## E-02 Highlighted Symposium - **The Respiratory System in Heart Failure**

Friday, June 1, 2018, 9:30 AM - 11:30 AM
Room: CC-101AB

The lungs have an intimate relationship with the heart. They are hemodynamically linked in series, accepting nearly all of the cardiac output, share a common surface area, compete for space in the thoracic cavity, are exposed to similar intrathoracic pressures and are neurally and humorally linked. Thus, as the heart remodels and function changes in patients with forms of chronic heart failure, the lungs become an important part of the heart failure syndrome. The interdependence is enhanced with exercise. This symposium will highlight current knowledge on the influence of heart failure on the pulmonary system and their interdependence at rest and during exercise.

2032 **Chair:** Sophie Lalande. *The University of Texas at Austin, Austin, TX.*
*(No relevant relationships reported)*

2033 **Chair:** Bruce D. Johnson. *Mayo Clinic, Rochester, MN.*
*(No relevant relationships reported)*

2034 June 1 9:35 AM - 9:55 AM
**Keynote -**
Bruce D. Johnson. *Mayo Clinic, Rochester, MN.*
*(No relevant relationships reported)*

2035 June 1 9:55 AM - 10:10 AM
**Precapillary Pulmonary Hypertension in Heart Failure: Potential Cause and Consequences**
Bryan J. Taylor[1], Barry A. Borlaug[2], Robert P. Frantz[2], Andrew D. Miller[2], Thomas P. Olson, FACSM[2], Bruce D. Johnson[2]. *[1]Mayo Clinic, Rochester, MN; University of Leeds, Leeds, United Kingdom. [2]Mayo Clinic, Rochester, MN.*
*(No relevant relationships reported)*

Combined pre- and post-capillary pulmonary hypertension (CpcPH) develops in 10-40% of heart failure (HF) patients and is a powerful predictor of short-term mortality. However, the mechanisms that underpin the pathophysiological development of CpcPH in HF remain elusive. In addition, the impact of CpcPH on the pulmonary haemodynamic response to exercise in HF requires further investigation. Purpose. To determine 1) the relationship between systemic oxygen levels and the presence of CpcPH; and 2) the impact of CpcPH on the pulmonary haemodynamic response to exercise in HF patients. Methods. Thirty-nine HF patients undergoing right-heart catheterisation were studied. Blood was drawn for the determination of PaO2, SaO2, PvO2, SvO2, and vasoactive neurohormones. Pulmonary arterial and wedge pressure (PAP; PWP), transpulmonary pressure gradient (TPG; PAP - PWP) and cardiac output ($\dot{Q}$) were assessed at rest and throughout exhaustive incremental exercise. Results. Post catheterization, patients were classified as having no PH (n = 11), isolated post-capillary PH (IpcPH) (n = 11), or CpcPH (n = 17). At rest: PaO2 and PvO2 were lower in CpcPH compared to no PH and IpcPH (65 ± 9 vs 78 ± 11 mmHg and 75 ± 14 mmHg; 29 ± 4 vs 36 ± 3 mmHg and 33 ± 2 mmHg; P < 0.05). Also, SaO2 and SvO2 were lower in CpcPH vs. no PH (93 ± 3% vs 96 ± 3%; 51 ± 11% vs 68 ± 4%; P < 0.05). TPG was inversely related to PaO2, PvO2, SaO2, and SvO2 in the CpcPH only ($r \leq -0.557$; P < 0.05). Similarly, plasma endothelin-1 correlated with PaO2, PvO2, SvO2 ($r \leq -0.495$) and TPG (r = 0.662) (P < 0.05) in CpcPH only. With exercise: At peak exercise, mean PAP (mPAP) and mean PWP (mPWP) were greater in CpcPH compared to no PH and IpcPH. The slope of the mPAP-$\dot{Q}$ and mPWP-$\dot{Q}$ relationship during exercise was greater in CpcPH vs IpcPH vs no PH (mPAP-$\dot{Q}$: 6.7 ± 3.2 vs 4.1 ± 3.9 vs 2.6 ± 1.7 mmHg/L/min; mPWP-$\dot{Q}$: 4.2 ± 1.4 vs 3.3 ± 1.2 vs 2.9 ± 1.5 mmHg/L/min); however, only the differences between no PH and CpcPH were statistically significant. Conclusion. 1) Systemic hypoxaemia may play a role in the development of CpcPH in HF, potentially via a hypoxia-induced increase in endothelial release of the vasoconstrictor endothelin-1; and 2) the development of CpcPH is associated with greater pulmonary vascular pressures and a steeper pulmonary vascular pressure-to-$\dot{Q}$ relationship in response to exercise in HF patients.

2036 June 1 10:10 AM - 10:25 AM
**Manipulation of Intrathoracic Pressure Improves Stroke Volume During Exercise in Patients with Heart Failure**
Sophie Lalande[1], Andrew D. Miller[2], Bruce D. Johnson[2]. *[1]The University of Texas at Austin, Austin, TX; Mayo Clinic, Rochester, MN. [2]Mayo Clinic, Rochester, MN.*
*(No relevant relationships reported)*

Exercise accentuates within-breath fluctuations in intrathoracic pressure (ITP). The more negative ITP during inspiration increases left ventricular (LV) preload and afterload while the more positive ITP during expiration decreases LV preload and afterload. In healthy individuals, the more negative ITP generated during exercise is necessary to maintain an optimal LV preload and, consequently, stroke volume (SV). Curiously, patients with heart failure avoid breathing at high lung volumes and display large positive expiratory ITPs during exercise. In heart failure, a decreased LV compliance results in an increased sensitivity to changes in LV afterload, a decreased sensitivity to increased LV preload and a resulting inability to augment SV through the Frank-Starling mechanism. It was therefore hypothesized that the shallow breathing adopted by patients with heart failure during exercise preserves or enhances SV through decreases in LV preload and afterload. PURPOSE: To investigate the effect of a less negative inspiratory and a more positive expiratory ITP on SV during moderate-intensity exercise in patients with heart failure and reduced ejection fraction (HFREF) and healthy individuals. METHODS: SV was obtained by echocardiography during 2 min of spontaneous breathing (S), two progressive levels of inspiratory unloading (UL1 and UL2) using a ventilator and during expiratory loads of 5 and 10 cmH2O produced by a ventilator in 11 patients with HFREF (61 ± 9 years, EF: 32 ± 4 %, NYHA class I-II) and 11 age-matched healthy individuals during exercise at 60% of maximal aerobic capacity on a semi-recumbent cycle ergometer. RESULTS: During exercise, inspiratory unloading decreased SV indexed to body surface area (SVI) in healthy individuals (S: 44 ± 7, UL1: 41 ± 5, UL2: 40 ± 4 ml/m2) while it increased SVI (S: 41 ± 7, UL1: 43 ± 7, UL2: 44 ± 5 ml/m2, p = 0.02) in patients with HFREF. Expiratory loading increased SVI in patients with HFREF (S: 43 ± 6, 5: 45 ± 3, 10: 44 ± 6 ml/m2) but decreased SVI in healthy individuals (S: 44 ± 8, 5: 40 ± 5, 10: 39 ± 5 ml/m2, p = 0.01). CONCLUSION: Inspiratory unloading and expiratory loading elicited increases in SVI during moderate-intensity exercise in patients with HFREF, possibly due to beneficial reductions in LV afterload and preload.

2037 June 1 10:25 AM - 10:40 AM
**Breathing With Heart Failure: How Hard Can It Be?**
Troy J. Cross[1], Surendran Sabapathy[2], Ken C. Beck[3], Norman R. Morris[2], Bruce D. Johnson[3]. *[1]Griffith University, QLD, Australia; Mayo Clinic, Rochester, MN. [2]Griffith University, QLD, Australia. [3]Mayo Clinic, Rochester, MN.*
*(No relevant relationships reported)*

The syndrome of heart failure (HF) is often accompanied by numerous derangements in ventilatory function. These pathophysiological changes in ventilatory function are believed to augment the mechanical work required to breathe during exercise (Wb). However, the precise contributions of resistive and elastic work to this overall higher Wb in HF remain unclear. PURPOSE: To quantify the resistive and elastic components of Wb during exercise in HF patients and age-matched, healthy controls at standardized levels of minute ventilation ( ). METHODS: The elastic and resistive Wb were assessed in 9 male HF patients (NYHA class I-III) and 9 age-matched, healthy male controls at minute ventilations of 20, 40, 60 and 80 L·min-1 during graded exercise. The components of Wb were quantified using oesophageal manometry and modified Campbell diagrams. RESULTS: Dynamic lung compliance was lower across all minute ventilations in HF patients (P<0.05). Moreover, the inspiratory and expiratory resistive Wb was higher in HF patients compared with controls at any given (P<0.05). The inspiratory elastic Wb was higher at minute ventilations of 40-60 L·min-1 during exercise in HF patients. (P<0.05). CONCLUSIONS: The findings of this study indicate that the overall higher Wb in HF patients may be more so related to greater amounts of resistive than elastic Wb during exercise.

2038 June 1 10:40 AM - 10:55 AM
**The Link between Muscle Mass, Afferent Feedback and Ventilatory Control in Heart Failure**
Manda L. Keller-Ross[1], Bruce D. Johnson[2], Rickey E. Carter[2], MIchael J. Joyner, FACSM[2], John H. Eisenach[3], Timothy B. Curry[2], Thomas P. Olson, FACSM[2]. *[1]University of Minnesota, Minneapolis, MN. [2]Mayo College of Medicine, Rochester, MN. [3]Kaiser Permanente, Denver, CO.*
*(No relevant relationships reported)*

Skeletal muscle afferent feedback modulates ventilatory control during exercise. Skeletal muscle atrophy in patients with heart failure (HF) may contribute to increased

afferent feedback which can lead to high ventilation to carbon dioxide production (VE/VCO2) slope. Low peak oxygen consumption (VO2 peak) and high VE/VCO2 slope are strongly associated with mortality in patients with HF. PURPOSE: This study examined the influence of muscle mass on low VO2 and the change in VE/VCO2 with afferent neural block during exercise in HF. METHODS: 17 participants [9 HF (60±6 yrs, mean±SD) and 8 controls (CTL) (63±7 yrs)] completed 3 experimental sessions. Session 1: peak exercise test on a cycle ergometer to volitional fatigue and dual energy x-ray absorptiometry. Sessions 2 and 3: 5 min of steady-state exercise on a cycle ergometer (65% of peak power) randomized to a lumbar injection of fentanyl (afferent blockade) or placebo. Ventilation (VE) and gas exchange (oxygen consumption, VO2; carbon dioxide production, VCO2) were measured. RESULTS: Peak work and VO2 were lower in HF ($p<0.05$). Leg fat was greater in HF (34.4±3.0 and 26.3±1.8%) and leg muscle mass was lower in HF (63.0±2.8 and 70.4±1.8%, respectively, $p<0.05$). VE/VCO2 slope was reduced in HF during afferent blockade compared with CTL (-18.8±2.7 and -1.4±2.0%, respectively, $p=0.02$). The reduction in VE/VCO2 was positively associated with leg muscle mass ($r2=0.58$, $p<0.01$) and negatively associated with leg fat mass ($r2=0.73$, $p<0.01$) in HF only. In addition, the reduction in VE/VCO2 was also positively associated with arm, trunk and total muscle mass ($p<0.01$). Importantly, there was a strong relationship between peak VO2 and the reduction in VE/VCO2 slope in HF ($r2=0.87$, $p<0.01$), but not CTL. CONCLUSIONS: HF patients with the highest fat mass, least leg muscle mass and lowest peak VO2 had the greatest improvement in VE/VCO2 with afferent blockade. Both muscle mass and fat mass are important contributors to ventilatory abnormalities and strongly associated to improvements in VE/VCO2 slope with locomotor afferent inhibition in HF. This indicates a strong link between muscle atrophy, skeletal muscle afferent activation and ventilatory control in HF.

2039 June 1 10:55 AM - 11:15 AM

**Keynote -**

Norman Morris. *Griffith University, Gold Coast, Australia.*

*(No relevant relationships reported)*

## E-05 Thematic Poster - **Firefighting**

Friday, June 1, 2018, 9:30 AM - 11:30 AM
Room: CC-Mezzanine M100C

2049 **Chair:** Denise L. Smith, FACSM. *Skidmore College, Saratoga Springs, NY.*

*(No relevant relationships reported)*

2050 Board #1 June 1 9:30 AM - 11:30 AM

**Comparison of Firefighters and Instructors Physiological Responses Throughout a Day of Live-fire Training**

Andrea Wilkinson, Patricia Fehling, FACSM, Leland Haigh, Denise L. Smith, FACSM. *Skidmore College, Saratoga Springs, NY.*

*(No relevant relationships reported)*

Approximately 10-12% of firefighter (FF) fatalities occur during training, with a significant proportion (56%) of these due to cardiac events. Although the cardiovascular strain of firefighting drills has been well documented, the cardiac and thermal strain experienced throughout an entire training day has not been well characterized.

**Purpose:** To compare the physiologic responses of FF and instructors during a day of departmental live-fire training that involved 3 training drills. **Methods:** On a work day, 29 career FF (34.7 ± 9.6 yr) and 6 instructors (36.2 ± 2.9 yr) wore a physiologic status monitor during an entire day of live-fire training (~ 7 hours) to record heart rate (HR) and estimated core temperature (EST $T_{co}$). Three drills (fire attack with ventilation and a multiple floor search; high-rise standpipe drill; ventilation, enter, and search), each lasting around 30 minutes were performed on each training day with debrief and clean-up periods after each drill. **Results:** There were no significant differences between the FF and instructors in any of the physiological responses ($p > 0.05$; see Table 1). FF and instructors achieved approximately 100% of age-predicted maximal heart rate (APMHR; 220-age) at some point during the day. Over the entire day HR mean was ~62% of APMHR. Additional analysis revealed physiologic strain was high during a single clean-up period (173 ± 16 b·min$^{-1}$, 37.8 ± 0.2°C).

**Conclusions:** All participants reached APMHR and had a mean HR throughout the day >60% APMHR. There were no differences in HR or EST $T_{co}$ between instructors or FF. We also found that physical exertion during cleanup activities can be as physically demanding as the live-fire drills. When considering the physiologic strain of FF training, the physical work associated with set-up and clean-up should be taken into consideration.Supported by FEMA AFG Grant EMW-1015-FP-00731

Table 1. Physiologic Characteristics

| Variable | Instructors (n=6) | FF (n=2) |
|---|---|---|
| HR Peak (b·min$^{-1}$) | 183 +/- 15 | 188 +/- 19 |
| HR Mean (b·min$^{-1}$) | 114 +/- 14 | 116 +/- 11 |
| EST Tco Peak(°C) | 38.3 +/- 0.4 | 38.6 +/- 0.5 |
| EST Tco Mean (°C) | 37.7 +/- 0.4 | 37.8 +/- 0.3 |

Values are means +/- SD; EST = estimated

2051 Board #2 June 1 9:30 AM - 11:30 AM

**Cardiorespiratory Responses to the USFS Wildland Firefighter Arduous Pack Test**

Christopher J. Alfiero, Charles L. Dumke, FACSM, Brent C. Ruby, FACSM, Matthew W. Bundle. *University of Montana, Missoula, MT.* (Sponsor: Brent Ruby, FACSM)

*(No relevant relationships reported)*

**Cardiorespiratory Responses to the USFS Wildland Firefighter Arduous Pack Test**

Alfiero CJ, Dumke CL FACSM, Ruby BC FACSM and Bundle MW
University of Montana

US wildland firefighters administer over 30 000 physical tests per year to qualify candidates for the occupational demands of fire suppression. The primary assessment is the arduous pack test (APT) a 4.83 km hike that must be completed in 45 min while wearing a 20.45 kg pack. Delivery of individual feedback to guide the physical training of candidates is hampered by two factors; first, passing the pack test is widely considered the minimum performance level necessary needed for this occupation, and second, the binary nature of the assessment presents candidates with a task representing an unknown and self-selected exercise intensity.

**PURPOSE**: To determine the cardiorespiratory response elicited by the APT within a subject population whose aerobic capacity and body masses vary. **METHODS**: 63 young (age = 22.8±3.2 yrs) adults (37 males, $M_b$ = 81.2±9.4 kg; 26 females, $M_b$ = 63.6±8.5 kg; study range: 55.6-100.0 kg) performed the APT and subsequently underwent a hiking inclined-treadmill test to $VO_{2peak}$ while wearing a skin mounted heart rate (HR) monitor and 20.45 kg pack. **RESULTS**: 50 of the 63 subjects achieved the 45 min cutoff with a finishing time of 41.8 ± 2.1 min, the non-passers had a mean time of 47.7 ± 2.7 min. Non-passers were 77% female and 23% male. The $VO_{2peak}$ values of the passing and non-passing groups were 49.4 ± 7.2 and 42.6 ± 9.6 ml$O_2$ kg$^{-1}$ min$^{-1}$, respectively; the study range was 62.1 to 30.8 ml$O_2$ kg$^{-1}$ min$^{-1}$. HR, whether expressed as a fraction of the subject's maximum rate (passers = 81.2 ± 17.1 and non-passers = 79.9 ± 12.7% of $HR_{max}$), or as the fraction of the HR reserve (passers = 68.0 ± 7.9 and non-passers = 67.7 ± 15.3% of HR reserve) were not different between the groups. Regression of $VO_{2peak}$ on completion time yielded a negative relationship ($R^2$=0.45). In contrast, the HR responses and completion time were consistent among the participants ($R^2 < 0.01$ for both % of $HR_{max}$ and % of HR reserve). **CONCLUSION**: To successfully complete the APT candidates must achieve a HR reserve of 68% or less while maintaining a walking speed of 1.8 m s$^{-1}$. These data suggest that monitoring HR during load carriage may be used to identify candidates with adequate and inadequate pre fire season readiness.

2052 Board #3 June 1 9:30 AM - 11:30 AM

**Accelerometer-based Physical Activity And Sedentary Time Assessment In Brazilian Wildland Military Firefighters - Brasilia Firefighters Study**

Daniel Saint Martin[1], Leonardo Correa Segedi[2], Edgard Von Koenig Soares[1], Rosenkranz Maciel Nogueira[2], Keila Elizabeth Fontana[1], Maria Korre[3], Guilherme Eckhardt Molina[1], Denise L. Smith[4], Stefanos N. Kales[3], Luiz Guilherme Grossi Porto[5]. *[1]University of Brasília and GEAFS, Brasília, Brazil. [2]University of Brasília, Brasília Fire Department and GEAFS, Brasília, Brazil. [3]Harvard T.H. Chan School of Public Health, Boston, MA. [4]Department of Health and Exercise Sciences, Skidmore College, Saratoga Springs, NY. [5]University of Brasília, Harvard T.H. Chan School of Public Health, Boston, MA, and GEAFS, Brasília, Brazil.*

*(No relevant relationships reported)*

Wildland firefighting is characterized by outdoor duties that include long walks and high physical demands. The Brasilia Fire Department Environmental Protection Brigade (EPB) is a wildland fire suppression specialized unit that also perform other duties, such as rescues. **PURPOSE**: To objectively evaluate the physical activity level (PAL) and sedentary time (ST) of wildland firefighters during a routine 24-hour on-

duty period. **METHODS**: We evaluated 26 firefighters from the EPB with mean age of 35.8±6 yrs, BMI of 25.3±3.2 kg/m² and $VO_{2max}$ of 44.4±3.7 mL(kg.min)$^{-1}$. Volunteers wore the ActiGraph GT3X+ accelerometer set in 60s epochs, at the right waist during a 24-hour on-duty period. Main duties were reported on a written log. PAL and ST were evaluated using vector magnitude cut-points as follow: ST <200 counts per minute (cpm), light activity: 201-2689 cpm and moderate to vigorous activity (MVPA) ≥2690 cpm. **RESULTS**: Table 1 shows descriptive data. 23 participants (88.5%) accumulated at least 30min of MVPA. 16 firefighters (61.5%) achieved ≥10,000 steps. 20 (77%) reached the MVPA intensity and 6 (23%) the very vigorous one. Of those who participated in wildland fire suppression (50% of the sample), they spent 6% less time in ST (p=0.08) and 4.6% more time in MVPA (p=0.045).

**Table 1:** Median (min-max) values of ST and PAL during a 24h on-duty period (n = 26)

| | Absolute (min) | Relative (%) |
|---|---|---|
| Sedentary time | 561.5 (210-807) | 50.4 (19.9-70.1) |
| Light PA | 450 (277-614) | 40.3 (27.7-54.2) |
| MVPA | 98.5 (19-272) | 8.4 (2.0-25.8) |
| Steps/day | 13145 (4833-40593) steps | |
| Wear time | 1090 (900-1380) min | |

PA: physical activity; MVPA: Moderate to vigorous physical activity

**CONCLUSIONS**: On average, wildland firefighters spent ≥1h30min on MVPA during a routine 24h shift-work. Including night rests, almost half of on-duty period was of ST. The other 50% of the time was mainly spent on light activities but interspersed with MVPA. Almost 80% of the firefighters had at least one episode of MVPA during a routine work period. Those who responded to an episode of wildland fire accumulated more MVPA than those involved only in other firefighters' routine duties.

Funding: CNPq 480092/2013.3.

2053 Board #4 June 1 9:30 AM - 11:30 AM

## The Relationship Between Firefighters' Physical Activity Levels and Cardiorespiratory Fitness

Allison M. Barry[1], Nathan D. Dicks[1], Kassiann D. Landin[1], Tanis J. Walch[2], Kyle J. Hackney[1], Katie J. Lyman[1]. *[1]North Dakota State University, Fargo, ND. [2]University of North Dakota, Grand Forks, ND.* (Sponsor: Donna J. Terbizan, FACSM)

*(No relevant relationships reported)*

Improved physical activity (PA) and cardiorespiratory fitness (CRF) levels are necessary for firefighters to adequately perform strenuous occupational demands. These demands have been associated with increased cardiovascular events leading to disability and death. Sudden cardiac death accounted for 44% of all annual on-duty deaths in U.S. firefighters from 1995-2004. Thus, the National Fire Protection Association (NFPA) has made it a priority to emphasize PA levels in order to maintain and increase CRF.

**PURPOSE:** The purpose of the study was to investigate the relationship between sedentary behavior (SB), light physical activity (LPA), and moderate-to-vigorous physical activity (MVPA) to CRF in career firefighters. **METHODS:** Firefighters wore an accelerometer for eight consecutive on- and off-duty days. The accelerometer was worn on the right hip and tracked SB, LPA, and MVPA. Freedson's (1998) cut point determined PA intensity, while Choi's (2011) algorithm was used to remove non-wear time. Additionally, each participant completed a stage-graded exercise test with submaximal square-wave verification bout to determine maximal oxygen uptake ($VO_{2max}$). $VO_{2max}$ was also estimated using self-reported physical activity rating and a non-exercise regression equation. Pearson's correlations were performed between the PA components and $VO_{2max}$ as well as between estimated and actual $VO_{2max}$ (ml/kg/min).

**RESULTS:** Preliminary results (n=9) for total wear time for the accelerometer was 920 (min) with 58.7% SB, 37.7 % LPA, and 3.6% MVPA. There were no significant correlations between $VO_{2max}$ and SB (r = -0.18, P = 0.637) or LPA (r = 0.33, P = 0.388). Further, there was no significant correlation between estimated (45.2 ± 7.5) and actual $VO_{2max}$ (39.2 ± 7.1) (r = 0.52, P = 0.149). There was a statistically significant correlation between $VO_{2max}$ and MVPA (r = 0.74, P = 0.022). **CONCLUSION:** The initial results suggest that firefighters are meeting ACSM's PA guidelines but are not are not meeting the NFPA's minimal CRF recommendation of 42 ml/kg/min. Therefore, further research is necessary in order to make recommendations regarding PA and CRF for active firefighters. Twenty-one additional firefighters are expected to complete the study for a total sample of 30.

