post-Exercise Oxygen Consumption Energy Expenditure Compared to a Traditional Resistance Training Design.

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(No relationships reported)

PURPOSE: To compare the differences in session energy expenditure and excess post-exercise oxygen consumption (EPOC) between traditional (TRAD) and functional (FUNCT) resistance 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 FUNCT 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 FUNCT 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 exercise EE during TRAD and FUNC were 204.0 ± 74.2 kcal and 269.1 ± 87.2 kcal, respectively. Group means ± SD for EPOC EE during TRAD and FUNC were 44.3 ± 24.2 kcal and 51.4 ± 24.8 kcal, respectively. Group means ± SD for total EE during TRAD and FUNC session were 245.5 ± 96.0 kcal and 325.9 ± 113.8 kcal, respectively. Compared to the TRAD, the FUNC bout was significantly higher for exercise EE (95%CI: 51.4-79.0 kcal, $p < .05$), EPOC (95%CI: 1.2-13.0 kcal, $p < .05$), and total session EE (95%CI: 65.0-95.7 kcal, $p < .05$). **CONCLUSION:** These 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. Electing to implement a functional over a traditional resistance training design may be more beneficial for the purposes of increasing exercise and post-exercise energy expenditure.

1567 Board #242 June 1 8:00 AM - 9:30 AM

Relationship Between Anthropometrics, Body Composition, and Functional Movement Quality

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(No relationships reported)

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 per published testing 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 $R^2 = .220$; $p = .003$). Specifically, %BF had the strongest relationship [standardized beta coefficient (β) = -.502; $p = .008$] followed by LL ($\beta = -.278$; $p = .045$). However, AL ($\beta = -.028$; $p = .847$) and BMI ($\beta = .016$; $p = .927$) 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.

1568 Board #243 June 1 8:00 AM - 9:30 AM

The Impact of Past Athletic Experience on Functional Movement Screen (FMS) Scores in University Students

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(No relationships reported)

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 injury than scores ≥15. A series of Chi-Square tests were performed comparing scores ≥15 and ≤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 ($r = .32$, $p < 0.05$). 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.

1569 Board #244 June 1 8:00 AM - 9:30 AM

Efficacy of a Task-Specific Periodized Resistance Training Program on Functional Movement Screening in ROTC Cadets

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(No relationships reported)

PURPOSE: Functional Movement Screening (FMS) is a testing procedure that examines the "quality" of movement patterns to identify individuals that have 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 consisted of 23 Army and Air Force ROTC cadets (male=18, female=6), Age (yrs) = 2.26±5.96, Height (cm)=172±8.68, Weight(kg)=72.98±12.91. The intervention group (IG n=14) trained for 1 hour/day, 4 days/week and the control

group (CG n=9) participated in traditional military training protocol for 1 hour/day, 3 days/week. A 2x2 mixed factorial ANOVA was used to compare mean change values of total FMS scores for experimental and control groups.
RESULTS: No significant ($p > .05$) differences in mean change values for FMS scores were observed between groups. A significant main effect ($p = 0.02$) was observed for FMS scores. Both groups had an increase in FMS scores after 7-weeks of training.
CONCLUSIONS: Although this study did not find differences in FMS scores between a specific periodized strength training program and a traditional military training program among ROTC cadets it is necessary that future studies address certain limitations that this study encountered (sample size and length of training period). FMS scores are being used more frequently as screening tools for risk of injury and as a result it is important to study methods that will improve FMS scores in diverse athlete's populations.

1570 Board #245 June 1 8:00 AM - 9:30 AM
Validation of a Modified Functional Movement Screen Test for Division III Male Soccer Players
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(No relationships reported)

The Functional Movement Screen (FMS) is a battery of 7 tests to assess movement patterns. These tests include the deep squat, hurdle step, inline lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotary stability test. It is not known whether a shorter version could yield the same results, while allowing for more efficient screening in athletic settings. The modified version includes the deep squat, hurdle step, active straight leg raise, and an added test: a single leg squat.
Purpose
 To validate a modified version of the Functional Movement Screen in Division III male soccer players.
Methods
 The soccer group was scored once for original (21 points) and modified FMS (10 points), while the control group was scored twice by an FMS certified athletic trainer. The single leg squat was scored as 1 (no knee valgus) or 0 (knee valgus). Reliability was calculated as Pearson Product Moment and concurrent validity was calculated between modified FMS and original FMS scores, using R Statistical Software.
Results
 Mean age for the soccer group was 19.6 ± 0.73 years, with mean FMS score of 15.6 ± 1.5 and mean modified FMS score of 7.3 ± 1.63 . Mean age for the control group was 20.5 ± 1.19 years, with a mean FMS score of 14.8 ± 1.64 for trial 1 and 15.3 ± 1.5 for trial 2. There was a strong correlation ($r = 0.74$) between trials for both the original and modified FMS scores and a strong correlation of ($r = 0.73$) between the original FMS and the modified FMS. Trial 2 scores were approximately 3% higher for both original and modified FMS, suggesting a possible practice effect. The addition of a third trial could possibly have attenuated this.
Conclusion
 The modified version of the FMS is valid for division III male soccer players. Athletic trainers and coaches may use this modified version for more efficient screening.

1571 Board #246 June 1 8:00 AM - 9:30 AM
The Effects of Brief High Intensity Intermittent Functional Training on Body Composition and Anaerobic Fitness
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(No relationships reported)

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 exercises.
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 s: 5 s 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 = $31.1\% \pm 8.6$ to $30.3\% \pm 8.3$; FM = $26.5 \text{ kg} \pm 14$ to $25.8 \text{ kg} \pm 13.6$, control group: BFP = $26.3\% \pm 10.2$ to $25.6\% \pm 9.6$; FM = $19.34 \text{ kg} \pm 12.6$ to $18.6 \text{ kg} \pm 11.5$), 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 and/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.

1572 Board #247 June 1 8:00 AM - 9:30 AM
Modified Functional Movement Screen as a Predictor of Knee Valgus in Male Soccer Players
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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 7.33 ± 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.

1573 Board #248 June 1 8:00 AM - 9:30 AM
Functional Movement and Personal Fitness Training in a Community College Setting
 Tinker D. Murray, FACSM¹, Gene Power², Lisa Roslanova³, James Eldridge⁴.
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(No relationships reported)

Movement screening (MS) for functional patterns has been advocated as an effective method to evaluate high performance populations such as American football players, firefighters, and military personnel. Corrective strategies are also often implemented in training to improve movement competency and theoretically reduce future injury rates. **PURPOSE:** The purpose of this study was to examine if basic anthropometric/functionality measures and modified simple movement assessments can be significantly influenced (Pre/Post) in young adults (a non-high performance population) with personal fitness training in a Community College setting. **METHODS:** All subjects (N = 142; Males = 57, Females = 85; mean age = 21.29 years) enrolled in a personal fitness course and completed basic anthropometric measures (waist and hip girths, shoulder mobility etc.) and a modified simplified MS (scored as yes/no for success with no pain). Subjects then completed the personal fitness course which emphasized an initial 15-20 minutes of developmental/corrective exercise and then 30 minutes of general resistance training per each class session. Data were analyzed with interval (Repeated Measures ANOVA) and ordinal (Chi

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Square) statistical techniques, and evaluated at the $p < 0.05$ level. **RESULTS:** Subjects reduced their waist and hip girths significantly; mean = 34.94 to 34.24 inches and 40.41 to 39.88 inches, respectively. Left bicep girths and grip strength also increased significantly (left bicep mean = 12.34 to 12.48 inches; left grip strength mean = 61.0 to 64.7 lbs; and, right grip strength mean = 65.27 to 69.7 lbs.). Mean left and right shoulder mobility (scratch test) improved significantly from 6.35 to 5.72 inches left and 5.64 to 4.96 inches right. Four screens (rotary stability- RS, pushups - PU, ankle mobility - AM, and toe touch - TT) out of six simplified MS measures (yes/no responses) increased significantly as well, (RS = 62.7 % to 72.2%; PU = 52.8 and 64.8%; AM = 83.1 to 90.8 %; TT = 81 to 90.7 %). **CONCLUSIONS:** A personal fitness course that focused on developmental/corrective exercise and general resistance training significantly improved basic anthropometric/functionality measures and modified MS assessments. Our results may provide an intervention for other young adults to improve their movement competency and fitness levels.

C-45 Free Communication/Poster - Heat Exposure/ Hydration

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

1574 Board #249 June 1 9:00 AM - 10:30 AM Effectiveness of a Mobile Cooling Unit on Perceptual Responses During Preseason Collegiate Female Soccer Practices

Rebecca M. Lopez, Byron Moran, Candi Ashley, Amanda J. Tritsch, Karan Shukla, Eric Coris. *University of South Florida, Tampa, FL.* (Sponsor: Douglas J. Casa, FACSM)
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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 (ESQ) were measured during 4 preseason collegiate female soccer practices in a warm environment ($31.3 \pm 2.1^\circ\text{C}$). 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 ($9.5 \pm 1.6^\circ\text{C}$) during a practice break halfway through each practice while CON players rested on the sideline. ESQ 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 (α set at $P < 0.05$). Pearson correlations were used to compare physiological and perceptual measures.

RESULTS: Pre-break TST for POD (6 ± 1) and CON (5 ± 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 THM in POD (2 ± 1) compared to CON (5 ± 1 ; $P=0.00$). Δ RPE from pre- to post-break was significantly different between conditions ($P=0.00$). There was a strong, positive relationship between cooling rate and Δ THM 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 TGI and HR 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 a lack of physiological effects.

1575 Board #250 June 1 9:00 AM - 10:30 AM Novel Cooling Device Enhances Autonomic Nervous System Responses Following Live Fire Training

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(No relationships reported)

Firefighting results in high levels of cardiac strain, due to muscular work, dehydration, and heat stress. Cardiac strain has traditionally been investigated via heart rate responses. However, measures of autonomic nervous system balance in recovery

may provide greater insight into physiological disruption and cardiac risk. Further, because heat stress impairs performance and adds to cardiac strain, firefighters would benefit from portable, effective cooling technology. **PURPOSE:** To investigate the role of a wrist cooling band (dhamaSPORT) on heart rate variability (HRV) during recovery from live fire training. **METHODS:** 10 volunteer firefighters wore a Zephyr Heart Rate monitor during live fire training. Participants performed two evolutions of live-fire training drills and reported to a "rehab station" for rest and recovery. This pattern of 2 drills and rehab was repeated 3 times. When in rehab, the cooling band was placed on the wrist and was turned ON (cooling) for one rehab, then OFF (control) for the next. The on/off cycles continued throughout the 3 cycles with the position of on or off at the first rehab randomly determined. The cooling band instantly reaches a temperature of 44° when turned on. Perceptual measures of thermal comfort and strain were also collected. Participants remained in rehab for 15 minutes before returning to live-fire drills. **RESULTS:** There was no significant difference in HR between conditions (ON vs. OFF) at any time-point during rehab ($p>0.05$). Likewise, there was no significant difference in thermal sensation ($p>0.05$) and thermal comfort ($p>0.05$) between each condition during rehab ($p>0.05$). In contrast, RMSSD (parasympathetic modulation) was significantly reduced from rest to both rehab conditions (ON, $p < 0.05$; OFF, $p < 0.05$). The reduction in parasympathetic modulation was -21% in the ON condition vs. -40% in the OFF condition ($p=0.01$). **CONCLUSION:** There was no difference in HR between conditions but the cooling band blunted the shift in cardiac autonomic balance and helped maintain parasympathetic tone during recovery from live firefighting activity. This study found that the DhamaSPORT cooling band was easy to use during incident rehab and facilitated recovery, suggesting that it may be a useful tool during firefighting training and operations.

1576 Board #251 June 1 9:00 AM - 10:30 AM

Hydration Provides No Thermo-Physiological or Cognitive Motor Skill Improvement during Passive Hyperthermia and Subsequent Cooling

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Maintaining hydration is understood to minimize deleterious effects of exercise-induced hyperthermia. Stimulation of arteriovenous anastomoses (AVAs) to induce cooling following hyperthermia is associated with positive changes in cooling time, thermo-physiological and cognitive function, and perception of thermal strain. However, the impact of hydration on these responses is unclear. **PURPOSE:** To determine the impact of hydration during passive hyperthermia and subsequent AVA-stimulated cooling on thermo-physiological function and cognitive motor skill. **METHODS:** Eight participants (23 ± 6 yrs; 172 ± 10 cm; 69.3 ± 10.8 kg) reported either dehydrated (USG > 1.020) or hydrated (USG < 1.010). Waking hydration status was assessed using a hand-held pen refractometer. Hyperthermia ($T_{re} 39.5^\circ\text{C}$) was induced whilst seated in circulated warm water (42°C) to the level of the clavicle. Post-hyperthermia cooling was performed by immersing one hand and forearm in circulated cold water (10°C) until $T_{re} \leq 38.0^\circ\text{C}$. Heart rate (HR) was monitored continuously during hyperthermia and cooling. A battery of cognitive motor skill tests (Stroop Word Color [SWC] and Trail-Making Task [TMT]), quadriceps maximal voluntary contraction (MVC), and perceived thermal sensation (TS) were assessed at baseline, upon reaching hyperthermia, and when $T_{re} \leq 38.0^\circ\text{C}$. Hydration status and cooling time, and thermo-physiological and cognitive motor skill comparisons were made using two-way and three-way ANOVA with repeated measures, respectively. **RESULTS:** Time to cool improved with AVA stimulation (24 ± 9 min vs. 40 ± 14 min, $p=0.001$), and T_{re} ($p=0.006$), HR ($p=0.004$) and TS ($p=0.004$) showed positive interaction effects (cooling and time). However, hydration had no effect or interaction effect ($p>0.05$) on thermo-physiological function. Trail-making task was negatively impacted by hyperthermia (Baseline 38 ± 12 s vs. Hyperthermia 50 ± 22 s vs. Cooled 41 ± 15 s, $p=0.017$), and performance of SWC ($p=0.077$) trended towards a positive interaction effect (cooling and time). However, hydration had no effect or interaction effect ($p>0.05$) on cognitive motor skill. **CONCLUSION:** Hydration status may have little impact on thermo-physiological function or cognitive motor skill during passive hyperthermia or subsequent cooling.

- 1577 Board #252 June 1 9:00 AM - 10:30 AM
Importance Of Sample Volume To The Measurement And Interpretation Of Plasma Osmolality
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(No relationships reported)

Small sample volumes may artificially elevate plasma osmolality (Posm) measured by freezing point depression. **PURPOSE:** To compare different sample volumes of measured Posm (mmol/kg) to each other, and to calculated osmolality (mmol/L) in euhydrated (EUH) and dehydrated (DEH) volunteers.

METHODS: Posm 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 μ L and 250 μ L Posm samples (n = 158 pairs). Protinol (240, 280, 320 mmol/kg) and Clinitol (290 mmol/kg) reference solutions were compared similarly (n = 246 pairs). Twenty-one volunteers were tested multiple times while EUH (n = 72) or DEH (n = 7) by - 4.0% body mass.

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

- 1578 Board #253 June 1 9:00 AM - 10:30 AM
Assessment of the Efficacy of Military Training Fluid Intake Guidance in a Variety of Conditions
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(No relationships reported)

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 configurations and were then compared to prescribed fluid intakes for each condition (clothing, environment, workload, duration). **METHODS:** Whole body sweat losses of 141 soldiers were measured over a variety of environmental conditions (White-Black flag), uniform configurations (including Battle Dress Uniform and 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 \pm 2% body water flux (BWF) were deemed acceptable. This threshold was considered the starting point for performance and health concerns. To simulate a worst-case scenario, it was assumed no urine was produced throughout testing. **RESULTS:** During short work durations (2 and 4hr), 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 \pm 2% BWF) during work durations lasting \leq 4 hours. However, for conditions beyond published guidance (>4hr), 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.

- 1579 Board #254 June 1 9:00 AM - 10:30 AM
Considerations For Using Spot UsG To Detect Inadequate Between Running Bout Fluid Intake Volume
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PURPOSE: No single measure to detect real time hydration status is without limits; however, the validity of using urine specific gravity (USG) has received considerable scrutiny recently. Data used to draw these conclusions potentially suffers from multiple flaws (e.g. samples collected immediately after exercise or when significant sweat loss has not been incurred) in regards to practical application for runners. This study examined the efficacy of USG to detect inadequate beverage fluid consumption between training bouts in a twice-per-day training scenario.

METHODS: Data was pooled from multiple studies resulting in 143 total samples. USG of male and female runners was measured 10-14 hours after runs of 60-90 min in temperate to hot environments. Two meals and snacks were provided during the recovery period of each study. Multiple type of beverages were consumed, and all beverage fluid consumption was measured with some samples being taken before and after the second meal. Pearson r was examined for percent of sweat loss that was replaced with fluid from beverages and USG. Inadequate fluid intake detection was deemed to have taken place when <100% of sweat losses were replaced and USG was \geq 1.020. Analysis was repeated after removing 80 samples in which participants did not begin their run euhydrated (USG < 1.020) and/or lost <3% body mass in sweat.

RESULTS: When all samples were included, moderate correlation between fluid replacement percentage and USG (r = -0.50; p < 0.001) was found. Total false diagnosis was detected in 22.4% (n = 32) of samples with 22% of runners replacing <100% of sweat losses exhibiting a USG < 1.020. After removing samples correlation strength increased (r = -0.69). Total false diagnosis was reduced to 12.7% (n = 8), and most importantly error for runners replacing <100% of sweat losses exhibiting a USG < 1.020 was decreased to 15%.

CONCLUSIONS: Pre-run spot USG assessment can be used as a practical field assessment to determine if intentional increased recovery fluid intake is warranted when training twice per day, particularly if the first running bout is undertaken in a euhydrated state (USG < 1.020) and significant sweat losses are incurred (3% body mass).

- 1580 Board #255 June 1 9:00 AM - 10:30 AM
Fluid Intake During Exercise in Tropical Climate in Young Athletes with Pre-Exercise Euhydration or Hypohydration
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Many young athletes start exercise in a state of body fluid deficit, which magnifies the risk of an excessive increase in body temperature and may lead to deterioration of skills related to sports performance. It is not clear if when water is readily available their voluntary fluid intake during exercise compensates for the pre-exercise fluid deficit, or if it is not enough and initial hydration status worsens. **Purpose:** To compare the amount of fluid replaced during exercise in the heat between young athletes who arrive to an exercise session in a state of euhydration (EUH) and hypohydration (HYP) and are provided water to drink ad libitum. **Methods:** Young athletes (N = 56, mean age = 15.7 \pm 1.4 yr) completed an exercise sweat test, running or racewalking at an intensity > 70% of age-predicted maximum heart rate, in a hot and humid environment (WBGT = 28.5 \pm 1.9°C). Pre-exercise urine specific gravity (USG) was used to categorize the athletes as EUH (USG \leq 1.020 g/mL, N = 15) and HYP (USG > 1.020 g/mL, N = 41). Water was provided in bottles and they drank ad libitum. Sweat loss was calculated from the change in body weight [BW] (corrected for urine output) plus fluid intake. Dehydration was calculated as % change in BW. Ratings of perception of thirst (N = 35) and hot/overheated (N = 39) were examined with a 0 - 10 scale. **Results:** Pre-exercise USG was higher in HYP (1.025 \pm 0.003 g/mL) compared to EUH (1.013 \pm 0.006 g/mL), P < 0.05. Exercise duration, sweat loss (27.4 \pm 11.2 vs 24.2 \pm 9.3 mL/kg) and urine loss (1.5 \pm 1.6 vs 0.7 \pm 0.4 mL/kg) were similar for EUH and HYP, respectively, P > 0.05. Despite fluid availability, fluid intake was low (EUH = 7.8 \pm 6.3 mL/kg; HYP = 9.2 \pm 7.5 mL/kg) and both groups showed significant reductions in BW (EUH = 2.0 \pm 1.0%; HYP = 1.6 \pm 0.8%), P > 0.05. Thirst increased during the session in both groups and was moderately high at the end (EUH pre = 2.2, post = 5.9; HYP pre = 1.9, post = 6.7). Mean perception of hot/overheated was high at the end of exercise (EUH = 6.3; HYP = 7.2). **Conclusion:** Young athletes that start exercise in a state of hypohydration do not drink enough water during exercise to compensate for the pre-exercise fluid deficit and subsequent fluid loss, and their initial hydration status worsens. Thirst may not be a good indicator of the need to drink and the ad libitum intake of water is insufficient even when it is readily available.

Abstracts were prepared by the authors and printed as submitted.

1581 Board #256 June 1 9:00 AM - 10:30 AM
Does Oral Fluid Intake Following Dehydration Influence Subsequent Athletic Performance? A Systematic Review and Meta-Analysis

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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). **RESULTS:** 46 trials (n=404 subjects) derived from 33 publications were reviewed. Dehydration decreased BM by 1.3-4.2% 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 (P=80.5). Differences in ambient temperature (*p*<0.001) and exercise duration (*p*=0.050) affected the magnitude of the performance change, with fluid intake demonstrating greater efficacy when exercise was performed in hotter environments and over longer durations (R²=0.95). 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. No funding was received for the preparation of this abstract

1582 Board #257 June 1 9:00 AM - 10:30 AM
Hydration Status and Repeated Sprint Performance in Females

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Hydration Status and Repeated Sprint Performance in Females

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 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., O_{2peak}] 47.1 ± 3.9 ml⁻¹ kg⁻¹ min⁻¹, BF 21.3 ± 3.4]. All subjects were utilizing a chemical contraceptive. Subjects completed the study in both a euhydrated 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 four 30 m sprints. The sprints were divided into 3 sets of 8. Subjects rested for 10 s between each sprint, and 2 min between each set of sprints. Core temperature (T_c), 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 T_c 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 (46.85 ± 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 T_c 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 T_c due to a decrease in heat dissipation. Dehydration did not affect the repeated sprint performance of the female subjects.