2054 Board #5 June 1 9:30 AM - 11:30 AM

## Physical Factors Associated with Tower Stair Climbing In Firefighter Recruits

Kyle T. Ebersole[1], Cody S. Tesch[2], Robert J. Flees[1], Michael H. Haischer[1], Edward K. Smith[1], David J. Cornell[1]. *[1]University of Wisconsin-Milwaukee, Milwaukee, WI. [2]City of Milwaukee Fire Department, Milwaukee, WI.* (Sponsor: Terry Housh, FACSM)

*(No relevant relationships reported)*

Stair climbing in structural fires is a common task for firefighters. Firefighters also frequently have to ascend the stairs while carrying various equipment. The physical factors related to performance on a timed stair climb task are unclear. As a result, there is a lack of evidence to guide training programs for firefighter recruits that target the development of physical factors associated with performance on this task. **PURPOSE:** To determine the physical factors that are associated with performance during a timed stair climbing task in firefighter recruits. **METHODS:** 17 male firefighter recruits (20.4 ± 0.5 yrs, 178.5 ± 5.5 cm, 83.7 ± 8.7 kg) volunteered to participate. The recruits completed a battery of physical fitness and performance tests including: estimated body fat percentage (%Fat) via skinfold assessment; estimated one-repetition maximum squat (Squat) and bench press (Bench); seated weighted ball chest pass (Pass); 2-minute maximal push-up test (Push); estimated maximal aerobic capacity ($VO_{2max}$) via a submaximal step-test ; functional movement quality via a movement efficiency screen (MES); and time to complete a 5-story tower climb test ($Tower_{TIME}$). Heart rate (HR) was recorded immediately after the step-test ($HR_{STEP}$) and the tower climb ($HR_{TOWER}$). Squat, Bench, and Pass data were normalized to body mass (kg). Push data were normalized to the maximum number possible (80). Bivariate correlations were used to determine the relationship between $Tower_{TIME}$ and all the physical fitness and performance factors measured. **RESULTS:** Statistically significant ($P < 0.05$) correlations were identified between $Tower_{TIME}$ and %Fat ($r = 0.563$, $P = 0.019$), Bench ($r = -0.571$, $P = 0.017$), Pass ($r = -0.549$, $P = 0.023$), Push ($r = -0.532$, $P = 0.028$), $VO_{2max}$ ($r = -0.560$, $P = 0.019$), $HR_{STEP}$ ($r = 0.611$, $P = 0.009$), and $HR_{TOWER}$ ($r = -0.638$, $P = 0.002$). Non-significant ($P > 0.05$) correlations were identified for Squat ($r = 0.448$, $P = 0.072$) and MES ($r = 0.353$, $P = 0.165$). **CONCLUSIONS:** Performance during a maximal tower climb task was related to fitness (%Fat and $VO_{2max}$), as well as upper body strength (Bench), power (Pass), and endurance (Push), but not lower body strength (Squat) or functional movement quality (MES). Further, those who performed better on the tower climb had a lower HR after the step-test and a higher HR after the tower climb test.

2055 Board #6 June 1 9:30 AM - 11:30 AM

## Cardiovascular Risk Factor Characterization and Isokinetic Muscle Strength in Overweight and Obese Male Firefighters

Gena Gerstner[1], Andrew J. Tweedell[2], Craig R. Kleinberg[3], Hayden K. Giuliani[1], Timothy J. Barnette[1], Abbie E. Smith-Ryan, FACSM[1], A. C. Hackney, FACSM[1], Katie R. Hirsch[1], Jacob A. Mota[1], Eric D. Ryan[1]. *[1]University of North Carolina at Chapel Hill, Chapel Hill, NC. [2]Army Research Laboratory, Aberdeen Proving Ground, MD. [3]Under Armour, Baltimore, MD.* (Sponsor: Abbie E. Smith-Ryan, FACSM)

*(No relevant relationships reported)*

Sudden cardiac death is the cause of nearly half of on duty fatalities among firefighters. Although firefighters endure strenuous occupational duties, they often have sub-standard levels of fitness, and are at risk for cardiovascular disease (CVD). It is unclear if muscular strength provides a protective effect, independent of cardiorespiratory fitness (CRF). **PURPOSE**: The purpose of this study was to examine the influence of isokinetic strength on CVD risk factor characterization in overweight and obese career firefighters, prior to and after accounting for CRF. **METHODS**: Forty-four overweight and obese male firefighters [Mean ± SD; Age: 36.9 ± 7.1 yrs; Stature: 180.1 ± 7.0 cm; Body mass: 107.9 ± 19.8 kg; BMI: 33.1 ± 4.7 kg·m$^2$] performed three maximal concentric isokinetic leg extensions on a calibrated isokinetic dynamometer at slow (1.05 rad·sec$^{-1}$; $PT_{slow}$) and fast (4.19 rad·sec$^{-1}$; $PT_{fast}$) velocities, in a randomized order. Peak torque was normalized to body mass for both velocities. Cardiovascular risk was determined based on published cutpoints for systolic blood pressure, total cholesterol, high-density lipoproteins, low-density lipoproteins, triglycerides, and trunk fat/limb fat ratio. Firefighters were characterized into three cardiovascular risk profiles (≤1 [n=14], 2 [n=16], and ≥3 [n=14] risk factors). A non-exercise prediction model including age, percent body fat from dual-energy X-ray absorptiometry, and self-reported exercise status from a questionnaire was used to calculate CRF. Two separate one-way analyses of variance (ANOVA) were used to evaluate potential differences in $PT_{slow}$ and $PT_{fast}$ between the three groups. Two separate analyses of covariance (ANCOVA) were used to examine whether $PT_{slow}$ and $PT_{fast}$, adjusted for CRF, differed between the three groups. An alpha level was set *a priori* at $P \leq 0.05$ for all analyses. **RESULTS**: There were no differences between groups for $PT_{slow}$ or $PT_{fast}$ prior to ($P$ =0.130; $P$ =0.337) or after ($P$ =0.054; $P$ =0.191) accounting for CRF, respectively. **CONCLUSIONS**: These findings suggest that isokinetic muscular strength does not provide a protective

effect from CVD risk factor characterization in this sample of overweight and obese male firefighters. **FUNDING**: Supported in part by a Junior Faculty Award from UNC-Chapel Hill.

2056 Board #7 June 1 9:30 AM - 11:30 AM

### The Influence of Age and Adiposity on Functional Balance Performance in Career Firefighters

Jacob A. Mota[1], Timothy J. Barnette[1], Gena R. Gerstner[1], Andrew J. Tweedell[2], Craig R. Kleinberg[3], Hayden K. Giuliani[1], Eric D. Ryan[1]. *[1]University of North Carolina at Chapel Hill, Chapel Hill, NC. [2]Army Research Laboratory, Aberdeen Proving Ground, MD. [3]Under Armour, Baltimore, MD.* (Sponsor: Abbie Smith-Ryan, FACSM)

*(No relevant relationships reported)*

Slips, trips, and falls (STF) are one of the primary causes of non-fatal injuries in firefighters, incurring a large economic burden. Laboratory based measures of functional balance may help identify key risk factors for STF injuries.
**PURPOSE:** The purpose of the current investigation is to examine the impact of age and adiposity [body mass index (BMI) and percent fat (%BF)] on a functional balance assessment in career firefighters.
**METHODS:** Forty-nine healthy career firefighters (mean ± SD age = 35 ± 8 yrs; stature = 178.72 ± 7.99 cm; mass = 93.76 ± 21.85 kg; BMI = 29.11 ± 5.34 kg/m$^2$; %BF = 25.22 ± 5.34%) volunteered to participate in this study. Data were collected over two separate visits. The first visit required participants to arrive to the laboratory following a four-hour fast prior to a dual energy x-ray absorptiometry scan to estimate %BF and be familiarized with the functional balance assessment. On the subsequent visit, participants completed the assessment for time while wearing their personal protective equipment and a self-contained breathing apparatus. The task required firefighters to step down from a raised platform, walk across a narrow beam, pass beneath an overhead obstacle (at 75% of their height), and step up to a final raised platform. The task was repeated while walking backwards as fast as possible. Each participant performed five trials that were digitally recorded to account for minor (i.e. foot contact with the ground) and major errors (i.e. overhead obstacle falls) with a minute rest between each to create a performance index (PI). Pearson product-moment correlation coefficients were used to examine the relationship between PI and age, BMI, and %BF with an *a priori* alpha level set a $P \leq 0.05$.
**RESULTS:** There was a significant relationship between PI and age (r = 0.406; $P$ = 0.004) and %BF (r = 0.401; $P$ = 0.004), but not BMI (r = 0.242; $P$ = 0.093).
**CONCLUSION:** The results from the present study demonstrated that increased age and %BF were associated with poorer functional balance performance. These findings may highlight key risk factors that may contribute to an increased risk of STF injuries. Lastly, %BF may be a more sensitive measure of adiposity than BMI when identifying STF risk factors.
**GRANT FUNDING:** National Institute of Occupational Safety and Health (T42OH008673)

## E-06 Thematic Poster - Moving Beyond Aerobic Exercise: New Science of Strength and Health

Friday, June 1, 2018, 9:30 AM - 11:30 AM
Room: CC-Lower level L100C

2057 **Chair:** Duck-Chul Lee, FACSM. *Iowa State University, Ames, IA.*

*(No relevant relationships reported)*

2058 Board #1 June 1 9:30 AM - 11:30 AM

### Risk Of Metabolic Syndrome In Adulthood Attributable To Childhood Grip Strength

Brooklyn Fraser[1], Leigh Blizzard[1], Michael Schmidt[2], Terence Dwyer[3], Alison Venn[1], Costan Magnussen[1]. *[1]University of Tasmania, Hobart, Australia. [2]University of Georgia, Athens, GA. [3]Oxford University, Oxford, United Kingdom.*

*(No relevant relationships reported)*

**PURPOSE**: Low levels of grip strength in adults independently predicts cardiovascular disease and type 2 diabetes. However, longitudinal evidence spanning child to adulthood is sparse. This study examined the association between child grip strength and adult metabolic syndrome (MetS). **METHODS**: Longitudinal study examining participants who had grip strength, cardiorespiratory fitness (CRF, physical work capacity at 170 beats per minute), and waist circumference measured in childhood (9, 12, 15 years) and who had measures of MetS taken 20 years later. Child grip strength was categorised according to age-and sex-specific cut-points proposed by Catley and Tomkinson (2013) based on Australian normative data (very high, high, average, low, very low). Waist circumference, blood pressure, HDL cholesterol, triglycerides, and glucose were measured in adulthood and MetS was defined using the harmonised definition and a continuous MetS risk score. **RESULTS**: Children with very low or low grip strength were at six times increased risk of MetS and had a higher continuous MetS risk score in adulthood independent of CRF (RR=6.00, 95% CI=2.53, 14.19; β=0.38, 95% CI=0.23, 0.52), compared with children without very low or low grip strength. Adjustment for childhood waist circumference reduced the effect estimates for both MetS outcomes by 50-62% (RR=2.26, 95% CI=0.90, 5.64; β=0.19, 95% CI=0.07, 0.31) and statistical significance was lost for the dichotomous MetS outcome (p=0.08). **CONCLUSIONS**: Lower levels of childhood grip strength were associated with adult MetS independent of CRF, with part of this effect potentially being mediated through childhood waist circumference. These results suggest strategies aimed at improving grip strength in childhood might reduce future development of MetS. Supported by NHMRC Grant APP1098369

2059 Board #2 June 1 9:30 AM - 11:30 AM

### Muscular Strength And Cardiovascular And All-cause Mortality In Adults With Hypercholesterolemia

Duck-chul Lee, FACSM[1], Carl Lavie[2], Xuemei Sui, FACSM[3], Steven Blair, FACSM[3]. *[1]Iowa State University, Ames, IA. [2]Ochsner Health System, New Orleans, LA. [3]University of South Carolina, Columbia, SC.*

*(No relevant relationships reported)*

**PURPOSE**: To determine the associations of muscular strength (MS) with cardiovascular disease (CVD) and all-cause mortality in adults with hypercholesterolemia.
**METHODS**: Participants comprised 1,925 adults aged ≥40 years (mean age 50) who had a medical examination during 1980-1990 in the Aerobics Center Longitudinal Study. They were free of CVD, cancer, had ≥85% of their age-predicted maximal heart rate on a treadmill test, and hypercholesterolemia at baseline. MS was measured by 1 repetition maximums of bench and leg presses and a composite MS score was computed by combining the standardized values of both tests. Cardiorespiratory fitness (CRF) was estimated from a maximal treadmill test. We used tertiles of the sex- and age-specific total MS scores. Further, MS and CRF were dichotomized into either weak (lower one-third) or unfit (lower half), or strong (upper two-thirds) or fit (upper half) in a joint analysis of MS and CRF with mortality. Mortality follow-up was through 2003 using the National Death Index. Cox regression models included baseline age, sex, examination year, body mass index, smoking, alcohol intake, physical activity, parental CVD, hypertension, diabetes, abnormal electrocardiogram, total cholesterol, and CRF.
**RESULTS**: During an average follow-up of 18 years, 67 CVD and 172 all-cause deaths occurred. Compared with lower MS group, the hazard ratios (HRs) and 95% confidence intervals (CIs) for CVD and all-cause mortality were 0.45 (0.24-0.85) and 0.58 (0.40-0.85) in middle MS group ,respectively, and 0.46 (0.25-0.86) and 0.63 (0.43-0.93) in upper MS group, respectively, after adjusting for confounders including CRF. We found similar trends in both men and women, and normal weight and overweight or obese adults. In the joint analysis, compared with unfit and weak group, HRs (95% CIs) for CVD and all-cause mortality were 0.41 (0.22-0.78) and 0.41 (0.27-0.62) in unfit and strong group, respectively; 0.70 (0.30-1.66) and 0.60 (0.34-1.08) in fit and weak group, respectively; and 0.39 (0.19-0.82) and 0.59 (0.39-0.90) in fit and strong group, respectively.
**CONCLUSIONS**: MS, independent of CRF, should be promoted as a predictor of CVD and all-cause mortality in adults with hypercholesterolemia who are at increased mortality risk. Supported by NIH Grant AG06945, HL62508, DK088195, and HL133069.

2060 Board #3 June 1 9:30 AM - 11:30 AM

### The Time-Varying Longitudinal Associations Between Muscle Strength, Functional Limitations, and Mortality in Older Adults

Ryan McGrath[1], Brenda Vincent[2], I-Min Lee, FACSM[3], William Kraemer, FACSM[4], Mark Peterson, FACSM[1]. *[1]University of Michigan, Ann Arbor, MI. [2]VA Ann Arbor Healthcare System, Ann Arbor, MI. [3]Harvard University, Boston, MA. [4]The Ohio State University, Columbus, OH.*

*(No relevant relationships reported)*

Understanding how factors, such as muscle strength, slow the disabling process may better inform interventions designed to preserve function and delay mortality.
**PURPOSE**: To determine the time-varying associations between 1) handgrip strength (HGS) and individual activities of daily living (ADL) functions, and 2) disaggregated ADL limitations and time to mortality in older adults. **METHODS**: A United States nationally-representative sample of 18,467 older adults (age: 66.9±11.1 years) from the Health and Retirement Study were followed for 8 years. Maximal HGS was measured

with a hand-held dynamometer. Ability to perform ADL functions were self-reported. Date of death was identified by the National Death Index and exit interviews. Separate covariate-adjusted hierarchical logit models were used to examine the association between HGS and each ADL outcome. Discrete covariate-adjusted Cox models were used to analyze the association between disaggregated ADL limitations and time to mortality. **RESULTS**: Every 5-kilogram increase in HGS was associated with decreased odds for the following ADL limitations: 9% (95% confidence interval (CI): 0.89, 0.93) for bathing, 6% (CI: 0.92, 0.96) for transferring, 9% (CI: 0.89, 0.93) for walking, 6% (CI: 0.92, 0.96) for dressing, 12% (CI: 0.84, 0.91) for eating, and 4% (CI: 0.94, 0.98) for toileting. The presence of a bathing, transferring, walking, dressing, eating, or toileting ADL limitation was associated with a 1.20 (CI: 1.19, 1.21), 1.04 (CI: 1.03, 1.05), 1.21 (CI: 1.20, 1.22), 1.02 (CI: 1.01, 1.03), 1.14 (CI: 1.13, 1.15), and 1.14 (CI: 1.13, 1.15) higher hazard for mortality, respectively. **CONCLUSIONS**: HGS was associated with reduced odds for each ADL limitation, which in turn, decreased the hazard for mortality in older adults. These findings provide insights into how preserving strength decelerates the disabling process by identifying which ADL functions are most impacted by muscle strength and the subsequent time to mortality for each ADL limitation.

2061 Board #4 June 1 9:30 AM - 11:30 AM

## Defining Gender-specific Cut-off Points Of Lower Extremity Muscle Strength For Predicting All-cause Mortality Among Us Older Adults

Ran Li[1], Xi Zhang[2], Jianjun Guo[1], Yiqing Song[3]. *[1]China Institute of Sport Science, Beijing, China. [2]Xinhua Hospital affiliated to Shanghai Jiao Tong University School of Medicine, Shanghai, China. [3]Richard M. Fairbanks School of Public Health, Indiana University, Indianapolis, IN.*

*(No relevant relationships reported)*

Aging-related loss of muscle strength is an important predictor of mortality; but few studies have defined appropriate cut-off point of muscle strength in relation to mortality in a nationally representative population. **PURPOSE**: We aimed to explore the optimal cutoff values of lower extremity muscle strength (LMS) for predicting all-cause mortality in a nationally representative sample of US older adults from the National Health and Nutrition Examination Survey (NHANES). **METHODS**: Data sources included the NHANES1999-2002 with public-use 2011 linked mortality files, which comprised 2,209 men and 2,240 women aged 50 years and older with complete data of knee extension strength measurements. Weighted multivariable logistic regression models were used to account for multistage stratified and clustered sampling. All models were adjusted for age, race, BMI, muscle mass, cigarette smoking, alcohol use, education, leisure time physical activity, sedentary time, and comorbidities. Receiver operating characteristic curves (ROC) and Youden's J statistic were used to identify the gender-specific cutoff points. The validation of the optimal cutoff points for predicting all-cause mortality was internally assessed using bootstrap sampling method. **RESULTS**: Overall, there were nonlinear "L" shaped associations between LMS and all-cause mortality in men and women, separately. ROC curves showed that LMS appeared to provided additional predictive values beyond traditional risk factors with (c statistics: 0.94 (0.93-0.95) in men and 0.96 (0.94-0.98) in women) and without muscle mass (c statistics: 0.93 (0.92-0.95) in men and 0.96 (0.95-0.97) in women) in predicting all-cause mortality. Ten candidate gender-specific cutoff points of LMS, which had the highest Youden's J Index, were identified. In the multivariable logistic regression models the cutoff points were determined at 266newtons for men and 221newtons for women, which were the lowest cutoff points significantly associated with all-cause mortality. Internal validation using the bootstrap method with 500 sex-stratified replications revealed no apparent overfitting problem. **CONCLUSIONS**: Optimal cutoff points of LMS independent of muscle mass may help us to better assess and promote musculoskeletal fitness in terms of health outcome in older adults.

2062 Board #5 June 1 9:30 AM - 11:30 AM

## Strength Training versus Aerobic Exercise in Relation to Cause-Specific Mortality

Alpa V. Patel[1], Erika Rees-Punia[2], James M. Hodge[1], Lauren R. Teras[1], Peter T. Campbell[1], Susan M. Gapstur[1]. *[1]American Cancer Society, Atlanta, GA. [2]University of Georgia, Athens, GA.*

*(No relevant relationships reported)*

BACKGROUND: Physical activity guidelines recommend that all adults engage in at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity (MVPA) per week, and also state that adults should engage in muscle-strengthening activity (MSA) two or more times per week. While many studies have examined the association between aerobic MVPA and mortality, few have examined the association between MSA independent of or in combination with aerobic MVPA and mortality.
PURPOSE: To examine the role of MSA in relation to mortality independent of, and in combination with, MVPA.
METHODS: Data from 72,440 men and women enrolled in the Cancer Prevention Study-II Nutrition Cohort who completed a lifestyle and medical survey (including information on MVPA and MSA) in 2001 were available for analysis. Multivariable Cox proportional hazards regression modeling was used to compute hazard ratios (HR) and 95% confidence intervals (CI) to examine the association between MSA (none versus any) and total mortality. In addition, effect modification by MVPA (<8.75, 8.75-<17.5, and 17.5+ MET-hours per week) and body mass index (BMI, kg/m$^2$: normal weight 18.5-24.9, overweight 25.0-29.9, obese 30.0+) was examined.
RESULTS: During 12 years of follow-up (2001-2013), 18,023 deaths occurred. After adjusting for MVPA and other potential confounders, engaging in any MSA was associated with a modest, albeit statistically significant, lower risk of total mortality compared to no MSA (HR=0.93, 95% CI 0.89-0.98). Associations were similar when examining cardiovascular disease and cancer-specific mortality. There was no evidence of effect modification by MVPA (interaction p=0.66). The association between MSA and mortality was limited to normal weight individuals (HR=0.88, 95% CI 0.83-0.94), with no association among overweight (HR=0.97, 95% CI 0.90-1.05) or obese (HR=1.03, 95% CI 0.91-1.17) individuals (p for interaction=0.05).
CONCLUSIONS: Engaging in any MSA as part of a physical activity regimen is associated with a modest mortality benefit, regardless of aerobic MVPA participation. MSA may have a greater reduction in risk of normal weight vs overweight or obese individuals.
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2063 Board #6 June 1 9:30 AM - 11:30 AM

## Strength Training in Older Cancer Survivors in Pennsylvania: What Role Does Multimorbidity Play?

Shirley M. Bluethmann, Wayne Foo, Joachim Wiskermann, Scherezade K. Mama, William Calo, Kathryn H. Schmitz, FACSM. *Penn State College of Medicine, Hershey, PA.*
(Sponsor: Kathryn Schmitz, FACSM)

*(No relevant relationships reported)*

**Background:** Older survivors experience physical deterioration from aging and cancer treatment. Strength training (ST) may mitigate symptoms but is underutilized. The extent to which physical limitations from chronic conditions ("multimorbidity") affect ST participation in older survivors is not well known. The purpose of this paper is to: 1) describe ST participation among older cancer survivors (≥55 years) by cancer site and; 2) assess the relationship of multimorbidity and ST in older cancer survivors.
**Methods:** We analyzed data from older survivors (n=485), identified from the Pennsylvania Cancer Registry, who were mailed a BRFSS-based questionnaire. Per ACSM guidelines, we operationalized ST participation as ≥2 sessions/week. We created age-groups (e.g., 55-64, 65-74, 75+) and a composite score of 7 common conditions (e.g., COPD, heart disease) to assess multimorbidity. Logistic regression estimated the association of demographic and behavioral risk factors (e.g., multimorbidity) with ST participation.
**Results:** Most respondents were female (62%), older (mean 69 years; range 55-95 years) and represented diverse cancer sites, including breast (n=106), gynecologic (n=99), prostate (n=119), colorectal (n=90) and lung (n=71) cancer survivors. ST participation was generally low; 75% of survivors reported no ST. Among those reported doing ST, survivors reported a mean ST frequency of 2.8 times/week (SE 2.8; CI 2.5,3.8), varying by cancer site/age. Gynecologic (OR=0.10, p<.05; CI 0.107-1.01) and prostate cancer survivors (OR=0.10, p<.05; CI 0.01, 0.95) were less likely to report doing ST than breast cancer survivors. We observed that older survivors with 3 comorbid conditions were less likely (OR=0.23, p=.10; CI 0.43,1.32) than survivors with fewer conditions to do ST, controlling for covariates.
**Conclusion:** Uptake of recommended ST is suboptimal in older survivors. Older gynecologic and prostate survivors, and those with greater multimorbidity (i.e. score=3) may have greater difficulty achieving recommended ST than survivors of other sites or with less comorbidity. Designing interventions for survivors with unique barriers, such as gynecologic and prostate cancer survivors and those with greater multimorbidity, may help these older survivors to use ST to improve symptoms and quality of life.