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1583 Board #258 June 1 9:00 AM - 10:30 AM
Inter-season Dehydration Prevalence In Soccer Players that Rehydrate During Trainings Drinking Ad Libitum

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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 time (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.

| Age type | N | Summer | | | | Autumn | | | |
|----------|-----|-------------------------|---------------------|----------------------|--------------------------------|-------------------------|---------------------|----------------------|--------------------------------|
| | | General dehydration (%) | Low dehydration (%) | Mild dehydration (%) | Temperature (°C)/ Humidity (%) | General dehydration (%) | Low dehydration (%) | Mild dehydration (%) | Temperature (°C)/ Humidity (%) |
| Major | 47 | 76.6 | 51.1 | 25.5 | 20/76 | 91.5 | 66.0 | 25.5 | 19/74 |
| Minor | 59 | 88.1 | 45.8 | 42.3 | 25/49 | 64.4* | 45.8* | 18.6 ^b | 22/65 |
| Total | 106 | 83.0 | 48.1 | 34.9 | | 76.4 | 54.7 | 21.7 | |

* Significant difference vs major group (*p*<0.05); ^b Significant difference vs Summer (*p*<0.05)

1584 Board #259 June 1 9:00 AM - 10:30 AM
Frontal Asymmetry Changes Following Passive Hypohydration

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 (Sponsor: 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 hyponatremia, 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

session to account for unusual affective states. **RESULTS:** EEG recordings were applied to the Frontal Asymmetry Index (FAI). Higher scores on the FAI indicate higher relative left frontal lobe activity, corresponding with an affinity to water (R). Lower scores indicate higher relative right frontal activity, thus less reward motivation (NR). Data revealed that FAI decreased by a mean of 0.05 ± 0.17 from EU to HO states, with EU and HO FAI of 0.06 and 0.01 respectively. In total, 42.9% of participants showed an increased affinity (R) for water from EU to HO states. **CONCLUSIONS:** R/NR motivational orientations changes were less than anticipated following HO trials. However, data revealed that 42.9% of participants exhibited an increased affinity for water thereby, supporting the hypothesis. It is possible that 2% body mass loss is insufficient to create distinct motivational orientation changes.

1585 Board #260 June 1 9:00 AM - 10:30 AM
Are all Heat Loads Created Equal?
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(No relationships reported)

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 yrs) 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 (T_{es}) and mean skin (T_{sk}) temperatures as well as heart rate (HR) were measured continuously. Mean body temperature (T_{mb}) and physiological strain index (PSI) were calculated from T_{es} and T_{sk} and T_{es} and HR, respectively. **RESULTS:** During exercise whole-body sweat rate was similar between conditions ($P=0.48$), as was T_{mb} ($P=0.65$). In contrast, T_{es} was greater in 439W[30°C] ($37.67 \pm 0.04^\circ\text{C}$) and 391W[35°C] ($37.58 \pm 0.07^\circ\text{C}$) relative to both 317W[40°C] ($37.35 \pm 0.06^\circ\text{C}$) and 258W[45°C] ($37.20 \pm 0.07^\circ\text{C}$; all $P \leq 0.05$). However, T_{sk} was different between all conditions (33.85 ± 0.16 , 34.53 ± 0.08 , 35.67 ± 0.07 and $36.54 \pm 0.08^\circ\text{C}$ for 439W[30°C], 391W[35°C], 317W[40°C] and 258W[45°C], respectively; all $P < 0.01$). HR was greater in 439W[30°C] (107 ± 3 beats·min⁻¹) in comparison to both 317W[40°C] (103 ± 4 beats·min⁻¹) and 258W[45°C] (89 ± 2 beats·min⁻¹; both $P < 0.01$) whereas PSI was elevated in 439W[30°C] and 391W[35°C] compared with 317W[40°C] and 258W[45°C] (all $P \leq 0.04$). **CONCLUSIONS:** While exercise performed at a fixed E_{req} resulted in similar whole-body sweat rates and T_{mb} , physiological responses (i.e. T_{es} , T_{sk} , HR and PSI) varied as a function of the relative contribution of metabolic and environmental heat load. Supported by Ontario Ministry of Labour and NSERC

1586 Board #261 June 1 9:00 AM - 10:30 AM
Postexercise Activation of Muscle Metaboreceptors Modulates Whole-Body Evaporative Heat Loss
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Studies show that heat dissipation following dynamic exercise is suppressed for a prolonged period despite a sustained elevation in body core temperature. More recent work demonstrates that nonthermal factors associated with the activation of metaboreceptors may mediate the postexercise attenuation of local skin blood flow and sweating. However, it is unclear if this may translate into a reduction in whole-body heat dissipation. **PURPOSE:** To evaluate the influence of metaboreceptor activation on the modulation of postexercise whole-body evaporative heat loss (EHL). **METHODS:** On three separate days, 7 young (24 ± 3 years) physically active males performed 45 min of moderate intensity cycling at a fixed rate of heat production of 400 W, followed by a 60-min recovery period in the heat (35°C). At 15, 30 and 45-min of recovery, participants completed one of three experimental conditions: 1) no isometric handgrip exercise (IHG) or ischemia (forearm occlusion, OCC) (CONTROL), 2) 1 min IHG at 60% of maximal voluntary contraction (MVC) (IHGonly), 3) 1 min

IHG at 60% of MVC followed by 5 min of forearm ischemia (IHG+OCC). Whole-body EHL was measured by direct calorimetry. Mean arterial pressure was measured continuously during the recovery period. **RESULTS:** Relative to pre-IHG levels, EHL increased similarly (~110 W, all $P < 0.05$) during IHG exercise at 15, 30 and 45-min of recovery for both the IHGonly and IHG+OCC conditions. As a consequence, EHL was significantly different relative to CONTROL at the end of IHG (all $P < 0.05$). The elevation in EHL was sustained during the 5-min forearm ischemia performed during the IHG+OCC condition, albeit values were slightly reduced from the levels 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 $P=0.139$, respectively). Differences were only measured at 45-min of recovery ($P=0.039$). **CONCLUSIONS:** We show that the activation of muscle metaboreceptors can modulate whole-body evaporative heat loss following dynamic exercise in the heat.
 Supported by the Natural Sciences and Engineering Research Council of Canada

1587 Board #262 June 1 9:00 AM - 10:30 AM
Aerobic Fitness Modulates Whole-body Heat Loss in Young Adult Females during Exercise in the Heat
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(No relationships reported)

Aerobic fitness is considered a key determinant of the body's ability to lose heat during exercise in the heat. Recent studies show that fitness-related differences in heat loss are dependent upon the exercise-induced heat load. However, it remains unclear if like fitness, an individual's level of physical activity may play an equally important role in modulating whole-body heat loss. **PURPOSE:** To examine at what level of metabolic heat production, and therefore level of heat stress, aerobic fitness as defined by aerobic capacity (indexed by $\dot{V}O_{2peak}$) and physical activity level (indexed volume and intensity) may modulate whole-body heat loss in young females (21 ± 3 yrs). **METHODS:** Using whole-body direct calorimetry, we compared dry and evaporative heat exchange between endurance ($n=8$, 53.1 mL·kg⁻¹·min⁻¹) and non-endurance trained females ($n=8$; 35.8 mL·kg⁻¹·min⁻¹, $P < 0.01$) with matched physical characteristics (*Study 1*) and between those with low ($n=7$) and high ($n=7$) physical activity levels ($P < 0.01$) but of similar aerobic capacity (~35 mL·kg⁻¹·min⁻¹, $P=0.05$) (*Study 2*). Participants performed three successive 30-min bouts of semi-recumbent cycling at increasing rates of metabolic heat production (to ensure a similar thermal drive for sweating) of 250 (Ex1), 325 (Ex2), and 400 W (Ex3) in the heat (40°C), each followed by a 15-min recovery period. **RESULTS: Study 1:** Dry heat gain was greater in the endurance group for Ex2: (80 ± 10 W) and Ex3 (80 ± 12 W) compared to the non-endurance trained females (Ex2: 58 ± 13 W; Ex3: 58 ± 14 W, both $P \leq 0.02$). However, a correspondingly greater evaporative heat loss was measured in the endurance (Ex2: 375 ± 29 W; Ex3: 432 ± 33 W) compared to non-endurance trained females (Ex2: 331 ± 22 W; Ex3: 371 ± 25 W, both $P \leq 0.03$) for these two exercise bouts. As such, body heat storage over the protocol was ~26% greater in the non-endurance compared to the endurance trained group ($P=0.04$). *Study 2:* Dry and evaporative heat exchange did not differ between low and high physical activity groups ($P \geq 0.72$), leading to similar levels of body heat storage ($P \geq 0.47$). **CONCLUSION:** We demonstrate that aerobic capacity, but not physical activity level modulates heat loss in females and that these differences are heat load dependent. Support: Natural Sciences and Engineering Research Council of Canada

1588 Board #263 June 1 9:00 AM - 10:30 AM
The Effects of Aerobic Fitness on Sweating and Skin Blood Flow in Older Adults
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(No relationships reported)

High aerobic fitness has been shown to prevent age-related decrements in heat dissipation in older adults; however, the mechanisms underlying the influence of this response on sweating and cutaneous vasodilation remain unclear. **PURPOSE:** To determine the role of superoxides and NADPH oxidase on sweating and skin blood flow in older adults during exercise in the heat. **METHODS:** Nineteen older adults (56 ± 6 years) were separated into two groups based on their aerobic fitness ($\dot{V}O_{2peak}$, mL·kg⁻¹·min⁻¹: Low Fit (LF), <28; High Fit (HF), >32). They performed two 30 min bouts of cycling in the heat (35°C); separated by a 30 min recovery. LF participants exercised at 65% of their $\dot{V}O_{2peak}$. HF participants exercised at the same heat production to that measured for the physically matched LF participants during their first bout (to compare responses for a similar thermal drive) and at 65% of their $\dot{V}O_{2peak}$ for the second bout (to compare responses as a function of relative exercise

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 NG-nitro-L-arginine methyl ester (LNAME) (NOS inhibitor); 3) 100 μ M Apocynin (NADPH Oxidase inhibitor); or, 4) 100 μ M 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 $\text{mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}$, $P>0.05$). 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 $\text{mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}$, $P<0.05$). 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

1589 Board #264 June 1 9:00 AM - 10:30 AM
Blockade Of BKCa Channels Limits Sweat Output In Human Skin
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Purpose: Sudomotor control of sweat gland function results in an increase in cytosolic Ca^{++} due to an IP_3 -mediated Ca^{++} release from intracellular stores and an influx of Ca^{++} from extracellular fluid. While K^+ channels have been implicated in modulating sweat gland function, it is unclear which specific K^+ channels modulate cholinergic sweating. As such, we tested the hypothesis that large conductance Ca^{++} -activated K^+ (BKCa) channels modulate sweat output. **Methods:** To evaluate this hypothesis, we examined the ability of two doses of tetraethylammonium (100 μ M 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 0.2, 1, 2, 4, 8, 16, 32, and 64 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 $0.511 \pm 0.104 \text{ mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}$ which was significantly ($p<0.05$) reduced by application of 50 mM TEA to $0.317 \pm 0.060 \text{ mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}$. 100 μ M TEA did not reduce peak sweat rate ($0.542 \pm 0.153 \text{ mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}$). 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 0.234 ± 0.27 , $p<0.05$) but with a similar EC_{50} 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.

1590 Board #265 June 1 9:00 AM - 10:30 AM
KCA, KATP, And KV Channel Roles In Regulating Cutaneous Vasodilation And Sweating During Dynamic Exercise
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 (No relationships reported)

We recently showed the varying roles of Ca^{2+} -activated (K_{Ca}), ATP-sensitive (K_{ATP}) and voltage-gated (K_{V}) K^+ channels in regulating methacholine-induced cutaneous vasodilation and sweating in normothermic resting humans. However, it is unclear whether these contributions remain intact during dynamic exercise in the heat. **PURPOSE:** To determine the influence of various K^+ channels in regulating cutaneous vasodilation and sweating during exercise in the heat. **METHODS:** Young (23±4 years) habitually active males ($n=11$) completed a 30-min exercise bout at a fixed rate of metabolic heat production of 400 W (to maintain a constant thermal drive), followed by a 40-min recovery period in the heat (35°C). Cutaneous vascular conductance (CVC) and local sweat rate were assessed at four forearm skin sites perfused via intradermal microdialysis with either: 1) lactated Ringer solution (Control), 2) 50 mM tetraethylammonium (a nonspecific K_{Ca} channel blocker), 3) 5 mM glibenclamide (a selective K_{ATP} channel blocker), or 4) 10 mM 4-aminopyridine (a nonspecific K_{V} channel blocker). Responses were compared at baseline and at 10-min intervals during and following exercise. **RESULTS:** K_{Ca} channel inhibition resulted in greater CVC compared to Control at the end of exercise (62 vs. 56 %CVC_{max}, $P<0.05$) and the 10- and 20-min time points of recovery (~63 vs. ~45 %CVC_{max}, both $P<0.01$). K_{ATP}

channel blockade attenuated CVC in comparison to Control during baseline (32 vs. 39 %CVC_{max}, $P<0.05$), exercise (~41 vs. ~51 %CVC_{max}, all $P<0.05$) and at 10-min into recovery (37 vs. 46 %CVC_{max}, $P<0.05$). No differences in CVC from Control were observed with K_{V} channel inhibition during baseline resting (44 %CVC_{max}, $P=0.15$), exercise (~56 %CVC_{max}, all $P\geq 0.06$), or recovery (~49 %CVC_{max}, all $P\geq 0.14$). Local sweat rate did not differ from Control with any K^+ channel blockers (all $P\geq 0.07$), with the exception that sweat rate was augmented with K_{V} channel inhibition during baseline resting in the heat (0.45 vs. $0.37 \text{ mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}$, $P=0.05$). **CONCLUSIONS:** We demonstrate that K_{Ca} and K_{ATP} channels contribute to the regulation of cutaneous vasodilation during rest, exercise, and recovery in the heat. In contrast, only the K_{V} channel modulates the sweating response during rest in the heat. Supported by the Natural Sciences and Engineering Research Council of Canada.

1591 Board #266 June 1 9:00 AM - 10:30 AM
Role of Oxidative Stress in Modulating Cutaneous Vasodilation and Sweating During Exercise in Type-2 Diabetics
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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 yrs) 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 $\text{VO}_{2\text{peak}}$), 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 N⁶-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 $P\geq 0.18$). 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 $P\leq 0.05$). 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 $P\leq 0.01$). In T2D, CVC was attenuated at the combination site relative to Control throughout (baseline: 20%, end-exercise: 27% and end of recovery: 23%) (all $P\leq 0.01$). Conversely, in NoT2D the combination of ASC+L-NAME attenuated CVC during baseline (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 $P\geq 0.10$). **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

1592 Board #267 June 1 9:00 AM - 10:30 AM
The Influence Of Aerobic Training On Maximum Skin Wettedness And Its Effects During Uncompensable Heat Stress
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 (Sponsor: Dr. Ollie Jay, FACSM)
 (No relationships reported)

PURPOSE: The purpose of the present experiment was to quantify how maximum skin wettedness (ω_{max}) 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 trial to assess ω_{max} ; and ii) a 60-min treadmill march (450 W of heat production) in an uncompensable environment: 38°C, 60% RH, on three separate occasions: pre-training (PRE-T), post-training (POST-T), and post-heat acclimation (POST-HA); The change in rectal (ΔT_{re}), and mean skin temperature (T_{sk}) were recorded. Whole body sweat loss (WBSL) was calculated as the change in nude body mass and sweating efficiency (S_{eff}) was derived by dividing the sweating

required to achieve ω_{\max} (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: 45.8±11.8 ml/kg/min; POST-T: 52.0±11.1 ml/kg/min, $P<0.001$). In the humidity ramp trial, ω_{\max} 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, ΔT_{re} was greater PRE-T (1.13±0.16°C) compared to POST-T (0.96±0.13°C, $P<0.001$) and POST-HA (0.96±0.20°C, $P<0.001$). PRE-T T_{sk} 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 PRE-T (671±83 g, $P<0.001$), however S_{eff} was similar throughout (PRE-T: 67±10%; POST-T: 68±11%; POST-HA: 66±8%). **CONCLUSIONS:** Aerobic training and HA independently increase ω_{\max} without altering S_{eff} . A graded 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

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(No relationships reported)

The popularity of tattoos has increase tremendously in the last 10-years particularly among college and professional athletes. The tattooing process involves permanently depositing ink under the skin at a similar depth as eccrine sweat glands (3-5 mm). **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-yrs) 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-μL vs. 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; $p=0.01$). 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.

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

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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 to offer a reasonable degree of validity for the measurement of sweat sodium concentration under field conditions. The inter-instrument reliability of the LaT has never been determined. **PURPOSE:** To assess the inter-instrument reliability of the LaT sodium analyzer. **METHODS:** Seventy sweat samples collected in 14 athletes were analyzed in duplicate with 3 different LaTs. Sweat samples were collected during 40-min cycling or running exercises (~29-30°C and 20-40% relative humidity) from five anatomical sites using 5 x 7 cm absorbent pads covered with highly-adhesive impermeable transparent dressings. Sweat samples were extracted from the pads using centrifugation and then frozen at -20 °C until thawed and analyzed. **RESULTS:** All data were normally distributed and showed no sign of heteroscedasticity. Relative reliability was excellent between LaT 1 and 2, 1 and 3, and 2 and 3 with Pearson correlation coefficients of respectively 0.991, 0.995 and 0.996 and intraclass correlation coefficients of 0.986, 0.993, and 0.996. Mean biases between instruments were low (LaT 1 and 2: -2.6 mmol/L; 1 and 3: -1.8 mmol/L; and 2 and 3: 0.8 mmol/L) but statistically significant. The typical error of measurements as well

as the coefficient of variations were also low between instruments, ranging between 1.8 and 2.6 mmol/L and 2 and 4%, respectively. For comparisons between LaT 1 and 2, 1 and 3, and 2 and 3 the 95% limits of agreement reached ± 7.3, ± 5.3, and ± 4.8 mmol/L, respectively.

CONCLUSION: The inter-instrument reliability of the LaT is adequate enough such that sports clinicians can confidently interpret exercise sweat sodium concentration values obtained from, and develop sodium replacement strategies for athletes based on, sweat sodium testing realized by different LaTs.

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

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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 y) 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 (+2.0 ± 0.8 vs. +1.1 ± 0.3°C, $P<0.01$), body weight (-0.9 ± 0.6 vs. -0.7 ± 0.5%, $P=0.04$) and plasma volume (-12 ± 5 vs. -8 ± 6%, $P=0.03$) 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, Rec: 0.6 ± 0.4 mg/dL) and LONG (Post: 0.5 ± 0.5, Rec: 0.8 ± 0.6 mg/dL, $P\geq 0.41$). 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. -16.1 ± 6.6 ml/min/1.73 m², $P\leq 0.02$). Increases in NGAL were greater in LONG at Post (21.9 ± 21.0 vs. 10.6 ± 9.6 ng/mL, $P=0.01$) and Rec (12.4 ± 9.8 vs. 2.1 ± 9.1 ng/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 mediated by 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

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(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 thus 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 ml kg⁻¹ min⁻¹) underwent a motor task-based blood-oxygen-level dependent (BOLD) fMRI scan while donning a water-perfused thermal suit in a familiarization and four randomized, counterbalanced trials. fMRI 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_{re}) and heart rate (HR) were assessed using two-way ANOVA with $p < 0.05$ considered as significant.

RESULTS: Participants started all trials euhydrated (mean serum osmolality: 292 ± 1 mOsmol/kg; $p = 0.719$), with similar baseline HR (66 ± 2 beats/min; $p = 0.908$) and T_{re} ($36.9 \pm 0.1^\circ\text{C}$; $p = 0.431$). Post-intervention percent body mass change were similar across trials ($-0.7 \pm 0.2\%$; $p = 0.110$). Post-intervention T_{re} for EX ($39.4 \pm 0.2^\circ\text{C}$) was similar to PAH trial ($39.3 \pm 0.2^\circ\text{C}$; $p = 0.59$) but higher than ICE ($39.0 \pm 0.2^\circ\text{C}$; $p = 0.01$) and CON trials ($36.5 \pm 0.2^\circ\text{C}$; $p < 0.01$). Mean T_{re} achieved during post-intervention fMRI scan were $38.5 \pm 0.1^\circ\text{C}$ for both EX and PAH trials, $37.7 \pm 0.1^\circ\text{C}$ for ICE trial and $36.3 \pm 0.1^\circ\text{C}$ for CON trial. Task-based fMRI detected lower BOLD signals from primary motor cortex in PAH (fold changes from baseline: 0.46 ± 0.35) compared to EX trials (1.03 ± 0.21 , $p = 0.01$). BOLD signals were also lower in 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 BOLD analysis showed that passive heating led to functional suppression in the sensorimotor areas in the brain. Supported by DIRP Grant, PA No. 9015102335.

1597 Board #272 June 1 9:00 AM - 10:30 AM
Outcomes from a Modified Heat Tolerance Test to Track Thermal Strain

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 (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 $5\text{ km} \cdot \text{h}^{-1}$ with a 2% grade in 40°C ambient temperature [T_A] 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 $\text{VO}_{2\text{max}}$ test (T_A , $22.9 \pm 1.1^\circ\text{C}$; RH, $39 \pm 3.9\%$) and a mHTT (T_A , 40°C ; RH, 40%) on a motorized treadmill set at 2% incline. mHTT consisted of sustained treadmill running at 60% of the velocity achieved at $\text{VO}_{2\text{max}}$ for up to thirty minutes. Heart rate (HR) and rectal temperature (T_{REC}) were measured throughout the mHTT. Nude body mass (BM) was measured pre and post mHTT. Body surface area (BSA) was calculated using the equation by DuBois (1989). Adjusted physical strain index (PSI_A) was calculated using the formula developed by Moran et al. (1998) with an adjustment based on the maximal HR observed during the $\text{VO}_{2\text{max}}$ test as the upper HR threshold for each participant. **RESULTS:** Average $\text{VO}_{2\text{max}}$ was $42.4 \pm 7.2\text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$. Percent body mass loss from mHTT was $1.3 \pm 0.3\%$, and average end T_{REC} was $38.87 \pm 0.38^\circ\text{C}$. The mean rate of T_{REC} rise in the last 15 minutes of mHTT was $0.05^\circ\text{C} \cdot \text{min}^{-1}$ (range, 0.02 - $0.09^\circ\text{C} \cdot \text{min}^{-1}$). Standard linear regression analysis showed BM (R^2 change, 0.23; β , -0.93 ; $p = 0.009$), BSA (R^2 change, 0.12; β , 0.56; $p = 0.053$), and $\text{VO}_{2\text{max}}$ (R^2 change, 0.12; β , 0.46; $p = 0.047$) explained 48% of the variance observed in the T_{REC} gain at the end of mHTT ($R^2 = 0.48$, $p = 0.064$). Mean end mHTT PSI_A was 7.89 (range, 5.95-9.95; Shapiro-Wilk test, df , 31, $p = 0.629$). There was no correlation between PSI_A and BM, BSA, and $\text{VO}_{2\text{max}}$ ($p > 0.05$). **CONCLUSION:** While T_{REC} response in mHTT was influenced by BM, BSA, and $\text{VO}_{2\text{max}}$, PSI_A was able to track thermal strain independent from these variables and with normal distribution, suggesting further exploration of the utility of PSI_A during the mHTT.

1598 Board #273 June 1 9:00 AM - 10:30 AM
Reduced Cardiorespiratory Fitness Causes Heat Tolerance Test Failures

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 (No relationships reported)

Heat tolerance tests (HTTs) are conducted to determine tolerance to exercise in a hot environment. Current HTT fail criteria state heart rate (HR) cannot exceed 160 bpm and core temperature (T_{rec}) cannot exceed 38.6°C within 120 min. Based on previous observations, some individuals have failed an HTT by exceeding the HR criterion, while T_{rec} remained well below fail criterion. Therefore, it is hypothesized that cardiorespiratory fitness, and not heat intolerance, may be the primary determinant for individuals failing HTTs. By comparing HR responses during exercise in thermoneutral and hot conditions, the impact of exercise load on HR response may be assessed without the confounding variable of increased environmental temperature.

PURPOSE: To compare HR responses during exercise in thermoneutral and hot conditions. **METHODS:** Ten healthy individuals (age: 25.7 ± 2.3 yrs, height: 171.1 ± 7.6 cm, weight: 64.1 ± 9.3 kg) completed one $\text{VO}_{2\text{max}}$ treadmill test and two trials

of treadmill walking at 3.3 mph, 4% grade for up to 120 min. One trial was conducted in thermoneutral conditions (22°C , 40% relative humidity) and one in hot (40°C , 40% relative humidity). HR and T_{rec} were recorded every 5 min during each trial. The trial ended if HR exceeded 160 bpm, T_{rec} exceeded 38.6°C , or 120 min was reached. Data were analyzed to determine heat and exercise tolerance among individual subjects.

RESULTS: Four of the 10 subjects were unable to complete the hot trial. One subject failed by exceeding the criterion for T_{rec} . Three subjects exceeded the criterion for HR, with end of test (EOT) HR responses significantly greater than those who did not exceed HTT criteria (165 ± 4 vs. 130 ± 22 bpm; $p < 0.01$). The same three subjects had higher EOT HR responses in the thermoneutral trial compared with those who never exceeded HTT criteria (131 ± 11 vs. 104 ± 13 bpm; $p = 0.02$). $\text{VO}_{2\text{max}}$ scores were also lower in the three subjects that exceeded the criterion for HR compared with those who did not (44.5 vs. 51.4 ml/kg/min; $p = 0.03$). **CONCLUSIONS:** The presence of elevated HR in both hot and thermoneutral trials, with evidence of lower $\text{VO}_{2\text{max}}$, supports a reduced aerobic capacity among the three individuals exceeding the criterion for HR. Thus, exercise intolerance and reduced aerobic capacity were the likely causes for subjects exceeding the HR criterion in the hot trial.

1599 Board #274 June 1 9:00 AM - 10:30 AM
Thermoneutral Exercise Correlates With End of Trial Heart Rate During Exercise in the Heat

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 (No relationships reported)

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 obtained 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 each thermoneutral and hot trial, $r = .94$, $r = .91$, respectively. Additionally, there was a strong correlation between thermoneutral 30 min HR and hot EOT HR, $r = .83$. 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 prescreening 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.

1600 Board #275 June 1 9:00 AM - 10:30 AM
Accuracy Of ECTemp Models In Predicting Core Temperature And Circadian Rhythm Indicators From Heart Rate

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 (No relationships reported)

ECTemp is a heart rate (HR) based core temperature (CT) estimation model is being used to monitor and manage heat strain in warfighters and athletes during exercise in the heat. ECTemp may also be valuable for sedentary CT research on circadian rhythm disturbances. A recent modification to better reflect physiology may also improve ECTemp prediction of CT and circadian rhythm indicators (Midline Estimator of Rhythm MESOR, amplitude, and acrophase).

PURPOSE: To compare the accuracy of the original ECTemp model (Quadratic model) and a modified ECTemp model (Sigmoid model) in estimating CT during exercise and rest periods as well as circadian rhythm indicators. **METHODS:** 12 subjects (Age, 23 ± 3 yr; HT, 173.8 ± 7.7 cm; BM, 70.12 ± 8.94 kg) were monitored continuously for CT and HR while enclosed in a calorimeter chamber over two 22.5-hr

trials. Except for a one hour treadmill protocol, participants were required to restrict physical activity to sedentary tasks. Circadian rhythm indicators were extracted from rest periods using mixed effects models. Pearson's correlation coefficients and mean absolute errors (MAE) were determined to evaluate each model's performance during exercise and rest. **RESULTS:** Sigmoid model estimates had slightly stronger correlations with CT during exercise (0.90 vs. 0.89) and rest (0.74 vs. 0.67). Similarly, MAE for the Sigmoid model were lower for the Sigmoid model during exercise ($0.27 \pm 0.23^\circ\text{C}$ vs. $0.28 \pm 0.23^\circ\text{C}$, $p < 0.001$) and rest ($0.22 \pm 0.18^\circ\text{C}$ vs. $0.26 \pm 0.22^\circ\text{C}$, $p < 0.001$). MAE were significantly lower for Sigmoid model estimates of the MESOR ($0.07 \pm 0.06^\circ\text{C}$ vs. $0.16 \pm 0.07^\circ\text{C}$, $p < 0.001$) and acrophase (1.19 ± 0.97 hr vs. 1.57 ± 0.97 hr, $p < 0.001$) but similar for amplitude ($0.08 \pm 0.07^\circ\text{C}$ vs. $0.09 \pm 0.06^\circ\text{C}$, $p = 0.74$). **CONCLUSIONS:** While both models performed well (overall MAE $< 0.28^\circ\text{C}$), the Sigmoid model had more accurate estimates of exercise and rest CT as well as closer estimates of circadian rhythm indicators. Consequently, the modified ECTemp 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.

1601 Board #276 June 1 9:00 AM - 10:30 AM
Weighted Heat Stress Score as a Predictor of Rectal Temperature in a Warm Weather Race
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Torres et al. (2014) found minor correlations between Heat Stress Score (HSS) and rectal temperature (T_{REC}) in a warm weather race. **PURPOSE:** To examine if the weighted HSS equation (HSS_w) is more effective at predicting T_{REC} in a warm weather race. **METHODS:** Data from twelve participants (males, $n=7$; females, $n=5$) who ran in the 2015 Falmouth Road Race were examined (age, 38 ± 11.5 y; body mass, 66.12 ± 7.91 kg; body fat, $16.70 \pm 4.92\%$). Participants logged their exercise for 28-days leading up to race day using an online questionnaire. Zip codes were used to retrospectively calculate weather data (ambient temperature [T_{AMB}], relative humidity [RH]) using an online weather database. For indoor exercise bouts, the environmental conditions were standardized to $T_{\text{AMB}} = 20^\circ\text{C}$ and $\text{RH} = 30\%$. T_{REC} and finish time (FT) were measured on race day. HSS was calculated for training (HSS_T) and for race day (HSS_R) using the equation $\text{HSS} = (T_{\text{AMB}} [^\circ\text{C}] \text{ duration [min]})$ to determine total heat exposure. Edward's Training Impulse Score (TRIMP = exercise duration [min] heart rate weighting factor) was used to quantify exercise intensity for training (TRIMP_T) and for race day (TRIMP_R). Values from HSS and TRIMP were then weighted using the updated equation: $\text{HSS}_w = 2 \checkmark (\text{HSS}_T / \text{HSS}_R) + 1 \checkmark (\text{TRIMP}_T / \text{TRIMP}_R)$. Standard linear regression and Pearson product correlation were used to investigate anthropometric and physiological variables that are associated with T_{REC} . Significance was set *a priori* at $p = 0.05$. **RESULTS:** Average HSS_w ($R^2=0.004$, $p=0.841$), difference between finish time (FT) and predicted FT ($R^2=0.139$, $p=0.234$), FT ($R^2=0.104$, $p=0.298$), and body mass ($R^2=0.112$, $p=0.282$) did not predict participant's T_{REC} . Combined, the above variables predicted approximately 43% of the variance in T_{REC} ($r=0.652$, $R^2=0.425$, $p=0.359$). Additionally, average HSS_w ($r=0.125$, $R^2=0.02$, $p=0.671$) and FT ($r=-0.024$, $R^2=0.001$, $p=0.936$) were not correlated with T_{REC} . **CONCLUSION:** HSS_w did not exhibit improved prediction for post-race T_{REC} . Further investigation should examine anthropometric and physiological variables that were not collected in the study to predict T_{REC} response in a warm weather race.

1602 Board #277 June 1 9:00 AM - 10:30 AM
Comparison Of Rectal Temperature Prediction Models Utilizing Machine Learning
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 (No relationships reported)

The only valid methods for assessment of deep body temperature during exercise in the heat are invasive or logistically difficult to implement. Non-invasive prediction of deep body temperature has the potential to provide physiological information to exercising individuals. **PURPOSE:** To examine the use of machine learning models for the prediction and classification of rectal temperature (Trec) derived from non-invasive measurements. **METHODS:** We pooled data from two studies wherein participants, wearing athletic shorts and a tee shirt, walked and ran on a motorized treadmill in an environmental chamber (ambient temperature, $39.8 \pm 1.7^\circ\text{C}$; relative humidity, $33.4 \pm 10.7\%$). Data from twenty-five recreationally active participants were used (mean \pm SD; male, $n=19$; female, $n=6$, age, 24 ± 4 y; height, 177 ± 10 cm; body mass, 75.94 ± 12.45 kg;

body fat, $15.31 \pm 6.55\%$). Heart rate, 7-site skin temperature, speed, incline and T_{rec} were collected throughout exercise. Data were split into a 7:3 partition for model development and evaluation. Skin temperature, heart rate, speed, incline, environmental conditions and anthropometric information were selected as predictors. Multivariate linear regression, recursive partitioning, M5' modeling and multivariate adaptive regression splines (MARS) analyses were performed to develop prediction models. K-nearest neighbor and C5.0 model tree analyses were performed to develop classification models for when individuals became hyperthermic ($T_{\text{rec}} > 39^\circ\text{C}$). **RESULTS:** Standard stepwise linear regression accounted for 61% of the variability in Trec (predictors=17, SEE=0.52). A MARS model accounted for 77.6% of the variance in Trec (predictors=10, RMSE=0.428). A C5.0 decision tree was able to identify cases where an individual was hyperthermic with a sensitivity of 0.625 and a specificity of 0.906 (predictors=13, positive likelihood ratio=6.58). **CONCLUSIONS:** A MARS model improved upon linear regression analyses for the prediction of Trec during exercise. Additionally, a C5.0 decision tree model was able to classify individuals who were hyperthermic with a moderate shift in diagnostic probability. These techniques may be useful for refinement and implementation of future models to predict deep body temperature in an athletic setting.

1603 Board #278 June 1 9:00 AM - 10:30 AM
Dietary Curcumin Supplementation Reduces Gastrointestinal Barrier Permeability During Exertional Heat Stress
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 (No relationships reported)

Exertional heat stress increases gastrointestinal barrier permeability and risk of exertional heatstroke (EHS) via a TLR4-mediated inflammatory pathway. Oral curcumin supplementation is known to inhibit both the MyD88 & TRIF-dependent pathways of TLR4 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 ($65\% \text{VO}_{2\text{max}}$) for 60min in a Darwin[®] chamber ($37^\circ\text{C}/26\% \text{RH}$) two times (CURCUMIN/PLACEBO). Intestinal fatty acid binding protein (I-FABP) and associated pro-inflammatory (MCP-1, TNF α , 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 (Tb) temperatures; HR; and physiological strain index (PSI) were measured throughout exercise. Group differences were determined with 2-Way (Condition x Time) RM ANOVAs. **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%) and 1-POST (33%) in PLACEBO exceeded that in CURCUMIN (58% & 18%; respectively). IL-1ra also increased more from PRE to 1-POST in PLACEBO (153%) than in CURCUMIN (77%). TNF α increased ($p=0.01$) from PRE to POST (19%) and 1-POST (24%) in PLACEBO but not in CURCUMIN. IL-10 increased ($p < 0.01$) from PRE to POST (61%) and 1-POST (42%) in PLACEBO but not in CURCUMIN. The PSI, which indicates EHS risk, was also lower ($p < 0.01$) in CURCUMIN from 40-60min of exercise. **CONCLUSION:** Collectively, these data suggest 3d curcumin supplementation reduces GI permeability and cytokine responses to exertional heat stress.

1604 Board #279 June 1 9:00 AM - 10:30 AM
Curcumin Improves Systemic Responses to Exertional Hyperthermia but Doesn't Alter Protein Expression in Circulating Leukocytes
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 (No relationships reported)

Exertional heat stress increases gastrointestinal barrier permeability and risk of exertional heatstroke (EHS) via a TLR4-mediated inflammatory pathway. Curcumin has been shown to inhibit TLR4 signaling *in vitro* but has not been examined in a human exertional heat stress model. **PURPOSE:** This work investigated the effect of 3d of 500mg/d dietary curcumin supplementation on the cellular and systemic responses to exertional heat stress in non-heat acclimated humans. **METHODS:** Subjects ($N=6$) ran ($65\% \text{VO}_{2\text{max}}$) for 60min inside an environmental chamber ($37^\circ\text{C}/26\% \text{RH}$) two times (CURCUMIN/PLACEBO). Core temperature (Tc), heart rate (HR), and physiological strain index (PSI) were 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,

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MyD88, pNFKB, NFKB) and indicators of cellular energy status (SIRT1 & p-AMPK) were determined with Western Blot. Group differences were determined with 2-Way (Condition x Time) RM ANOVAs. **RESULTS:** Under CURCUMIN, Tc rose less ($0.23 \pm 0.15^\circ\text{C}$; $p < 0.01$) and both HR and PSI were lower from 45-60min of exercise (HR: 9 ± 2 bpm, PSI: $12 \pm 1\%$; $p < 0.05$). In PBMC, the ratio of pNFKB to NFKB at 1-POST was increased by 64% in PLACEBO and 51% in CURCUMIN ($p = 0.05$). Intriguingly, TLR4 was reduced at 1POST in both conditions (PLACEBO: -28%, CURCUMIN: -17%; $p = 0.05$), as were pAMPK (PLACEBO: -62%, CURCUMIN: -57%; $p < 0.01$) and SIRT1 (PLACEBO: -61%, CURCUMIN: -48%; $p = 0.02$). **CONCLUSIONS:** Despite robust improvements in systemic responses to exertional heat stress under CURCUMIN, there was no difference in the protein expression profile of PBMC that were collected under CURCUMIN and PLACEBO conditions. However, in both conditions we did note a significant elevation in pNFKB:NFKB at 1-POST, which (ironically) coincided with a significant reduction in TLR4 (but not MyD88). At present, our working hypothesis is that pAMPK and SIRT1 were downregulated in an effort to maintain the pro-inflammatory capacity of PBMC during this “open window”, an effect that has not previously been described in PBMC collected under exertional heat stress conditions.

1605 Board #280 June 1 9:00 AM - 10:30 AM
Impact of Heat Stress and Prolonged Exercise on the Oral Microbiome in Adults

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PURPOSE: To assess the impact of completing a 164-km road cycling event performed in a hot environment (Wichita Falls, Texas in August), on the oral microbiome in men and women.

METHODS: 28 participants completed the ride and had their complete oral microbiome analyzed. Oral microbiome samples were collected in the morning before (PRE) and immediately after (IP) completing the ride. Sample's DNA was isolated and the V4 region of the 16S rRNA was then amplified by PCR. Libraries were sequenced on MiSeq, and reads were aligned and processed through QIIME to generate an OTU table. Microbial diversity was estimated using the following indexes: chao1, observed species, Shannon, PD whole tree and equitability. In addition, Lefse was utilized to identify tax enrichment in different sex, age and BMI groups - using pre/post as a subcategory.

RESULTS: Across all samples, the top 5 phyla accounted for 97% of bacteria present: *Firmicutes* (0.69 ± 0.02) > *Proteobacteria* (0.11 ± 0.01) > *Bacteroidetes* (0.08 ± 0.007) ~ *Actinobacteria* (0.08 ± 0.006) > *Fusobacteria* (0.01 ± 0.002). Microbial diversity was not changed due to the event. However, there was significant increase in the relative abundance of *Firmicutes* ($P = 0.007$) and decreased abundance of *Bacteroidetes* ($P = 0.01$) after the exercise. There was also a borderline-significant trend for *Proteobacteria* to decrease after exercise ($P = 0.055$). In addition, the ratio of *Firmicutes* to *Bacteroidetes* rose from approximately 10.9 before exercise to 22 post exercise ($P = 0.01$). 14 taxa were associated with males (5 *Fusobacteria*, 4 *Actinobacteria*, 2 *Bacteroidetes*, 2 *Firmicutes*, 1 *Proteobacteria*) and 1 (*Actinobacteria*) with females. With BMI divided into 3 categories (Group 1 <25; Group 2= 25 - 30; Group 3 >30), three taxa (all *Actinobacteria*) were associated with the leanest group, 5 with the intermediate group (all *Bacteroidetes* class *Flavobacteriia*) and 3 (2 *Bacteroidetes* family *Porphyromonadaceae*, 1 *Tenericutes*) with the “obese” group. **CONCLUSIONS:** Completing a 164-km road cycling event in hot conditions resulted in increased ratios of *Firmicutes* to *Bacteroidetes* and *Firmicutes* to *Bacteroidetes* in both men and women. Therefore, the shift of the oral microbiome caused by the stress of the prolonged riding in the heat may lead to some populations more susceptible to immune dysfunction.

1606 Board #281 June 1 9:00 AM - 10:30 AM
Effects Of Lower-body Versus Upper- And Lower-body Resistance Exercise On Lower-body Intramuscular Temperature

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PURPOSE: Intramuscular temperatures above 38.6° C are associated with impaired endurance. However, the effects of resistance exercise on intramuscular temperature has not been studied. Further, some studies have shown that exercise in one muscle group can impair performance in other muscles. Thus, the purpose of this study was to compare the effects of lower-body (LB) only and lower-body with upper-body (UB) resistance exercise on intramuscular temperature of the vastus lateralis.

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METHODS: Ten subjects (age=19.9±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. During UB, participants completed three circuits of 90% one-repetition 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 thermocouple sampled vastus lateralis temperature. For all statistical analyses, alpha was set at .05.

RESULTS: A 2 (condition) by 4 (set) by 2 [intra-set change (start versus end)] repeated measures ANOVA revealed a significant interaction between set and intra-set change on muscle temperature ($p = 0.001$; $\eta^2 = .647$); there were no other significant interactions. Collapsed across conditions, intra-set muscle temperature increases were progressively attenuated (highest $p = .006$) from a maximum of $.5^\circ \pm .2$ in set 1 to $.2^\circ \pm .2$ in set 4. There was no significant main effect of condition on muscle temperature ($p = .257$; $\eta^2 = .140$). Two one-sample t-tests showed that muscle temperature at the end of set 4 was significantly less than 38.6° in the LB (CI=35.6-37.2°; $p < .001$) and UB (CI=35.2-36.6°; $p < .001$) conditions. A 2 (condition) by 4 (set) repeated measures ANOVA yielded no significant main effect of condition on total number of completed hip sled repetitions ($p = .494$; $\eta^2 = .053$; LB CI=6.5-10.8 reps; UB CI=5.7-10.5).

CONCLUSIONS: During resistance exercise, it is unlikely that muscle temperatures get high enough to enhance the rate of fatigue development. Furthermore, the addition of UB resistance exercise does not appear to significantly increase LB muscle temperature or affect performance under these conditions.

1607 Board #282 June 1 9:00 AM - 10:30 AM

Deep Tissue Heating Increases Mitochondrial Respiratory Capacity of Human Skeletal Muscle

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Environmental factors such as hypoxia and heat stress have been shown to disrupt cell homeostasis, resulting in altered cellular energy status and the activation of signaling pathways associated with mitochondrial biogenesis. In response to heat stress, mitochondrial biogenesis has been confirmed in skeletal muscle using both animal and *in vitro* research models. **Purpose:** To investigate the effect of deep tissue heating on skeletal muscle respiratory capacity in humans. **Methods:** Ten healthy men ($n = 5$) and women ($n = 5$) volunteered for the study (20.3 ± 2.05 yrs, 171 ± 13 cm, 65 ± 14 kg). From each volunteer, a randomly selected leg was chosen to receive daily heat therapy over a 6-day period via short-wave diathermy. Intramuscular temperature was measured with the insertion of a temperature probe to the approximate depth at which muscle tissue would be sampled (≈ 3.5 cm). Muscle biopsies were taken before and after the therapeutic intervention from both the treated and untreated vastus lateralis muscles. Maximal respiratory capacity (OXPHOS) and maximal uncoupled respiration (ETS) were measured according to the standard Substrate-Uncoupler-Inhibition Titration (SUIT) protocol for high-resolution respirometry. **Results:** No differences in OXPHOS ($p = 0.215$) or ETS ($p = 0.4114$) were detected between the treatment and control muscles before heat therapy. Muscle temperature increased significantly in response to diathermy treatment ($3.96 \pm 0.51^\circ\text{C}$, $p < 0.0001$). After 6 days of heat therapy, there was a strong trend for increased maximal OXPHOS (5.55 ± 3.50 pmol·kg⁻¹·sec⁻¹, $p = 0.055$). Following heat therapy, there was also a significant increase in ETS (9.40 ± 4.17 pmol·kg⁻¹·sec⁻¹, $p = 0.035$). **Conclusion:** In support of previous animal and *in vitro* research, these data support increases in mitochondrial respiratory capacity in response to heat stress in human skeletal muscle. Such increases in mitochondrial respiratory capacity may have implications for individuals suffering from mitochondrial myopathies, as improved respiratory capacity may promote improvements in skeletal muscle health and function. Additional research involving more practical heating modalities is necessary if these findings are to be extended to clinical populations.