2064 Board #7 June 1 9:30 AM - 11:30 AM

### Muscle Strength And Prevalence Of Diabetes, A Cross-sectional Study Among Japanese Men

Rumi Miyamoto[1], Susumu S. Sawada, FACSM[2], Yuko Gando[2], Munehiro Matsushita[3], I-Min Lee, FACSM[4], Steven N. Blair, FACSM[5], Shingo Muranaga[1], Yumiko Osawa[1], Kaori Ishii[6], Kohichiro Oka[6]. *[1]Kameda Medical Center, Kamogawa, Chiba, Japan. [2]National Institutes of Biomedical Innovation, Health and Nutrition, Tokyo, Japan. [3]Dokkyo Medical University, Tochigi, Japan. [4]Harvard Medical School, Boston, MA. [5]University of South Carolina, Columbia, SC. [6]Waseda University, Saitama, Japan.*

*(No relevant relationships reported)*

Some studies report that there is an inverse relationship between muscle strength and the prevalence of diabetes. However, limited data are available on this relationship among Japanese.
**PURPOSE:** To investigate the relationship between muscle strength measured by a very simple one-leg-stand-up (from a 40cm high seat) test and the prevalence of diabetes among Japanese men.
**METHODS:** This cross-sectional analysis was conducted in 1,674 Japanese men [median (inter quartile range) age 61 (55-67) years] who completed health examinations and a one-leg-stand-up test. Smoking and drinking habits were collected via a self-administered questionnaire. The prevalence of diabetes, defined as fasting plasma glucose ≥126 mg/dL and/or hemoglobin A1c ≥6.5% and/or self-reported physician-diagnosed diabetes, was evaluated. Odds ratios and 95% confidence intervals for the prevalence of diabetes were obtained using logistic regression models to assess the relationship between muscle strength and the prevalence of diabetes.
**RESULTS:** In total, 187 participants had diabetes, and 467 participants could not stand up from a 40cm high seat. Using men who could stand up as reference, the age-adjusted odds ratio of diabetes for men who could not stand up was 1.44 (1.06-1.94). After adjustment for age, smoking and drinking, the multivariable odds ratio was 1.43 (1.05-1.93). With additional adjustment for body mass index, the multivariable odds ratio was 1.26 (0.92-1.71).
**CONCLUSION:** Low muscle strength measured by a very simple fitness test was associated with a higher prevalence of diabetes among Japanese men. This association was mediated in part by body mass index.

2065 Board #8 June 1 9:30 AM - 11:30 AM

### Muscular Strength and Cardiorespiratory Fitness on Osteopenia in Older Adults

Hyun Soo Kim, Nathan Meier, Duck-chul Lee, FACSM. *Iowa State Univrsity, Ames, IA.* (Sponsor: Duck-chul Lee, FACSM)

*(No relevant relationships reported)*

**Purpose** To examine the independent associations of muscular strength (MS) and cardiorespiratory fitness (CRF) with the prevalence of osteopenia in older adults.
**Methods** This cross-sectional study consisted of 127 men and 177 women aged ≥65 years old (mean age 74) from the Physical Activity and Aging Study (PAAS). MS was assessed by 1-repetition maximum (1-RM) leg press (lbs) and CRF was assessed by time (minutes) to complete a 400-meter walk test. Both MS and CRF were categorized into four groups based on the sex-specific quartiles of each MS and CRF. Bone mineral density was assessed by dual-energy X-ray absorptiometry (DXA), and osteopenia (pre-osteoporosis stage) was defined as t-score below -1.0 following the World Health Organization guidelines. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated using logistic regression to determine the independent associations of MS and CRF with the prevalence of osteopenia.
**Results** The prevalence of osteopenia was 45.4% in this study. Compared to the lower MS quartile 1 (lowest 25%), ORs (95% CIs) of osteopenia in MS quartiles 2, 3, and 4 were 0.75 (0.36-1.58), 0.33 (0.15-0.73), and 0.25 (0.11-0.59), respectively, after adjusting for age, sex, heavy alcohol consumption (>14 drinks per week for male, >7 for female), smoking status, physical activity, and CRF. However, we found that CRF was not significantly associated with the prevalence of osteopenia after adjusting for the confounders including MS in this study (trend P=0.19). In the stratified analysis by CRF, we found that higher MS was significantly associated with lower prevalence of osteopenia in both low CRF (lower 50%) (trend P=0.02) and high CRF (higher 50%) (trend P=0.03) after adjusting for age, sex, heavy alcohol consumption, smoking status, and leisure-time physical activity.
**Conclusion** Higher MS, independent of CRF, was associated with a lower prevalence of osteopenia in older adults. However, prospective studies are required to make causal inferences between MS, independent of and combined with CRF, and the development of osteopenia and osteoporosis in older adults.

## E-07 Thematic Poster - Nutritional Status of Athletes I

Friday, June 1, 2018, 9:30 AM - 11:30 AM
Room: CC-Lower level L100E

2066 **Chair:** Floris Wardenaar. *Arizona State University, Phoenix, AZ.*

*(No relevant relationships reported)*

2067 Board #1 June 1 9:30 AM - 11:30 AM

### Effects Of A Ketogenic Diet On Triathlon's Athletes Performance: A Pilot Trial.

Antonio Paoli, Davide Grigoletto, Fabio Zambolin, Giuseppe Marcolin. *University of Padova, Padova, Italy.*

*(No relevant relationships reported)*

**PURPOSE** Sport nutrition guidelines support the idea that carbohydrates (CHO) are fundamental for performance, mainly for endurance. However recently published studies on long distance athletes suggested some advantages of a low CHO, high fat approach, i.e. ketogenic diets. We aimed to investigate the effects of ketogenic diet (KD) on triathlon athletes. :
**METHODS**: Sixteen expert athletes (age 30.67±10.46 yrs) were enrolled in the pilot trial. Eight athletes followed a ketogenic diet (KD) for 5 weeks whilst other eight followed a standard western diet (WD). Subjects were tested for maximal oxygen consumption ($VO_2$max), peak power output (PPO), respiratory ratio (RR), heart rate, $VO_2$, and blood lactate during one hour cycloergometer test at 45% of PPO, and body composition through electrical impedance (BIA). A two way ANOVA treatment x time test was performed.
**RESULTS**: After 5 weeks subjects in the KD group showed a significant increase of $VO_2$max ($mlO_2xKg^{-1}xmin^{-1}$) 35.68±3.86 to 36.6±5.1; a significant increase of PPO (140±5.29 to 145±9), a significant decrease of fat mass (from 10.28±3.04 to 7.86±2.53 Kg), lactate (from 2.02±0.7 to 1.2±0.6) and of RR (from 0.86±0.03 to 0.79±0.01). No changes of lean body mass and time to exhaustion were detected.
**CONCLUSIONS**: Our data suggest that a ketogenic diet performed for a sufficient time (> 4 weeks) could improve some parameters related to performance in high level triathlon athletes

2068 Board #2 June 1 9:30 AM - 11:30 AM

### Comparative Analysis of the Gut Microbiota and Acute Changes in Exercise Among Collegiate Swimmers

Jarrad T. Hampton-Marcell. *University of Illinois at Chicago, Chicago, IL.*

*(No relevant relationships reported)*

**ABSTRACT**
**Background**: Numerous physiological responses occur due to changing energy demands induced by exercise training, including changes in substrate sensing and utilization in the gastrointestinal tractn and extracellular sensing to optimize substrate availability. The gut microbiota can contribute up to 10% of the host's energy demand via short-chained fatty acid production and modulate intestinal permeability and signaling. The interaction between gut microbiota and exercise is poorly understood.
**Purpose**: Characterize the gut microbiota in collegiate swimmers whom undergo a sequentially reduced volume of training.
**Methods**: Fecal samples, body composition (air displacement plethysmography) and training logs were collected from Division I NCAA collegiate swimmers for six consecutive weeks for 2016 (n = 9) and 2017 (n = 7), starting just before the taper and proceeding into the off-season. The fecal microbiota was characterized with shotgun metagenomics sequencing followed by multivariate statistical analysis using Qiime v1.9.1 and R programming language. Permutational ANOVAs, supervised learning and Bayesian modeling was used to determine significance ($p < 0.05$) of host-microbe interactions.
**Results**: Systematic reduction in practice volume from Phase 1 (mean = 23.7 km/wk) to Phase 3 (mean = 13.9 km/wk) did not show any significant shifts in body composition ($p > 0.05$). Yet the microbial community showed a moderate but significant shift in structure (Adonis, $p < 0.05$, $R = 0.154$) and predicted function (Adonis, $p < 0.05$, $R = 0.352$). During high levels of practice volume, swimmers were dominated by the Clostridiales order of Firmicutes. Despite interpersonal variation in community composition, its temporal shift was largely explained by Clostridium Cluster IV and XIVa, which are known short-chained fatty acid producers.
**Conclusion**: Acute reduction in exercise among collegiate athletes significantly shifts the sub-phylum of specific Clostridiales in gut microbiota, possibly due to reduced exercise volume or requisite alterations in the diet.

2069 Board #3 June 1 9:30 AM - 11:30 AM

### Describing Weight Regain Methodologies of Male Competitive Natural Bodybuilders

Venny Lalu, Diane DellaValle. *Marywood University, Scranton, PA.*

*(No relevant relationships reported)*

PURPOSE: Research focusing on bodybuilding training and nutrition strategies is limited and no research has attempted to examine weight regain strategies in these athletes. Due to this limited research, contemporary bodybuilding protocols are often based on anecdote and self-trial. This study will provide information for future research that may lead to evidence based strategies for coaches and athletes. The purpose of this cross-sectional study was to describe demographic characteristics and weight regain methodologies of male, competitive, natural bodybuilders.
METHODS: Recruitment was conducted via social media posts. Participants were invited to complete an online survey that included health and demographic information, dietary supplement use, and recreational and performance enhancing drug use. Bodybuilding training and competition information included weight regain methodology, and training phase-related weight loss and gain information. Body Mass Index (BMI) was calculated based on self-reported height and weight.
RESULTS: Participants included 24 male natural bodybuilders (Age 28.3±6.6 years, 100% male, 77.8% white). The average BMI of the sample was 25.9±6.6. Participants reported using an average of 5.9±2.9 supplements during the offseason, 6.2±2.9 during contest preparation, and 5.4±2.8 during the recovery period. The majority of the sample (85.2%) reported being amateur competitors, and 48.1% of participants reported previously competing in 1-2 bodybuilding competitions. Participants reported an average contest preparation length of 152.3±95.3 days, and an average competitive season of 40.4±42.5 days. 62.9% of participants reported losing > 25 lbs during contest preparation while weight gain varied from ≤10lbs to ≥35lbs. Participants reported using the reverse dieting method of weight regain most often in the past (48.1%).
CONCLUSION: This study is the first to describe the weight regain methods of male, natural, bodybuilders and allows for further exploration of this understudied population's nutritional strategies. The current study allows for future research to be conducted which may inform coaches and athletes of the safest and most effective methods for constructing individualized dietary and training protocols.

2070 Board #4 June 1 9:30 AM - 11:30 AM

### Physical Performance is not Improved with Vitamin D Repletion

Shane D. Scholten[1], Mikenzie Mikkelson[2], Jesse Springer[3], Cortney Dowling[4], Nathan Lucs[5]. *[1]Augustana University, Sioux Falls, SD. [2]Black Hills State University, Spearfish, SD. [3]University of Sioux Falls, Sioux Falls, SD. [4]Liberty University, Lynchburg, VA. [5]Des Moines University, Des Moines, IA.* (Sponsor: Sherry Barkley, PhD, FACSM)

*(No relevant relationships reported)*

Vitamin D insufficiency is associated with impaired physical performance in physically active adults. Vitamin D repletion could have a positive effect on neuromuscular function, which could increase physical performance. **PURPOSE:** This study assessed the role of vitamin D repletion on markers of anaerobic performance in physically active adults. **METHODS:** 16 physically active participants (5 insufficient/deficient participants with vitamin D<75 nmol/L, 11 sufficient participants with vitamin D>75 nmol/L) participated in a double blind study to assess anaerobic fitness (vertical jump, hand grip strength, 10 meter sprint, and Wingate bike test). Anaerobic fitness was assessed pre and post 8 weeks supplementation. Vitamin D insufficient/deficient participants were given doses sufficient to reach 120 nmol/L while sufficient participants received a placebo. All liquid supplements were prepared by a local pharmacy. **RESULTS:** The vitamin D group significantly increased vitamin D status (64.2 to 135.6 nmol/L, p<0.01) compared with the placebo (115.4 to 110.2 nmol/L). Vitamin D repletion was not found to significantly improve any of the anaerobic performance tests (p>0.05). **CONCLUSION:** This investigation demonstrated a lack of effectiveness for vitamin D repletion on markers of anaerobic performance in physically active adults. Supported by NIH grant P20GM103443.

| Performance data. None of the variables were significant at the p>0.05 level. | | |
|---|---|---|
| | Pre-supplement | Post-supplement |
| 10 meter sprint (s) | | |
| Vitamin D | 2.00 + 0.14 | 2.01 + 0.15 |
| Placebo | 2.04 + 0.09 | 2.08 + 0.15 |
| Vertical Jump (cm) | | |
| Vitamin D | 63.50 ± 11.91 | 62.03 ± 14.58 |
| Placebo | 61.84 ± 11.22 | 61.97 ± 11.86 |
| 30 second Wingate (avg watts) | | |
| Vitamin D | 613.72 ± 58.35 | 608.02 ± 91.59 |
| Placebo | 567.47 ± 146.88 | 555.81 ± 235.88 |
| Hand Grip (kg) | | |
| Vitamin D | 54.70 ± 11.12 | 56.78 ± 9.51 |
| Placebo | 50.05 ± 14.553 | 49.10 ± 11.06 |

2071 Board #5 June 1 9:30 AM - 11:30 AM

### Antioxidant Intake, Adiposity, And Aerobic Capacity In An Athlete Population

Emily N. Werner[1], Sinclair A. Smith[2], Janell Mensinger[3], Brandy-Joe Milliron[3], Heather H. Betz[4], Stella L. Volpe, FACSM[3]. *[1]Michigan State University, East Lansing, MI. [2]Drexel University, Phildelphia, PA. [3]Drexel University, Philadelphia, PA. [4]Albion College, Albion, MI.* (Sponsor: Stella L. Volpe, FACSM)

*(No relevant relationships reported)*

Dietary intake, body composition, and aerobic capacity contribute to an athlete's performance.
**PURPOSE:** To evaluate relationships among antioxidant intake, adiposity, and aerobic capacity, and determine what characteristics have the greatest relationship with aerobic capacity in an athlete population. **METHODS:** Athletes defined as ≥18 years of age and exercising ≥ twice weekly were recruited. Measurements included days of self-reported physical activity per week, height, body weight, body mass index, and waist circumference. Percent body fat (PBF), lean body mass, and fat-free mass were measured via dual-energy X-ray absorptiometry. Maximal oxygen consumption ($VO_2$max) was analyzed using indirect calorimetry. Kilocalorie, macronutrient (carbohydrate, protein, fat), and antioxidant (β-carotene, vitamins A, C and E, iron, zinc, copper, and selenium) intakes were self-reported via Block 2005 Food Frequency Questionnaires. Antioxidants were analyzed as percentages of the Recommended Dietary Allowance. Bivariate Pearson Product Moment correlations were conducted to explore relationships among antioxidant intake, adiposity and aerobic capacity. A backwards multiple regression was used to determine which characteristic(s) had the strongest relationship with $VO_2$max. **RESULTS:** Thirty-two athletes (n=17 women, n=15 men; 35.7 ± 11.3 years of age) were measured. There were no differences between antioxidant intake and adiposity or aerobic capacity. There were significant negative relationships between PBF and $VO_2$max for women and men combined (p<0.001), as well as women (p = 0.013), and men (p=0.013), respectively. The backwards regression showed PBF (B = -0.504, p<0.001), vitamin C intake (B = -0.492, p=0.063), and vitamin E intake (B = 2.055, p=0.154) combined explained approximately 51% of the variance in $VO_2$max [$R^2$ = 0.514, F(3,28) = 0.9.853, p<0.001]. After excluding vitamin C and vitamin E from the model, PBF alone explained 41% of the variance in $VO_2$max [B = -0.493, p<0.001; $R^2$ = 0.442, F(1, 30) = 23.799, p<0.001]. **CONCLUSION:** Percent body fat alone, or combined with vitamins C and E, may have a substantial relationship with $VO_2$max. Further research should consider antioxidant intake and body composition in the investigation of the nutrition-related exercise benefits.
This research was unfunded.

2072 Board #6 June 1 9:30 AM - 11:30 AM

### Relationship between In-Race Nutrition and Experience Level on Overall Finish Time for Ironman Triathletes

Stephanie Harpenau, Elaina Biechler. *Loras College, Dubuque, IA.* (Sponsor: Vincent Paolone, FACSM)

*(No relevant relationships reported)*

Nutrition and experience level of triathletes are two factors that can affect overall finish time in an Ironman triathlon. While there appears to be a dose-response relationship between in race calories consumed and Ironman performance, there is little to no current research linking this with the experience level of the triathletes. **PURPOSE**: The purpose of the present investigation is to determine the relationship between years participating in triathlon, calories per hour on the bike, and overall ironman finish time.

**METHODS**: Ironman triathletes (n=152) were surveyed at Ironman Wisconsin and Ironman World Championships to determine their in-race nutrition strategy and years of experience in triathlon. A multivariate regression was used to determine if there was a relationship between years participating in triathlon, calories per hour consumed on the bike, and overall ironman finish time. **RESULTS**: The overall regression model was statistically significant F(8, 284)= 2.27, p < .05. Tukey's HSD post-hoc test revealed that the number of years in triathlon was not a significant predictor of finish time (p= .836), however the number of years in triathlon was uniquely significant in the prediction of calories consumed per hour on the bike (p < .05). **CONCLUSIONS**: Although there was no relationship between number of years in triathlon and overall finish time, there was a significant relationship between number of years in triathlon and prediction of calories consumed per hour on the bike. This suggests that the more experienced Ironman triathletes consumed more calories per hour on the bike.

2073 Board #7 June 1 9:30 AM - 11:30 AM

### Longitudinal Changes in Vitamin D and Body Composition in NCAA D1 Male Basketball Players

Carolyn Aprik[1], Terry Sauerbry[1], Lorenzo DiPace[1], Brigid Byrd[2], Lisa DeCeuninck[1], Barb Ledin[3], Tamara Hew-Butler, FACSM[1]. *[1]Oakland University, Rochester, MI. [2]Wayne State University, Detroit, MI. [3]Crittenton Hospital, Rochester, MI.* (Sponsor: Dr. Tamara Hew-Butler, FACSM)

*(No relevant relationships reported)*

Quantification of body composition changes with seasonal Vitamin D changes is not well-described. **PURPOSE**: To: 1) assess longitudinal changes in total body fat, lean, and bone tissue mass over 10-months and 2) explore relationships between Vitamin D, body composition, diet and sun exposure. **METHODS**: Male collegiate basketball players underwent dual energy x-ray absorptiometry (DXA) scans on four occasions: December 2016 (Start); April 2017 (End); July 2017 (Start Weights); October 2017 (End Weights) to quantify total body fat, lean, and bone mass. Blood was collected on 3 occasions (End; Start Weights; End Weights) and analyzed for serum 25-hydroxy vitamin D (25-OH-D). Food frequency questionnaires completed twice (Start and End Weights) with subjective reporting of sun exposure throughout weight-training. **RESULTS**: 11 (7 African-American) completed testing (age 20±1years; BMI 24.0±1.7kg/m$^2$). Non-significant (NS) changes noted in total body fat percentage, which was lowest at End (16.1±2.1; 15.5±1.8; 16.6±2.2; 15.8±2.0%) and lean mass which was highest at End Weights (70.4±9.5; 71.4±9.1; 70.8±9.1; 74.3±9.3kg) while bone mineral density (BMD) increased steadily over time (1.33±0.10; 1.34±0.13; 1.35±0.12; 1.36±0.12g/cm$^2$); (Start; End; Start Weights; End Weights, respectively). Serum 25-OH-D levels were deficient (<20ng/mL) at End (18.9±7.3ng/mL) but replete at Start Weights (32.2±12.8ng/mL) and End Weights (32.2±7.7ng/mL). African-American players spent less hours per week in the sun vs Caucasian players (6.5±2.3 vs. 11.2±3.7 hours/week; p=0.02) and ingested less Vitamin D in their diet (135.9±58.6 vs. 207.0±70.4; p=0.10)(African-American vs. Caucasian, respectively). Start Weight serum 25-OH-D levels significantly associated with: End Weight minus Start Weight (Δ) total fat mass (r=0.69;p=0.02), dietary sodium intake (r=0.65;p=0.04), and dietary iron intake (r=0.89;p=0.001). **CONCLUSION**: Collegiate male basketball players living in the Midwest (latitude 42°) demonstrate serum 25-OH-D deficiency at the end of the competitive season, but are replete (>30ng/mL) during summer training. Mild (NS) fluctuations in body composition occurred, with increased fat while detraining and increased lean mass with strength training. BMD increased despite seasonal variation in serum 25-OH-D.

2074 Board #8 June 1 9:30 AM - 11:30 AM

### Exploration of the Influences on Food Choices by a Culturally Diverse Cohort of International Athletes

Rachael Thurecht, Fiona Pelly. *University of the Sunshine Coast, Sippy Downs, Australia.*

*(No relevant relationships reported)*

Optimised nutrition and hydration can have a substantial effect on athletic performance, recovery and weight goals. However, an athlete's food selection may not be ideally matched to performance goals due to the various influences that drive food choice. **PURPOSE:** The aim of this study was to administer a preliminary Athlete Food Choice Questionnaire (AFCQ) with a diverse international athlete population. Objectives 1) to identify the factors that are frequently influencing athletes' food choices; 2) to investigate if frequently reported influences vary between athlete cohorts based on gender, sport and nationality. **METHODS:** The AFCQ was developed for the purpose of this study based on existing literature and input from sports nutrition experts. This consisted of demographic questions, and a 5-point Likert scale question comprising 84 factors possible of influencing food choice, organized into 10 groupings. Athletes living in the athlete's village at the 2017 Universiade were invited to complete an AFCQ. Kruskal-Wallis ANOVA and the Bonferroni adjusted Mann-Whitney U test were used to examine associations between variables. Only Performance group factors are presented here. **RESULTS:** A total of 156 AFCQ were received (41.6% male, 58.4% female, age *M*=21.5 ± 2.3 years). Athletes were from 31 (24.4%) attending countries and 17 (77.3%) competing sports. The top three influential factors were from the Performance group, the number one was "*My need to fuel my body for competition*" (*M*= 4.25 ± 0.8). Across all sporting types, country regions and gender either the Sensory Attributes or Performance groups ranked as the top factors frequently influencing athletes' food choices. Athletes in athletics or swimming were more frequently (*Mdn*= 5) influenced by their need to fuel their body for training than those in team sports (*Mdn*= 4), *U*= 952.5, *p*<0.003, *r*= 0.3, or skill-based and racquet sports (*Mdn*= 4), *U*= 117.5, *p*<0.001, *r*= 0.4. **CONCLUSION:** The results of this study will help inform the development of a validated food choice questionnaire for athletes and provide information to assist those working with athletes from a variety of sports and countries to deliver suitable advice for fuelling performance and recovery. Supported with funding from the event organisers and caterers of the 2017 Universiade athletes' village dining hall.