1608 Board #283 June 1 9:00 AM - 10:30 AM
Repeated Thermal Stress Sensitizes C2C12 Myotubes To Subsequent LPS Exposure

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 (No relationships reported)

Purpose: This study investigated the hypothesis that “preconditioning” hyperthermia affords cytoprotection against subsequent LPS stimulation in C2C12 myotubes. **Methods:** C2C12 myotubes were incubated for 2hr/d at 40°C for 6d (HEAT) or maintained at 37°C (CONTROL). After recovering for 24 hours, myotubes were stimulated with LPS (500ng/ml) for 2hr, following which protein markers of the heat shock response (HSR), NFKB activation, and lipid/glycogen storage capacity were examined via Western Blot. **Results:** As expected, the HSR was strongly activated by HEAT [HSP32 (+38%; $p < 0.01$), HSP60 (+32%; $p < 0.01$), HSP70 (+68%; $p < 0.01$)].

Unexpectedly, HEAT exhibited a *heightened* inflammatory response [p-IKk α /b (+81%; p=0.04), p-IKb α (+432%; p<0.01), p-NFKBp65 (+283%; p=0.04)]. Intermediate enzymes of lipid [p-ACCa (-33%; p=0.02)] and glycogen [p-GSK3 α /b (+367%; p=0.03)] biosynthesis were also down regulated, with elevated p-AMPK (+80%; p<0.01) suggesting an energetic deficit. Apoptosis activators Caspase 8 (+53%; p=0.04) and FOXO1 (+74%; p=0.02) were up regulated, as was p-JNK (+41%; p=0.03). Through follow-up analysis we determined these undesirable responses were linked to up-regulation of TLR4 (+24%; p=0.03) and MyD88 (+308%; p<0.01), as well as p-NIK (+199%; p=0.02) but not IRAK-1 (p=0.46). **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).

1609 Board #284 June 1 9:00 AM - 10:30 AM
Human Skeletal Muscle Myogenic and Proteolytic Response To Environmental Temperature

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 (Sponsor: Dr. Dustin Slivka, FACSM)
 (No relationships reported)

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 \pm 5, height 183 \pm 5 cm, weight 84.1 \pm 13.0 kg) each completed three trials in hot (33 $^{\circ}$ C), cold (7 $^{\circ}$ C), and room temperature (20 $^{\circ}$ 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 = 0.987), MYOG (p = 0.444), MYF5 (p = 0.343), MYF6 (p = 0.458), MYOD (p = 0.201), FOXO3 (p = 0.102), atrogin1 (p = 0.543), or MURF1 (p = 0.693). MSTN, MYF5, and FOXO3 decreased over the 3 h trial period (p < 0.001, p = 0.003, p = 0.004 respectively), whereas MYF6 and MYOD increased (p = 0.026, p = 0.004, respectively). Core temperature was significantly higher in hot (37.2 \pm 0.1 $^{\circ}$ C, p = 0.001) and cold (37.1 \pm 0.1 $^{\circ}$ C, p = 0.013) environments compared to room temperature (36.9 \pm 0.1 $^{\circ}$ C). Whole body oxygen consumption was also significantly higher in hot (0.38 \pm 0.01 L \cdot min $^{-1}$, p < 0.001) and cold (0.52 \pm 0.03 L \cdot min $^{-1}$, p < 0.001) compared to room temperature (0.35 \pm 0.01 L \cdot min $^{-1}$). **CONCLUSIONS:** These data demonstrate that acute temperature exposure alone does not elicit significant changes in skeletal 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).

C-46 Free Communication/Poster - Immunology I

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

1610 Board #285 June 1 8:00 AM - 9:30 AM
Changes In Parameters Of Immunological And Oxidative Status In Elite Athletes During Winter

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PURPOSE: The current study monitored markers of immunological and oxidative status in 9 male elite athletes (triathlon and athletics): VO2max: 68 \pm 11 mL/kg/

min, age: 24 \pm 2.5 years, training loads: 13 \pm 1.2 h/week, during 14 weeks in winter. **METHODS:** The resting blood samples were collected at baseline and at the end of the study. Spectrophotometric methods and enzyme-linked immunosorbent assay (ELISA) were used for parameters determination. **RESULTS:** The level of concanavalin A (ConA) stimulated interferon- γ (IFN- γ) from peripheral blood mononuclear cells (PBMCs) was increased (562 (147-852) vs. 1097 (451-1842) pg/mL, p=0.013). Also, the level of tissue growth factor-1 (TGF- β 1) in serum was elevated (2.5 (1.4-5.1) vs. 7.2 (4.9-8.2) ng/mL, p=0.015). There was no change in the level of peptidoglycan (PGN) stimulated interleukin (IL)-10 from PBMCs. There were no significant changes in PBMCs proliferation/viability upon stimulation with ConA and PGN during the study. No changes in superoxide dismutase (SOD), pro-oxidative-anti-oxidative balance (PAB), total oxidant status (TOS) and thiobarbituric acid reactive substances (TBARS) were observed along the study. Total antioxidant status (TAS) was increased (610 \pm 174 vs. 760 \pm 102 μ mol/L, p=0.018) and activity of paraoxonase (PON1) was decreased (523 \pm 295 vs. 335 \pm 183 U/L, p=0.003) at the end of the study. Advanced oxidation protein products (AOPP) were increased (25 \pm 7.9 vs. 42 \pm 7.6 μ mol/L, p=0.011). Negative correlation between TOS and PBMCs proliferation/viability upon stimulation with ConA (p=0.040, r=-0.392) was found, as well as between PAB and proliferation/viability upon stimulation with PGN (p=0.045, r=-0.391). **CONCLUSIONS:** In conclusion, 14 weeks of regular training and competitions in winter induced prominent changes in cytokines, biomarkers of oxidative stress and antioxidative enzyme activity. These perturbations of immune and oxidative status could cause increased susceptibility to infections and consequently impair performances.

1611 Board #286 June 1 8:00 AM - 9:30 AM
SlgA and Upper Respiratory Syndrome During a College Cross Country Season

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 (No relationships reported)

PURPOSE: To examine changes in mucosal immunoglobulin A (SlgA) and the incidence of upper respiratory syndrome (URS) during a college cross country season. **METHODS:** Twenty-two cross country athletes (XC) (20.7 \pm 1.4 years) and twenty-three matched controls (C) (20.4 \pm 1.4 years) served as subjects in this investigation. Using standardized data collection procedures, all participants provided unstimulated resting saliva samples at four targeted time points (pre-season, two in-season, and post season) over a four-month study period. These samples were subsequently analyzed in one batch by an enzyme-linked immunosorbent assay (Salimetrics, Philadelphia, PA), to determine absolute SlgA (μ g/ml) concentration and calculate the secretion rate of SlgA (μ g/min). Throughout the study, subjects completed standard weekly logs indicating signs and symptoms of URS from which a total symptom score (TSS) was calculated according to the method of Gleeson. (2012). Differences between groups and across the duration of the study were examined using repeated measures ANOVA. **RESULTS:** Analysis of SlgA data revealed significant main effects for SlgA, F(1,43) = 15.617, p = .000 with a moderate effect size (.266) as well as a significant Group x Time interaction, F(3,41) = 6.386, p = .001 with a moderate effect size (.318). Analysis of the secretion rate of SlgA data revealed significant main effects for the secretion rate of IgA, F(1,43) = 15.617, p = .000 with a moderate effect size (.223) as well as a significant Group x Time interaction, F(3,41) = 5.998, p = .002 with a moderate effect size (.305). A Bonferroni adjusted multiple comparison test revealed that resting absolute SlgA concentration and secretory SlgA in XC decreased throughout the season but remained unchanged in C. There was no significant difference in the saliva flow rate, F(3,41) = 1.719, p = .178. There was also a group by time interaction for TSS F(1,42) = 5.8, p = .020. XC had both higher TSS scores during the season and a significant negative correlation of moderate strength between those scores and the secretion rate of SlgA (p<.05). **CONCLUSIONS:** These results indicate that a season of college cross country running is associated with a progressive reduction in mucosal SlgA levels and an increase in URS.

1612 Board #287 June 1 8:00 AM - 9:30 AM
IL-6 Linkage To Exercise-induced Shifts In Lipid-related Metabolites: A Metabolomics Analysis

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IL-6 and lipolysis have been linked in cell culture and IL-6 infusion studies, but this has not yet been tested using metabolomics-based procedures that allow the simultaneous evaluation of a high number of metabolites from the lipid super pathway following intensive exercise. **PURPOSE:** Metabolomic profiling and bioinformatic

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 treadmills to exhaustion (2.26±0.01 h, 24.9±1.3 km, 69.7±1.9% VO_{2max}), 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-, 2.4±0.3-, and 1.4±0.1-fold increases in plasma IL-6, IL-8, and MCP-1, respectively, and 95.0±18.9% and 158±20.6% increases in cortisol and epinephrine, respectively (all, P<0.001). The metabolomics analysis revealed changes in 209 plasma metabolites, especially long- and medium-chain fatty acids, fatty acid oxidation products (dicarboxylate 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). OPLSR 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-methylmyristic 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 numerous 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

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

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(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 modulate 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 (RIH) 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 (ANOVAs) 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 RIH 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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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: 40 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, 13.58 J/cm²). The rats in all E-related groups went through 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, sIgA 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 sIgA (↓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 sIgA 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: sIgA (↑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)

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(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 (E) to target cell (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.

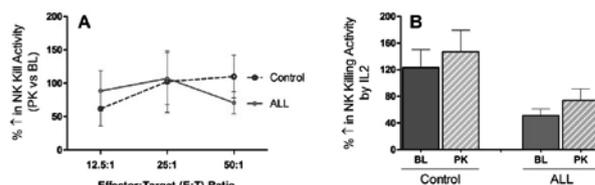


Figure 1: Significant increase in NK kill activity in PBMC in response to PK exercise (A) and to activation by IL2 (B). Note the reduced NK cell killing activity in response to IL2 in ALL survivors.

1616 Board #291 June 1 8:00 AM - 9:30 AM

Acute Exercise Alters Cell Populations Within Lymph Nodes Draining Exercising Muscle

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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 Flour 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: $5.86 \times 10^6 \pm 8.37 \times 10^5$ vs. NO EX: $4.82 \times 10^6 \pm 8.44 \times 10^5$, p = 0.40). However, EX mice had both a higher percentage ($16.83 \pm 4.69\%$ vs. $5.25 \pm 1.53\%$, p = 0.03) and absolute number ($8.54 \times 10^5 \pm 1.53 \times 10^5$ vs. $2.73 \times 10^5 \pm 7.24 \times 10^4$, 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 and CD86 as assessed by mean fluorescence intensity within the CD11c⁺ MHCII⁺ cell populations. **CONCLUSIONS:** Acute exercise alters the cell populations within the lymph nodes draining exercising muscles 24 hours post-injection, although an increase in costimulatory molecule expression is not evident at this time point. Whether these effects are more pronounced at earlier or later time points and the direct results on antibody production following exercise coupled with a vaccine remain to be elucidated.

1617 Board #292 June 1 8:00 AM - 9:30 AM

Progenitor Cell Mobilization Following a Half-Marathon in Elite Wheelchair Athletes

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Progenitor cells circulate in the blood, and are believed to be involved in tissue repair and adaptation. Acute lower body endurance exercise transiently increases various circulating progenitor cell populations in able-bodied individuals. The effects of exercise on progenitor cell mobilization in wheelchair athletes (WCAs) performing upper body exercise remain unknown. **PURPOSE:** To investigate the effects of a half-marathon on progenitor cell mobilization in elite WCAs. **METHODS:** Eight elite endurance WCAs (27.5±4.0 years, 162.5±18.6 cm, 53.5±10.9 kg, 2.4±0.6 ml/kg VO_{2peak}, 21.5±6.7 years post spinal cord injury) completed a 25-km time trial. Peripheral blood samples were collected prior to and immediately upon completion of the trial for analysis of circulating progenitor cells (CPCs: CD34⁺, hematopoietic progenitor cells (HPCs: CD34⁺CD45^{dim}), hematopoietic stem cells (HSCs: CD34⁺CD38⁺CD45^{dim}), endothelial progenitor cells (EPCs: CD34⁺VEGFR2⁺), bone marrow-derived mesenchymal stromal cells (BM-MSCs: CD45⁺CD34⁺CD31⁺CD105⁺), adipose tissue-derived MSCs (AT-MSCs: CD45⁺CD34⁺CD31⁺CD105⁺), and lactate. **RESULTS:** At baseline, the concentration of HPCs were significantly positively correlated to VO_{2peak} (Rho=0.71, p<0.05), the concentration of HSCs tended to be positively correlated to VO_{2peak} (Rho=0.62, p=0.086), and the concentration of AT-MSCs was significantly negatively correlated to VO_{2peak} (Rho=-0.69, p<0.05). Exercise tended to increase the concentration of CPCs (2 fold, p=0.099), and decrease the percentage of HPCs (39%, p<0.05), and HSCs (38%, p=0.057). The exercise-induced change in blood lactate was positively correlated to the change in the concentration of CPCs (Rho=0.88, p<0.0001), EPCs (Rho=0.81, p<0.01), and AT-MSCs (Rho=0.67, p=0.059). **CONCLUSIONS:** In elite WCAs, the quantity of circulating progenitor cells at rest was related to fitness, and the mobilization of progenitor cells was

related to exercise intensity as determined by blood lactate levels. These data have implications for the effects of exercise tissue adaptations in WCA, and for the mechanisms responsible for progenitor cell mobilization in weight-bearing versus non-weight bearing exercise.

1618 Board #293 June 1 8:00 AM - 9:30 AM

Military Recruits Who Typically Sleep <6 Hours Miss Training Due To Upper Respiratory Infection

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The National Sleep Foundation recommends 7–9 hours of sleep per night for young adults. Habitually sleeping <6 hours per night has been shown to lower immunity and increase susceptibility to common cold following exposure to rhinovirus. However, no investigations have examined the importance of sleep duration on upper respiratory infection (URTI) and loss of training days in military recruits. **PURPOSE:** To identify if military recruits who typically sleep <6 hours per night during training suffer a greater incidence of URTI and, as a consequence, miss more training than recruits who meet sleep recommendations. **METHODS:** Participants included 651 British Army recruits aged 22 ± 3 years who completed 13 weeks of Phase 1 military training (67% males, 33% females). Recruits were members of 21 platoons (11 male, 10 female) who commenced training across the seasons (19% winter, 19% spring, 28% summer, and 33% autumn). At week 13, participants completed a questionnaire asking the normal time they went to sleep and awoke during training. Incidence of physician-diagnosed URTI and reduced or missed training days due to URTI were retrieved from medical records. **RESULTS:** Typical sleep duration during training was reported as 7.0 ± 0.8 hours per night with 5% of recruits reporting they normally slept <6 hours and 60% of recruits reporting 7-9 hours of sleep each night. In a logistic regression model, recruits who slept <6 hours per night were 4 times more likely to be diagnosed with URTI compared with recruits who slept 7–9 hours per night after controlling for sex, BMI, alcohol, smoking, and season of recruitment (OR 4.6; 95% CI, 1.7–12.8, P < 0.01). URTI's diagnosed in recruits who slept <6 hours were spread across both sexes, 5 platoons and 3 seasons, showing sufficient heterogeneity. Overall, 49 recruits (8%) were diagnosed with at least one URTI, and 3 recruits (<1%) were diagnosed with two URTI's. On average, each URTI resulted in 2.9 ± 1.5 reduced or missed training days. **CONCLUSION:** These findings show that military recruits who sleep <6 hours per night are more susceptible to URTI and miss more training due to URTI. Future studies should examine interventions to improve sleep hygiene in military training. Supported by MoD, UK.

1619 Board #294 June 1 8:00 AM - 9:30 AM

Exploring the Mechanisms Underlying Exercise-Induced Changes in Natural Killer Cell Cytotoxicity

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Natural Killer (NK) cells are cytotoxic effectors of the innate immune system that eliminate tumor cells. We have previously shown that NK cell cytotoxicity (NKCA) is enhanced by acute bouts of exercise. However, the mechanisms underlying exercise-induced changes in NKCA are not yet fully understood. Exercise-induced mobilization of highly cytotoxic NK cell subsets has been proposed as one mechanism. Alternatively, exercise increases glucocorticoid and cytokines levels, which have also been shown to alter NKCA. **PURPOSE:** To examine the role of shifts in proportions of NK cell subsets, cytokines, and hormones on exercise induced changes in NKCA. **METHODS:** Adults (n=13) cycled 30 min at 115% of their lactate threshold power. Blood was collected pre, post, and 1h post exercise. Effector cells isolated from blood were incubated with K562 or U266 tumor target cells in the presence of autologous serum. NKCA was assessed after 4h by measuring lysed target cells in a flow cytometry based assay. To investigate the effects of factors (hormones and cytokines) released during exercise, pre exercise effectors were incubated with targets in the presence of pre, post, and 1h post exercise serum. The effect of shifts in NK cell subsets was determined by incubating pre, post and 1h post exercise cells with targets in presence of pre exercise serum. We also tested the cytotoxicity of pre, post, and 1h post effectors incubated with serum from the corresponding time point. **RESULTS:** Autologous pre, post, and 1h post exercise serum did not cause tumor cell lysis in the absence of effectors. The cytotoxicity of pre exercise effector cells was significantly increased against U266 target cells when incubated in 1h post exercise serum (Pre vs. post vs. 1h post = 0.318±.039 vs. 0.334±.039 vs. 0.438±.039, p<0.05). There was no

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. 0.323 ± 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 June 1 9:00 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) \times 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-s \times 3 for each quadriceps). For jumping, two-legged maximal vertical jumps using lower-extremity pre-stretch and double-arm swinging 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 ($F_{6,154} = 1.71$, $p = 0.12$). 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%, $ES = 0.66$). An increased quadriceps MNPE under the condition B 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 ($F_{2,70} = 2.14$, $p = 0.13$). Jump heights between-time ES were very small (< 0.1 for all values). **CONCLUSIONS:** Our data suggest that (1) static stretch may reduce MNPE, (2) explosive contraction may increase MNPE for 20-min, (3) 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 minimally influence explosive performance. This study was funded by Yonsei Institute of Sports Science & Exercise Medicine.

1621 Board #296 June 1 9:00 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 in a counterbalanced order, with five minutes rest between exercises. Rectus abdominis (RA), external oblique (EO), & rectus femoris (RF) EMG, and trunk and hip kinematics were synchronously recorded during exercise. Normalized data were compared via a two-way repeated measures ANOVA with *post-hoc* comparisons. **RESULTS:** For RA there was an effect of phase ($F_{3,17} = 3.40$, $p = 0.042$). RA EMG was greatest overall in phase 2 and greater in MSU than FS in phase 2 (38% versus 23% MVIC, respectively; $t = 5.26$, $p < 0.001$). For EO there was an effect of exercise ($F_{1,19} = 6.79$, $p = 0.017$) and phase ($F_{3,17} = 3.86$, $p = 0.014$). EO EMG was greatest overall

in phases 2 and 3 and greater in MSU than FS in phase 2 (99% versus 35% MVIC, respectively; $t = 3.23$, $p = 0.004$). For RF there was an effect of phase ($F_{3,17} = 2.82$, $p = 0.047$). RF EMG was greatest overall in phases 3 and 4 and greater in FS than MSU in phase 1 (16% versus 7% MVIC, respectively; $t = -2.16$, $p = 0.044$). Repetition time was greater for MSU than FS (9.2 seconds versus 2.7 seconds, respectively). Trunk motion was greatest in phases 1 and 4, hip motion was greatest in phases 2 and 3, and hip motion was greater in FS than MSU in phase 2 (58° versus 35° , respectively; $t = -3.87$, $p = 0.001$) and phase 3 (56° versus 33° , respectively; $t = 4.34$, $p < 0.001$). **CONCLUSIONS:** The MSU elicited a greater response from the abdominal muscles than FS during the hip dominant phases of the sit-up. There was greater hip motion during the FS than the MSU and the RF was more active for the FS than the MSU during the trunk flexion phase. The RF appears to be activated to control eccentric descent in both exercises. There was no funding for this project.

1622 Board #297 June 1 9:00 AM - 10:30 AM
Acute Effects Of Cooling On Muscle Contractile Properties
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(No relationships reported)

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 participants (50% males; 19-20 yr) 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), sustain time (Ts), half-relaxation time (Tr), and maximal displacement /Dm). **RESULTS:** After IPA we found that Td, Tc, Ts and Tr 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 June 1 9:00 AM - 10:30 AM
Effects of Different Neuromuscular Electrical Stimulation Parameters on Quadriceps Neuromuscular Performance in Competitive Athletes
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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 μ s (MF-500) ($n = 7$), low frequency current group of with 500 μ s (PC-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 (VAS). The training with NMES was performed 3 times per week and consisted of 18 sessions, 15 minutes per session (36 isometric involuntary 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 (MF500: pre = 222.5 ± 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 = 243 ± 40.1 Nm and post = 225.3 ± 43.2 Nm), muscle thickness (MF500: pre = 22.9 ± 2.5 mm and post = 23.7 ± 2.8 mm; PC500: pre = 23 ± 2.6 mm and post = 23.5 ± 2.7 mm; CG: pre = 25.9 ± 4.7 mm and post = 25.9 ± 4.3 mm) and EMG (MF500: pre = 0.4 ± 0.4 RMS and post = 0.5 ± 0.5 RMS; PC500: 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

VAS (MF500: pre = 9.6 ± 0.5 and post = 9.1 ± 1.5 ; PC500: pre = 9.8 ± 0.5 and post = 9.4 ± 1.3). **Conclusion:** The NMES training applied with medium or low frequency currents and the same pulse duration have the same efficiency and neuromuscular performance in the quadriceps of competitive athletes.

1624 Board #299 June 1 9:00 AM - 10:30 AM
Knee And Shoulder Flexion And Extension Strength Differences Between Genders Along The Force Velocity Curve

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 (No relationships reported)

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 6.2 ± 0.8 vs. 4.4 ± 0.5 hrs/week for males and females, respectively. Maximal torque normalized to body weight (T/BW) and F/E at each speed were compared between genders at each joint with 2-way ANOVAs. **RESULTS:** At the knee and shoulder T/BW in males was significantly greater than females for flexion and extension at all speeds with the exception of shoulder flexion ($p < 0.05$). For knee extension, 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.

1625 Board #300 June 1 9:00 AM - 10:30 AM
The Strain Of The Pull: Examining The Physiological Effects Of An Endurance Tug-of-War

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Each fall, Hope College (Holland, MI) hosts an endurance tug-of-war (The Pull) between members of the freshman and sophomore classes. Both teams have three weeks to prepare for the event, which can last upwards of three hours. **PURPOSE:** To examine the physiological effects of training for, and competing in, The Pull. **METHODS:** Seventeen male "Pullers" (Freshman, n=6) from each 18-man team agreed to participate in this study. Pullers' fitness (flexibility, power, muscular strength, and body composition) was assessed at the start (PreTrain) and end (PostTrain) of training. Blood and urine were collected at four time points (PreTrain, PostTrain, PullDay, and PostPull (56-hours post)) to assess hydration (specific gravity (SG)) and muscle damage (creatin kinase (CK)). Fitness data was analyzed using dependent, 2-tailed t-tests. Urine and blood data were analyzed using a one-way, repeated measures ANOVA. **RESULTS:** Fifteen Pullers completed pre and post fitness testing. Pullers' mean flexibility increased during training (24.42 ± 5.2 vs. 31.03 ± 6.1 cm, $p < 0.05$). No other significant changes in fitness markers occurred. Thirteen Pullers reported to each of the blood and urine collection times. The Pullers' mean hydration levels decreased during training (PreTrain: 1.02 ± 0.01 vs. PostTrain: 1.03 ± 0.01 vs. PullDay: 1.03 ± 0.01 , $p < 0.05$), but hydration status returned to baseline levels 56 hours after the event (PostPull: 1.02 ± 0.01). At no time were hydration levels outside of the normal range ($1.0-1.03$). Mean CK levels were above the normal range ($0-320$ mg/dL) at each of the four time points. CK was greatest PreTrain (2113.7 ± 1207.6) and PullDay (1384.8 ± 936.6). These were significantly greater than PostTrain (598 ± 73) and PostPull (910.7 ± 244.7) time points ($p < 0.05$). **CONCLUSIONS:** The first urine

and blood collection (PreTrain) took place three days into training. Elevated CK levels appear to reflect the intense nature of the training, whereas lower values the day of the Pull, indicates a training effect. The lack of improvement in overall fitness suggests modifications to each teams' training regimen may be warranted. Overall, our data suggests that an endurance tug-of-war elicits minimal muscle damage, compared with pre-training, similar to other endurance activities in its physiological impact on the body.

1626 Board #301 June 1 9:00 AM - 10:30 AM
The Effects Of A Heavy Resistance Warm-up On Sprint Speed: A Post Activation Potentiation Study

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 (No relationships reported)

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 36.6 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.

1627 Board #302 June 1 9:00 AM - 10:30 AM
Effectiveness of Neuromuscular Electrical Stimulation During Rest and Exercise

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 (No relationships reported)

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 = 35.0 ± 15.0 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 (VO_2), 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. **RESULTS:** 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. Supported and funded by UNCW Undergraduate Research Fellowship Award.

1628 Board #303 June 1 9:00 AM - 10:30 AM
Effect of Energy Beverage Consumption on Muscle Peak Power and Peak Velocity
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 (No relationships reported)

Effect of Energy Beverage Consumption on Peak Power and Peak Velocity
 Bert H. Jacobson FACSM¹, Garrett M. Hester², Ty B. Palmer³, Kathryn Williams¹, Zachary K. Pope¹, John H. Sellers⁴, Eric C. Conchola¹, Conrad Woolsey⁵, Carlos Estrada¹

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Energy drinks comprise a multibillion 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 effect of an ES on power and velocity in a forehand 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. For FHS 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 attained, however; larger doses of EDs have resulted in health complications.

1629 Board #304 June 1 9:00 AM - 10:30 AM
Muscle Activation During Variations of the Short Arc Quadriceps Exercise: An Electromyographic Study
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 (No relationships reported)

The vastus medialis obliquus (VMO) muscle is recognized for providing knee control and has been shown to be most active during the final phase of knee extension range of motion. Weakness of this muscle can lead to knee dysfunction, pain, and functional mobility deficits. **PURPOSE:** The purpose of this study was to: 1) determine if the electromyography (EMG) activity of the VMO differed during three variations of the commonly used short-arc quadriceps (SAQ) exercise; and 2) examine gender differences in VMO muscle activation for the same exercises. **METHODS:** Twenty healthy, active, pain-free adults (mean age \pm SD, 24.2 \pm 1.6, and range 22 to 27 years) participated in the study. EMG data were collected from the dominant lower extremity of all subjects (10 males, 10 females) and normalized to a percent of the maximum voluntary isometric contraction (MVIC). Raw EMG signals were sampled at 1500 Hz with a bandwidth of 10-500 Hz. Subjects performed the SAQ exercise and three different variations of the SAQ that included the addition of tibial internal rotation (TIR), hip adduction (HA), and hip extension (HE). Computerized voice commands were used to record and synchronize the data collection process. The mean root mean-square of the EMG signal was normalized to the MVIC. Exercise and gender comparisons were made using the non-parametric Wilcoxon signed-rank test and the Mann-Whitney *U* test, respectively. **RESULTS:** The mean VMO muscle activity values for all subjects were 13.1% (SAQ), 12.5% (IR), 13.7% (HA) and 18.4% (HE). The results of the analysis comparing exercise variations of the SAQ showed that VMO activity was significantly higher with addition of HE ($P<0.001$). The VMO activation between gender groups was significantly higher for females during the SAQ with the addition of TIR (15.2% versus 9.9%, $P=0.03$). **CONCLUSIONS:** Surface EMG was used to examine VMO activity during 3 different variations of the SAQ exercise. Our data suggest that adding HE to the SAQ will activate the VMO at greater levels. The evidence comparing VMO activation between genders is limited. Female subjects in our study displayed greater VMO activation during the SAQ exercise with the addition of TIR. These preliminary findings may facilitate additional research which could assist with exercise selection and progression decisions.

1630 Board #305 June 1 9:00 AM - 10:30 AM
Associations of Hip Extension Torque with Muscle Size of Hip Extensors and Intra-abdominal Pressure
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 (No relationships reported)

PURPOSE: It is generally considered that the muscle size of the hamstring and/or gluteus maximus (GM) is mainly responsible for the maximal voluntary isometric torque of hip extension. However, there is no evidence supporting this consideration. Thus, it remains unclear whether the muscle size of the hamstring and GM is associated with the maximal voluntary isometric torque of hip extension. On the other hand, we have recently revealed that maximal intra-abdominal pressure (IAP) as well as maximal voluntary isometric torque of hip extension increased after an 8-wk training of the abdominal bracing (Tayashiki et al. 2016). This finding leads us to hypothesize that IAP can be a potential factor contributing to the hip extension torque. The purpose of present study was therefore to clarify the associations of not only the muscle size of the hamstring and GM but also IAP with the maximal voluntary isometric torque of hip extension.

METHODS: Twenty healthy young males voluntarily participated in this study. Anatomical cross-sectional area (ACSA) of the hamstring and thickness of the GM were determined using an ultrasonography apparatus with a linear scanner. Then, each subject performed maximal voluntary isometric contraction of hip extension. In the hip extension task, torque and IAP were simultaneously measured. The IAP was assessed using a pressure transducer placed in the rectum, and determined at the time at which the peak torque was attained.

RESULTS: No significant relations were observed between the peak torque and the ACSA of the hamstring ($r = 0.307$, $P = 0.188$) or the thickness of the GM ($r = 0.405$, $P = 0.076$). On the other hand, the IAP was significantly correlated with the peak torque ($r = 0.504$, $P = 0.024$). This association was still significant even when the ACSA of the hamstring and the thickness of the GM were adjusted statically ($r = 0.486$, $P = 0.041$).

CONCLUSIONS: The current results suggest that maximal voluntary isometric torque of hip extension is attributable to IAP during the task, not to muscle size of the muscle size of the hamstring and GM.

1631 Board #306 June 1 9:00 AM - 10:30 AM
Peak Muscle Activity across Four Sets to Volitional Fatigue between Rest-Pause and Traditional Bench Press.
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 (No relationships reported)

Purpose: This study compared pectoralis major muscle activity (EMG) and lifting volume across four sets to volitional fatigue between a rest-pause and traditional resistance training protocol. **Methods:** Trained males ($N = 20$) were randomly assigned to either a rest-pause or a traditional training group. Participants completed a testing sessions where they performed a one repetition maximum (1RM), and a separate session during which they completed four sets of Smith machine bench press to volitional fatigue at 80% of pretest 1RM with 2-minutes rests between sets for both the rest-pause and traditional lifting protocol. The traditional protocol was allocated no rest between repetitions (reps) while the rest-pause protocol was elicited a four second unloaded rest between each rep. The RMS signal of the last rep during sets 2, 3, and 4 were normalized to the RMS signal of the last rep of set 1 and expressed as a delta (Δ) percent change. Total number of repetition was also recorded to assess lifting volume.

Results: A 1-way repeated measures ANOVA indicated no differences in Δ change across sets between the traditional and rest-pause protocol ($p > .05$). Furthermore, three independent samples t-tests showed no significant differences in Δ change from set 1 to sets 2, 3, and 4. Lastly, an independent samples t-test revealed the rest-pause protocol showed significantly greater reps ($M = 39.9$ reps, $SD = 9.5$, $N = 10$) in comparison to the traditional protocol ($M = 30.2$ reps, $SD = 6.4$, $N = 10$; $T(18) = 2.685$, $p < .05$. The magnitude of the differences in the means (9.7, 95% CI: -17.3 to -2.) was small ($d = .29$). **Conclusions:** Muscle activity did not change across four sets to volitional fatigue between and within a rest-pause and traditional Smith machine bench press. However, if volume is the focus of training (i.e., hypertrophy phases), the rest-pause resistance training method may be a superior method of training.

1632 Board #307 June 1 9:00 AM - 10:30 AM
Electromyographic Analysis of Left and Right Side Gluteus Medius in Unilateral and Bilateral Bodyweight Exercises
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(No relationships reported)

A wide variety of exercises directed at gluteus medius muscle (Gmed) activation are used both in athletic performance and for rehabilitation. A common way to increase the load on Gmed is to change from a bilateral (BI) to a unilateral (UNI) stance in the same exercise. Muscle activation levels $\geq 40\%$ MVIC are suggested for strength gains, however, muscle activity lower than that may be useful in developing muscle endurance. Despite numerous studies investigating which exercises best target Gmed, only muscle activity on one side of the body has been investigated, and knowledge about how an exercise affects both left and right side Gmed in BI and UNI stance is lacking. **PURPOSE:** To investigate the single and combined muscle activity magnitude in left and right side Gmed during standing and supine bodyweight exercises performed bilaterally and/or unilaterally. **METHODS:** 15 healthy college-aged subjects performed squat and supine bridge exercises in both a BI and UNI stance, and a UNI standing hip abduction exercise. The dominant (DOM) leg acted as the supporting leg in UNI exercises. Gmed electromyography activity from both left and right side was collected during the 3 exercises and normalized to a maximal voluntary isometric contraction (MVIC). Average μV was collected for 3 repetitions (paced at 2 s) of each exercise (total 6s). **RESULTS:** During the squat, Gmed activity in the DOM leg had a significantly higher ($p < 0.01$) muscle activity in UNI (36.7% MVIC) compared to BI (9.4% MVIC) stance, whereas Gmed in the non-DOM leg was similar for both stances (UNI 10.7 and BI 9.9% MVIC; $p = 0.63$). During supine bridge, Gmed in DOM leg was significantly increased ($p < 0.01$) in UNI (33.2% MVIC) compared to BI (14.7% MVIC). In contrast, the non-DOM leg displayed a significant lower activity ($p < 0.01$) in UNI (7.0% MVIC) compared to BI (15.3% MVIC) stance. For UNI standing hip abduction DOM leg (34.5% MVIC) had higher muscle activation ($p < 0.01$) compared to non-DOM leg (24.7% MVIC). **CONCLUSION:** Highest total muscle activity (left and right side) in Gmed was found in standing hip abduction, whereas Gmed maximum activity on one side only was similar for the DOM leg in UNI stance in all three exercises (33-37% bridge, hip abduction, squat). Knowledge about Gmed activation magnitude on both sides can aid in selection of strengthening exercises which targets Gmed.

1633 Board #308 June 1 9:00 AM - 10:30 AM
Influence of Gastrocnemius Muscle Length on Overhead Squat Movement Compensations Among Active-Duty Firefighters
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(No relationships reported)

The popularity of overhead squat assessments to identify movement compensations that may place an individual at risk for future musculoskeletal injury (MSKI) 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 among active-duty firefighters. **METHODS:** 50 active-duty firefighters (48 males, 2 females) participated in this study (40.8 \pm 7.7 yrs; 178.5 \pm 5.9 cm; 89.8 \pm 10.3 kg). Gastrocnemius muscle length was assessed by passively measuring bilateral ADF ROM ($^{\circ}$) using a goniometer with participants in supine and knees fully extended. Participants then completed a two-leg overhead squat assessment as part of the FusioneticsTM 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 $\alpha < .05$ determined statistical significance. **RESULTS:** Participants displaying right FTO exhibited significantly ($p = .041$) lower right ADF ROM (12.0 \pm 4.0 $^{\circ}$ vs. 14.6 \pm 4.9 $^{\circ}$, respectively). Participants displaying left FTO and HR both exhibited significantly ($p = .005$; $p = .005$, respectively) lower left ADF ROM (9.8 \pm 3.5 $^{\circ}$ vs. 13.1 \pm 4.3 $^{\circ}$; 6.0 \pm 4.0 $^{\circ}$ vs. 12.0 \pm 4.0 $^{\circ}$, respectively). Participants with any of the four left LE movement compensations exhibited significantly ($p = .035$) lower left ADF ROM (10.5 \pm 3.7 $^{\circ}$ vs. 13.1 \pm 4.6 $^{\circ}$, respectively). **CONCLUSIONS:** Restricted gastrocnemius muscle length may influence LE movement mechanics observed during an overhead squat assessment among active-duty firefighters. In order to decrease the risk of MSKI among this cohort population, practitioners should incorporate interventions designed to increase gastrocnemius flexibility.

1634 Board #309 June 1 9:00 AM - 10:30 AM
Muscular Contributions to Upper-Body Exercise
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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 musculature to submaximal and maximal arm cranking, an exercise model for evaluating upper-body work performance. **METHODS:** Eight healthy males (24 \pm 4 years, 79 \pm 8 kg, 1.8 \pm 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 their arms and trunk, while the legs were restricted and were 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 peak oxygen consumption (VO_{2peak}). Paired *t*-tests were used to compare differences in maximum neuromuscular power and VO_{2peak} . **RESULTS:** Maximum neuromuscular power produced when the legs were restricted decreased by 24 \pm 10% (762 \pm 63 vs. 579 \pm 55 W, $p < 0.05$). When the trunk and legs were restricted, power decreased further by 28 \pm 9% (762 \pm 63 vs. 543 \pm 53 W, $p < 0.05$). Results also indicated that VO_{2peak} decreased by 16 \pm 12% when the legs were restricted (3.02 \pm 0.8 vs. 2.47 \pm 0.54 L/min, $p < 0.05$) and decreased by 23 \pm 9% when the trunk and legs were restricted (3.02 \pm 0.8 vs. 2.28 \pm 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.

1635 Board #310 June 1 9:00 AM - 10:30 AM
Emg Characteristics Of Elite Trampoline Athletes' Feet On Impact: Evaluating [i1] Performance With Modified Trampoline Shoes [i1]new Title
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(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 Longus while doing a whole set of jumping. 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 on the net. The "rebound" (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 analyzed. **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 Tibia Anterior decreased on the right dominate leg when wearing 8-shaped shoes during IC period. EMG values for Peroneus Longus increased during the RB might be due to athletes' unfamiliarity with insoles. **CONCLUSIONS:** Wearing the 8-shaped shoe increased right leg Rectus Femoris, Medial Hamstring, and Tibialis anterior EMG activity during IC time and the FP time. This might enable an athlete to increase wanted power to the feet's impact on the net which results in a higher rebound. Right Lateral Gastrocnemius EMG activity 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.

THURSDAY, JUNE 1, 2017

1636 Board #311 June 1 9:00 AM - 10:30 AM
Comparison Of Emg Activity Between The American And Russian Kettlebell Swings
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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 of the K overhead. **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♂). A minimum of 24 hours after familiarization, subjects performed an isometric maximal voluntary 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: 106.2 & 131.9, RF: 82.0 & 109.5, GM: 36.4 & 51.6, and ES: 77.9 & 85.4 for A and R, respectively. **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
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 (No relationships reported)

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 ± 14.81 kg) underwent 6 ultrasound scans (US) of the RF during two different body positions. For the first position, participants were instructed to lie supinated (lying) on a padded plinth for 5 minutes to allow for potential fluid shifts prior to collecting ultrasound images. For the second position, participants were instructed to sit upright (seated) on the edge of the padded plinth with their leg hanging freely and a 90° angle at the knee. During each position, mCSA and EI were assessed in the dominant limb via three panoramic US scans. Each image was scaled and mCSA and EI were quantified using image analysis software. The best image for each position was used for analysis. Repeated measures analyses of variance (ANOVA) were used to analyze mCSA and EI of the RF across the different body positions (lying vs. seated).

RESULTS: There was no significant difference in mCSA during the supine (Mean $\pm 95\%$ CI; 10.71 ± 1.57 cm) versus seated (10.95 ± 1.47 cm) positions ($p = 0.166$). Furthermore, there was no significant difference in EI during the supine (34.25 ± 3.08 AU) versus seated (33.27 ± 3.28 AU) positions ($p = 0.301$).

CONCLUSIONS: The 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.

1638 Board #313 June 1 9:00 AM - 10:30 AM
Post Activation Potentiation in North American High School Football Players
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 (No relationships reported)

Post activation potentiation (PAP) is an acute enhancement of muscular power production resulting from a high intensity potentiating exercise. Practical applications of PAP phenomena as a warm-up strategy are the focus of ongoing research. **PURPOSE:** This study compared the effects of a dynamic and a PAP warm-up strategy on speed and horizontal plane muscular power output. **METHODS:** High School male football players ($n=16$) participated in a repeated measures cross over design study consisting of 3 testing days. Day 1: one repetition maximum (1-RM) back squats were established. Day 2: half of the participants completed a dynamic warm-up (DWU) consisting of dynamic movements (ex. high knees, butt kickers, frog jumps, cherry pickers, lateral slide, karaokes, back pedal) while the other half of the participants performed a PAP warm-up consisting of back squats culminating in a set of 4 repetitions at 85% of 1-RM. Following the warm-ups (4-minutes), the participants performed 3 trials of weighted sled push 91 kilograms (200 lb.) over a 9.1 meter (10 yards) linear path. Following the sled pushes the participants then performed three trials 18.2 meter (20 yard) sprints. Day 3: participants crossed over with respect to the warm-up procedures and again performed the three sled push and sprint trials. Dependent t-tests were used to compare the sled push and sprint times between warm-up conditions. **RESULTS:** Both the 18.2 meter sprint (PAP: 3.19 ± 0.39 , DWU: 3.24 ± 0.39 , $p < 0.01$) and the 91 kilogram sled push (PAP: 4.80 ± 0.67 , DWU: 5.27 ± 0.90 , $p < 0.01$) showed a significant improvement when PAP was utilized as a warm-up rather than the DWU. **CONCLUSIONS:** Within the parameters of the study, it was concluded that PAP as a warm-up strategy enhances sprint ability and horizontal plane muscular power output

1639 Board #314 June 1 9:00 AM - 10:30 AM
The Effects Of Bilateral And Unilateral Protocols On Muscle Power And Rate Of Force Development
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PURPOSE: Postactivation potentiation (PAP) is used to improve the force generating capacity of skeletal muscles. However, no studies have examined if there is a difference in PAP response when comparing a unilateral versus a bilateral conditioning exercise. This is important because differences exist in muscle activation when comparing unilateral and bilateral exercises. This difference plays a role in the apparent strength difference between unilateral and bilateral exercise, called "the bilateral deficit" (BLD). Therefore, the purpose of this investigation was to determine if a unilateral exercise would cause a different PAP response compared to a bilateral exercise.

METHODS: Ten recreationally trained males participated (mean \pm SD; age = 21.9 ± 2.1 yrs; body mass = 83.3 ± 10.5 kg; height = 1.8 ± 0.1 m; BMI = 25.8 ± 3.2 ; percent body fat = $14.8 \pm 3.5\%$). Following a familiarization period and baseline strength testing (5 rep maximum [5RM] for unilateral and bilateral squat), in a randomized repeated measures design, all subjects completed 3 trials: unilateral, bilateral and control. Each trial consisted of a conditioning activity (4 reps at the 5RM load) followed by a maximal voluntary isometric leg extension contraction (60° knee extension) 7 minutes after finishing the conditioning activity.

RESULTS: Neither conditioning activity (unilateral or bilateral squat) resulted in an increased peak torque value expressed in absolute or relative values as compared to control ($P > 0.05$). Interestingly, following both conditioning activities, there was a statistically significant increased time to reach half peak torque compared with the control trials ($P < 0.05$).

CONCLUSIONS: Our results demonstrated that neither conditioning activity (unilateral or bilateral squat) prior to a maximal voluntary isometric contraction caused a PAP response. However, both conditioning activities appeared to cause residual fatigue. Future investigations should expand the time domain to further explore the PAP response.

1640 Board #315 June 1 9:00 AM - 10:30 AM
Changes In Upper-body Strength Are Independent Of Initial Fat-free Mass And Strength Level
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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 wellness course over 3 years volunteered to participate. Each participant was measured before and after 12 weeks of periodized resistance training for body composition and 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. The relationships between initial level and delta FFM ($r = -0.10, p < 0.001$) 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 ($22.0 \pm 21.1\%$) than men ($14.8 \pm 14.0\%$). 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 gain 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.