## E-08 Thematic Poster - O2 Uptake Kinetics

Friday, June 1, 2018, 9:30 AM - 11:30 AM
Room: CC-Lower level L100F

2075 **Chair:** John M. Kowalchuk. *University of Western Ontario, London, ON, Canada.*

*(No relevant relationships reported)*

2076 Board #1 June 1 9:30 AM - 11:30 AM

### A Nonlinear Dynamics Approach To Oxygen, Ventilation, and Heart Rate Dynamics During Exercise In Young Adults

Nathaniel T. Berry[1], Jessica Dollar[1], Lily Shanahan[2], Susan D. Calkins[1], Susan P. Keane[1], Laurie Wideman, FACSM[1]. *[1]University of North Carolina at Greensboro, Greensboro, NC. [2]University of Zurich, Zurich, Switzerland.* (Sponsor: Laurie Wideman, FACSM)

*(No relevant relationships reported)*

Fitness induced adaptations, such as changes in oxygen uptake ($VO_2$), respiration, and cardiac autonomic regulation are known to occur at rest and during exercise following endurance training. For example, submaximal intensities are associated with reductions in $VO_2$ per workload, reductions in heart rate (HR), and reductions in ventilation ($V_E$) while maximal intensities are associated with increases in $VO_2$ and $V_E$. However, less is known about the breath-by-breath dynamics of $VO_2$ and $V_E$ during exercise with changes in cardiac autonomic regulation in relation to fitness. **PURPOSE** To investigate the influence of gender, body fat (BF) and maximal $VO_2$ ($VO_{2max}$) on the breath-by-breath dynamics of $VO_2$ and $V_E$, as well as HR variability (HRV), during an incremental treadmill test to exhaustion. **METHODS** Breath-by-breath $VO_2$ and $V_E$, as well as continuous R-R intervals were collected throughout an incremental treadmill test for N=39 individuals (Males: n=20; height=177±8 cm, weight=79±18 kg; BF=18±9%; $VO_{2max}$=54±9 ml/kg/min – Females: n=19; height=164±6 cm, weight=74±21 kg; BF=33±12%; $VO_{2max}$=36±10 ml/kg/min). Individual time-series were fit using polynomial regression models. The residuals from these models were used to detrend the data. The standard deviation of normal intervals (SDNI), root mean square of successive differences (rMSSD), and sample entropy (SampEn) of the residuals were calculated and relations among these variables with gender, BF, and $VO_{2max}$ were analyzed using multivariate analysis of variance. **RESULTS** There were statistically significant differences in the variability around the increase in physiological demands of incremental exercise (SDNI; rMSSD) based on Gender (p<0.001; p=0.004), BF (p<0.001; p=0.002), and $VO_{2max}$ (p=0.05; p=0.04). However, the complexity (SampEn) surrounding the increase in $VO_2$, $V_E$, and HRV dynamics during incremental exercise were not different based on gender, BF, or $VO_{2max}$. **CONCLUSIONS** The variability surrounding the increasing physiological demands (specifically, $VO_2$ and $V_E$) of incremental exercise appear to be differentially affected by gender, BF, and fitness. Better understanding these relationships may provide important information about how chronic stimuli, such as training or disease, impact the dynamics of the system.
Funded by NICHD R01HD078346

2077 Board #2 June 1 9:30 AM - 11:30 AM

### Dynamics of Skeletal Muscle Interstitial $PO_2$ During Recovery from Contractions

Daniel M. Hirai, Trenton D. Colburn, Jesse C. Craig, Ayaka Tabuchi, Timothy I. Musch, FACSM, David C. Poole, FACSM. *Kansas State University, Manhattan, KS.* (Sponsor: David C. Poole, FACSM)

*(No relevant relationships reported)*

The oxygen partial pressure in the interstitial space ($PO_2$is) drives $O_2$ diffusion into the myocyte thus supporting oxidative phosphorylation. Although crucial for metabolic recovery and the capacity to perform repetitive tasks, the time course of skeletal muscle $PO_2$is during recovery from contractions remains unknown. **PURPOSE:** To resolve the temporal profile and determine model parameters of $PO_2$is off-kinetics after cessation of contractions in healthy skeletal muscle. We tested the hypothesis that $PO_2$is would recover to resting values and display considerable on-off asymmetry (fast on- and slow off-kinetics) reflective of slower microcirculatory $O_2$ delivery relative to muscle $O_2$ utilization dynamics in recovery. Microvascular $PO_2$ ($PO_2$mv) was also evaluated to test the hypothesis that a significant transmural gradient ($\Delta PO_2$=$PO_2$mv-$PO_2$is) would be sustained during recovery. **METHODS:** $PO_2$mv and $PO_2$is were determined via phosphorescence quenching (Oxyphor probes G2 and G4, respectively) in the exposed rat spinotrapezius muscle during and after contractions (1 Hz, 6 V, 3 min per transition; n=12). **RESULTS:** Muscle $PO_2$is rose progressively ($p<0.05$) from an end-contraction value of 11.2±1.5 to 17.6±2.2 mmHg at the end of the recovery period, which was not different from resting $PO_2$is (17.8±1.9 mmHg; $p>0.05$). $PO_2$is off-kinetics were slower than on-kinetics (mean response time: 49.3±12.4 vs. 19.2±2.5 s, respectively; $p<0.05$). A significant transmural $\Delta PO_2$ observed at the end of contractions (17.7±2.7 mmHg) was maintained throughout the recovery period (end-recovery: 19.3±4.5 mmHg; $p>0.05$). **DISCUSSION:** Consistent with our hypotheses, skeletal muscle $PO_2$is recovered back to resting values with slower off-kinetics compared to the on-transient in line with the on-off asymmetry for capillary hemodynamics. Maintenance of a substantial transmural $\Delta PO_2$ during recovery supports that the microvascular-interstitium interface provides considerable resistance to $O_2$ transport. As dictated by Fick's law ($VO_2$=$DO_2$*$\Delta PO_2$), modulation of $O_2$ flux during and following contractions ($VO_2$) must be achieved via corresponding changes in effective diffusing capacity ($DO_2$; mainly capillary red blood cell hemodynamics and distribution) in the face of unaltered $\Delta PO_2$. Funding: NIH HL-2-108328

2078 Board #3 June 1 9:30 AM - 11:30 AM

### Different Central Hemodynamic Response Among Patients with Incomplete Spinal Cord Injury

Monira I. Aldhahi, Lisa MK Chin, Randall E. Keyser, FACSM, Andrew A. Guccione. *George Mason University, Fairfax, VA.*

*(No relevant relationships reported)*

The cardiovascular response to physical activity is largely regulated by the autonomic nervous system. Sympathetic innervation of the heart originates between segments T1-5, while innervation originating between segments T6-L2 affects vascular response. Injury to the spinal cord induces loss of supraspinal sympathetic control over the cardiovascular system, which may culminate in blunted speed and magnitude of central hemodynamic responses during transitions in metabolic demand. **Purpose:** To investigate the cardiac output (Qt) response in relation to oxygen consumption ($VO_2$) in patients with incomplete spinal cord injury (iSCI). **Methods**: We tested 11 subjects in 3 groups: Tetraplegic group (TG, n=4, 41 ± 21 years); Paraplegic group (PG, n=4, 47 ± 19 years) and healthy controls (HC; n=3, 27 ± 8 years). Each group performed a constant-workload test on the treadmill at a self-selected walking speed. Qt and $VO_2$ were measured simultaneously by impedance cardiography and pulmonary gas exchange analysis. **Results**: Despite HC walking at a greater speed (1.5 mph vs. TG at 0.6 mph and PG at 1.0 mph), there was no difference in Qt or $VO_2$ amplitude amongst the groups. Qt kinetics (reported as the time constant, τ) was longer ($p<0.05$) in TG (45 ± 21s) compared to either PG or HC (17±4s; 6±5s, respectively). Phase 2 $VO_2$ on-kinetics were not different among the groups (TG, 33±30s; PG, 25±20s; HC, 20±6s). The ratio of $\tau Qt/\tau VO_2$ was poor (>1.0) in only TG, however was correlated ($r = 0.96$, $p = 0.002$) with the responsiveness of the oxidative metabolic system ($\Delta VO_2/\tau VO_2$) across all groups. **Conclusion:** Sympathetic innervation appears to influence the temporal profile of Qt depending on the level of lesion. Tetraplegics demonstrated slower Qt adjustment to increased metabolic demand compared to paraplegics. The slow increase in Qt relative to $VO_2$ observed in tetraplegics suggests poor matching between central hemodynamics and metabolic demand in those with a higher level of injury. SCI elicits a lesion-dependent impairment in Qt kinetic profiles that may contribute to oxygen delivery to utilization mismatch occurring during walking in people who have incomplete cervical injury.

2079 Board #4 June 1 9:30 AM - 11:30 AM

### Predicting Oxygen Uptake Responses During Cycling Using an Artificial Neural Network

Andrew Borror[1], Michael Mazzoleni[2], James Coppock[3], Brian Mann[4], Claudio Battaglini, FACSM[1]. *[1]The University of North Carolina at Chapel Hill, Chapel Hill, NC. [2]Under Armour Inc., Baltimore, MD. [3]The University of North Carolina at Greensboro, Greensboro, NC. [4]Duke University, Durham, NC.* (Sponsor: Dr. Claudio Battaglini, FACSM)

*(No relevant relationships reported)*

PURPOSE: Oxygen Uptake ($VO_2$) is a valuable metric for the prescription of exercise intensity and the monitoring of training progress. However, $VO_2$ is difficult to measure in a non-laboratory setting. Conversely, heart rate (HR), which is intrinsically linked to $VO_2$, is an easily obtained measure. Recently, $VO_2$ predictions have been made during steady-state exercise using an artificial neural network (ANN). However, these previous models incorporated protocol-specific variables, making them unable to accurately estimate $VO_2$ during arbitrary exercise intensities. Therefore, the purpose of this study was to predict $VO_2$ during different exercise intensities with an ANN using HR and exercise intensity data. METHODS: 12 moderately-active adult males (age: 21.1 ± 2.5 years) performed a 50-minute bout of cycling at a variety of exercise intensities. $VO_2$, HR, power output, and cadence were recorded throughout the test. An ANN was trained, validated and tested using the following inputs: HR, time derivative of HR, power output, cadence, and body mass. RESULTS: The ANN accurately predicted the experimental $VO_2$ time series values throughout the test ($R^2$ = 0.95, SEE = 1.7 mL/kg/min). CONCLUSIONS: The predictive accuracy of this ANN is promising considering the large range of intensities and long duration of exercise. Future applications of this method could allow athletes to have accurate real-time $VO_2$ predictions during exercise, improving the accuracy of training intensity.

2080 Board #5 June 1 9:30 AM - 11:30 AM

### Recovery Interstitial $PO_2$ Dynamics Following Contractions in Healthy Skeletal Muscle of Different Oxidative Capacity

Trenton D. Colburn, Jesse C. Craig, Daniel M. Hirai, Timothy I. Musch, FACSM, David C. Poole, FACSM. *Kansas State University, Manhattan, KS.* (Sponsor: Timothy I. Musch, FACSM)

*(No relevant relationships reported)*

The recovery of skeletal muscle from repetitive tasks is dependent, in part, on adequate $O_2$ delivery and blood-mitochondrial $O_2$ diffusion. Key steps in this pathway include the microvascular and interstitial space (is) and novel use of specific phosphorescence probes allow measurements of $O_2$ partial pressures ($PO_2$) at those sites near the myocytes. Given the disparate contribution of nitric oxide (NO) between fiber types we sought to resolve how NO impacts $PO_2$is in recovery following rhythmic muscle contractions. **PURPOSE**: To determine the contribution of NO bioavailability to the temporal profiles of $PO_2$is off-kinetics in two fast-twitch muscles with different oxidative capacities (citrate synthase: peroneal (PER) ~20 vs white gastrocnemius (WG) ~8-11 µmol/min/g). We tested the hypothesis that the more oxidative PER would display faster kinetics while recovering to baseline $PO_2$is levels compared to the WG. In addition, NO synthase inhibition via L-nitroarginine methyl ester (L-NAME) would slow recovery off-kinetics whereas this process would be speeded by increased NO. **METHODS**: $PO_2$is was determined via phosphorescence quenching (Oxyphor G4) in the exposed rat PER and WG (n=5) during and following electrically stimulated muscle contractions (1 Hz, 8 V, both 3 min) under control (CON), sodium nitroprusside (SNP, NO donor) and L-NAME (n= 3 PER, 5 WG) conditions. **RESULTS**: PER $PO_2$is was higher than WG for CON at baseline (18.1 ± 1.8 vs 11.3 ± 1.2 mmHg), end contractions (11.5 ± 1.2 vs 5.2 ± 0.9 mmHg), and following recovery (19.6 ± 2.1 vs 10.1 ± 0.9 mmHg; $p<0.05$ for all). SNP elevated $PO_2$is at all time points in both muscles compared to CON and L-NAME ($p<0.05$). $PO_2$is recovered to baseline levels in both muscles in CON and L-NAME ($p>0.05$) but not SNP ($p<0.05$). Off-kinetics were faster in the PER compared to WG in CON (35 ± 6 vs 76 ± 6 s; $p<0.05$). L-NAME did not alter PER off-kinetics but prolonged recovery in WG (101 ± 8 s; $p<0.05$). **CONCLUSIONS**: Consistent with our hypothesis, $PO_2$is returned to baseline levels faster in the CON PER than WG. This likely reflects greater $O_2$ delivery in PER. However, NO synthase inhibition via L-NAME did not diminish the magnitude nor rate of recovery in PER indicating that the interstitial-mitochondrial pressure head for $O_2$ delivery may be preserved via other pathways in more oxidative muscles in health.

2081 Board #6 June 1 9:30 AM - 11:30 AM

### Estimating the Aerobic Load of Short Non Steady State Cyclic Tasks

Ilse J. Blokland, Thomas van Kan, Jos J. de Koning, FACSM, Han Houdijk. *Vrije Universiteit Amsterdam, Amsterdam, Netherlands.*

*(No relevant relationships reported)*

Current analysis of aerobic load requires steady state oxygen uptake ($VO_2$), limiting analyses to relatively long lasting, cyclic activities. This is problematic when assessing the aerobic load experienced by patients who are unable to perform cyclic tasks for a longer duration. **PURPOSE**: To assess validity and reliability of a method estimating the aerobic load of short non steady state cyclic tasks. **METHODS**: Thirteen healthy adults walked on a treadmill while $VO_2$ was measured using breath by breath respirometry. Six trials of varying length and intensity (1, 2 and 6 minutes at both 4 and 5 km/h) were performed and repeated on a second day. Aerobic load of the short walking tasks ($VO_{2short}$) was estimated by adding the recovery $VO_2$ to the $VO_2$ over the exercise period. The 6 minute trials were used to calculate steady state $VO_2$. Concurrent validity of $VO_{2short}$ with steady state $VO_2$ was assessed using a no-intercept linear regression analysis. Test-retest reliability of all trials was assessed using intraclass correlation coefficients (ICC). **RESULTS**: $VO_{2short}$ was correlated with steady state $VO_2$ ($r = 0.60$-$0.84$) with highest correlations for the lower intensity trials. Steady state $VO_2$ was consistently lower than $VO_{2short}$. Regression coefficients between steady state $VO_2$ and $VO_{2short}$ ranged between 0.72-0.81 ($p<0.001$). Test-retest reliability of $VO_{2short}$ (ICC = 0.60-0.87) was comparable to that of steady state $VO_2$ (ICC = 0.63-0.78). **CONCLUSIONS**: The estimated aerobic load of short walking bouts is highly correlated with steady state $VO_2$ at similar intensity but systematically larger, potentially due to overestimation of recovery $VO_2$. Test-retest reliability of the presented method is similar to that of steady state $VO_2$. Therefore, based on this study, using short bouts of activity seems feasible to assess aerobic load in patients unable to perform cyclic tasks for a longer time, but the overestimation of recovery $VO_2$ needs to be better understood.

2082 Board #7 June 1 9:30 AM - 11:30 AM

### Do Contrasting Recruitment Patterns Underlie The Different Patterns Of Muscle Deoxygenation And Hemoglobin Response In Quadriceps Muscles?

Dai Okushima[1], David C. Poole, FACSM[2], Thormas J. Barstow, FACSM[2], Narihiko Kondo[3], Shunsaku Koga[1]. *[1]Kobe Design University, Kobe, Japan. [2]Kansas State University, Manhattan, KS. [3]Kobe University, Kobe, Japan.*

*(No relevant relationships reported)*

Previous investigations reported greater convective and diffusive $O_2$ conductance in whole-leg muscles during knee extension exercise (KE) compare to conventional cycling (CE). One reason for this is thought to derive from different muscle recruitment pattern in CE and KE. However, it is unknown whether the different muscle recruitment patterns might account for the disparate $O_2$ conductances during KE and CE or not. **PURPOSE:** Using time-resolved near-infrared spectroscopy (NIRS) during ramp incremental KE and CE, we tested the hypotheses that compared to CE, KE would have (1) lower amplitude (from baseline to exhaustion) of deoxy[Hb+Mb] (reflecting a greater $O_2$ delivery-to-utilization), (2) greater amplitude and value at task failure (i.e. reaching $VO_{2max}$) of total[Hb+Mb] (diffusive $O_2$ potential) in quadriceps (*vastus lateralis* [VL] and *rectus femoris* [RF]). We also hypothesized that muscle recruitment pattern will determine muscle oxy- and deoxygenation characteristics. **METHODS:** Eight subjects completed ramp incremental CE (20 W/min) and KE (10 W/min) to the limit of tolerance. Pulmonary $VO_2$ was measured breath-by-breath. Deoxy- and total[Hb+Mb] were quantified in the VL and RF muscle by time-resolved NIRS. VL and RF muscle activation levels were estimated by electromyography. **RESULTS:** In VL muscle, despite greater activation for CE than KE, the amplitude of deoxy- and total[Hb+Mb] from baseline to task failure were not different between exercise modes. However, in RF muscle, deoxy- (17.0±11.3 vs. 39.5±13.8 μM, $P<0.05$) and total[Hb+Mb] amplitude (5.3±4.0 vs. 23.8±8.5 μM, $P<0.05$) were lower for KE compared with CE despite greater activation for KE than CE. In addition, total[Hb+Mb] values at task failure were not a function of exercise mode in either VL or RF muscle. **CONCLUSION:** These results do not support the notion that different recruitment patterns for CE versus KE underlie the different patterns of muscle deoxygenation and hemoglobin response across quadriceps muscles. Indeed, the total[Hb+Mb] responses suggest that perfusive and diffusive $O_2$ delivery in VL and RF muscles are determined more by structural and functional factors (e.g. arteriolar vasodilation regulation and capillary hematocrit control) as opposed to muscle recruitment patterns *per se.* Supported by JSPS-15K16476, 16K13011.

## E-09 Thematic Poster - Training in Youth

Friday, June 1, 2018, 9:30 AM - 11:30 AM
Room: CC-Lower level L100H

2083 **Chair:** Meghan Baruth. *Saginaw Valley State University, University Center, MI.*

*(No relevant relationships reported)*

2084 Board #1 June 1 9:30 AM - 11:30 AM

### Validation of A Pacer Prediction Equation For Assessing Aerobic Capacity Of Visually Impairedchildren

Mónika Kaj, Katalin Kälbli, Anita Király, Tamás Csányi. *Hungarian School Sport Federation, Budapest, Hungary.*

*(No relevant relationships reported)*

The Hungarian National Student Fitness Test (NETFIT®) is a health-related, criterion-referenced test system developed by the Hungarian School Sport Federation (HSSF) and The Cooper Institute (TCI) that was implemented in 2014/15 in schools throughout the country. The test battery was developed for typically developing children (TDC), so the interpretation of the test results was difficult for students with special educational needs (SEN).
**PURPOSE**: to evaluate the validity of the Progressive Aerobic Cardiovascular and Endurance Run (PACER) test for children with visual impairment.
**METHODS:** 20 partially sighted and 20 legally blind children (aged 10–19 years old) were selected randomly from 3 special schools to complete both laboratory (maximal treadmill protocol) and field assessments (PACER) of aerobic capacity. Agreement between lab- and PACER-derived peak oxygen consumption ($VO_2$) was examined using linear regression analyzis and two-sided equivalence testing techniques, respectively.
**RESULTS:** The final sample resulted in a total of 22 visually impaired children. The regression modell used in NETFIT® fit well for the partially sighted children ($R^2$=0.827), but not for blind children. There was a significant difference between the predicted and the measured peak $VO_2$ values by blind children (34.88 vs. 39.14 mL/kg/min, t=-2.287, p=0.038). Multiple regression analyzis of PACER performance variables and peak $VO_2$ measures indicated the best model for estimating relative peak $VO_2$ for blind children: peak VO2 =43.608 + (0.636*shuttles) – (0.829 * BMI). The lab and PACER $VO_2$ using the new regression model shared 84% of the variance by blind children ($R^2$=0.835) and that limits of agreement ranged from -9.86 mL/kg/min to +18.9 mL/kg/min. The absolute error values were 1% for girl and 11% for boys, and the average peak $VO_2$ estimates from PACER were within the 10% equivalence region for both sexes (girls: 35.22 to 28.18 mL/kg/min, boys: 37.82 to 46.22 mL/kg/min).
**CONCLUSION:** The PACER test using the new regression model for blind children is a reliable field test to assess aerobic capcity for children with visual impairment. From the schoolyear 2017/2018 the adapted NETFIT® will use this method in the mandatory assessments.
Financed by priority project EFOP 3.2.8.-16. granted by European Union.

2085 Board #2 June 1 9:30 AM - 11:30 AM

### Development And Validation Of Sports Orientation Questionnaire For Chinese Adolescent Students

Jindong Chang[1], Xiaolei Liu[2], Ming Yang[1], Yi Liu[1], Mingxi Guan[3], Yang Li[1], Yunsai Chen[1], Xin Liu[1], Yan Peng[4], Hao Guo[5], Naiqing Song[1]. *[1]Southwest University, Chongqing, China. [2]High School Affiliated to Southwest University, Chongqing, China. [3]Chongqing Business Vocational College, Chongqing, China. [4]Sichuan Aerospace Vocatinal College, Chengdu, China. [5]Chongqing College of Humanities,Science & Technology, Chongqing, China.*

*(No relevant relationships reported)*

**PURPOSE**: Sports orientation is critical for the adolescent. Gill & Deeter (1988) had developed and validated a sports orientation questionnaire for elite athletes. However, it was a lack of assessment for general students of sports orientation. The purpose of this study was to develop and validate a "Sports Orientation Questionnaire" for Chinese Adolescent Students (SOQ-CAS).
**METHODS**: Based on literature review and focus group interviews, a 30-item instrument was developed for the initial tests. Using a 5-point Likert scale, formed the SOQ-CAS and was investigated to 486 junior middle school students in Chongqing of China. Finally, 36 missing individuals data were excluded, and 450 valid data were analyzed as study samples (male=236, female=214). Exploratory factor analyses (EFA) and confirmatory factor analysis (CFA) were used to analyze samples data by SPSS 24.0 and AMOS24.0 software.

**RESULTS**: The sample was randomly split (a computer-generated randomization sequence into two groups with the ratio 1:2). The first subset of the 30 items (N=150) was performed EFA (KMO=0.877, p=0.000). EFA resulted in a 12-item, 3-subscale that each included a 4-factor scale. EFA item loadings ranged from 0.68 to 0.85, and Cronbach's alpha ranged from 0.81 to 0.87. Based on the EFA results, CFA was performed to cross-validate and confirm the 4-factor structure model (N=300). Results showed that the model index were x2=0.000, RMSEA=0.06, GFI=0.94, NFI=0.91, TLI= 0.93, CFI=0.95. The final three subscales of the SOQ-CAS was named competitiveness, win orientation, and goal orientation.
**CONCLUSIONS**: The SOQ-CAS was a reliable and valid measure of sports orientation of Chinese adolescent students. It can be used for the assessment of daily exercise or physical education. The future research will focus on exploring the Motor Quotient (MQ) assessment by SOQ-CAS.
**ACKNOWLEDGEMENT**: Supported by NPOPSS Grant 15CTY011, and Fundamental Research Funds for the Central Universities SWU1709240.