1641 Board #316 June 1 9:00 AM - 10:30 AM
The Effects of Muscle Damage on Muscle Spindle Function
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 (No relationships reported)

The effects of eccentric muscle damage on extrafusal 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:** Fifteen males (mean \pm SD: age = 24.1 ± 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 $60^\circ \cdot s^{-1}$ 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 myoelectric 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 vs ECC/CON) x time (Pre vs Post vs Recov)] was used to analyze all reflex data. An alpha value of $P \leq 0.05$ 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.

1642 Board #317 June 1 9:00 AM - 10:30 AM
The Effects of Post-activation Potentiation on Contractile Properties and Jump Performance in Athletes
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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 ± 1 yr; mass: 65.9 ± 9.3 kg) 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 tibial nerve stimulation (single, doublet and triplet 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). TT 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). CMJ parameters included peak power, peak force, take-off velocity, and jump height. **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 ($p = 0.02$), doublet PT at T1 ($p = 0.044$) and T2 ($p = 0.049$), and triplet PT at T1 ($p = 0.007$) and T2 ($p = 0.034$). KB had the largest change in PT ($+11.1 \pm 7.8\%$) compared to TJ ($+8.6 \pm 11.0\%$) and DJ ($-5.5 \pm 14.1\%$) averaged across T1-T3 ($p < 0.05$). Contractile properties extracted from singlets revealed KB had larger PT ($+22 \pm 15\%$) than DJ ($-4 \pm 21\%$) at T1 ($p = .027$), and a prolonged HRT ($+9 \pm 17\%$) compared to DJ ($-3 \pm 14\%$) at T3 ($p = .031$). RTD was elevated at T1 ($+37.8 \pm 36.7\%$), T2 ($+28.8 \pm 37.2\%$) and T3 ($+25.7 \pm 28.9\%$; $p = .026$) 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 ($p = 0.07$; $\eta^2 = 0.412$) at T5, where KB ($+1.6 \pm 1.1\%$) and DJ ($+2.0 \pm 3.3\%$) were larger than TJ ($-1.6 \pm 2.7\%$). **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.

1643 Board #318 June 1 9:00 AM - 10:30 AM
Comparison Of The Electromyographic Fatigue Thresholds During Taekwondo Specific Tests And Running Cardiopulmonary Exercise Test
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 (No relationships reported)

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 4,6s and reduced 0,4s every minute until participant's fatigue. $\dot{V}O_2$, 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 inflections - 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 tests. **RESULTS** Detailed results were present in table 1. Taekwondo athletes presented similar 1st and 2nd EMG threshold responses during the 3 tests. **CONCLUSIONS** Taekwondo tests' EMG threshold responses did not differ from CPET's threshold responses, suggesting a suitable intensity progression and a proportional peripheral fatigue behavior across the stages. **FINANCIAL SUPPORT** CAPES, FAPERJ, and CNPq.

Table 1 – Comparison of cardiopulmonary exercise tests' electromyographic thresholds (n=10).

| | CPET | cTKDet | ITKDet | p value (ES) |
|---|--------------------------------------|------------------------------|------------------------------|-----------------|
| 1st Electromyographic threshold | | | | |
| VO ₂ (mL.kg ⁻¹ .min ⁻¹) | 35.6 ± 3.2 (33.3 - 37.9) | 37.9 ± 3.6 (35.3 - 40.5) | 36.3 ± 4.9 (33.3 - 39.9) | 0.44 (0.31) |
| VO ₂ (%VO _{2PEAK}) | 71.5 ± 6.0 (67.2 - 75.8) | 72.8 ± 8.6 (66.7 - 79.0) | 68.4 ± 8.8 (62.1 - 74.7) | 0.42 (0.08) |
| HR (beats.min ⁻¹)* | 160 ± 8 (153 - 167) | 173 ± 10 (153 - 178) | 170 ± 31 (137 - 177) | 0.11 (0.22) |
| HR (%HR _{PEAK})* | 82.7 ± 8.2 (78.5 - 90.4) | 86.3 ± 6.3 (79.9 - 89.7) | 83.1 ± 9.0 (65.9 - 85.6) | 0.20 (0.16) |
| HRR (%HR)* | 76.0 ± 11.1 (70.2 - 86.2) | 80.4 ± 7.1 (73.3 - 84.4) | 76.1 ± 14.1 (51.1 - 79.3) | 0.21 (0.16) |
| Relative time to 1 st EmgT (% duration) | 34.9 ± 9.7 (27.9 - 41.9) | 39.4 ± 7.7 (33.9 - 44.9) | 36.9 ± 11.7 (28.5 - 45.3) | 0.69 (0.04) |
| Kicks interval stage (s)* | - | 3.6 ± 0.4 (3.4 - 3.8) | 3.4 ± 0.8 (3.0 - 3.8) | 0.36 (-0.29) |
| Perceived Exertion Scale (0-10) | 4 ± 1 (3 - 5) | 4 ± 1 (3 - 5) | 4 ± 1 (3 - 5) | 0.77 (0.03) |
| 2nd Electromyographic threshold | | | | |
| VO ₂ (mL.kg ⁻¹ .min ⁻¹) | 43.1 ± 8.7 (40.5 - 45.8) | 44.1 ± 5.0 (40.5 - 47.7) | 44.5 ± 7.3 (39.3 - 49.7) | 0.75 (0.03) |
| VO ₂ (%VO _{2PEAK})* | 89.0 ± 5.8 (82.0 - 90.0) | 85.5 ± 10.8 (78.0 - 91.0) | 80.5 ± 15.0 (74.0 - 95.0) | 0.73 (0.03) |
| HR (beats.min ⁻¹)* | 175 ± 13 ^c (167 - 186) | 186 ± 10 (178 - 189) | 183 ± 11 (168 - 189) | 0.06 (0.28) |
| HR (%HR _{PEAK}) | 92.5 ± 2.6 (90.7 - 94.0) | 92.4 ± 3.4 (89.9 - 94.9) | 90.5 ± 3.0 (88.6 - 92.6) | 0.29 (0.13) |
| HRR (%HRR) | 89.5 ± 3.7 (86.9 - 92.3) | 89.2 ± 4.4 (86.2 - 92.4) | 86.5 ± 4.2 (83.5 - 89.7) | 0.25 (0.14) |
| Relative time to 2 nd EmgT (% duration) | 75.0 ± 10.8 (62.8 - 78.2) | 79.1 ± 12.5 (70.2 - 88.0) | 71.8 ± 9.2 (65.4 - 78.5) | 0.24 (0.15) |
| Kicks interval (s)* | - | 2.2 ± 0.5 (1.4 - 2.2) | 1.8 ± 2.6 (1.8 - 2.6) | 0.72 (-0.11) |
| Perceived Exertion Scale (0-10)* | 8 ± 2 (5 - 8) | 7 ± 4 (4 - 9) | 6 ± 3 (4 - 8) | 0.15 (0.19) |

CPET - treadmill running cardiopulmonary exercise test; cTKDet - continuous taekwondo cardiopulmonary exercise test; ITKDet - interval taekwondo cardiopulmonary exercise test. p - significance level. Variables with the absence of asterisk (*) denotes parametric data, presented as mean ± standard deviation and 95% confidence interval of mean (inferior limit - superior limit). * Denotes non-parametric data, presented as median, interquartile range and 95% confidence interval of median (inferior limit - superior limit). Parametric data compared through repeated measures ANOVA (and Bonferroni post-hoc, if necessary). Non-parametric data compared through Friedman test (and Dunn post-hoc, if necessary) (3 columns) or Wilcoxon signed rank test (2 columns). VO₂ - Oxygen uptake. HR - Heart Rate. HRR - Heart Rate Reserve. EmgT - Electromyographic threshold. VO_{2PEAK} - Highest oxygen uptake value observed. HR_{PEAK} - Highest heart rate value observed. Percentage variables (%) were calculated with the peak value observed at each test.

1644 Board #319 June 1 9:00 AM - 10:30 AM
The Influence of Exercise Surface Inclination on Trunk and Lower Extremity Muscle Activity During Common Pilates Exercises

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(No relationships reported)

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 exercise, 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 and trunk 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 maximus (GM), tibialis anterior (TA), peroneals (PL), and the medial gastrocnemius (GAS) on the right side of the body were recorded using surface electrodes. The average root mean square of muscle activity over three trials was expressed as a percent of the individual muscles maximum voluntary contraction (MVIC) recorded at the beginning of the data collection. The %MVIC for each muscle group were compared using 1-way repeated measures ANOVAs for each pose during the three inclination conditions. **RESULTS:** During the boat pose, %MVIC for the RA was greater in the incline (46%) compared to the decline (19%, $p = 0.002$) and floor (28%, $p = 0.027$). During the decline plank, the %MVIC for the EO (43%) was greater in comparison to both the floor (35%, $p=0.028$) and the incline (29%, $p = 0.005$). The RA muscle activity also showed increased activity when on the decline (30%) in comparison to the incline (20%, $p=0.036$). The single leg balance pose showed greater activation of the TA muscle on the incline (27%) in comparison to the floor (19%, $p=0.013$). No differences were detected during the bridge pose. **CONCLUSION:** The results of this study suggest that trunk muscle activity can be altered by modifying the inclination angle. Such modifications may be useful in planning exercise progressions. Further investigation is required to examine the influence of surface inclination angle and long-term training benefits.

C-48 Free Communication/Poster - Physical Activity and Mental Health

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

1645 Board #320 June 1 8:00 AM - 9:30 AM

Effect of a College Course to Reduce Weight Bias among Undergraduate Pursuing a Health Degree

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PURPOSE: To examine the effect of a college course on weight bias and body image on explicit and implicit weight bias in health majors.

METHODS: This 15-week intervention included four groups. The experimental group contained students ($n=16$) in a course with the main focus on weight bias and body image. One comparison group consisted of students ($n=16$) in a health course containing topics on weight management. Another comparison group consisted of students ($n=18$) in a health course unrelated to weight management. The control group consisted of students ($n=14$) in an economics course unrelated to health. Extrinsic weight bias was assessed with the Anti-fat Attitudes Test (AFAT), and implicit weight bias was assessed with the Implicit Attitudes Test for weight. To analyze change in explicit weight bias and if these changes differed by group, a 2x4 repeated measures ANOVA was conducted. Change in implicit weight bias by group was assessed using chi-square tests.

RESULTS: At baseline, most participants had an automatic preference for thin people over fat people that was strong (26.6%), moderate (39.1%), or slight (7.8%). Just 17.2% of participants had no automatic preference between fat and thin people, and few participants had a strong (3.1%), moderate (1.6%), or slight (4.7%) automatic preference for fat people over thin people. There were no significant changes in implicit weight bias pre- and post-semester. For AFAT composite scores, a significant main effect for time was present ($F_{(1,60)} = 5.02, p = .029$), indicating changes in scores pre- and post-semester. The group by time interaction ($F_{(1,60)} = 4.1, p = .01$), demonstrated that these changes significantly differed by group. The simple main effect revealed a significant change ($p < .001$) for the experimental group pre- and post-semester. There were no significant changes in AFAT scores for any other group. **CONCLUSIONS:** No changes in intrinsic weight bias were found in any group. Because intrinsic bias is developed over years and is highly engrained, longer, more intense interventions may be necessary to elicit change. However, post-semester, extrinsic bias significantly decreased in students enrolled in the course focused on weight bias. Thus, this type of course may be a useful tool within educational settings to reduce weight bias, especially among health majors.

1646 Board #321 June 1 8:00 AM - 9:30 AM

The Relationship Of Physical Activity Level (Self-reported Versus Objectively Measured) With Depression, Satisfaction With Life, And Cognitive Function In Older Adults

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Evidence has shown relationships between physical activity and mental health and well-being in older adults. Yet, there is little research regarding whether self-reported (SRPA) or objectively measured physical (OMPA) activity is a stronger predictor of mental health and well-being in this population. Therefore, the **PURPOSE** of this study was to examine relationships among SRPA (Community Healthy Activities Model Program for Seniors questionnaire), objectively measured physical activity (Actical accelerometer), and measures of quality of life and mental health, including satisfaction with life (Satisfaction with Life Scale, SWLS), geriatric depressive symptoms (Geriatric Depression Scale: GDS), and cognitive function (Addenbrooke's Cognitive Examination-Revised, ACER) in older adults. We hypothesized that OMPA would be more strongly correlated with these variables of mental health and well-being than SRPA. **METHODS:** Here we report preliminary data from forty-eight older adults (age: 78 ± 8 years, BMI: 27 ± 4 kg·m⁻²) who have successfully completed 7-days of objective physical activity monitoring using Actical accelerometers (Phillips Respironics, Bend, Oregon). All subjects have additionally completed the CHAMPS questionnaire with guidance from study personnel. To examine relationships among SRPA, OMPA, SWLS, GDS, and ACER, partial correlations were conducted while controlling for age and sex. Statistical significance was set to $p < 0.05$. **RESULTS:**

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 (-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.

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 (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 assessed 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 $I^2=6\%$, $X^2=7.43$ $df=7$, $p=0.39$ and $I^2=39\%$, $X^2=9.90$ $df=6$, $p=0.13$. 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. In further research, other facets of mental health could also be considered to further understand how 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

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 (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 ($r=.299$, $p<.001$), as well as PSD and WB ($r=.519$, $p<.001$), but there was no significant correlation between PA and WB ($r=.139$, $p>.05$). 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, $p<.526$. However, there was a significant main effect for PSD and WB ($p<.001$), indicating that students with a stronger perception of their physical selves 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

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 (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 high-risk subjects were directed to a targeted ED prevention program. 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 ($p=.004$) and greater sleep problems ($p=.045$) compared to non-minority students (e.g., European Americans). A preliminary analysis of Year 3 ($n=95$) 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 core 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/retirement 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

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 (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: RET significantly reduced anxiety symptoms by a mean effect delta (Δ) of 0.38 (95%CI: 0.22-0.54; $z=4.61$; $p<0.001$). Significant heterogeneity was not indicated ($Q_1(28)=36.80$, $p>0.12$; $I^2=26.6\%$, 95%CI: 7.30%-41.91%). Anxiety reductions were significantly moderated by whether or not the trial primary outcome was anxiety ($\beta=0.42$, $p\leq 0.01$). 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; $k=11$; $z=2.57$, $p\leq 0.01$). 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 ≥ 12 weeks ($\Delta=0.51$), and for moderate-to-vigorous intensities ($\Delta=0.46$).

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

1651 Board #326 June 1 8:00 AM - 9:30 AM
The Synergistic Effects Of Exercise In Combination With Other Antidepressant Therapies.

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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; secondly, 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 non-exercise group. 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.

1652 Board #327 June 1 8:00 AM - 9:30 AM
Physical Activity Levels and Psychological Well-being/ Ill-being in Costa Rican College Students

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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 Rican 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 profiler, STAI and BDI-II) as well as the short form of the IPAQ. Students were categorized into low, moderate or high physical activity levels following the IPAQ 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 ($p = 0.01$). Students in 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

1653 Board #328 June 1 8:00 AM - 9:30 AM
Relationship Between Time Spent Sedentary and Psychological Distress in Middle-Aged and Older Adults

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 (No relationships reported)

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 ($n = 72,867$) 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.

1654 Board #329 June 1 8:00 AM - 9:30 AM
Endocannabinoid Responses Following an Aerobic Exercise Session in Individuals with and without Post-Traumatic Stress Disorder

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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-arachidonylglycerol, 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 ± 6 yrs) participated in this study. Participants engaged in an aerobic exercise session in which they walked or ran on a treadmill for 30 minutes

at a moderate-intensity (70-75% MHR; 12-15 RPE). Blood draws were performed before and after exercise in order to quantify circulating concentrations of eCBs. Data were analyzed using 2 (group: PTSD, control) x 2 (time: pre-, post-exercise) repeated measures ANOVAs and Cohen's d effect size calculations. **RESULTS:** There were no significant ($p > 0.05$) differences between groups in RPE, HR, treadmill speed or incline throughout the exercise session. AEA, 2-AG, and OEA were found to increase significantly ($p < 0.05$) in both groups following exercise, while PEA did not change ($p > 0.05$) following exercise. Effect size calculations indicated the healthy controls vs. adults with PTSD experienced a greater magnitude of change for AEA (controls = 1.21; PTSD = 0.45), 2-AG (controls = 0.43; PTSD = 0.21) and OEA (controls = 0.70; PTSD = 0.46). **CONCLUSION:** These findings suggest that the eCB system is activated in adults with PTSD following moderate-intensity aerobic exercise. However, further research examining the eCB system is warranted as the magnitude of change for eCBs and related biogenic lipids was greater among healthy controls compared to individuals with PTSD.

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1655 Board #330 June 1 8:00 AM - 9:30 AM
Mental Health, Cardiorespiratory Fitness And Brain Volumes: Cross-sectional And Longitudinal Results From The Hunt-MRI Study

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 (No relationships reported)

PURPOSE: To explore whether cross-sectional and longitudinal mental health measures predict brain volumes in a general population, and whether there is an interaction effect between mental health and estimated cardiorespiratory fitness (eCRF) on brain volumes.

METHODS: 754 participants (52% women, mean age 59 yr) from the Nord-Trøndelag Health Study HUNT MRI cohort, who had also participated in HUNT 2 (1995-97), were included. Mental health was assessed using the Hospital Anxiety and Depression Scale (HADS). HADS-A (anxiety), HADS-D (depression), and HADS-T (total) were used in the analyses. Changes in HADS scores from HUNT 2 to HUNT 3 were stratified based on changes of 1 standard deviation into 3 groups: increased, decreased, and stable symptoms. eCRF was estimated based on self-reported physical activity, sex, age, waist circumference, and resting heart rate. Brain MRI was performed using a 1.5 T GE Signa HDx 1.5 T MRI scanner, and the T1 weighted 3D scan (ADNI volume) was used. Brain parenchymal fraction (BPF), bilateral hippocampus and amygdala volumes were obtained in FreeSurfer V5.3.0. A generalized linear model with gamma distribution was used to assess main effects of HADS, change in HADS, and interaction effects of HADS and eCRF, on BPF (adjusted for age and sex), bilateral hippocampus and amygdala volumes (adjusted for age, sex, and intracranial volume).

RESULTS: HADS-D, HADS-A, and HADS-T scores at HUNT 3 significantly predicted BPF ($p < .05$), showing smaller BPF with higher HADS scores. In addition, change in HADS-D, HADS-A, and HADS-T significantly predicted BPF ($p < .05$), with smaller BPF in the increased group when compared to the stable group. Change in HADS-A and HADS-T significantly predicted amygdala volume ($p < .05$), with smallest volume in the increased group when compared to the stable group. Finally, change in HADS-T significantly predicted hippocampus volume ($p < .05$), with smaller volume in the increased and decreased group when compared to the stable group. There were no significant effects of HADS score at HUNT 2 on brain volumes, nor was there any significant interaction between HADS and eCRF on brain volumes. **CONCLUSION:** Cross-sectional HADS and changes in HADS from middle-age into early old age have important implications for brain volumes, but eCRF was not found to moderate this relationship.

1656 Board #331 June 1 8:00 AM - 9:30 AM
Psychological Responses to Standard Care and Exercise in Individuals with Substance Use Disorders

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 (No relationships reported)

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 (SUD) 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, psychophysical 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.

1657 Board #332 June 1 8:00 AM - 9:30 AM
The Relation Between Personality and Physical Activity in Older Adults Living in a Retirement Community

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 (No relationships reported)

The relation between personality traits and physical activity (PA) is well researched in younger populations; however, most studies on personality and PA have relied on self-report measures. There is also a lack of evidence for the association between personality and PA specifically in older adults. **PURPOSE:** This study examined the relation between Five Factor Model personality traits and objective measures of PA in older adults. **METHODS:** Sixty-nine participants (80.2 ± 7.1 yrs; BMI: 27.5 ± 5.0 kg/m²) wore the ActiGraph ActiSleep monitor for 7 days and completed the NEO Personality Inventory-3 First Half. ActiGraph data were analyzed using Freedson Adult (1998) cut points. Each participant's average 15-hour daily moderate-to-vigorous physical activity (MVPA) and average daily steps were determined from all valid days. Partial correlations were used to examine the relation between PA measures and personality, controlling for age, gender, and number of days the activity monitor was worn. Significance was accepted at $p \leq 0.05$. **RESULTS:** Seventy-five percent of participants were female. Mean MVPA was 113.3 ± 64.9 min/day and average step counts were 8832 ± 2917 steps/day. Extraversion, Agreeableness, and Conscientiousness were associated with more MVPA ($r_s = .35, .36, \text{ and } .28$, respectively) and more steps per day ($r_s = .25, .36, \text{ and } .24$); Neuroticism was associated with fewer steps ($r = -.26$). **CONCLUSION:** These findings are consistent with self-report evidence that personality traits are associated with PA levels in older adults.

C-49 Free Communication/Poster - Physical Activity Assessment in Youth

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

1658 Board #333 June 1 8:00 AM - 9:30 AM
Comparison of Self-Reported Physical Activity with Objectively Measured Physical Activity in Undergraduate Students

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 (No relationships reported)

The short-form of the International Physical Activity Questionnaire (IPAQ) is widely used to assess physical activity (PA), however, research suggests the validity of the IPAQ is inconsistent across studies.

PURPOSE: To investigate differences between estimates of sedentary behavior and PA from the IPAQ and accelerometry in undergraduate students.

METHODS: 56 students (mean \pm SD: age 20.6 ± 1.4 y; BMI 24.4 ± 3.6 kg/m²; and VO_{2peak} 45.7 ± 7.7 mL/kg/min) participated in the study. Step counts and time spent in sedentary behavior, light, moderate, and vigorous PA were measured by an Actigraph GT3X+ for 7 days during waking hours. Following accelerometer wear, students self-reported their time spent sitting and in PA with the IPAQ. Partial correlations were used to assess associations among time spent sitting and in PA between the IPAQ and accelerometer while controlling for age, sex, and accelerometer wear time. The agreement between methods was assessed via Bland-Altman plots using 95% limits of agreement. The ability of the IPAQ to correctly classify students as meeting the PA guidelines was analyzed with McNemar's test.

RESULTS: IPAQ sitting time was associated with accelerometer sedentary time ($r=0.38$, $p<0.01$). IPAQ walking time was associated with accelerometer light PA ($r=0.33$, $p=0.02$) but not step counts ($r=0.20$, $p=0.16$). Although IPAQ moderate ($r=0.34$, $p=0.02$) and vigorous PA ($r=0.47$, $p<0.01$) were associated with accelerometer values, minutes spent in moderate-to-vigorous PA were underestimated by the IPAQ (409.1 ± 50.1 vs. 520.4 ± 29.6 min/week, respectively). Bland-Altman plots revealed acceptable agreement between methods. However, bias was evident for all PA intensities, with students tending to under-report moderate and over-report vigorous PA. Proportional bias existed for vigorous PA, indicating as the amount of vigorous PA increased, so did the error between methods. The IPAQ indicated that 71% of participants met PA guidelines compared with 55% for the accelerometer ($p=0.09$).

CONCLUSIONS: Researchers should exercise caution when interpreting PA assessed via the IPAQ in undergraduate students. Although correlations appear acceptable, significant bias may be present. However, the IPAQ may be a viable tool for assessing whether students meet current PA guidelines.
Funded by NIH 1U54GM104944

1659 Board #334 June 1 8:00 AM - 9:30 AM

Examining Fifth-Grade In-School Physical Activity Patterns: How Many Days of Monitoring Are Needed?

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(No relationships reported)

PURPOSE: The purpose of the study was to determine the minimum number of days necessary to estimate mean physical activity levels, as both moderate-to-vigorous physical activity (MVPA) and steps per day, in fifth-grade students using objective physical activity monitors across two semesters. **METHODS:** Activity patterns were assessed during two school semesters, spring ($N = 82$ boys & 84 girls) and fall ($N = 89$ boys & 91 girls), from 10-12 year old fifth-grade students in four Midwestern elementary schools. Data was collected using wrist worn activity trackers. The devices were administered by teachers at the start of each school day and collected at the end of each school day for two consecutive weeks. Monitors measured MVPA and steps per day. Demographic and anthropometric data were also recorded (age, height, weight). All data was uploaded to the monitor's manufacturer website and then collected by the researchers. Steps and MVPA were examined, individually, with Cronbach's alpha to determine how many days of measurement were needed to assess mean activity patterns. **RESULTS:** The reliability analysis suggested that at least four days of measurement were needed to achieve an alpha of 0.80 for both steps ($\alpha = 0.825$, 95% CI [0.777-0.865]) and MVPA ($\alpha = 0.839$, 95% CI [0.795-0.87]) during spring collection. During the fall semester, at least four days were also necessary to achieve a reliability of 0.80 in steps ($\alpha = 0.803$, 95% CI [0.751-0.846]) and MVPA ($\alpha = 0.811$, 95% CI [0.761-0.852]). However, fall five-day activity patterns did exhibit greater variability than four-day activity patterns in both steps ($\alpha = 0.784$, 95% CI [0.730-0.830]) and MVPA ($\alpha = 0.794$, 95% CI [0.742-0.838]). **CONCLUSIONS:** These results indicate that four-day activity monitoring protocols most accurately estimate the mean in-school physical activity patterns, steps and MVPA, in fifth grades students. It should be noted that the results indicate consistency was not improved by a fifth day of measurement in steps and MVPA during a five-day collection period.

1660 Board #335 June 1 8:00 AM - 9:30 AM

Accuracy of Smartwatches in Assessing College Students' Energy Expenditure in Exercise with Different Intensities

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PURPOSE: Despite the recent prevalence of health wearable devices (e.g., smartwatches), the validity and reliability of smartwatches' physiological outcomes remain largely unexplored. This study was designed to examine the accuracy of the Microsoft Band (MS), Fitbit Surge HR (FB), TomTom Cardio Watch (TT) and Apple Watch (AW) in assessing energy expenditure (EE) during three exercise sessions with different intensities.

METHODS: Participants were 25 college students (12 males; $M_{age} = 23.52$, $SD = \pm 1.04$) from Southcenter region in China. They completed three separate 10-minute exercise sessions at light physical activity (LPA, walking at 3.0 km/h), moderate PA (MPA, running at 5.0 km/h), and vigorous PA (VPA, running at 7.0 km/h) conditions on the Hpcosmos treadmill at a highly controlled laboratory. In this study, the AW and TT were placed on the right wrist while the FB and MS were worn on the left wrist. All demographic information (i.e., height, weight, age, gender) was loaded onto each smartwatch prior to testing. EEs of smartwatches were then validated against EE data from a Actigraph wGT3X accelerometer worn on the right side of waist.

RESULTS: ANOVAs with repeated measures revealed significant differences between smartwatches for EE, $F(9, 16)=45.73$, $p<0.01$, $\eta^2=0.98$. When validated against accelerometer, post-hoc comparisons suggested significantly different EE assessments for the FB at LPA and MPA conditions ($p<0.01$), and for MS and FB at the VPA ($p<0.01$). Interclass correlations between the accelerometer and smartwatches revealed reliability for EE for the TT at LPA ($r=0.65$, $p<0.01$), for the FB, TT and AW at MPA ($r=0.53-0.59$, $p<0.01$), and for MS, FB and TT at VPA ($r=0.59-0.65$, $p<0.01$). However, only the TT demonstrated excellent agreement with the accelerometer at LPA with coefficient of variation of 2.0%. Additionally, Bland-Altman plots yielded satisfactory precision/no bias for FB and TT measurements against the accelerometers at all conditions ($p<0.05$), for MS at LPA and VPA ($p<0.05$), and for AW at VPA ($p<0.05$).

CONCLUSIONS: Findings suggested EE measurements of smartwatches are far from ideal in terms of validity and reliability. In this study the most valid and reliable measurements were from the TT. Future study may investigate the validity and reliability of smartwatch measurements in everyday life.

1661 Board #336 June 1 8:00 AM - 9:30 AM

Relationships of Objectively Measured Parent-Child Physical Activity and Sedentary Behavior in Toddlers

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(No relationships reported)

Parents play an important role in shaping their children's lifestyle behaviors, particularly in early childhood. However, there is a lack of evidence about whether there are associations between parents' and toddlers' objectively measured physical activity (PA) and sedentary behavior (SB). **PURPOSE:** To determine the relationships between parent-child PA and SB. **METHODS:** This study was a cross-sectional study of 24 toddlers (2.2 ± 0.5 yrs; 12 boys and 12 girls) and their mothers (33.4 ± 4.5 yrs) and fathers (34.7 ± 6.2 yrs) in Kyoto, Japan. All participants wore an accelerometer on their waist for seven days except for during water activities and while sleeping (including naps). We measured toddlers' PA and SB as well as parents' SB, light intensity physical activity (LPA), and moderate-to-vigorous intensity physical activity (MVPA), and calculated the proportions of the total accelerometer wear time for each (%PA, %SB, %LPA, and %MVPA). Partial correlations that adjusted for toddlers' sex, age, childcare situation, mothers' work situation, and household income were used to analyze the associations between toddlers' and parents' physical activity variables. **RESULTS:** Toddlers' %PA was moderately associated with mothers' %SB ($r = -0.58$, $p = 0.009$), %LPA ($r = 0.55$, $p = 0.014$) and %MVPA ($r = 0.51$, $p = 0.026$) on weekdays, as well as with mothers' %SB ($r = -0.54$, $p = 0.017$) and %LPA ($r = 0.55$, $p = 0.014$) on weekends. However, no significant associations were observed between toddlers' %PA and fathers' %SB ($r = -0.12$), %LPA ($r = 0.04$) and %MVPA ($r = 0.25$, $p = 0.293$) on weekdays, as well as with fathers' %SB ($r = -0.05$), %LPA ($r = 0.13$), %MVPA ($r = -0.24$, $p = 0.323$) and mothers' %MVPA ($r = 0.01$) on weekends. **CONCLUSION:** These results suggest that mothers' PA and SB, but not fathers', correlates with their children's PA in early childhood. Supported by JSPS KAKENHI Grant Number 15K21576.

1662 Board #337 June 1 8:00 AM - 9:30 AM

Accuracy of Accelerometer-based Activity Energy Expenditure Prediction Equations for Children ages 3 to 6 years

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(No relationships reported)

Accelerometers have been widely used to measure activity energy expenditure (AEE) in free-living environments for young children. However, little research has examined the accuracy of accelerometer-based AEE prediction equations in preschool age children.

Purpose: To compare the estimates of AEE from accelerometer-based prediction equations with AEE measured by indirect calorimetry in 3-6-year-old children.

Methods: A total of 28 preschool age children (Female: 46%, Age: 4.6 ± 1.0 yrs, BMI: 16.4 ± 1.5 kg/m²) wore a portable indirect calorimetry, Oxycon Mobile (OM), and an

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 measures from OM were averaged into minute-by-minute VO_2 ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) and AEE ($\text{kcal}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$). 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 AEE and VO_2 measures from OM using Pearson correlations, dependent t-tests and mean absolute percent error (MAPE).

Results: Overall, the estimates of AEE and VO_2 from accelerometer-based equations were highly correlated with those from OM (VO_2 : $r = 0.78, p < .05$, AEE: $r = 0.80, p < .05$). When compared with measures from OM, the PT and PY equations significantly underestimated VO_2 (mean difference (MD) = $-1.93 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}, p < .05$) and AEE (MD = $-0.04 \text{ kcal}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}, p < .05$) 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 : $r = 0.54, p < .05$, AEE: $r = 0.58, p < .05$). The PT and PY equations underestimated VO_2 (MD = $-4.75 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}, p < .05$) and AEE (MD = $-0.07 \text{ kcal}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}, p < .05$) for MVPA respectively.

Conclusions: Relatively high correlations support the validity of accelerometer-based AEE prediction equations. However, researchers should be aware that accelerometer based prediction equations may underestimate AEE and VO_2 , especially for MVPA in 3-6-year-old children.

1663 Board #338 June 1 8:00 AM - 9:30 AM

Estimating Physical Activity Intensity in Youth With Accelerometers: A Flexible Suite of Tools

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(No relationships reported)

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 Sojourn 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 the different pairings of attachment sites and device outputs using indirect calorimetry as the criterion measure. The ANNs were invoked and combined with decision trees and bout-identification code (adapted from the Sojourn method) to generate estimates of PA intensity. An independent validation in free-living was then 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% ($\kappa = 0.39$) for the hip and 59.5% ($\kappa = 0.28$) 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: 64.0%; Wrist RA: 53.9%). Results for the free-living validation are shown 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.

| Method | % Accuracy | Kappa | Sensitivity | Specificity | |
|----------|------------|-------|-------------|-------------|------|
| Hip AC | 71.70% | 0.44 | Sedentary | 0.75 | 0.95 |
| | | | Light | 0.49 | 0.80 |
| | | | MVPA | 0.78 | 0.75 |
| Wrist AC | 65.10% | 0.32 | Sedentary | 0.67 | 0.90 |
| | | | Light | 0.28 | 0.84 |
| | | | MVPA | 0.81 | 0.62 |
| Hip RA | 64.00% | 0.34 | Sedentary | 0.72 | 0.87 |
| | | | Light | 0.36 | 0.81 |
| | | | MVPA | 0.75 | 0.71 |
| Wrist RA | 53.90% | 0.24 | Sedentary | 0.50 | 0.93 |
| | | | Light | 0.58 | 0.57 |
| | | | MVPA | 0.53 | 0.78 |

1664 Board #339 June 1 8:00 AM - 9:30 AM

Not All Physical Activity Guidelines Are Created Equal: A Comparison Of Compliance In Preschool Children

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(No relationships reported)

Insufficient physical activity (PA) is one factor that has been shown to contribute to overweight and obesity. Increasing PA has been advised as a strategy for the treatment and prevention of obesity. Multiple PA recommendations have been established for preschool-age children. These recommendations are highly variable and differ in intensity and duration. Within the last few years, new guidelines have been issued from independent expert panels in the United States, Australia, and United Kingdom: Guideline A) $\geq 15 \text{ min/hr}$ of total PA (TPA) every day and Guideline B) $\geq 180 \text{ min/day}$ (or $\geq 3 \text{ hr/day}$) of TPA every day. **PURPOSE:** The purpose of this study was to compare compliance between Guidelines A and B in a cross-sectional sample of preschool children. **METHODS:** PA was assessed for 7 days in 241 preschool-age children via accelerometer (ActiGraph GT3X+). A total of 197 children (4±1 yrs.; 100 boys, 97 girls) met PA wear time standards and were utilized for data analysis using age appropriate cut-points. The main outcome of interest was TPA (sum of light, moderate, and vigorous intensity PA). TPA was used to determine the number of subjects meeting Guidelines A and B. Differences in the frequency of preschool children meeting Guidelines A and B were compared via chi-square with statistical significance set at $p \leq 0.05$. Data are presented as mean \pm SD. **RESULTS:** Descriptive characteristics of the subjects are as follows; height: $103.69 \pm 6.54 \text{ cm}$, weight: $17.27 \pm 2.68 \text{ kg}$, BMI percentile: 57.25 ± 27.65 . Mean TPA was $11.76 \pm 2.84 \text{ min/hr}$ and $164.5 \pm 39.79 \text{ min/day}$. A greater number of children met Guideline B ($n=71$; 36%) than Guideline A ($n=23$; 11%), $p < 0.001$. None of the subjects met Guideline A during all waking hours every day. On average, subjects met Guideline A 4 hr/day. Only $n=10$; 5% of subjects met Guideline B every day. **CONCLUSION:** There is a high degree of variability between the frequency of subjects meeting Guidelines A and B. Considering that on average, subjects met Guideline A only 4 hours/day showcases that children are engaging in long bouts of activity as well as long bouts of sedentary time throughout the day. A majority of children are not meeting these new guidelines and further efforts aimed at increasing PA among preschool-age children should focus on breaking-up long sedentary bouts with activity.

1665 Board #340 June 1 8:00 AM - 9:30 AM

International Physical Activity Questionnaire (IPAQ-SF) for Chinese College Students: A Validation Study

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(No relationships reported)

Purpose: To validate the International Physical Activity Questionnaire-Short Form (IPAQ-SF) for Chinese college students using health-related fitness tests. **Methods:** 2513 (1698 males & 815 females; Aged $18.8 \pm 0.8 \text{ yr}$; Height = $170.1 \pm 7.8 \text{ cm}$; Weight = $63.1 \pm 11.3 \text{ kg}$; 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 male students, 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:

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

| | Total-METs | Vigorous-METs | Moderate-METs | Walking-METs | BMI | VC | Step Test | SLJ | Pull ups | Sit ups | 50-M dash(s) | 800-M (s) | 1000-M (s) |
|------|------------|---------------|---------------|--------------|------|--------|-----------|-------|----------|---------|--------------|-----------|------------|
| Mean | 1407.0 | 627.2 | 566.8 | 213.0 | 21.6 | 3727.4 | 217.5 | 217.5 | 10.3 | 45.4 | 7.4 | 240.8 | 242.4 |
| SD | 807.2 | 571.2 | 422.3 | 269.0 | 2.7 | 815.6 | 32.3 | 32.3 | 7.4 | 7.1 | 0.8 | 24.1 | 23.7 |

| | BMI | VC | Step test | SLJ | Pull-ups | 50-M dash | 800-M | 1000-M |
|---------------|--------|--------|-----------|--------|----------|-----------|---------|--------|
| Vigorous-METs | .239** | .294** | -.258** | .247** | .043** | 0.017 | -.258** | -.091* |
| Moderate-METs | .121** | .185** | .096** | .081** | 0.023 | 0.023 | -.108** | 0.035 |
| Walking-METs | .113** | .122** | 0.036 | 0.014 | -0.028 | -0.02 | -.045** | 0.022 |
| Total-METs | .270** | .346** | .245** | .228** | .033* | 0.023 | -.254** | -0.033 |

* $p < 0.05$, ** $p < 0.01$

Conclusion: Consistent 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.

THURSDAY, JUNE 1, 2017

1666 Board #341 June 1 8:00 AM - 9:30 AM

Effect of Wearing a Portable Metabolic Unit on Children's Physical Activity Level and Enjoyment

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(No relationships reported)

Researchers use portable metabolic units (PMUs) to assess the physical expenditure of children in free-living settings, with the assumption that physical activity level and participation are not affected due to the PMU's light weight and small size. However, any effect would potentially impact research on energy expenditure, monitor validation, or activity enjoyment or prescription. **PURPOSE:** The purpose of this study was to assess differences in accelerometer-derived activity level and enjoyment while wearing a PMU versus not wearing the PMU during a variety of common children's games (e.g., tag).

METHODS: Youth (N=26; 8-12 y; 15 males, 8 overweight) played a combination of 29 games (mean 4.8 min each) while 1) wearing and 2) not wearing a PMU. During both conditions, children wore a triaxial accelerometer on their right hip to determine total vertical axis counts and counts/min, steps, and vector magnitude counts. After every game, participants responded to questions about their enjoyment on a 9-item facial affective scale. Because children participated in different numbers of games, each child's data for each condition were averaged across all games played. Paired t-tests determined if activity level and enjoyment were different while wearing the PMU.

RESULTS: The PMU weighed 1.2-1.3 kg depending on whether the small or large backpack size was worn. The average relative weight of the PMU was 3.5% of the participant's weight. When comparing wearing the PMU to not wearing the PMU, enjoyment (7.2 ± 1.7 vs. 7.4 ± 1.5 ; $p=0.369$), counts (14124 ± 3527 vs. 14911 ± 3902 ; $p=0.329$), counts/min (2932 ± 749 vs. 3107 ± 843 , $p=0.311$), steps (295 ± 70 vs. 302 ± 71 , $p=0.526$), and vector magnitude (23309 ± 4318 vs. 24188 ± 4949 , $p=0.371$) were lower, but not significantly different.

CONCLUSIONS: In this sample, wearing the PMU did not affect accelerometer-derived activity level or enjoyment, but more research is justified because of the small sample size. Additionally, future research should examine if the effect of the PMU varies by physical activity intensity. Different age groups should also be explored, since the effect may be more noticeable in younger populations, for which the relative weight of the PMU is greater.

1667 Board #342 June 1 8:00 AM - 9:30 AM

Comparison Of Hip And Wrist Accelerometers In Pre-adolescents During Free-living And Semi-structured Physical Activity

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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 (Crouter 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 or not meeting PA guidelines. **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 accelerometry data. **RESULTS:** For aim 1, compared to D.O., the wrist-worn accelerometer was inaccurate in measuring time spent in light PA (D.O. = 44.77 ± 6.82 ; wrist = 5.27 ± 4.98), vigorous PA (D.O. = 0.50 ± 1.01 ; wrist = 27.65 ± 22.87) and MVPA (D.O. = 6.59 ± 5.34 ; wrist = 44.14 ± 7.57). The hip-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 ± 6.82 ; hip = 30.23 ± 5.47), vigorous PA (D.O. = 0.50 ± 1.01 ; hip = 4.05 ± 3.56) and total PA (D.O. = 51.36 ± 2.19 ; hip = 40.46 ± 8.25). For aim 2, there was no location differences for meeting PA guidelines for 1-2 days. However, there was a significant difference for 3-4 days (OR = 7.01) and ≥ 5 days (OR = 7.01). **CONCLUSION:** Both the hip and wrist-worn accelerometer algorithms provided poor classification accuracy for PA during dance class. Relative to the hip-worn accelerometer, the wrist-worn accelerometer was more likely to classify girls as meeting guidelines for PA. Future research should move away from cut-point methods and use pattern recognition algorithms that leverage the rich data available in the acceleration signal.

ACSM May 30 – June 3, 2017

1668 Board #343 June 1 8:00 AM - 9:30 AM

Comparison Of Accelerometer And Pedometer Measured Physical Activity In Rural Elementary Schools.

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(No relationships reported)

Schools are an ideal setting for physical activity (PA) promotion efforts. Objective methods to monitor moderate-to-vigorous PA (MVPA) have emphasized accelerometers, which can be cost prohibitive. To monitor the success of promotion efforts, schools need access to low-cost, valid and reliable tools. Using pedometers to count accumulated steps above 120 steps/min has been suggested as an alternative MVPA measure.

PURPOSE: To determine if using the 120 steps/min threshold with pedometers to measure children's MVPA at school provides equivalent MVPA estimates compared to research-grade accelerometers.

METHODS: Children (n=316, 52.8% boys) from six rural elementary schools (grades 1, 3, and 5) had their PA monitored at school over 4 consecutive days. Two PA monitors were placed on an elastic belt and positioned over each child's right hip. Pedometer data were downloaded daily and accelerometer data were processed using the Evenson cutpoints in 15 s epochs. MVPA estimates from the monitors were compared with: 1) t-tests, 2) Pearson correlations, and 3) Bland-Altman plots.

RESULTS: Pedometers measured ($M \pm SD$) 17.5 ± 6.4 min of MVPA during the school day, while accelerometers measured 24.0 ± 9.0 min of MVPA ($p < 0.001$; Table 1). The correlation between pedometer- and accelerometer-determined MVPA was 0.64. Correlations for boys and girls were 0.63 and 0.67, respectively. Grade-level correlations ranged from 0.54 to 0.66. Bland-Altman plots indicated the limits of agreement ranged from -7.4 to 23.5 min of MVPA.

CONCLUSION: Although pedometer-determined MVPA was moderately 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

| Variables | Pedometer | Accelerometer |
|-----------------|-----------------|----------------|
| Sex | | |
| Boys | 18.3 \pm 6.9* | 26.7 \pm 9.5 |
| Girls | 16.6 \pm 5.6* | 20.9 \pm 7.2 |
| Grade | | |
| 1 st | 17.8 \pm 5.8* | 24.6 \pm 9.2 |
| 3 rd | 19.7 \pm 5.9* | 26.6 \pm 8.2 |
| 5 th | 15.1 \pm 6.6* | 20.9 \pm 8.6 |

Note. Values presented as $M \pm SD$. * $p < 0.001$.