Table1. Factor structures by Exploratory Factor Analysis and Reliability (N=150)

| | F1 | F2 | F3 | Total Variance explained | r_ subscales | r_full scales | r_ scale |
|---|---|---|---|---|---|---|---|
| S28 | .803 | | | | .858** | .733** | 0.869 |
| S29 | .801 | | | | .871** | .744** | |
| S23 | .748 | | | | .827** | .708** | |
| S24 | .730 | | | | .837** | .745** | |
| S9 | | .804 | | | .818** | .593** | 0.833 |
| S7 | | .798 | | | .839** | .658** | |
| S3 | | .757 | | | .812** | .630** | |
| S8 | | .725 | | | .800** | .654** | |
| S10 | | | .849 | | .788** | .466** | 0.809 |
| S14 | | | .791 | | .819** | .612** | |
| S18 | | | .763 | | .806** | .599** | |
| S26 | | | .677 | 68.933% | .776** | .639** | |

2086 Board #3 June 1 9:30 AM - 11:30 AM

## In-situ Testing Of Cardiorespiratory Fitness And Body Mass Index Of School Children In The UK

Samuel Tuvey[1], Elizabeth Horton[1], Alfonso Jimenez[1], Steven Mann[2]. *[1]Coventry University, Coventry, United Kingdom. [2]ukactive Research Institute, London, United Kingdom.* (Sponsor: Gary Liguori, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** Decreasing physical activity (PA) levels of children in the UK is a public health issue. Systematic measurement of objective PA is difficult, however cardiorespiratory fitness (CRF) has been shown to be a valid marker of PA and is a more scalable metric. In the UK there is no national measure of CRF that could be used to identify children at risk for cardiometabolic disease (CMD). The aim is to investigate the relationship between CRF and body mass index (BMI) to identify children at risk for CMD. **METHODS:** This study recruited 665 children (52% male; age 9±0.87years) from 11 primary schools in London. Testing was performed by in-place delivery staff from an external organisation. Data collection took place with the same participants in Autumn 2016 and Summer 2017. CRF was measured using the 20m Multistage Shuttle Run (20mMSR) and BMI was calculated from height and mass. Boys not reaching 33 and girls 25 shuttles are at an increased risk of CMD and were classified as "unfit". CRF and BMI z-scores were calculated adjusting for age and gender. BMI and CRF z-scores were correlated, the change in variables were assessed by paired t-tests, and differences in groups were analysed by chi square. **RESULTS:** Moderate negative correlations were found between CRF and BMI in the Autumn Term (r=-0.310, p<0.001) and Summer Term (r=-0.359, p<0.001). There was a significant increase in CRF (p<0.05) and a significant decrease in BMI (p<0.001) between the Autumn and Summer Term. Percentage of children that failed to reach the 20mMSR cut-point decreased from 47% to 38% (p<0.01). Percentage of children that were categorised as overweight or obese decreased from 30% to 22% (p<0.01). Percentage of children categorised as healthy weight but did not meet the cut-point for reduced risk to CMD decreased, from 27% to 23% (p=0.069). **CONCLUSION:** This study indicates that there is a strong association between CRF and BMI and that the health of children improves throughout the academic year. This study also found that a quarter of children categorised as being a healthy weight failed to reach the cut-point in the 20mMSR. Currently, only BMI is measured on a national scale in the UK, and these results demonstrate that a large proportion of children are not recognised as being at risk for CMD, therefore, the inclusion of the 20mMSR may be beneficial.

2087 Board #4 June 1 9:30 AM - 11:30 AM

## Effects Of Chronic Hypobaric Hypoxia, Biological Maturation And Training On The Hemoglobin Mass In Children And Adolescents

Erica Mabel Mancera-Soto[1], Diana Marcela Ramos-Caballero[1], Edgar Cristancho[1], Walter Schmidt[2]. *[1]Universidad Nacional de Colombia, Bogotá, Colombia. [2]Bayreuth University, Bayreuth, Germany.* (Sponsor: William Byrnes, FACSM)

*(No relevant relationships reported)*

Hemoglobin mass (Hbmass) is an important factor for endurance performance and athletes born and living at altitude are described to possess elevated Hbmass values due to lifelong hypoxic exposure. It may be hypothesized that this adaptation already occurs in early life. To date, however, there exists only few data on the training influences on Hbmass during childhood and no data exists describing chronic hypoxic effects in children and adolescents. **PURPOSE:** To investigate the effects of age, sex, training status and altitude on Hbmass in children and adolescents in a cross-sectional study. **METHODS:** 436 children, 197 females and 237 males, homogenously distributed over the age from 9 to 18 years participated in the study. 189 of them were born and lived permanently at 960m, 247 at 2600m. 168 did not practice any training and 268 were endurance trained with a mean endurance training volume of 14.0h ±5.8/week. Hbmass was determined using the optimized CO-rebreathing technique and VO2max by an incremental step-test on a treadmill. Analyses of variance and multiple regression analyses were performed to estimate the effects of sex, body mass, age, sexual development (scale according to Tanner), training status, and altitude on Hbmass. **RESULTS:** Overall, ANOVA yielded highly significant effects for sex, age, body mass, altitude and training state (all p< 0.001); and regression analysis (r=0.91) showed highest effects of sex (+121.5g, ß=0.31 in males) and body mass (9.5g/kg, ß=0.57). Because Hbmass of girls reached a plateau at approx. 14 years and boys increased Hbmass until the age of 17 regression analyses were performed separately for females and males and the following effects were found: Males: r=0.93; Hbmass = 11.8*kg + 15.4*years + 60.9 (for trained status) + 35.1 (for altitude residents) + 13.7*(stage of Tanner) - 254.2; females: r=0.84; Hbmass = 6.8*kg + 9.8*years + 54.6 (trained) + 36.9 (altitude) -24.8. Absolute and relative VO2max was closely related to Hbmass (absolute values: r=0.85, y=3.57x + 308; relative values: r=0.70, y=3.56x+6.1). **CONCLUSION:** Beside the well-known effects of body mass, age and sex also growing-up at altitude and endurance training have remarkable effects on Hbmass in children and adolescents. VO2max is closely related to Hbmass. Like in adults, a change by 1 gram changes VO2max by 3.5ml/min.

2088 Board #5 June 1 9:30 AM - 11:30 AM

## Effect Of Cardiorespiratory Fitness, Fatigue And Muscular Strength On Gait Biomechanics In Obese Children

Bhupinder Singh, Melanie F. Niino, Jennifer D. Goulart, Amber Hammons. *California State University, Fresno, CA.*

*(No relevant relationships reported)*

**PURPOSE**: The purpose is to explore the effects of cardiorespiratory fitness, fatigue, adiposity, and muscular strength in predicting altered gait biomechanics in 8-11 year old obese children.
**METHODS**: Thirty children, 15 girls and 15 boys, mean age 9.8±0.9 years, and mean BMI percentile 96.1±4.1, were recruited from University of Iowa Obesity Clinic. The 15 m Progressive Aerobic Cardiovascular Endurance Run (PACER) protocol was used to estimate aerobic fitness ($VO_2$max) and to fatigue the subjects. Adiposity, measured as percent body fat, was estimated by air displacement plethysmography (Bod Pod). Right leg isometric strength was assessed on a leg press device. Three-dimensional gait analysis (Optotrak, Kistler) using a link-based model was performed pre- and post-fatigue to calculate joint moments. Paired t-tests were used to compare pre- and post-fatigue moments, and a stepwise regression model including moments as dependent variable and fitness, adiposity and strength, as the three independent variables was used for pre- and post-fatigue. P-value < 0.05 was considered significant.
**RESULTS**: Subjects completed an average of 17.5±8.5 PACER laps (range: 4-45). Mean aerobic fitness as estimated by PACER was low (34.1±6.0 mL·min-1·kg-1). Mean adiposity was 32.2±7.6 % body fat and mean right lower limb strength, was 7.54±2.29 N/kg. Following fatigue, knee adduction moments (0.35±0.2 to 0.43±0.2 Nm/kg, p= 0.01), knee extensor moments (0.57±0.3 to 0.67±0.2 Nm/kg, p= 0.02) and hip extensor moments increased (0.77±0.4 to 0.97±0.4 Nm/kg, p=0.01). The step-wise regression model for knee extensor moments pre-fatigue selected strength and adiposity as predictor variables ($R^2$=0.35) and post-fatigue selected strength ($R^2$=0.29). Knee and hip adductor moments selected adiposity as a predictor variable for pre-fatigue ($R^2$=0.3 and 0.22 respectively). None of the models included cardiorespiratory fitness.
**CONCLUSIONS**: Increase in hip and knee moments after fatigue suggests biomechanical deficiencies, which may lead to increased joint stress or to injury.

The result suggests that level of adiposity and strength might be important factors in predicting gait biomechanics and could make a significant impact for healthcare professionals as they encourage wellness and fitness among their obese clientele.

2089 Board #6 June 1 9:30 AM - 11:30 AM

**Effects Of A 5-day Sports/Fitness Camp On Walking Efficiency In Children With Cerebral Palsy**

Adam R. Blanchard[1], Katherine Dimitropoulou[1], Paul Weiland[2], Kelly Boscarino[2], Amber Newell[1], Heakyung Kim[1]. *[1]Columbia University Medical Center, New York, NY. [2]Chapter 126 Sports & Fitness, Bristol, CT.*

*(No relevant relationships reported)*

Physical activity (PA) participation and fitness in children with cerebral palsy (CP) are decreased compared to typically developing peers. Exercise improves fitness and walking ability but little is known for its impact on walking efficiency. **PURPOSE:** The purpose of this pilot/feasibility study was to examine the influence of a five day community sports and fitness camp at an adaptive fitness facility on walking energy consumption (walking efficiency) in children with CP. **METHODS:** Six boys with CP (mean±SD; age, 11.3±4.7 yr; height, 136.9±27.5 cm; weight, 44.9±26.8 kg) participated in supervised sports and PA for 3 hr/d on 5 consecutive days. Activity energy expenditure (AEE; $J \cdot kg \cdot s^{-1}$) and oxygen consumption ($VO_2$; $ml \cdot kg \cdot min^{-1}$) were assessed by Actiheart monitor during five, 10meter walks on day 1 and 5. The PA Questionnaire for Adolescents assessed baseline PA levels. Paired samples t-tests evaluated differences in AEE and $VO_2$ pre- to post- camp; and independent-samples t-test evaluated between-group differences between high and low baseline PA with changes in AEE and $VO_2$. **RESULTS:** Although non-significant (low N), medium effect size was seen in the reduction of AEE during walking on day 5 (2.5±0.5 $J \cdot kg \cdot s^{-1}$) compared to baseline (2.9±0.5 $J \cdot kg \cdot s^{-1}$; $p$=0.28, Cohen's $d$=-0.66). Similarly, submaximal $VO_2$ was lower on day 5 (8.4±2.0 $ml \cdot kg \cdot min^{-1}$) compared to baseline (9.3±3.1 $ml \cdot kg \cdot min^{-1}$; $p$=0.28, Cohen's $d$=-0.35). A strong effect size was seen in that children with low PA (n=3) reduced their $VO_2$ greater (Δ-1.6±2.3 $ml \cdot kg \cdot min^{-1}$) than children with high PA (n=3) (Δ0.0±0.9 $ml \cdot kg \cdot min^{-1}$; $p$=0.31; Cohen's $d$=0.92) on day 5 compared to day 1. **CONCLUSIONS:** This study was a feasibility study to test the measures and intervention procedures for the development of an evidence-based camp. Findings show that children with CP may improve walking efficiency after participating in a five day community sports/fitness camp held at an adaptive fitness facility. Our next step is to design an appropriately powered intervention to confirm these results and to determine the best frequency, intensity, time, and type of sports/PA performed in the camp.

2090 Board #7 June 1 9:30 AM - 11:30 AM

**Differences In Lean Mass And Strength In Adolescent ACLR Female Athletes: A Case-Control Study**

Christiana J. Raymond-Pope[1], Donald R. Dengel, FACSM[1], John S. Fitzgerald[2], Bradley J. Nelson[1], Tyler A. Bosch[1]. *[1]University of Minnesota, Minneapolis, MN. [2]University of North Dakota, Grand Forks, ND.* (Sponsor: Donald R. Dengel, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** To compare differences in total and segmental lean mass (LM), muscle strength and lower leg force production between adolescent female athletes with and without anterior cruciate ligament repair (ACLR). **METHODS:** Twenty-four females, 12 ACLR and 12 healthy controls (CON), were matched by age (16.4±0.9 vs 16.4±1.0 yrs), body mass index (23.2±2.1 vs 23.2±2.7 $kg/m^2$), and sport. Total, segmental, and regional body composition were measured by 3 DXA scans (1 total body, 2 lateral leg). Muscle peak torque for knee extension/flexion (60, 120°/sec) was measured using isokinetic dynamometry. Lower limb force, power and jump height were measured using a squat jump on dual force plates. Paired t-tests assessed total, regional and segmental lean mass, peak torque and lower limb force production differences within (Involved/Non-involved) and between groups (ACLR/CON). Linear regression assessed the total-leg LM vs peak force relation of each leg and of ACLR vs CON. **RESULTS:** No body composition differences were observed between ACLR and CON groups ($p$=0.07-0.90). However, ACLR INV legs had significantly lower total LM (7.1±0.8 vs 7.4±1.0 kg, $p$=0.004), anterior upper leg LM (1.5±0.3 vs 1.62±0.2 kg, $p$=0.007), and posterior upper leg LM (1.9±0.2 vs 2.0±0.2 kg, $p$=0.036). Peak torque was significantly lower in ACLR INV vs NINV legs ($p$<0.003) and vs CON ($p$=0.010-0.019) for extension at 60 and 120°/sec and flexion at 60°/sec ($p$=0.011), with no differences between ACLR NINV vs CON ($p$=0.23-0.90). Peak force was significantly lower in ACLR INV vs NINV legs (296±45 vs 375±55 N, $p$<0.001) and between ACLR INV legs vs CON (296±45 vs 372±88 N, $p$<0.015), but no significant ($p$=0.736) difference between ACLR NINV leg vs CON. The slope between total LM and peak force was smaller for ACLR participants (INV: m=0.02 $r$=0.36, $p$=0.25; NINV: m=0.03, $r$=0.50, $p$=0.10) compared to CON (INV: m=0.06, $r$=0.63, $p$=0.03; NINV: m=0.06, $r$=0.62, $p$=0.03). **CONCLUSION:** One year post-ACLR female athletes have significant differences in the quantity and quality of leg muscle, compared to matched CON athletes, for both involved and non-involved legs. Importantly, muscle function (strength and force production) is limited in both ACLR legs relative to the amount of lean mass, which may provide evidence for increased risk of ACL tear in the involved and non-involved legs.

2091 Board #8 June 1 9:30 AM - 11:30 AM

**Predictors of Initial Acceleration and Maximum Speed Phases of Sprint Running in Children and Adolescents**

Lorena Correas-Gómez[1], José Ramón Alvero-Cruz[1], Jesús Barrera-Expósito[2], Elvis A. Carnero[3]. *[1]University of Málaga, Málaga, Spain. [2]Nuestra Señora de la Victoria "Martiricos" High School, Málaga, Spain. [3]Translational Research Institute for Metabolism and Diabetes, Florida Hospital, Orlando, FL.*

*(No relevant relationships reported)*

Sprint capacity is a key factor to succeed in many sports modalities and to identify successful predictors must be relevant to optimize speed training and talent detection. Jump tests, muscle strength, and anthropometric variables have been widely associated with sprint performance in adults. However, seeking the best sprinters among young individuals must be influenced by other variables such as sports training, body size, and maturation. Thus, the potential of jump and strength tests to explain sprinting phases (acceleration and maximum speed) might be affected during developmental ages. **PURPOSE**: To examine relations between the phases of sprinting performance (30m) and body composition (BC), maturation, strength, and jump tests in children and adolescents. **METHODS**: A database of 456 measures of participants aged 8-18y was analyzed (244 boys, age=14.8±2.3y, BMI=21.6±3.9$kg/m^2$). Photoelectrical cells were used to measure sprint times (S30m, S0-15m, and S15-30m). An electronic mat read flight time to calculate vertical height after squat jump (SJ), counter-movement jump (CMJ), and CMJ with arms (CMJA); the difference between SJ and CMJ was also calculated (VJ-d). Lower limbs strength was tested with a portable dynamometer (LLS). Fat-free mass (FFM) was assessed by anthropometry and bioelectrical impedance analysis. Sports participation (SP) was recorded by questionnaire. A stepwise regression analysis was used to explore the relationship between sprint phases and BC, SP, jump and strength. **RESULTS**: CMJA was the best predictor of S30m speed ($R^2$=0.724, $P$<0.001) and acceleration phase (S0-15m, $R^2$=0.566, $P$<0.001). Maximum speed phase was best explained by SJ (S15-30m, $R^2$=0.530, $P$<0.001). The model including FFM, gender, VJ-d, and maturity predicted S30m ($R^2$=0.780, SEE=0.28m/s) and S15-30m ($R^2$=0.698, SEE=0.51m/s). For S0-15m, the predictors were CMJA, impedance index, and SP ($R^2$=0.610, SEE=0.36m/s). **CONCLUSION**: In accordance with other studies, sprinting performance was partially dependent on FFM and maturity. As expected, participation in organized sports seems to affect positively S30m and acceleration performance but did not explain maximal speed phase. Overall, the results highlight the relevance of BC and jump tests as a plausible model to track sprint performance in children and adolescents.

## E-10 Free Communication/Slide - **Athlete Assessment**

Friday, June 1, 2018, 9:30 AM - 11:30 AM
Room: CC-Mezzanine M100D

2092 **Chair:** Erin H. Hartigan. *University of New England, Portland, ME.*

*(No relevant relationships reported)*

2093 June 1 9:30 AM - 9:45 AM

**Anthropometric Measures And Performance Tests In The Evaluation Of Performance And Injury Risk In Division 1 Collegiate Athletes**

Alexander M. Carnall[1], Jennifer Bunn[2], John Manor[2]. *[1]University of Memphis, Memphis, TN. [2]Campbell University, Buies Creek, NC.* (Sponsor: Dr. Mike Webster, FACSM)

*(No relevant relationships reported)*

PURPOSE: Simple tools of measurement like mean and peak power output, eccentric utilization ratio (EUR), and simple anthropometrics could potentially have predictive value in determining the accelerative and decelerative strategies of athletes. The objective of the present study is to determine the efficacy of these measurements in the identification of pathological preferential movement strategies which may limit performance or heighten injury risk. METHODS: 31 NCAA Division 1 athletes were recruited and asked to perform five trials of a simple drop-jump task. Subjects met inclusive criteria if they were cleared for full participation, and were assessed based on body composition, mean and peak power output, EUR, bodily segment lengths, and handheld dynamometer muscle forces. A motion capture system was used to measure peak joint flexion ranges of motion. RESULTS: A stepwise linear regression was

applied to identify potentially influential factors in the accelerative and decelerative preferential strategies between male and female athletes. Preliminary findings suggest that torso length (r=.530, p=.042) and torso to femur length ratio (r=.782, p=.005) are potentially related to peak trunk, and peak knee flexion values respectively in males. In females, it appears that EUR may hold value in identifying peak trunk flexion (r=.675, p=.004), hip flexion (r=.604, p=.013), and combined lower extremity flexion (r=.552, p=.027) strategies in females. CONCLUSIONS: Preliminary findings of the present study suggest that while males have highly variable movement strategies, females may tend to rely more heavily on storage and return of eccentric energy via the contractile component of the posterior chain in order to increase athleticism and create greater joint integrity in decelerative tasks.

2094 June 1 9:45 AM - 10:00 AM

### Pre-Season Measures of Neurologic Function and Subsequent Head Impact Exposure in Youth Football

Thayne A. Munce, FACSM[1], Jason C. Dorman[1], Paul A. Thompson[2], Verle D. Valentine, FACSM[1]. *[1]Sanford Sports Science Institute, Sioux Falls, SD. [2]Sanford Research, Sioux Falls, SD.*

*(No relevant relationships reported)*

Repetitive head impacts in football create a risk for concussion, as well as sub-concussive brain injury. Nearly 70% of US football players are younger than high school age, yet little is known about intrinsic characteristics of youth players that may make them more likely to experience repetitive head impacts, resulting in an increased injury risk. **PURPOSE:** To examine the association between select measures of neurologic function and head impact exposure of youth football players. **METHODS:** During a 5-year period (2012-2016), 66 middle school football players (12.9 ± 0.6 yr) were evaluated before their respective seasons (97 player-seasons) using objective, clinical assessments of neurologic function. Participants were assessed for rapid number naming speed (King-Devick Test; KD; sec), simple reaction time (RT; sec), and standing balance (BA) performed during an eyes-open, dual-task condition. Head impact frequency, severity (linear acceleration; rotational acceleration) and location during each practice and game were measured using the Head Impact Telemetry (HIT) system. Predictive modeling was performed to examine the relation of KD, RT and BA values with several head impact exposure outcome variables. **RESULTS:** The overall predictive model was significantly related to individual head impact frequency in practices (P = 0.002). Among the discrete variables, faster RT and KD times were both found to be significantly related to increased individual head impact frequency in practices (P < 0.001; P = 0.032, respectively). Faster KD times were also significantly associated with higher 95$^{th}$ percentile linear acceleration values (P = 0.014). There were no significant relations (P = 0.145-0.840) between any measure of neurologic function and the other head impact exposure measures examined. **CONCLUSION:** Faster reaction time and rapid number naming speed assessed during the pre-season were related to increased head impact frequency and/or severity of youth football players. While these associations are likely complex, it is possible that these specific measures of neurologic function are surrogate indicators of players' intrinsic ability and/or desire to initiate contact. Identifying players who are more likely to experience repetitive head impacts may be useful for efforts aimed at modifying injury risk.

2095 June 1 10:00 AM - 10:15 AM

### Kinematic Differences of the Single Leg Cross Over Triple Hop and Modified T-Test

David Mangone, Brandon Henley, Joshua Flores-Vitti, Kathryn Young, Richard Feinn, Karen Myrick, Juan C. Garbalosa. *Quinnipiac University, Hamden, CT.*

*(No relevant relationships reported)*

Return to sport (RTS) testing has been advocated as a means of reducing the high re-injury rates of the anterior cruciate ligament (ACL). The effectiveness of RTS testing has recently come into question. Potentially, the use of RTS tests that mimic game-like scenarios more closely may help resolve this issue.**PURPOSE**: To determine how a currently used RTS test, the cross over triple jump (COH), compares to a game-like agility test, the modified T-test (MTT) with respect to lower extremity biomechanics. **METHODS**: Nineteen Division I female athletes who were free of injury at the time of enrollment completed the testing protocol. The protocol consisted of having the athlete's complete a 5 minute warm-up followed the completion of COH and MTT test, the order of which was randomized. The COH test consisted of having the subject jump forward on one limb while crossing two parallel lines, 15.25 cm apart three times on each limb. The MTT consisted of having the subject run through a T shaped obstacle course 4 times, alternating sides. Adequate rest was afforded between trials to ensure non-fatigue. The location of retroreflective markers located over specific bony landmarks located on the subjects lower extremity was recorded while the athletes completed the tests using a 16 camera motion analysis system recording at 240 Hz. Using a multilevel multivariate analysis the three dimensional joint angles of the hip and knee at the time of maximum knee valgus were compared for angular differences (Δ) between the jump and cut performances using the marker data. **RESULTS**: Compared to MTT, athletes during COH were significantly more flexed at (Δ = 9.0 degrees ± 2.6, p=.001) and tended to be more internally rotated (Δ = 2.2 degrees ± 1.2, p=.088) at the hip and more flexed (Δ = 3.5 degrees ± 2.1, p=.093) at the knee. No differences were noted in the frontal plane position of the hip and knee or the transverse plane position of the knee. **CONCLUSIONS**: The COH and MTT do not appear to produce similar lower extremity kinematics. The MTT appears to place more stress on the lower extremity and may be a better test to determine RTS.

2096 June 1 10:15 AM - 10:30 AM

### Correlation of Hop Distance and Loading Symmetry during Return to Sport Testing in Healthy Subjects

Kristen Renner[1], Alex Peebles[1], Thomas K. Miller[2], Robin Queen, FACSM[1]. *[1]Virginia Tech, Blacksburg, VA. [2]Virginia Tech Carilion School of Medicine, Roanoke, VA.* (Sponsor: Robin Queen, FACSM)

*(No relevant relationships reported)*

The hop distance symmetry is used frequently to determine readiness to return to sport (RTS) following anterior cruciate ligament reconstruction (ACLR). It is unknown if loading symmetry is able to provide novel insights in determining readiness to RTS. **PURPOSE:** To determine if hop distance limb symmetry index (LSI) is correlated with loading LSI when completing RTS hop testing. **METHODS:** 33 healthy participants (16 male, 17 female - age 21.8 ± 3.0, height: 1.74 ± 5.79m , weight: 68.6 ± 7.8 kg) were fit with a pair of loadsol (Novel Electronics, St. Paul, MN), single sensor insoles (100 Hz). Each participant completed the Marx Activity Scale and 7 single hops (SH), 3 triple hops (TH) and 3 crossover hops (CH) per limb. The LSI (Sx/NSx*100) was calculated for hop distance as well as peak load (GRF), loading rate (LR) and impulse (I) for the final hop of each trial and condition. The LSI was calculated for each trial pair and then averaged across trials for each task. Pearson's correlation coefficients (R) were calculated between all symmetry metrics (distance and loading) and Marx score. A linear regression was completed to determine if the loading symmetry metrics predicted the hop distance symmetry. All tests were run in SPSS with a p-value<0.05 indicating significance. **RESULTS:** The hop distance and loading LSI measures either had no or weak correlations (Table 1). The Marx score was weakly correlated with the CH hop distance (R=0.36, p=0.04) and the SH LR (R=0.36, p=0.05). The regression analysis yielded no significant models for the SH, TH, or CH to predict the hop distance LSI. **CONCLUSIONS:** The load symmetry metrics and hop distance symmetry were weakly correlated and the load symmetry metrics were not able to predict hop distance symmetry. These results indicate that the loading symmetry and hop distance symmetry provide different information. Therefore, future work should determine which of these measures could be used as predictors of secondary ACL injury risk.

**Table 1**

| | SH | | TH | | CH | |
|---|---|---|---|---|---|---|
| | LSI | R | LSI | R | LSI | R |
| Distance | 94.65±10.71 | - | 98.30±8.71 | - | 98.08±12.75 | - |
| Peak Load | 94.47±16.92 | 0.38* | 99.95±22.14 | 0.09 | 102.43±28.14 | 0.31 |
| Loading Rate | 102.27±24.58 | 0.45* | 103.71±30.39 | 0.11 | 109.97±43.75 | 0.39* |
| Impulse | 99.33±11.22 | 0.41* | 100.80±13.04 | -0.08 | 98.98±11.37 | 0.34 |

* Significant correlation between measures p<0.05

2097 June 1 10:30 AM - 10:45 AM

### Wobble Board Dynamic Assessment in Subjects with Chronic Ankle Instability

Andrea Fusco[1], Philip X. Fuchs[2], Giuseppe F. Giancotti[1], Marianna De Maio[1], Carlo Varalda[3], Herbert Wagner[2], Laura Capranica[4], Cristina Cortis[1]. *[1]University of Cassino e Lazio Meridionale, Cassino, Italy. [2]University of Salzburg, Salzburg, Austria. [3]Italian Weightlifting Federation FIPE, Roma, Italy. [4]University of Rome Foro Italico, Roma, Italy.* (Sponsor: Carl Foster, FACSM)

*(No relevant relationships reported)*

Chronic ankle instability (CAI) has been shown to cause balance impairments during still standing and dynamic postural-control tasks. Although computerized wobble boards (WBs) are used to train postural stability and to assess dynamic balance performances, little is known about their ability to detect balance deficits in subjects with unilateral CAI. **PURPOSE:** To determine the WB ability in detecting impairments in subjects with unilateral CAI. **METHODS:** After a familiarization phase, 16 (8 female, 8 male) subjects (age=23.5±1.7years; weight=66.6±14.5kg; height=167.7±11.3cm) performed a single limb task on a WB and Y balance test (YBT). WB performance (Balance Board WSP, Italy; diameter=40cm) was assessed as the time spent in the target zone (diameter=6.5cm) displayed on a screen during a

single leg 30seconds trial with a 1-minute sitting rest in between. For YBT, normalized reach distances for anterior (A), posteromedial (PM), posterolateral (PL) directions and composite (COMP) values were recorded according to the protocol. ANOVA ($p<.05$) was used to evaluate limb differences (injured; uninjured) in relation to gender. **RESULTS:** For WB, females showed better ($p<.05$) performances than males, regardless of limb. Significantly ($p<.0001$) better performaces were found in the uninjured (WB=20±4.3s; A=89.4±9.9%; PM=101.8±13.1%; PL=107.7±13.4%; COMP=104±10.9%) limb compared to the injured (WB=16.6±4.3s; A=86.1±11.6%; PM=96.1±10.7%; PL=101.3±14.9%; COMP=100.2±11.9%) one, regardless of gender. **CONCLUSIONS:** WB test showed to be an effective tool for detecting balance deficits between injured and uninjured limb in subjects with unilateral CAI. The single outcome from the WB provided an accurate, precise and fast method for quantifying balance deficits in individuals with CAI. Hence, WBs have the capability to fill the gap caused by limitations between subjective-based clinical assessment and laboratory-based testing. Their affordable, portable and user-friendly nature make WBs suitable to be used outside of laboratory settings and helpful in clinical-decision making. Gender differences during the WB test could be due to anthropometric, neuromuscular and neurophysiologic factors. Therefore, future studies should investigate the influence of anthropometric factors on WB performances.

2098 June 1 10:45 AM - 11:00 AM

## Reliability and Performance Changes with the Addition of a Cognitive Task to Static and Dynamic Postural Stability Testing

Caroline Westwood, Carolyn Killelea, Mallory Faherty, Timothy Sell, FACSM. *Duke University, Durham, NC.* (Sponsor: Timothy Sell, FACSM)

*(No relevant relationships reported)*

Concussions are an unfortunate consequence of sports participation. They affect motor control, neurocognitive performance, and recent reports indicate they increase the risk of lower extremity musculoskeletal injury (LEMI) upon return to sport. The increased risk of secondary LEMI may indicate the need to establish a test that is predictive of LEMI risk following return to sport. **PURPOSE:** Assess the between-session reliability and the effects of adding a cognitive task to static and dynamic postural stability testing. **METHODS:** Twelve healthy, physically active subjects (Age: 22.3 ± 2.9 years, Height: 174.4 ± 7.5 cm, Weight: 154.5 ± 28.0 lbs) participated. Subjects underwent static and dynamic postural stability testing with and without the addition of a cognitive task (Stroop task) on two separate days. Static postural stability was assessed with a single-leg balance task under eyes open (with and without the addition of the Stroop task) and eyes closed conditions. Variability of each ground reaction force component was averaged across three trials for each of the static postural stability conditions. Dynamic postural stability testing consisted of forward jump over a hurdle with a one-legged landing performed with and without the addition of the Stroop task. A stability index was calculated based on the resultant ground reaction force and each of its components. Interclass correlation coefficients (ICC, 2,1) were calculated to determine the between-session reliability of each testing condition. Comparisons were made across the static conditions and between the dynamic postural stability tasks. **RESULTS:** The addition of a cognitive load proved to have moderate to excellent between-session reliability for the majority of variables calculated during static (ICC values 0.74 – 0.81) and dynamic postural stability testing (ICC values 0.77 – 0.80; ML=0.800, V=0.774, DPSI=0.781). No significant differences were observed between the postural stability tasks (with or without the Stroop task). **CONCLUSION:** Postural stability tasks with the addition of a cognitive load prove to have moderate to excellent reliability in a healthy population. These results provide new evidence on the feasibility of dual-task postural stability testing when examining risk of LEMI following return to sport.

2099 June 1 11:00 AM - 11:15 AM

## Effect of Training Level on a Visuomotor Balance Task in Youth with Previous Sport-Related Concussion.

Katelyn Mitchell, Michael E. Cinelli. *Wilfrid Laurier University, Waterloo, ON, Canada.*

*(No relevant relationships reported)*

**INTRODUCTION:** The demands of sport require the integration of cognition and sensory inputs to produce more complex, goal-directed movement. Howell and colleagues (1) revealed that the differences in balance control between athletes with or without previous concussion were greater in youth compared young adults during dual-task gait. **PURPOSE:** 1) To determine if a novel visuomotor dynamic balance task can objectively identify differences between youth hockey players with/without sport-related concussion (SRC); and 2) If there are balance control differences between players who participate in minor hockey and private hockey academy training. **METHODS:** Youth hockey players (N=47; age=12-17 years), who reported previous SRC (n=17) and CONTROL (n=30). Group 1 was from a minor hockey team (SRC1=4; CONTROL1=12) and group 2 a private hockey academy (SRC2=13, CONTROL2=18). Participants stood in single support on a Nintendo Wii Balance board sampled at 100Hz and performed a lower limb reaching task with their non-stance foot. Five FitLights were arranged on the floor anteriorly at ±60°, ±30°, and 0° and were used as Go(GREEN)/No-Go(RED) stimuli. Balance control was assessed using RMS velocity of COP (vCOP) in anterior-posterior (A/P) and medial-lateral (M/L) planes. **RESULTS:** There were significant differences for both A/P vCOP (SRC= 8.04cm/s; CONTROL= 11.04cm/s, $p<.05$) and M/L vCOP (SRC= 6.27cm/s; CONTROL= 7.72cm/s, $p<.05$), as the SRC group performed the task slower than CONTROL There were no significant differences between SRC1 and SRC2 in vCOP A/P ($p=0.50$) or M/L ($p=0.26$) likewise for CONTROL1 and CONTROL2 vCOP A/P ($p=0.88$) and M/L ($p=0.97$). **CONCLUSION:** The assessment of a visuomotor dynamic balance task can objectively identify youth athletes with previous history of SRC regardless of training levels. Incorporating cognitive-motor tasks may help to improve balance control deficits in youth post-SRC and ensure true readiness for return-to-sport.

1.
Howell DR, Osternig LR, Chou LS. Adolescents demonstrate greater gait balance control deficits after concussion than young adults. The American journal of sports medicine. 2015 Mar;43(3):625-32.

2100 June 1 11:15 AM - 11:30 AM

## Reliability of Evaluating the Single Leg Squat Using Multiple Assessment Methods

Carolyn Dartt, Sarah De La Motte, Patricia Deuster, Timothy Gribbin. *Uniformed Services University, Bethesda, MD.*

*(No relevant relationships reported)*

**Purpose:** The Single Leg Squat (SLS) test is a physical assessment to identify movement deficits that may predispose individuals to musculoskeletal injury (MSKI). The SLS is used clinically and in research to develop corrective exercise strategies for improving movement efficiency and modify potential MSKI risk factors. Our purpose was to compare the reliability of individual criteria and overall performance of the SLS test between three assessment methods: real-time scoring (RT); post-testing video analysis (PTVA); and post-testing analysis by using PhysiMax (PM) software.
**Methods:** Male U.S. Marines (N=81; PTVA n=35, PM n=22, RT n=8) entering the School of Infantry-West performed the SLS prior to beginning training. Squats were scored using RT, PTVA, and PM software. Nine individual SLS criteria were evaluated dichotomously: 0 indicated no deficiency and 1 indicated a deficiency was present. Overall SLS performance was scored as excellent, average or poor. Interrater (IRR) and intrarater (IAR) reliability were measured using % agreement (%), Cohen's Kappa (κ), and intraclass correlation coefficients (ICC).
**Results:** Individual SLS criteria reliability was poor for several items, namely Hip Drop (IRR-RT: 44.4%; κ=-0.15; PTVA: 22.5%, κ=-0.02; and IAR-PTVA: 83.4%, κ=0.31; PM: 77.2%, κ=0.15,) and Trunk Inward Rotation (IRR-RT: 55.5%, κ =0.05; PTVA: 63.4%, κ=0.26; and IAR-PTVA: 57.9%, κ=0. 16; PM 81.8%, κ=0.07). For SLS overall performance, IRR % agreement was weaker for PTVA (47.9%) compared to RT (62.5%); however ICC's were both poor (PTVA: 0.20 ICC, 95% CI: -0.03-0.41; RT: 0.35 ICC, 95% CI: -0.42-0.82). SLS overall performance IAR % agreement for PTVA and PM was similar (57.9% vs. 59.1%) but ICC's were good for PM (0.63 ICC, 95%CI: 0.30-0.83) and poor for PTVA (0.34 ICC, 95%CI: -0.12-0.68).
**Conclusion:** Although the SLS has been clinically validated to identify movement deficits, individual item IRR and IAR appear to be generally poor regardless of the assessment method. Overall performance evaluations also had low agreement, but PM software showed the best IAR-ICC, demonstrating good reliability which should be investigated further. However, our results may be limited by small sample sizes. Further research is needed with a larger sample to better compare SLS assessment reliability between RT, PTVA and PM.

## E-11 Free Communication/Slide - **Exercise Psychology- Pain**

Friday, June 1, 2018, 9:30 AM - 11:30 AM
Room: CC-Mezzanine M100F

2101 **Chair:** Erica M. Taylor, FACSM. *Delaware State University, Dover, DE.*

*(No relevant relationships reported)*

2102 June 1 9:30 AM - 9:45 AM

### Physical Activity is Indirectly Associated with Pain in College-Aged Women: Somatization and Panic Symptom Pathways

Patrick J. O'Connor, FACSM[1], Matthew P. Herring[2], Cillian P. McDowell[2], Rodney K. Dishman, FACSM[1]. [1]*University of Georgia, Athens, GA.* [2]*University of Limerick, Limerick, Ireland.*

*(No relevant relationships reported)*

Pain can be improved by the adoption and maintenance of physical activity (PA) but whether PA *per se* causes reductions in pain is uncertain. Pain is often greater in those with elevated symptoms of psychiatric disorders, including anxiety, mood and somatoform disorders. It is plausible that the severity of psychiatric symptoms mediates relationships between PA and pain as PA often reduces these symptoms. **PURPOSE:** To assess relationships among PA, pain and psychiatric symptoms known to increase the risk of pain. **METHODS:** College-aged women (N=1033; 19.7 ± 2.9 years) completed the 7-Day PA Recall and indicated if they had (11.4%), or had not, been experiencing pain for more than a month. The Psychiatric Diagnostic Screening Questionnaire assessed symptoms of somatization, panic, generalized anxiety (GAD) and major depressive (MDD) disorders, which were hypothesized as possible mediators of the relationship between PA and pain. Structural equation models were tested using robust maximum likelihood and Bayes estimation in M*plus* 8.0. **RESULTS:** The hypothesized causal model had good fit ($X^2$ (10) = 14.75, P = 0.141, CFI=0.996, SRMR=0.018, RMSEA= 0.021) and accounted for a significant (P=0.004) amount of variance ($R^2$, SE) in pain (5.3%, 1.9%). Direct paths (β, SE) from PA to: MDD (-0.163, 0.045), GAD (-0.175, 0.049), panic (-0.100, 0.046), and somatization (-0.175, 0.049) were significant (P-values ≤ 0.028). The path from PA to pain was not direct (P=0.770), but indirect (P-values ≤ 0.016) and through significant paths (P-values ≤ 0.005) to pain from panic (0.130, 0.046) and somatization (0.156, 0.044). There were no direct or indirect effects from pain to PA in a reciprocal causal model. **CONCLUSION:** The findings support that, among college-aged women, PA is associated with pain indirectly through its associations with symptoms of somatization and panic disorder.

2103 June 1 9:45 AM - 10:00 AM

### Resistance Training Does Not Alter Pain Sensitivity In Gulf War Veterans With Chronic Musculoskeletal Pain

Jacob B. Lindheimer[1], Aaron J. Stegner[2], Stephanie M. VanRiper[2], Ryan J. Dougherty[3], Neda E. Almassi[2], Jacob V. Ninneman[3], Laura D. Ellingson[4], Patrick J. O'Connor, FACSM[5], Dane B. Cook, FACSM[2]. [1]*US Department of Veterans Affairs, East Orange, NJ.* [2]*US Department of Veterans Affairs, Madison, WI.* [3]*University of Wisconsin-Madison, Madison, WI.* [4]*Iowa State University, Ames, IA.* [5]*University of Georgia, Athens, GA.* (Sponsor: Dane B. Cook, FACSM)

*(No relevant relationships reported)*

Chronic musculoskeletal pain (CMP) is a prevalent condition among Veterans of the Persian Gulf War (GV). We have previously demonstrated augmented sensitivity to painful stimuli in GV with CMP. Exercise training is an effective method for reducing pain symptoms in patients with CMP; however, the influence of exercise training on pain sensitivity to experimental stimuli is unknown. **PURPOSE:** To examine the effect of whole-body resistance exercise training (RET) on pain sensitivity among GV with CMP. It was hypothesized that, compared to a wait-list control (WLC) condition, sensitivity to painful stimuli would significantly decrease over time in participants assigned to RET. METHODS: GV who met criteria for widespread CMP were randomly assigned to a 16-week, whole-body resistance exercise training program ($n$=21; 49±5 years) or a wait-list control group ($n$=19; 50±7 years). Pain sensitivity was measured by recording perceptual ratings (0-20) of pain intensity and unpleasantness in response to a series of noxious thermal stimuli (45ºC, 47ºC, 48.9ºC) at baseline, 6, 11, and 17 weeks. Separate three-way repeated measures MANOVA models with time (baseline, 6, 11, and 17 weeks) and temperature (45ºC, 47ºC, 48.9ºC) as the within-subjects factors, and group (RET, WLC) as the between-subjects factor were used to examine the effect of RET on pain intensity and unpleasantness ratings. **RESULTS:** Whole body strength improved across the 16-week training period (average 1-RM% change from baseline across 10 upper & lower body exercises = 28.95%). Mean pain ratings across measurement time-points for 45ºC, 47ºC, and 48.9ºC stimuli corresponded to 3, 7, and 13, for intensity and 2, 5, and 10 for unpleasantness, respectively. Aside from a significant main effect of temperature in the intensity, $\Lambda$ = 0.14, $F$ (2,29) = 90.79, $p$ < .001, and unpleasantness, $\Lambda$ = 0.17, $F$ (2,29) = 72.14, $p$ < .001, MANOVA models, there were no significant main or interaction effects. **CONCLUSIONS:** Resistance exercise training does not affect pain sensitivity in GV with CMP. Importantly, this finding suggests that resistance exercise has a low risk of exacerbating pain sensitivity and is a safe strategy for increasing upper and lower body strength in this population.

Supported by US Department of Veterans Affairs grant #I01CX000383

2104 June 1 10:00 AM - 10:15 AM

### Energy, Health, and Productivity Following a Sedentary Behavior Intervention in Workers with Low Back Pain

Tyler D. Quinn[1], Andrea L. Hergenroeder[1], Sophy J. Perdomo[2], John M. Jakicic, FACSM[1], Anthony Delitto[1], Bethany Barone Gibbs[1]. [1]*University of Pittsburgh, Pittsburgh, PA.* [2]*University of Kansas, Kansas City, KS.* (Sponsor: John Jakicic, FACSM)

*(No relevant relationships reported)*

Decreased sedentary behavior is related to several positive health outcomes, however, further investigation of potential effects on presenteeism, health, and productivity in desk workers with chronic low back pain is warranted. **PURPOSE:** The Stand Back randomized trial evaluated subjective measures of health and psychosocial well-being before and after a six month intervention to reduce sedentary behavior. **METHODS:** 24 individuals with chronic low back pain and desk jobs (sitting ≥ 20 hours/week) completed either the control or intervention group. The intervention included monthly behavior counseling, a sit-stand desk attachment, a wrist-worn activity prompter, and cognitive behavioral therapy for pain self-management. The Stanford Presenteeism Scale (SPS), Health Work Questionnaire (HWQ), the SF-36 Health Survey (SF-36), and self-reported work sitting questionnaire were administered at baseline and six months. All questionnaires and subscales were analyzed across intervention groups using ANCOVA regression, adjusting for baseline values. Cohen's d was used to estimate effect size. **RESULTS:** At six month follow-up, the intervention group reported 1.5 hours/day less sitting time (p<0.001) and decreased low back pain Oswestry Disability Index (-7.8%, p=0.027) compared to control. Compared to controls, the subscales of energy/fatigue, social functioning, and pain (SF-36) were significantly improved across groups at six months. Productivity (HWQ), concentration (HWQ), and SPS-score remained unchanged (Table 1). **CONCLUSION:** Interventions to reduce sedentary time may be effective in improving energy, social functioning, and pain with no negative impact on productivity and concentration in desk workers with chronic low back pain.

| | | | |
|---|---|---|---|
| Table 1: Changes across groups at six months | | | |
| | β | p-value | *d* |
| Stanford Presenteeism Scale | | | |
| SPS score | 1.69 | 0.367 | 0.37 |
| Health Work Questionnaire | | | |
| Total Score | -0.04 | 0.905 | 0.03 |
| Productivity | -0.17 | 0.675 | 0.16 |
| Concentration/Focus | -0.74 | 0.269 | 0.39 |
| Supervisor relations | 0.04 | 0.944 | 0.02 |
| Non-work Satisfaction | 0.82 | 0.092 | 0.49 |
| Work Satisfaction | -0.04 | 0.947 | 0.02 |
| Impatience/Irritability | -1.12 | 0.073 | 0.64 |
| SF-36 | | | |
| General health | 5.61 | 0.268 | 0.32 |
| Physical functioning | 8.22 | 0.166 | 0.38 |
| Limitations (physical health) | 4.68 | 0.674 | 0.11 |
| Limitations (emotional problems) | 18.79 | 0.115 | 0.56 |
| Energy/Fatigue | 18.13 | ≤0.001 | 0.84 |
| Emotional well-being | 6.90 | 0.077 | 0.36 |
| Social functioning | 11.92 | 0.024 | 0.62 |
| Pain | 8.85 | 0.036 | 0.48 |
| Note: β = adjusted group effect, *d* = Cohen's d | | | |

2105 June 1 10:15 AM - 10:30 AM

### Pain Coping Skills of Female Ultrarunners

Mitchell W. Cushman, Ashley M. Bullers, Michael C. Meyers, FACSM. *Idaho State University, Pocatello, ID.*

*(No relevant relationships reported)*

A female ultrarunner's ability to cope with stressful situations during competition is crucial for optimal development. Therefore, the ability to cope under these circumstances is essential for creating a strong mental capacity that leads to competitive success. **PURPOSE:** To quantify the pain coping skills of female ultra runners. **METHODS:** Following written informed consent, 76 female ultra runners (mean age 38.9 ± 9.4) completed the Sports Inventory for Pain (SIP; Meyers et al., 1992): direct coping (COP), cognitive (COG), catastrophizing (CAT), avoidance (AVD), body awareness (BOD), and total coping resources (TCR). Data were grouped by distance (<50 miles, 50-99 miles, 100+ miles), experience in years (novice-3, 4-9, 10+), age (20-39 years, 40+ years), number of ultra competitions completed (1-2, 3-4, 5+), ethnicity (Caucasian, other), present injury status (yes, no), and competitive injuries (0, 1-2, 3+). To make the data more meaningful, raw SIP scores were converted to normalized standard scores (T-scores) with a mean of 50 and a standard deviation of 10. **RESULTS:** MANOVAs (Wilks' λ criterion) indicated no significant effects across distance ($F_{12,136}$ = 1.256, P = 0.252), experience ($F_{12,136}$ = 0.840, P = 0.609), age ($F_{6,69}$ = 0.511, P = 0.798), ultra competitions completed ($F_{12,136}$ = 1.004, P = 0.449), ethnicity ($F_{6,69}$ = 0.395, P = 0.880), current injury status ($F_{6,69}$ = 1.625, P = 0.153), and competitive injuries ($F_{12,136}$ = 0.856, P = 0.59). Coping skills among this group reflected above-average response, with T-scores ranging from 43 to 57. There is a trend for ultrarunners to respond more positively in COP, COG, CAT, AVD, BOD, and TCR when compared to normative values across other athletic populations. **CONCLUSION:** While the limited sample size may have affected the results, observed power was deemed adequate (1- β = .156 to .951), with data indicating that female ultrarunners respond positively under an adverse competitive environment. Further research is warranted to assess coping skills with larger ultra populations, as well as to determine the efficacy of coping skills interventions on ultra performance.

2106 June 1 10:30 AM - 10:45 AM

### Exercise For Improving Pain Sensitivity: Comparing Moderate-intensity Continuous And High-intensity Interval Training (HIIT).

Stefan Håkansson. *Karolinska Institutet, Stockholm, Sweden.*

*(No relevant relationships reported)*

Aerobic exercise training appears to promote hypoalgesia, with larger effects on pain tolerance than pain threshold. However, little is known about the optimal exercise training intensity for improving pain sensitivity. High-intensity interval training (HIIT) is becoming popular as a time-efficient alternative to moderate-intensity continuous training (MICT), with evidence of similar or greater efficacy across a range of cardiovascular and metabolic adaptations, but its effect on pain sensitivity has not been examined.

**PURPOSE:** To compare the effects of 6 weeks of HIIT or MICT on pressure pain sensitivity in overweight or obese, sedentary males.

**METHODS:** Twenty-eight males (age 28 ± 7, BMI 28.6 ± 2.9) were randomly allocated to moderate (n=12) or high intensity (n=16) aerobic exercise training. Participants trained 3 sessions/week for 6 weeks on cycle ergometers. HIIT sessions involved 10 × 1minute intervals at 90-100% workload at maximal aerobic capacity (Wmax), interspersed with 1minute of active rest at 35% of Wmax. MICT sessions involved 30minutes continuous cycling at 65-75% heart rate maximum. Training protocols were matched for total workload. Pressure pain threshold (PPT) was measured pre- and post-training using algometry over the trapezius, thigh and tibialis anterior.