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1669 Board #344 June 1 8:00 AM - 9:30 AM

Intensity of Commonly Reported Classroom-Based Physical Activity Opportunities in Public Schools

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PURPOSE: The purpose of this study was to examine and determine the intensity levels of classroom-based physical activity (CBPA) opportunities offered in public school classrooms. **METHODS:** Colorado schools (N = 101) in school districts (N = 25) receiving funding from the Kaiser Permanente Thriving Schools initiative reported CBPA opportunities using an online data collection tool over a two-year period (2014-2016). Using a randomized stratified sampling technique, 20-30% of pre-kindergarten through 12th grade teachers in each school were selected each week to report CBPA. Data collected included the type of CBPA opportunity offered, the number of students in the classroom, and the students' grade level. These responses resulted in N = 18,445 possible CBPA opportunities, which were cleaned to exclude responses indicating that no CBPA could take place (e.g., snow day) for a total of N = 18,210 usable responses. A researcher qualitatively determined the intensity of CBPA opportunities using the 2011 Compendium of Physical Activities as a guideline; two additional researchers confirmed the coded categories. A descriptive analysis of CBPA opportunities was conducted to describe the proportion of opportunities whose intensity levels were light (LPA), moderate (MPA), vigorous (VPA), sedentary (SED), and those of

Denver, Colorado

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 CBPA intensity offered by grade level. **RESULTS:** Most CBPA 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 CBPA 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 CBPA 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 CBPA opportunities offered in public schools.

1670 Board #345 June 1 8:00 AM - 9:30 AM
The Impact Of Epoch Length On Intensity Of Physical Activity Among Fourth Grade Children

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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 PA (LPA), and MVPA across different published CP for elementary school children.

Methods: Participants were 265 4th graders ($M_{age} = 9.4$ 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, Mattocks, Puyau, Pulsford) classified PA intensity. One-way, RM ANOVAs explored 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 within all CP ($p < .001$), except Puyau between 15s and 60s ($p = 1.0$; $d < .01$ 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 ($p = .41$; $d = .01$ to $d = 1.13$). For MVPA, *post hoc* Bonferroni tests showed that all epoch lengths differed from each other ($p < .001$; $d = .09$ to $d = 1.17$). Longer epoch length was associated with less time in sedentary and more time in LPA for all CP. Longer epoch length 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 public health and policy decisions, future research should use a criterion reference to determine which epoch length and CP combination provides the most accurate representation.

1671 Board #346 June 1 8:00 AM - 9:30 AM
Validity of a Sedentary Behavior Guideline for Youth

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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 are 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 guideline, 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, $F(1, 427) = 4.14, p = .043$. Recreational SB, however, was not related to VO₂max and BMI, $F(1, 427) = 1.62, p = .20$ and $F(1, 427) = 0.67, p = .413$, 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.

1672 Board #347 June 1 8:00 AM - 9:30 AM
Testing of a Novel Direct Observation Method for Children's Free Play Activity

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 (No relationships reported)

PURPOSE: Direct Observation (DO) has been used as a criterion measure of children's physical activity (PA) since the early 1990's. A limitation of these DO systems include researchers instantaneously recording only the highest activity level performed in a given time interval. Therefore, the purpose of this study is to compare the estimates of time spent in activity intensity categories using a novel video recorded DO methodology, compared to accelerometer data.

METHODS: Children ages 6-10 years old participated in a simulated free play session. Toys, equipment, and a sibling or friend were available to facilitate a full range of activity intensities; sedentary (SED), light (LPA), moderate (MPA), and vigorous (VPA) for 30 minutes. Participants wore an ActiGraph GT3X+ (AG) over their right hip (AG-H) and non-dominant wrist (AG-W). The sessions were recorded with a GoPro™ video camera and, using Noldus™ behavioral observation software, an activity intensity category was assigned each time the child changed their activity. Two observers independently coded every 30-minute session. The percent of time spent in each PA category (calculated from the Noldus software) was compared between AG and DO using Spearman-Rank Correlations and Wilcoxon Rank-Sum Tests.

RESULTS: Twelve children completed this study (8.9±1.2 yrs; 33% female). DO and AG-H were moderately correlated for all intensity categories ($r=0.32$ to 0.7), except for MPA ($r=0.15$). Mean values of percent of time spent in activity intensity categories were similar between DO and AG-H ($p = 0.11$ to 0.83), except for MPA (DO 12%±5%, AG-H 18%±8%, $p=0.02$). DO and AG-W showed weak or negative associates for all intensity categories ($r=-0.6$ to 0.09). The AG-W underestimated percent of time spent in SED, LPA, and MPA ($p<0.001$ for all) but overestimated VPA (DO 13%±5%, AG-W 81%±10%, $p=0.0001$), compared to DO.

CONCLUSIONS: Based on these results, the novel DO system tested here is promising but needs to be further refined to better distinguish moderate intensity activities from light or vigorous movement. Caution is warranted when interpreting wrist accelerometer data from free-living children.

C-50 Free Communication/Poster - Sports Biomechanics

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

1673 Board #348 June 1 9:00 AM - 10:30 AM
Rotational Head Acceleration of Thrown Person with Break-fall skills by Judo Throwing Techniques

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PURPOSE: Although the judo is an official Olympic event that played worldwide, serious head injuries, especially acute subdural hematomas (ASDHs) have occasionally occurred during judo competition or practice in Japan. Rotational head acceleration (RHA) at the head impact is considered as a major factor influencing the mechanisms for head injuries. On the other hand, the break-fall technique called "ukemi" has been developed in judo to prevent head collision against the judo-floor (mat) and to minimize its damages. However, the RHA-decreasing effect of ukemi on thrown

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 anthropomorphic test device (ATD) experiment without ukemi.

METHODS: One male judo expert (thrower) repeatedly threw another male judo expert (faller) for 4 times with Osoto-gari (Osoto) and with Ouchi-gari (Ouchi) techniques respectively, because most ASDHs in judo have occurred with these two throwing techniques. The faller took ukemi adequately without head collision against mat in all trials. A 3-axis angular rate sensor was mounted on the center of the faller's forehead and the angular velocities of the head were measured. In order to evaluate the magnitude of faller's impact of the head, we calculated the RHA from the angular velocities. Kinematic data of the faller's head were also recorded during trials using digital video cameras. The RHAs of ATD thrown by the same judo expert were obtained from our previous study (Murayama et al., 2013).

RESULTS: Kinematic data showed that the faller fell backwards without any head collisions against the mat in both throwing techniques. In all trials, a large acceleration appeared at the body contact phase to the mat. The peak resultant RHAs of faller (Osoto, 740.7 ± 139.2 rad/s²; Ouchi, 581.5 ± 69.5 rad/s²) were significantly lower than those observed in ATD (Osoto, $4,572.6 \pm 357.4$ rad/s²; Ouchi, 2176.0 ± 826.6 rad/s², $p < 0.05$ in both techniques).

CONCLUSIONS: These results suggested that an acquisition of adequate ukemi technique could substantially reduce the RHA on head impact and the risk of severe head injuries in judo.

1674 Board #349 June 1 9:00 AM - 10:30 AM
Influence Of Proprioceptive Intervention On Joint Configuration During Sprint Starts In Elite Collegiate Sprinters

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 (No relationships reported)

Purpose: An effective block clearance (BC) is crucial to the success of competitive sprinters. To have success a sprinter must exert an impulse to change his/her momentum while also staying low to the ground, in order to maximize the amount of forward force. The purpose of this experiment was to investigate the influence of proprioceptive priming on the kinetics and kinematics of the sprint start. **Methods:** Three female (age: 20yrs±1.73, height: 1.64m±.07, weight: 58.78kg±9.11) and three male collegiate sprinters (age: 23yrs±3.464, height: 1.84m±.08, weight: 75.3kg±4.46) participated in the study. Participants performed two baseline (BL) trials and two proprioceptive (PR) trials involving a resistance band. Participants were fitted with a full body 55-marker set, 3D kinematics were recorded with a 12-camera motion capture system sampling at 250Hz. 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 cross along with the RLL at take-off during the first two steps (S1AC, S1TO, S2AC, S2TO). **Results:** There were no significant changes in impulse or average force between interventions. There was, however, a significant difference between the force angle produced during proprioceptive ($51.7^\circ \pm 3.6$) and combination ($46.6^\circ \pm 8.6$) interventions ($p < 0.05$). Kinematic data were reported for BL and PR, respectively. As for S1, average peak toe height was $0.262 \text{ m} \pm .114$, and $0.241 \text{ m} \pm .054$. During S2, average peak toe height was $0.239 \pm .054 \text{ m}$, and $.232 \text{ m} \pm .057$. There was a significant decrease in peak toe height post-intervention for BC ($p < 0.05$). The RLL angle at S1AC were $63.88^\circ \pm 15.61$ and $70^\circ \pm 16.81$ along with $67.48^\circ \pm 10.29$ and $77.78^\circ \pm 13.28$ at S2AC. The angles for S1TO were $158.30^\circ \pm 4.30$ and $153.94^\circ \pm 4.61$ 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.

1675 Board #350 June 1 9:00 AM - 10:30 AM
Observing First Time Use Of The Backstroke Starting Device In Competitive Swimmers

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 (No relationships reported)

INTRODUCTION Since FINA's initial approval for use of the backstroke starting device (ledge) 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 (V_{MHD}), distance at max head depth (D_{MHD}), and entry angle (E_{Angle}) 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: 21.5 ± 1.2 yr and 18 high school, age: 16.2 ± 1.5 yr) were filmed in a water depth of 1.59 m performing two backstroke starts (1st trial no device; N_{DEV} 2nd trial with the device; W_{DEV}) in the sagittal plane at a sampling frequency of 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, V_{MHD} , D_{MHD} , 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, V_{MHD} , D_{MHD} , and entry angle were significantly ($p < 0.05$) greater in collegiate swimmers when compared to high school swimmers in both starting conditions (N_{DEV} : MHD; 1.14 ± 0.29 vs. 0.48 ± 0.17 m, V_{MHD} : 1.98 ± 0.75 vs. 1.04 ± 0.41 m·sec⁻¹, D_{MHD} : 5.14 ± 0.34 vs. 4.06 ± 0.50 m, E_{Angle} : $3.78 \pm 6.1^\circ$ vs. $30.7 \pm 6.4^\circ$ respectively, and W_{DEV} : MHD; 1.02 ± 0.18 vs. 0.53 ± 0.20 m, V_{MHD} : 1.63 ± 0.46 vs. 1.04 ± 0.38 m·sec⁻¹, D_{MHD} : 5.04 ± 0.31 vs. 4.28 ± 0.55 m, E_{Angle} : $9.9 \pm 10.2^\circ$ vs. $31.2 \pm 7.0^\circ$ College vs Novice respectively). Only E_{Angle} significantly ($p < 0.05$) increased in high school swimmers when using the backstroke starting device ($3.78 \pm 6.1^\circ$ vs. $9.9 \pm 10.2^\circ$). **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.

1676 Board #351 June 1 9:00 AM - 10:30 AM
A Common Drill Exercise In A World Champion Breaststroker - Does It Offer What It Promises?

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Breaststroke swimmers at all levels perform the common drill exercise of two leg kicks to one arm pull at submaximal effort for improving competitive performance through optimizing the timing between the arms and legs.

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 one 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 86%. 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 propulsion (38%), compared to 6% at medium effort and 10% at swimming with maximal effort.

CONCLUSION: The exercise needs to be performed at high effort and not medium effort in order to practice an earlier timing between the arms and legs. The drill exercise at both effort levels are suitable to optimize the muscle activation during leg 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.

1677 Board #352 June 1 9:00 AM - 10:30 AM
Bilateral Force Comparisons during a Demi-Plié Relevé Movement in Ballet Dance

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 (No relationships reported)

PURPOSE: Ballet dance is unique in that the physical performance must not interfere with the artistry of the movement, which makes bilateral balance in any ballet movement most important. Ballet dancers tend to favour one leg and ankle over another during different movements when the movements are supposed to be

completed as symmetrical as possible (Lin et al., 2014). The purpose of this study was to determine the changes in left/right ground reaction forces (GRF) during a Demi-Plié Relevé movement before and after training in beginner level ballet dance program. **METHODS:** Twenty-one college ballet students (2 males and 19 females; weight = 692.4 ± 125.5 N) performed three sets of eight Demi-Plié Relevé movements at the beginning (pre-test) and end (post-test) of a 15-week beginning ballet class. The participants trained in class for an average of 2.5 hours per week. Participants performed the Demi-Plié Relevé with each foot placed on a separate force platform (AMTI) to isolate GRFs associated with each foot. The peak vertical GRFs were analyzed for 16 of 24 movements. For each individual, an average peak difference was calculated between the left and right foot. The left/right peak vertical GRF differences were compared.

RESULTS: The average pretest difference was 72.1 ± 63.3 N, while the posttest difference was 37.9 ± 45.4 N. Pre-test differences ranged between 6.1 and 203.7 N, while post-test differences ranged between 0.4 and 82.2 N. A statistically significant difference between pre- and post-test was found ($t(20) = 2.44, p = 0.024$). There was a moderate effect size ($d\text{-value} = 0.53$).

CONCLUSION: Bilateral GRF differences in the pre-test accounted for 10% of body weight and were reduced to 5% in the post-test. It is noted that those subjects with small initial differences did not improve much, while those with large differences improved significantly. Results suggest that with proper instruction, ballet dancers can improve the symmetry of force production in a Demi-Plié Relevé movement.

1678 Board #353 June 1 9:00 AM - 10:30 AM
The Mechanomyographic Activity of the Upper Trapezius Muscle is Heterogeneous in Response to Eccentric Exercise

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 (No relationships reported)

The Mechanomyographic Activity of the Upper Trapezius Muscle is Heterogeneous in Response to Eccentric Exercise

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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 determinism (%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 0.028 ± 0.011 to 0.030 ± 0.009 m.s⁻² and from 56.3 ± 12.3 to $59.3 \pm 11.3\%$ ($P < 0.001$ 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 ($P < 0.001$). **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 increased MMG activity and regularity were revealed after high intensity eccentric exercise.

Supported by GigtForeningen R77-A1202.

1679 Board #354 June 1 9:00 AM - 10:30 AM
Effects of a 4-Week Intrinsic Foot Muscle Exercise Program on Motor Function

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 (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 ± 2.9 kg/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 any 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 (AbdH), 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 = 1.9 ± 0.5 , post = 2.6 ± 0.5 , $p = .008$) and less perceived difficulty in the toe spread out (pre = 3.1 ± 1.3 , post = 2.3 ± 1.2 , $p = .01$), isolated hallux extension (pre = 3.2 ± 1.5 , post = 2.0 ± 1.2 , $p = .005$), and lesser toe extension (pre = 1.9 ± 0.7 , post = 1.2 ± 0.4 , $p = .03$) exercises. Both groups demonstrated increased USI motor activation in the AbdH during the toe spread out exercise (intervention: pre = $1.07 \pm .06$, post = $1.11 \pm .08$; control: pre = $1.08 \pm .06$, post = $1.11 \pm .06$, $p = .05$). 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.

1680 Board #355 June 1 9:00 AM - 10:30 AM
Influence of Experience and Attentional Focus in a Single Arm Isokinetic Elbow Flexion

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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 focuses 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 focuses) 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 ± 3.2 N·m) and internal (50.1 ± 4.2 N·m) focus (all $p < 0.05$). For the NOV group, there were no significant differences in peak torque production between any conditions. Further, there were no within-group 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.

1681 Board #356 June 1 9:00 AM - 10:30 AM
Core Muscle Function and Endurance in Patients with Patellofemoral Pain following Impairment-Based Rehabilitation

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 (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 plank times) were compared before and after rehabilitation. **METHODS:** 19 PFP patients (23.7 ± 4.8 yrs, 14F, 5M) completed 12 clinician-supervised rehabilitation sessions over a 4-week

period. The rehabilitation program was based on individual patient deficits, measured prior to their first session, in lower extremity range of motion, strength, core weakness, and in movement patterns during functional tasks. Patients were also progressed based on their specific performance, inline with the individual impairment-based model. Prior to the first session and following the final session, USI thickness measures of TrA during a single leg squat (SLS) and plank times (forward, right, left) were collected. For the USI measures, TrA thickness at peak knee flexion during a SLS was normalized by dividing by the thickness in quiet stance. Forward planks and bilateral side planks were timed to failure. Paired t-tests were utilized to compare all measures before and after rehabilitation. **RESULTS:** There was no significant difference in TrA activity during the SLS following rehabilitation (0.08 ± 0.23 cm, $P=.14$). A significant increase in plank time was seen in both the right (14.4 ± 18.3 sec, $P=.05$) and left side planks (10.5 ± 22.1 sec, $P<.01$). A 2-second increase in forward plank time was shown, but did not reach significance (2.22 ± 36.0 sec, $P=.79$). **CONCLUSION:** The absence of change in core muscle activity during the SLS may indicate varying motor strategies to complete the functional task before and after rehabilitation. Significant findings in increased endurance via side planks support the inclusion of a core muscle focus in an impairment-based rehabilitation. Core stability does play a role in PFP and the contribution of task-specific (SLS) and endurance demands should be considered in impairment evaluation while designing a rehabilitation plan.

1682 Board #357 June 1 9:00 AM - 10:30 AM
Single-leg Squat: Interrater Reliability And Sex Differences In Medial Knee Displacement In Collegiate Athletes
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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 I collegiate athletes completed SLS testing as part of their preparticipation exam, including 46 men (age= 18.6 ± 1.6 y, height= 183.5 ± 7.9 cm, mass= 91.0 ± 18.9 kg) and 46 women (age= 18.6 ± 1.6 y, height= 169.1 ± 9.5 cm, mass= 65.4 ± 10.4 kg). 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 SLS in at least 3 of the 5 trials. Trials were scored by 2 members of the research team (GM, RM). Frequency counts were calculated and agreement of the SLS was analyzed with an unweighted 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 and 0.634, respectively, which indicated a substantial level of agreement. The overall percent agreement was 85%. More than half (50 of 92; 54.3%) of all athletes had a (+) SLS test result in at least 1 leg; 29.3% (27 of 92) had a (+) SLS in both legs. No association was found between sex and a (+) SLS score in at least 1 leg ($\chi^2=0.175$; $p=0.675$, OR=1.19, 95%CI=0.52-2.71). Although not significant, females were roughly twice as likely ($\chi^2=2.57$; $p=0.109$, OR=2.11, 95%CI=0.84-5.30) to have a (+) SLS score on both legs in comparison to males. **CONCLUSION:** The interrater reliability for the MKD component of the SLS demonstrated a substantial level of agreement. Although not significant, female collegiate athletes displayed a greater occurrence of bilateral MKD than male collegiate athletes. Future work will determine if SLS performance is a predictor of injury in collegiate athletes.

1683 Board #358 June 1 9:00 AM - 10:30 AM
Angular Momentum Comparison of Two Collegiate Discus Throwers of Different Skill Level
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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 retro-reflective markers using a 14-camera motion capture system. Whole-body angular momentum was calculated about the vertical (Z) and sagittal (Y) axes. Maximum 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 63.38 m and is a former NCAA national champion. Subject B (190.5 cm; 110.3 kg) has thrown a personal best of 57.93 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*s⁻¹). 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*s⁻¹). Maximum Y AngMom occurred late during the delivery phase and was 43.2% greater for Subject A (-38.33 ± 2.95 vs. -24.71 ± 0.53 kg*m²*s⁻¹). At the point of release, Subject A had 166.6% greater Y AngMom (-23.59 ± 1.97 vs. -2.15 ± 2.31 kg*m²*s⁻¹). **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 Board #359 June 1 9:00 AM - 10:30 AM
Predictors of Outcomes after ACL Reconstruction Differ Based on Meniscus Involvement
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Quadriceps and hamstring muscle strength have been shown to predict self-reported knee function, often quantified by the Knee Osteoarthritis Outcome Score (KOOS), in patients with anterior cruciate ligament reconstructed (ACLR) knees. Since up to 60% of these patients experience concomitant meniscal injury it is possible that relationships between muscle function and subjective function may differ based on meniscal involvement. Understanding these relationships may provide greater understanding of determinants of poor subjective function and allow for more individualized treatment strategies to improve outcomes post-ACLR.

Purpose: 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=35), ACLR with meniscectomy (n=29), or ACLR with meniscal repair (n=33). Isokinetic peak knee extension 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 ($R^2=.251$, $P=.002$). ACLR with meniscal repair: knee extension limb symmetry explained 19% of the variance in KOOS total score ($R^2=.190$, $P=.01$). 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.

1685 Board #360 June 1 9:00 AM - 10:30 AM
Analysis of Time Distribution Pattern and Surface Electromyography Characteristics of Wheelchair Racing "Butterfly" Technique
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Wheelchair racers, like sprinters, have special movement pattern, 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 Biomonitor Megawin6000 sEMG tester with eight electrode units was installed on eight muscles (biceps, triceps, flexor carpi radialis, extensor carpi radialis, erector spinae, 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 (24.54±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.

(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 V_{PK} ($p = 0.067$). 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), P_{AVG} (S1: 140 ± 18 Watts; S2: 302 ± 66 Watts), P_{PK} (S1: 375 ± 41 Watts; S2: 617 ± 82 Watts), V_{AVG} (S1: 5.70 ± 0.51 m · s⁻¹; S2: 5.32 ± 0.50 m · s⁻¹), F_{AVG} (S1: 23.8 ± 1.2 N; S2: 55.7 ± 8.8 N), F_{PK} (S1: 49.7 ± 1.3 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.

1686 Board #361 June 1 9:00 AM - 10:30 AM

Influence of Hybrid III Head and Neck Position to Frontal Impacts

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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 for each impact. A 2-way ANOVA (pitch x yaw) was used to test for differences in resultant accelerations and loads ($\alpha = 0.05$).

RESULTS: A pitch angle of 7.5° resulted in statistically greater maximum resultant angular acceleration (6319 ± 255.4 rad/s²; main effect: $p < 0.001$), but a smaller maximum resultant force (354.9 ± 8.9 N; main effect: $p < 0.001$) and moment (6.01 ± 0.4 N·m; main effect: $p < 0.001$) than a pitch angle of 22.5° (angular: 4356 ± 380.8 rad/s²; force: 552.7 ± 5.8 N; moment: 13.6 ± 0.6 N·m). Though there was a pitch and yaw main effect for linear acceleration (pitch: $p = 0.025$; yaw: $p < 0.001$) along with a yaw main effect for moment, the clinical relevance of these mean differences (linear acceleration: pitch: 1.2 g; yaw: 2.2 g; moment: yaw: -0.5 N·m) remains undetermined. There was also no yaw main effect for any of the other measures, nor was there an 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.

1687 Board #362 June 1 9:00 AM - 10:30 AM

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