**RESULTS:** Following training, PPT increased (i.e. less pain) in MICT participants over the thigh (% change: 52% ± 60, $d$ = 1.08, $p$ = 0.004) and tibialis anterior (62% ± 58, $d$ = 1.06, $p$ = 0.003) but not the trapezius (28% ± 55, $d$ = 0.44, $p$ = 0.08). For HIIT participants, PPT was unchanged at all sites following training (all $d$ -0.05 to -0.17, all $p$ > 0.52). The magnitude of the change in PPT after training for MICT compared to HIIT was greater at the thigh ($d$ = 1.14, $p$ = 0.005) and tibialis anterior ($d$ = 1.37, $p$ = 0.001) but not the trapezius ($d$ = 0.64, $p$ = 0.1).

**CONCLUSION:** Moderate but not high-intensity exercise training increases PPT in sedentary overweight males. The effect was largest at the worked muscles, suggesting regional-specific pain adaptations to exercise training. Inter-individual differences in PPT in response to training were prominent.

2107 June 1 10:45 AM - 11:00 AM

### Preferred Versus Novel Exercise Modalities on Endogenous Pain Inhibition Following Exercise

Jessica Peterson, Daniel Schubert, Michael Bemben, FACSM, Jason Campbell, Christopher Black, FACSM. *University Of Oklahoma, Oklahoma City, OK.* (Sponsor: Christopher Black, FACSM)

*(No relevant relationships reported)*

Athletes have been shown to be less sensitive to pain than sedentary individuals. However, it is unclear whether their ability to modulate pain via conditioned pain modulation (CPM) differs. Exercise-induced hypoalgesia is a phenomenon related to CPM where pain sensitivity decreases following a bout of exercise. Little data exist on whether the EIH response differs between athletes and non-athletes. **PURPOSE:** The study examined the effects of aerobic training status of sensitivity to pressure pain following a familiar (running) and unfamiliar (handgrip) exercise. **METHODS:** The pressure pain response of highly aerobically trained (N=13; T) and untrained participants (N=10; UT) were tested before and after performance of an isometric hand grip exercise to failure, a 30-min run at 110% of gas exchange threshold, and placing their foot in an ice bath (2°C) for 1-min. Pressure pain thresholds (PPT) were assessed in the vastus lateralis (VL) and brachioradialis (BR) using a pressure algometer. The difference between post and pre measures was defined the EIH response (exercise conditions) and CPM response (ice bath). **RESULTS:** The groups differed on $VO_{2\ peak}$ (T = 72.2 ± 4.6; UN = 44.0 ± 8.0 $ml \cdot kg^{-1} \cdot min^{-1}$; p < 0.001). PPT did not differ between groups in the VL or BR following both exercise modalities or following the ice bath (p ≥ 0.05). A significant main effect for time was observed for VL PPT's with values increasing 18.2 ± 14.3% following 30-min of running (p < 0.001), 14.8 ± 14.6% following handgrip (p < 0.001), and 19.7 ± 22.0 following the ice bath. In the BR EIH occurred following handgrip (26.5 ± 23.2% increase; p < 0.001) and the ice bath (17.6 ± 21.5% increase; p < 0.001), but not the treadmill run (10.4 ± 19.2; p = 0.057). **CONCLUSIONS:** Training status and exercise type had no effect on EIH or CPM when PPT were assessed in the VL. Interestingly running was not a sufficient stimulus to evoke EIH in the BR. While familiarity with the exercise modality appeared to play no role in the EIH response, the exercise modality did play a role in systemic pain modulation with isometric exercise yielding a more robust response.

2108 June 1 11:00 AM - 11:15 AM

### Pain Modulation in Response to Resistance Exercise Training in Gulf War Veterans with Chronic Pain

Stephanie M. Van Riper[1], Aaron J. Stegner[1], Jacob B. Lindheimer[2], Ryan J. Dougherty[3], Neda E. Almassi[1], Jacob V. Ninneman[3], Laura D. Ellingson[4], Patrick J. O'Connor, FACSM[5], Dane B. Cook, FACSM[1]. *[1]US Department of Veterans Affairs, Madison, WI. [2]US Department of Veterans Affairs, East Orange, NJ. [3]University of Wisconsin-Madison, Madison, WI. [4]Iowa State University, Ames, IA. [5]University of Georgia, Athens, GA.*

*(No relevant relationships reported)*

United States military Veterans of the Persian Gulf War (GV) suffer unresolved chronic musculoskeletal pain (CMP) that significantly impacts their functional ability and quality of life. Pain modulation is impaired in some groups with CMP and can be augmented with acute exercise. Whether chronic exercise training influences pain modulation in GV with CMP is unknown. **PURPOSE:** To examine the effects of a 16-week resistance exercise training (RET) program on pain modulation in GV with CMP. **METHODS:** Forty GV with CMP were randomly assigned to RET (n=19) or a wait-list control group (WLC; n=21). The RET program was individualized to begin at a low intensity and involved standardized progression. Pain modulation was evaluated at baseline and 3 subsequent time points by comparing pain ratings to a series of painful heat stimuli delivered alone or concurrently with the Stroop color word task, which has two levels of cognitive difficulty: congruent (CS) and incongruent (IS). Variance to mean ratios (VMR) of pain modulation scores were calculated as an indicator of dispersion. Separate repeated measures MANOVA were used to examine the effect of group (RET vs. WLC) and time (1-4) on pain modulation (change in pain ratings) for both types of Stroop presentation. **RESULTS:** Groups did not differ on age, height, weight, or gender (p < 0.05). Whole body strength improved with training (average 1-RM% change from baseline across 10 upper & lower body exercises = 28.95%). No significant main or interaction effects were detected for either Stroop presentation (p > 0.05). The proportion of individuals demonstrating a pain modulatory response did not differ at any time point, $X^2$ (1, N=40) = 0.14-2.10, p > 0.05. Pain modulation scores where highly variable for both groups across each time point (VMR Range: CS 1.77-1.96; IS 2.74-5.07). **CONCLUSION:** The degree to which GVs with CMP modulate pain at baseline does not appear to change as a result of RET, however pain modulation scores were highly variable across groups and time points. The lack of a change in pain modulation suggests that resistance exercise training in GVs with CMP does not influence the pain regulatory mechanism assessed here. Supported by US Department of Veterans Affairs grant #I01CX000383.

2109 June 1 11:15 AM - 11:30 AM

### The Effects of Mirthful Laughter on Pain Tolerance and Delayed Onset Muscle Soreness.

Stephanie Lapierre, Brett Baker, Hirofumi Tanaka, FACSM. *The University of Texas at Austin, Austin, TX.* (Sponsor: Hirofumi Tanaka, FACSM)

*(No relevant relationships reported)*

Chronic pain is a debilitating disease that affects more people than any other chronic disease. Currently, there is not a singular treatment known to cure or assure relief from chronic pain. Accordingly, the management of patients' discomfort is an integral part of treating chronic pain. Such treatment, however, is not effective for many patients. **PURPOSE:** We determined if mirthful laughter provided by comic relief can influence pain tolerance and muscle soreness in young healthy participants**. METHODS:** Forty participants underwent a randomized controlled cross-over designed experiment. Each participant was exposed to a comedy video eliciting mirthful laughter and a boring documentary. Delayed onset muscle soreness was induced in one leg at a time by eccentric exercises to mimic chronic pain. Pain tolerance was tested using the blunt force application**. RESULTS:** Watching the comedy video elicited a significantly greater irregular breathing pattern compared with watching the documentary video ($p<0.001$). After watching the comedy, the participants' positive affect was increased ($\Delta 2\pm1$) while it was largely decreased ($\Delta$-11±2) after watching the documentary video ($p<0.001$). Pain tolerance was decreased by 17±5 N after viewing the documentary video ($p<0.001$), but did not change significantly after watching the comedy. There were no significant changes in the visual analogue pain/soreness score from viewing either video. **CONCLUSION:** Thirty-minutes of watching a comedy eliciting laughter favorably influenced pain tolerance in healthy humans.

## E-12 Free Communication/Slide - **Physical Activity in Clinical Populations**

Friday, June 1, 2018, 9:30 AM - 11:15 AM
Room: CC-101G

2110 **Chair:** Matthew Harber, FACSM. *Ball State University, Muncie, IN.*

*(No relevant relationships reported)*

2111 June 1 9:30 AM - 9:45 AM

### Physical Activity Levels and Smoking Status in Relation to Weight Control after Bariatric Surgery

Ryan E.R. Reid, Nathan A. Chiarlitti, Alexandra Sirois, Patrick Delisle-Houde, Nicolas V. Christou, Ross E. Andersen, FACSM. *McGill University, Montreal, QC, Canada.* (Sponsor: Ross E Andersen, FACSM)

*(No relevant relationships reported)*

Smokers typically exhibit lower body weights than non-smokers despite poorer metabolic and physiologic profiles. Nicotine, an appetite suppressant found in cigarettes and cigars, may play a role in weight control. Physical activity also contributes to lower body weights; however, this simultaneously reduces all-cause mortality, risk of coronary artery disease, and other chronic conditions. **PURPOSE:** To investigate if smoking status has an impact on weight loss and physical activity levels in patients 1-17 years after Roux-en-Y gastric bypass (RYGB). **METHODS:** A total of 509 individuals who had previously undergone RYGB (1-17 years post) were recruited for this study. To assess physical activity habits, participants were asked, "How many times per week do you exercise for 30 min or more at an intensity that makes you sweat or breathe hard?" Participants were also asked if they were a current smoker, ex-smoker or never smoked. **RESULTS:** The sample consisted of 22% smokers (114 total, 81 females), 47% never-smokers (239 total, 190 females) and 31% ex-smokers (156 total, 120 females). There were no significant differences in smoking status ($p$=.45) or physical activity ($p$=.57) between sexes. Current smokers had the highest BMI change (-21.2±.8kg/m$^2$) compared to both never-smokers (-18.8±.6kg/m$^2$; $p$=.01) and ex-smokers (-18.7±.7kg/m$^2$; $p$=.02) while there was no significant difference between never-smokers and ex-smokers ($p$=.97). Ex-smokers reported being significantly more active (1.7±1.9bouts) compared to current smokers (1.1±1.7bouts; $p$=.01) while there were no differences in activity between never-smokers (1.5±1.7bouts) and current smokers ($p$=.07). **CONCLUSIONS:** Although smokers lost the greatest amount of weight post-surgery, they also reported being inadequately active. Post-surgical follow-ups should evaluate numerous health measures as indicators of surgical success, as long term weight change may also be equally affected by both healthy and unhealthy habits.

2112 June 1 9:45 AM - 10:00 AM

### The Effect Of Changes In Physical Activity After Bariatric Surgery On Health Outcomes.

Malou AH Nuijten[1], Rens Wolf[2], Onno Tettero[2], Esmée A. Bakker[1], Ignace MC Janssen[2], Maria TE Hopman, FACSM[1]. *[1]Radboud University Medical Center (RUMC), Nijmegen, Netherlands. [2]Dutch Obesity Clinic, Arnhem, Netherlands.*

*(No relevant relationships reported)*

**BACKGROUND**:The prevalence of obesity is increasing at an alarming rate, as is the number of morbidly obese individuals (i.e. BMI>40) in our society. Bariatric surgery is considered an effective treatment for morbid obesity with promising results on weight control, quality of life and health. However, the success of bariatric surgery in terms of health outcomes varies largely, which might be related to changes in physical activity from pre- to post-surgery. **PURPOSE**: This study aims to determine whether pre- to post-surgery changes in physical activity were associated with health outcomes such as, excessive weight loss, $VO_2$max, fat-free mass and quality of life up to two years after surgery.
**METHODS**: 3879 post-bariatric patients were divided into three groups based on pre- to post-surgery change in physical activity: decrease, stable and increase. Measurements regarding physical activity (Baecke questionnaire), body composition (bioelectrical impedance analysis), cardiorespiratory fitness (Astrand) and quality of life (SF-36) were performed pre-surgery and two years post-surgery. Linear regressions between change in physical activity and change in health outcomes were conducted.
**RESULTS**: Increasing physical activity was associated with larger excessive weight loss (β=3.17; 95%CI=1.40-4.93; $P$<0.001) and greater increases in $VO_2$max (β=2.01; 95%CI=0.51-3.51; $P$=0.009) and %fat-free mass (β=1.05; 95%CI=0.50-1.60; $P$<0.001) compared to stable- and declining physical activity. Decreasing physical activity was associated with a decrease in $VO_2$max (β=-3.91; 95%CI=-6.40- -1.43; $P$=0.002). The increase-group showed greater increases in all quality of life subscales compared to stable- and decrease-group ($P$<0.05), except for physical functioning. Change in physical activity was not related to changes in absolute fat-free mass.
**CONCLUSIONS**: Increasing physical activity from pre- to post-surgery was associated with greater excessive weight loss and greater improvements in body composition, cardiorespiratory fitness and quality of life. Therefore, increasing physical activity after bariatric surgery seems essential for bariatric success in terms of health outcomes.

2113 June 1 10:00 AM - 10:15 AM

### Effect of Obesity Coupled with Resting Alveolar-capillary Function on Exercise Capacity and Ventilatory Efficiency in Adult Heart Failure

Erik H. Van Iterson[1], Joshua R. Smith[1], Bruce D. Johnson[1], Katelyn Uithoven[2], Eric J. Bruhn[1], Thomas P. Olson, FACSM[1]. *[1]Mayo Clinic, Rochester, MN. [2]University of Minnesota, Minneapolis, MN.* (Sponsor: Thomas P. Olson, FACSM)

*(No relevant relationships reported)*

PURPOSE: Impaired oxidative capacity and exercise ventilatory inefficiency are primary features of human heart failure (HF). Although commonly assessed at rest, pulmonary limitations at the alveolar-capillary level also impact exercise. While it remains unclear how these interdependent features of HF contribute to exercise intolerance; obesity may further confound this issue. This study aimed to assess the impact of resting alveolar-capillary function on exercise capacity and ventilatory efficiency in obese (O) and non-obese (NO) HF patients.
METHODS: Male HF undergoing cardiopulmonary exercise testing (CPET) were stratified as NO or O (N=55 vs N=31; age 57±13 vs 55±13 yrs; LVEF 28±11 vs 30±11 %; BMI 26±2 vs 34±2 kg/m$^2$; NYHA class I-IV: 23 vs 5, 20 vs 16, 11 vs 9, 1 vs 1, respectively). Breath-by-breath ventilation and gas exchange were continuously measured via open circuit spirometry during CPET. Lung diffusion capacity for carbon monoxide ($DL_{CO}$) and alveolar volume ($V_A$) were measured at rest. The mixed expired $CO_2$ and end-tidal $CO_2$ ratio was used to estimate global ventilation-perfusion matching ($PECO_2/P_{ET}CO_2$~0.60 airway limited; ~0.70 airway/perfusion limited). The ventilatory equivalent for $CO_2$ ($V_E/VCO_2$) slope was calculated rest to peak exercise. RESULTS: NO and O resting $DL_{CO}$ (25±5 vs 24±5 mL/min/mm Hg), $V_A$ (6±1 vs 6±1 L) and $DL_{CO}/V_A$ (4±1 vs 4±1 mL/min/mm Hg/L) were similar (all P>0.05). Peak exercise RER (1.14±0.12 vs 1.12±0.15), $VO_2$ (1.8±0.7 vs 1.8±0.7 L/min), $PECO_2/P_{ET}CO_2$ (0.74±0.05 vs 0.76±0.04) and $V_E/VCO_2$ slope (35±12 vs 32±5) did not differ in NO and O (all P>0.05). Peak $VO_2$ correlated with $DL_{CO}$ and $V_A$ in NO and O (r=0.66 vs 0.48; r=0.62 vs 0.49; all P<0.05), but not for $DL_{CO}/V_A$ (r=0.11 vs 0.08). $V_E/VCO_2$ slope correlated with $DL_{CO}$ and $V_A$ in NO (r=-0.54 and -0.49; both P<0.05), but not O (r=-0.26 and -0.06); whereas $DL_{CO}/V_A$ was similar (r=-0.15 vs -0.25). Peak $PECO_2/P_{ET}CO_2$ correlated with $DL_{CO}$ and $V_A$ in NO (r=0.33 and 0.37), but only $V_A$ in O (r=0.37) (all P<0.05); whereas $DL_{CO}/V_A$ was similar (r=-0.06 vs -0.05).

CONCLUSION: These data suggest that exercise capacity, ventilation-perfusion matching, and ventilatory efficiency are similar in NO and O HF. However, the translation of resting alveolar-capillary function to these interdependent measures of exercise capacity may be confounded by obesity.

2114 June 1 10:15 AM - 10:30 AM

## Obstructive Sleep Apnea Negatively Impacts Objectively Measured Physical Activity

Trent A. Hargens, FACSM, Ryan A. Martin, Courtney L. Strosnider, Gabrielle Giersch, Christopher J. Womack, FACSM. *James Madison University, Harrisonburg, VA.*

*(No relevant relationships reported)*

Obstructive sleep apnea (OSA) is a disorder that results daytime sleepiness and fatigue. Additionally, OSA increases the risk for cardiovascular disease and diabetes, which is exacerbated by sedentary behavior. Obesity and OSA are frequent co-morbid conditions, so the impact of OSA, independent of obesity, on physical activity (PA) is not clear.
**PURPOSE:** To examine the effect of OSA on objectively measured PA via accelerometer.
**METHODS:** Overweight-to-obese individuals were recruited and screened for the presence of OSA via portable diagnostic device and divided into an OSA group [n = 35; Age = 45.2 ± 12.0; body mass index (BMI) = 33.0 ± 5.7 kg/m$^2$] and a Control group (n = 24; Age = 35.0 ± 11.7; BMI = 30.5 ± 4.3 kg/m$^2$). Daytime sleepiness was assessed with the Epworth Sleepiness Scale questionnaire. Body composition was assessed with dual-energy X-ray absorptiometry. Subjects wore an accelerometer for a minimum of 4 and maximum of 7 days, including at least 1 weekend day.
**RESULTS:** The OSA group's mean OSA severity (Apnea-Hypopnea Index = 20.4 ± 17.6) classifies as "moderate OSA". There were no group differences in BMI, percent fat, or daytime sleepiness. Waist (106.4 ± 11.7 vs. 98.6 ± 9.1) and neck circumference (41.9 ± 3.3 vs. 38.8 ± 2.7) were higher in the OSA group. The OSA group was significantly older than the control group. Pearson correlation analysis showed that age was not related to any PA variable except for the total number of moderate or greater PA bouts (PA for ≥ 10 consecutive minutes) and the average number of bouts per day. The OSA group had fewer steps (6409.0 ± 2317.6 vs. 7856.8 ± 2942.7, P = 0.04), moderate intensity minutes (29.9 ± 15.1 vs. 44.2 ± 25.4, P < 0.01), moderate-to-vigorous minutes (33.0 ± 3.0 vs. 46.0 ± 5.4, P = 0.03), total number of bouts (3.2 ± 3.4 vs. 5.9 ± 5.0, P = 0.02), and number of bouts per day (0.5 ± 0.5 vs. 1.0 ± 0.8, P = 0.01). When adjusted for age, the PA bout data was no longer significant.
**CONCLUSION:** Individuals screened as likely possessing OSA were less physically active than individuals without OSA when measured through objective means. We found no group differences in daytime sleepiness, BMI or percent fat, suggesting other mechanisms than obesity and sleepiness for this difference.

2115 June 1 10:30 AM - 10:45 AM

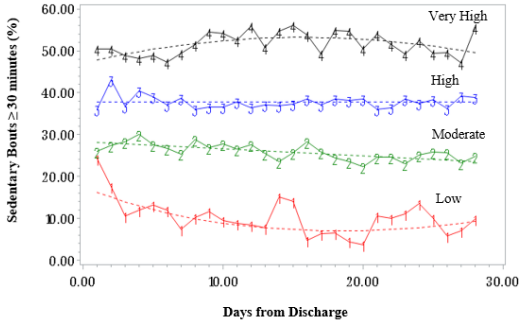
## Patterns of Prolonged, Uninterrupted Sedentary Bouts in the First Month after Acute Coronary Syndrome

Andrea T. Duran[1], Carol Ewing Garber, FACSM[1], Joseph E. Schwartz[2], Keith M. Diaz[2]. *[1]Teachers College, Columbia University, New York, NY. [2]Columbia University Medical Center, New York, NY.*

*(No relevant relationships reported)*

Total volume of sedentary behavior (SED) and its accrual in prolonged, uninterrupted bouts are crucial health risk behaviors to target in U.S. adults. Acute coronary syndrome (ACS) survivors engage in high volumes of SED post-hospitalization, but their accrual of prolonged, uninterrupted bouts is unclear.
**PURPOSE:** Characterize patterns of SED time accrued in prolonged, uninterrupted bouts and their trajectories of change in ACS patients over the first month post-discharge. **METHODS:** Participants (n=162) with confirmed ACS (myocardial infarction or unstable angina) from a university hospital in Manhattan were examined. SED was objectively measured for 28-days post-discharge via Actical wrist accelerometry. SED bout characteristics were quantified at the day-level and averaged over the 28-day period. Group-based modeling at the day-level was used to characterize the trajectories of change in SED bouts (% of total SED time accrued in ≥ 30 min) over the 28-days. **RESULTS:** Participants spent a mean (SD) of 9.5 ± 2.0 hrs/day in SED time, with a mean (SD) SED bout length of 7.1 ± 2.4 mins/bout, over one month post-discharge. The total number of SED bouts ≥30, ≥60 and ≥90 mins were, on average, 4.9 ± 2.3, 1.2 ± 0.8, and 0.3 ± 0.3 bouts/day, accounting for 31.8 ± 12.8%, 12.1 ± 8.2%, and 4.9 ± 4.8% of total SED time, respectively. Four distinct SED bout trajectory groups were identified (Fig 1). The very high (12.2%), high (38.3%), and moderate (38.9%) trajectory groups accrued, on average, 52.0%, 38.1%, and 25.7% of total SED time from bouts ≥30 min, respectively, with little change in day-level SED bouts post-discharge. The low trajectory group (10.6%) accrued, on average, 9.8% of total SED time from bouts ≥30 min, with a decline in SED bouts post-discharge. **CONCLUSION:** ACS survivors accrued ~30% of total SED in prolonged, uninterrupted bouts ≥ 30 min, on average, after hospitalization, with the majority showing little day-level change in such bouts over the first month post-discharge.

Figure 1. Trajectories of total sedentary time accrued in bouts ≥ 30 minutes in ACS survivors post-discharge.




2116 June 1 10:45 AM - 11:00 AM

## Abstract Withdrawn

2117 June 1 10:45 AM - 11:00 AM

## Effects of Eccentric and Concentric Cycling on Markers of Oxidative Stress and Inflamation in Elderly

Luis Peñailillo[1], Karen Mackay[1], Roberto Gonzalez[1], Denisse Valladares[1], Ariel Contreras-Ferrat[1], Hermann Zbinden-Foncea[1], Kasunori Nosaka[2]. *[1]Universidad Finis Terrae, Santiago, Chile. [2]Edith Cowan University, Perth, Australia.* (Sponsor: Alvaro Gurovich, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** The aim of this study was to examine the plasma concentration of oxidative stress and inflammation markers before and immediately after a moderate intensity concentric cycling bout, a moderate intensity eccentric cycling bout and high intensity eccentric cycling bout. **METHODS:** Ten healthy elderly participants (60.36 ± 6.79 years) performed 30 min of a concentric cycling bout (CONC) at 50% of the maximum power output (POmax), an eccentric cycling bout at 50% of POmax (ECC ISO PO) and an eccentric cycling bout at 50% of peak oxygen consumption (~100% POmax; ECC ISO VO2). Each bout was separated with one-week washout period. Before and after cycling blood samples were collected and plasma was stored at -80ºC until analyzes. Oxidative stress markers (MDA; protein carbonyl), antioxidant markers (total antioxidant capacity; glutathione peroxidase) and inflammatory markers (IL-6 and TNF- α) were analyzed using ELISA kits. Furthermore, indirect muscle damage markers were assessed before, immediately after and 24 and 48 h after exercise.
**RESULTS:** Average power output of ECC ISO VO2 was 48.8% and 41.8% higher than CONC and ECC ISO PO, respectively. Oxygen consumption during ECC ISO PO was 50% and 40% lower than CONC and ECC ISO VO2, respectively. Heart rate during ECC ISO PO was 16.8% and 23% lower than CONC and ECC ISO VO2, respectively. MDA concentration decreased immediately after CONC (-28%) and ECC ISO PO (-21.8%), but not after ECC ISO VO2. Glutathione peroxidase concentration increased after all three bouts of exercise (CONC=20.2%, ECC ISO PO= 27.2% and ECC ISO VO2=26.8%). IL-6 increased (+18%) only after ECC ISO VO2. Muscle damage was greater after ECC ISO VO2 than ECC ISO PO and CONC.
**CONCLUSION**: Moderate intensity eccentric cycling (ECC ISO PO) showed lower metabolic cost than concentric cycling for the same power output. Interestingly, moderate eccentric cycling induced similar oxidative stress than concentric cycling at lower metabolic cost. However, high intensity eccentric cycling (ECC ISO VO2) induces moderate muscle damage and inflammation, which may blunt the decrease of oxidative stress induced by lighter bouts of cycling. The moderate eccentric cycling exercise is safe with low risk of increasing inflammation and oxidative stress on elderly people.

2118 June 1 11:00 AM - 11:15 AM

**Impact of 10-weeks Of High Intensity Interval Training On the Myokine METRNL And Inflammatory Markers In Older Adults With Rheumatoid Arthritis Or Prediabetes**

David Bartlett. *Duke University, Durham, NC.* (Sponsor: William E. Kraus, FACSM)
*(No relevant relationships reported)*

**PURPOSE**: Rheumatoid arthritis (RA) and diabetes are inflammatory diseases associated with physical inactivity. Physical inactivity and inflammation are augmented by dysregulated skeletal muscle remodeling. During exercise, skeletal muscle produces a number of factors, termed 'myokines', which enhance exercise adaptations. One such myokine, meteorin-like protein (METRNL), regulates both muscle and systemic adaptations. The purpose of this study was to examine the effects of high-intensity interval training (HIIT) in older adults with RA or prediabetes on muscle and plasma METRNL.
**METHODS**: Twenty-two older adults (67 ± 7 years) with either RA (n=12) or prediabetes (n=10) completed 10 weeks of HIIT consisting 3 x 30 min sessions/ week of ≥60 second intervals at 80-90% interspersed by 50-60% $VO_{2peak}$. Clinical characteristics, blood and skeletal muscle METRNL and inflammatory markers were assessed before and after HIIT.
**RESULTS**: Following 10 weeks of HIIT, plasma METRNL increased in those with RA ($p$=0.02) but not in those with prediabetes ($p$=0.568). Muscle METRNL mRNA increased following exercise in those with prediabetes ($p$=0.002) but not RA ($p$=0.986) while muscle METRNL concentrations increased in both groups ($p$<0.05). Greater plasma METRNL with exercise was associated with a reduced percentage of inflammatory CD14+/CD16+ monocytes in those with RA ($p$<0.05). Greater METRNL mRNA with exercise was associated with greater muscle IL-8 ($r$ =.571; $p$=0.007). Greater muscle METRNL with exercise was associated with greater concentrations of muscle IL-10 and IL-6 (both $r$ >.663; $p$<0.003); greater muscle IL-6 with exercise was associated with better grip strength and 30-second chair stands (both $r$ >.443; $p$<0.05).
**CONCLUSIONS**: Although METRNL was not associated with changes in disease indices, exercise-induced increased plasma and muscle protein and mRNA were associated with improved inflammatory profiles. Our data suggest METRNL is associated with a beneficial inflammatory response to exercise training in patients with inflammatory disease; although protein translation responses may differ depending on the disease. Thus, HIIT may improve the coordination of cytokines and myokines critical for skeletal muscle and systemic exercise-induced adaptations. *Funding: EU Marie Curie (PIOF-GA-2013-629981).*

## E-13 Clinical Case Slide - **Hip and Pelvis II**

Friday, June 1, 2018, 9:30 AM - 11:30 AM
Room: CC-200E

2119 **Chair:** John Hatzenbuehler, FACSM. *St. Luke's Family Medicine, South Portland, ME.*
*(No relevant relationships reported)*

2120 **Discussant:** William W. Briner, FACSM. *Hospital for Special Surgery, Uniondale, NY.*
*(No relevant relationships reported)*

2122 June 1 9:30 AM - 9:50 AM

**Pelvic Injury - Weightlifting**

Erin S. Barnes. *Temple University, Philadelphia, PA.* (Sponsor: Mark Lavallee, FACSM)
*(No relevant relationships reported)*

**HISTORY**: A 34-year-old female was competing in the 90 kilogram weight-class at a national weightlifting competition. During her 3rd snatch attempt at 80 kilograms, the athlete was able to bring the barbell overhead. She failed to control the barbell and missed the lift behind her head, which resulted in the bar landing on her left posterior hip and lower back. She fell forward on both hands and knees and then to the platform. Medical team was present and immediately assessed the athlete.
**PHYSICAL EXAMINATION**: Urgent examination revealed an athlete lying on her back with her left hip slightly flexed with severe pain at rest and with passive movement of the hip joint. She was unable to move her left hip voluntarily. Her bilateral lower extremity sensory exam was intact and reflexes were symmetric. She was able to flex and extend both knees and ankles. There were no deformities on palpation of her lumbar spine and sacroiliac joints.
**DIFFERENTIAL DIAGNOSIS**: Posterior hip dislocation, Iliac Crest fracture, Hip Pointer, Acetabular Fracture, Femoral Neck Fracture
**TEST AND RESULTS**: XR AP Pelvis: showed a left comminuted acetabular fracture with an associated posterior hip dislocation
**FINAL WORKING DIAGNOSIS**: Acetabular pelvic fracture and posterior hip dislocation
**TREATMENT AND OUTCOMES**: She was transported to the local Emergency Room where she was evaluated and imaging was performed. She required a higher level of care and was transferred to a high level trauma center where she was admitted. The next morning (Monday), she underwent a surgical reduction of the posterior hip dislocation. She remained in traction until Tuesday when she had an additional CT scan and was taken back to the operating room for an open reduction, internal fixation of the acetabular fracture. She was up on crutches the next morning after surgery and spent one additional night in the hospital until being released on Thursday evening before flying home the next afternoon (Friday). After being admitted on Sunday night, she spent 4 days/nights total in the hospital and one night in a hotel. 5 days after the incident, she returned home to Utah.
The patient was non-weight bearing for 8 weeks. She was in formal physical therapy for 10 weeks and was able to ambulate without assistance 2.5 months after accident. She has slowly begun to return to weightlifting by 11 months post-injury.

2123 June 1 9:50 AM - 10:10 AM

**Groin Injury- Football**

Amanda Chaney[1], Amanda Goodale[1], Richard Okragly[1], Henry Stiene, FACSM[2]. [1]*Trihealth Sports Medicine, Cincinnati, OH.* [2]*Beacon Orthopedics and Sports Medicine, Cincinnati, OH.* (Sponsor: Henry Stiene, MD, FACSM)
*(No relevant relationships reported)*

**HISTORY**: A 22 year old division III college football player was running during practice and tried to make a cut on 8/22/17 and felt a pull in his left groin. The patient was evaluated by the athletic trainer and was diagnosed with adductor strain. He met with the athletic trainer frequently over the next few weeks to treat his pain with modalities such as laser therapy, electrical stimulation and cupping as well as doing strengthening exercises and activity modification. During game on 9/9/17, athlete played most of the game but had great amount of pain. He woke up the morning of 9/11 and noticed that he was severely bruised at the left groin region and was unable to walk without discomfort. The athlete said that he felt pain radiating into his abdomen and down into his left leg. At that point, he was referred to our Sports Medicine clinic.
**PHYSICAL EXAMINATION**:General: under no acute distress; alert and oriented Heart: regular rate and intact distal pulses; Lungs: CTA bilaterally; Abdomen: soft, mildly tender at right and left lower quadrants, non-distended, normal bowel sounds in all four quadrants; Groin- diffuse ecchymosis at left groin region & at pubic symphysis and left pubic tubercle; tender to palpation at left side of pubic region as well as at left lower quadrant of abdomen; weak left hip adductors & hip flexors noted on exam and pain with hip adduction and hip flexion **DIFFERENTIAL DIAGNOSIS**: 1. Left hip Adductor strain 2. Left hip Adductor tear 3. Left pubic tubercle bone contusion 4. Left Iliopsoas strain **TEST AND RESULTS**: Left Hip X-ray AP and Lateral: no acute fracture or abnormal findings MRI of Pelvis w/o contrast: left adductor longus tear with 2.5cm of retraction **FINAL WORKING DIAGNOSIS**: Left adductor tendon avulsion with approximately 2.5 cm of tendon retraction.
**TREATMENT AND OUTCOMES**: The athlete had approximately two weeks of rest after time of diagnosis. The consulting orthopedic surgeon recommended conservative treatment with activity modification and rehab exercises as he was desiring to finish his senior season. He continue to report pain with activity and at the conclusion of the season, will likely be reimaged to determine if conservative treatment is still acceptable or if injury has worsened further to the point of requiring surgery.

2124 June 1 10:10 AM - 10:30 AM

**Testicular Pain- Football**

Mary Iaculli, DO. *Evergreen Sports Medicine Fellowship, Augusta, ME.* (Sponsor: Peter Sedgwick, MD, FACSM)
*(No relevant relationships reported)*

**HISTORY**: 21 year-old collegiate football player presents to the clinic with recurrent, intermittent, severe left testicular pain occurring at rest for the past two weeks. The first episode was so severe it prompted him to go to the emergency department. There, urinary studies were performed which were negative for infection and he underwent a scrotal ultrasound. The ultrasound showed decreased left testicular vascularity, but negative for torsion. The pain had mostly resolved at the time of imaging. He returned to the ED the following day with another severe episode and underwent a second scrotal ultrasound, which showed swelling of epididymis. He was treated empirically for epididymitis with ciprofloxacin and asked to follow up.
At follow up, he reports his testicular pain is gradually improving but is still sore. Denies swelling or redness of testicle. No urinary symptoms. Denies risk factors for sexually transmitted infections. Denies history of genitourinary surgery. He admits to third episode that occurred one year prior and self-resolved with ice.
**PHYSICAL EXAMINATION**: Well appearing, no acute distress. Abdomen soft. No inguinal, femoral, ventral hernia. Normal scrotum bilaterally without erythema or rash. Normal vas deferens bilaterally, normal spermatic cord bilaterally. Left epididymidis

not enlarged, but mildly tender to palpation. Right normal. Left testes with Bell Clapper deformity, non-tender, no mass. Right testes normal. Circumcised penis with normal meatus.
**DIFFERENTIAL DIAGNOSIS**: Testicular torsion-detorsion syndrome; Epididymitis; Torsion of testicular appendage; Orchitis Inguinal hernia; Varicocele; Hydrocele; Epididymal hypertension
**TEST AND RESULTS**Urinalysis: negative; Urine culture: negative; Scrotal US 9/22/17: Left epididymitis. Normal testicles with symmetric blood flow; Scrotal US 9/23/17: modestly decreased but present vascularity of left testicle of uncertain significance but incompatible with torsion at this time. **FINAL WORKING DIAGNOSIS**: Testicular torsion-detorsion syndrome
**TREATMENT AND OUTCOMES**:
Referred to urology; Withheld from contact play until evaluated by urology; Urology recommended orchioplexy, which was performed within 1 week of specialty evaluation; Per urology, can return to aerobic and contact activity 2 weeks after procedure

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2125 June 1 10:30 AM - 10:50 AM

## Hip Pain - Hiking

Cory Mitchell, Caitlin Waters, Herb Stevenson. *UMass Memorial Medical Center, Worcester, MA.* (Sponsor: Pierre Rouzier, FACSM)

*(No relevant relationships reported)*

**HISTORY**: A 78-year-old male is seen for evaluation of left lateral thigh pain. Symptoms present over the past few years but have worsened over the past six months. Recalls no specific onset. Pain is 3/10 and aching in quality. It is located over the lateral hip and thigh. Symptoms are worse with lifting and hiking, particularly on an incline. Pain is better with rest and does not radiate. He has associated burning, also with activity, in the same distribution. Denies back pain. He has no allergies, is a former smoker and takes medications for high blood pressure and cholesterol. Denies prior injuries or surgeries of the back, hip or legs.
**PHYSICAL EXAMINATION**: GEN: A&Ox3, in NAD. Central obesity. HEENT: NCAT. EOMI. CV: RRR, 2+ peripheral pulses PULM: CTAB SKIN: No rashes or signs of infection. NEURO: Symmetric strength and sensation in all 4 extremities. MSK: No deformity of the left hip. He has tenderness over the anterior greater trochanter but is otherwise nontender. External/internal rotation full, passive flexion to 110. Resisted abduction causes pain without reproduction of burning sensation. Negative FABER and FADIR. Antalgic gait. Lumbar spine non-tender. Full flexion/extension. Negative straight leg raise.
**DIFFERENTIAL DIAGNOSIS**: Gluteus medius/minimus tendinopathy Left hip osteoarthritis IT Band syndrome Piriformis syndrome
**TEST AND RESULTS**: Left hip x-ray: Mild degenerative changes Rheumatologic consult: Negative screening labs Left hip MRI: Partial tear of the gluteus minimus tendon Neurosurgery consult: Lumbar spine MRI - negative Physiatry consult: EMG left leg - normal, cannot rule out lateral femoral cutaneous neuropathy
**FINAL WORKING DIAGNOSIS**: Gluteus minimus tendinopathy with partial tear Meralgia paresthetica
**TREATMENT AND OUTCOMES**:
12-week course of physical therapy: 40% decrease in pain, burning feeling unchanged. Palpation-guided greater trochanteric bursa cortisone injection: minimal relief. Ultrasound-guided needle tenotomy of gluteus minimus tendon: resolution of antalgic gait with 50% improvement in pain without an effect on burning sensation. Ultrasound-guided nerve block and cortisone injection: resolved burning symptom without effect on lateral hip pain. Returned to regular daily activities and household chores. Yet to resume hiking due to lack of muscular endurance.

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2126 June 1 10:50 AM - 11:10 AM

## Left Hip Pain and Swelling Following a Bicycle Accident

George A. Ceremuga[1], Edward R. Laskowski, FACSM[2], Kristina M. Colbenson[2]. *[1]Mayo School of Graduate Medical Education, Rochester, MN. [2]Mayo Clinic, Rochester, MN.* (Sponsor: Edward Laskowski, FACSM)

*(No relevant relationships reported)*

**HISTORY**
A 45-year-old male bicyclist presented for evaluation of left hip pain and swelling following a bicycle accident that occurred approximately one week prior to presentation. His chief complaint was left groin and posterolateral gluteal region pain that increased with activity and improved with rest and anti-inflammatory medications. Radiographs were performed revealing no definite acute fractures of the left hip. MRI revealed nondisplaced fractures of right sacral ala and left superior and inferior pubic rami as well as a large lentiform fluid collection overlying left gluteal musculature.
**PHYSICAL EXAMINATION:** Healthy-appearing individual in no apparent distress. Normal gait cadence and stride. Significant ecchymosis with underlying, ballotable, fluid collection of left lateral hip and gluteal region. Tenderness to palpation in this region. Joint range of motion is full. Strength is full and sensation is grossly intact throughout. Discomfort with hip internal rotation and Stinchfield's and FABER tests on left. Straight leg raise is negative bilaterally.
**DIFFERENTIAL DIAGNOSIS:**
1.Morel-Lavallee Lesion
2.Gluteus maximus contusion
3.Fracture of the greater trochanter
**TESTS AND RESULTS**
Left hip radiographs: No definite acute fractures involving left hip.
Left hip MRI: Nondisplaced fractures of the right sacral ala and left superior and inferior pubic rami. Large lentiform fluid collection overlying the left gluteal musculature with surrounding subcutaneous edema, consistent with a Morel-Lavallee lesion.
**FINAL/WORKING DIAGNOSIS:**
Moral-Lavallee Lesion
**TREATMENT AND OUTCOMES**
1. Touch weightbearing crutch ambulation for left lower extremity and use of compression shorts.
2. Ultrasound-guided needle aspiration of gluteal fluid collection: 180 cc of serosanguineous fluid obtained; compression dressing applied afterwards.
3. Two weeks later, surgical evaluation revealed 15 x 10 cm reaccumulation of fluid in the same location. Advised to undergo incision and drainage and partial capsulectomy. Surgery was without complications and a JP drain was placed.
4. Left thigh JP drain exchange performed for clogged drain.
5. Drain removed but 4 days later repeat aspiration of 32 cc was performed.
6. One week later, repeat aspiration of 32 cc was performed, followed by complete resolution.

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2127 June 1 11:10 AM - 11:30 AM

## "Hip Pop"- Acute Anterior Thigh Pain in an Adolescent Soccer Player

Jonathan Koretoff. *University of Minnesota, Minneapolis, MN.* (Sponsor: Suzanne Hecht, FACSM)

*(No relevant relationships reported)*

HISTORY: 15 year-old male club soccer athlete reported acute onset of left proximal thigh pain after sprinting straight ahead while playing in a game in a soccer tournament. He was the starting goalie for the team. While running, he felt a pop in his proximal thigh with inability to bear weight. Reported the sensation occurred while sprinting. He collapsed on the field and was evaluated by a sideline sports medicine physician as well as a certified athletic trainer. He was then transported to the on-site medical clinic. No numbness and tingling. No prior pain or injury.
PHYSICAL EXAM:
GEN: Mild distress while sitting in wheelchair. No distress while lying flat. Awake, alert, and oriented x 3
MSK: LEFT HIP: No bruising or gross deformity. Tenderness over proximal hip flexors. Tenderness on posteromedial aspect of hip adductor musculature. Unable to raise leg from the exam table unassisted. Marked pain with active range of motion in flexion with knee extended. Moderate pain with passive hip flexion. Unable to bear weight. 2/5 strength in hip flexion. FABER/FADIR elicited pain over proximal quadriceps. No bony pelvic tenderness
LUMBAR SPINE: No bruising or gross deformity. Non tender spinous processes and paraspinal musculature. No radicular pain with straight leg raise. Achilles and patellar reflexes bilaterally symmetrical
DIFFERENTIAL DIAGNOSIS: 1) Apophyseal avulsion fracture 2) Proximal quadriceps tendon rupture 3) Pathologic femoral fracture 4) Referred pain secondary to lumbar spinal pathology
TEST AND RESULTS: Xray left hip (AP and lateral): Lesser trochanteric apophyseal avulsion fracture, minimally displaced
FINAL WORKING DIAGNOSIS: Lesser trochanteric apophyseal avulsion fracture
TREATMENT AND OUTCOMES: He was placed non-weight bearing on crutches. At follow-up 1 week post injury he lacked active range of motion of his left hip. After his initial clinic visit, further follow up occurred at 2 weeks, 1 month, and 2 months. At 2 weeks he could bear weight with pain but lacked active range of motion. At 1 month he could bear weight without pain but lacked active range of motion. At 2 months he could bear weight and hop without pain but had 3/5 hip strength and had active range of motion with no pain. Referred to physical therapy. He is now enrolled in return to run program. Imaging at 6 weeks and 2 months showed stable fracture.

## E-14 Clinical Case Slide - **Shoulder and Elbow**

Friday, June 1, 2018, 9:30 AM - 10:50 AM
Room: CC-200F

2128 **Chair:** Mary Lloyd Ireland, FACSM. *UK Healthcare Sports Medicine, Lexington, KY.*
*(No relevant relationships reported)*

2129 **Discussant:** Edward G. McFarland, FACSM. *The Johns Hopkins University, Lutherville, MD.*
*(No relevant relationships reported)*

2130 **Discussant:** Lauren M. Simon, FACSM. *Loma Linda University Medical Center, Loma Linda, CA.*
*(No relevant relationships reported)*

2131 June 1 9:30 AM - 9:50 AM

### Suprascapular Nerve Entrapment or Compression in a Kayaker

Christa L. LiBrizzi, Jorge Rojas, Uma Srikumaranan, Edward G. McFarland. *The Johns Hopkins University, Lutherville, MD.* (Sponsor: Brian Krabak, FACSM)
*(No relevant relationships reported)*

**HISTORY**:
A 20-year-old male kayaker presented for a second opinion for increasing pain and dysfunction in his right, dominant shoulder joint for five months. The pain had begun insidiously with no history of trauma. The patient described the pain as aching, sharp, and burning which progressed to become constant in nature. The patient's pain was exacerbated specifically by kayaking and had become so severe that he had to cease participation. **PHYSICAL EXAMINATION**: The active range of motion of his shoulders was normal and symmetric. He had normal range of motion of his cervical spine. To inspection he had notable atrophy of his supraspinatus and infraspinatus of his right but not left shoulder. He had no winging but did have scapular dyskinesis. He had weakness to external rotation in the right shoulder with the arm at the side, but he had a negative external rotation lag sign. He had weakness to resisted abduction with the shoulder abducted 90 degrees and the elbow extended. He otherwise was neurologically intact for sensory, motor and reflex testing in both upper extremities. He had a negative Spurling's test. He had pain with elevation of the arm, but was not tender anywhere around the shoulder. **DIFFERENTIAL DIAGNOSIS**: 1. Suprascapular nerve entrapment or compression
2. Cervical radiculopathy
3. Facioscapulohumeral Muscular Dystrophy 4. Rotator cuff tear
**TEST AND RESULTS**:Cervical spine and shoulder radiographs: normal EMG-NCS: severe right suprascapular neuropathy MRI shoulder: muscle atrophy c/w nerve injury; multi-loculated synovial cyst base of coracoid MRI cervical spine: normal
**FINAL WORKING DIAGNOSIS**: Suprascapular nerve entrapment and compression
**TREATMENT AND OUTCOMES**:
1. Arthroscopic subacromial decompression, suprascapular nerve release at the transverse scapular ligament and spinoglenoid notch, and ganglion cyst excision
2. Sling for 1-2 weeks, early passive range of motion ok, no pendulums 3. No strengthening until 2 months post-op. 4. Cleared for PT, 8 days-post-op 5. Cleared to return to activities as tolerated, 4 weeks-post-op. 6 Returned to kayaking

2132 June 1 9:50 AM - 10:10 AM

### Shoulder Weakness In A 24-year-old Body Builder

Ryan Woods[1], Edward R. Laskowski, FACSM[1], James C. Presley[2], Jeff Strauss[1]. *[1]Mayo Clinic, Rochester, MN. [2]Mayo Clinic, Jacksonville, FL.* (Sponsor: Edward R. Laskowski, FACSM)
*(No relevant relationships reported)*

**HISTORY**: 24-year-old male body builder with a six month history of insidious right shoulder pain localized to the right deltoid. He reports increased shoulder discomfort working at his job as a physical therapy assistant. He also describes a one-year history of progressive right shoulder weakness noted most during bench pressing which decreased from 300 pounds to 135 pounds. No sensory symptoms present. Initial x-rays were negative. Physical exam demonstrated intact rotator cuff strength with positive impingement testing. He was diagnosed with rotator cuff tendinopathy and started on a rehab program with instructions to avoid overhead lifts, deep drop bench press, and dips. His pain improved with therapy, however he returned six months later after experiencing two to three months of painless atrophy of the right pectoralis region with continued weakness.
**PHYSICAL EXAMINATION**: Inspection: Visible atrophy of the right pectoralis major. Palpation: Unremarkable. Joint ROM: Full range of motion. Strength: Normal upper extremity strength. Provocative Tests: Negative Neer's, Hawkin's, Speed's and labral testing. Reflexes: Normal. Sensation: Intact to light touch throughout.
**DIFFERENTIAL DIAGNOSIS**:
Parsonage Turner Syndrome
Brachial Plexopathy
Radiculopathy, mononeuropathy
Inflammatory Myopathy
Facioscapulohumeral muscular dystrophy
**TEST AND RESULTS**: EMG: Isolated right pectoral nerve mononeuropathy. MRI: Denervation changes within the right pectoralis major muscle. No abnormalities of the right brachial plexus. Ultrasound: Atrophy of the right pectoralis major. Visualized elements of the lateral and medial pectoral nerves are normal.
**FINAL WORKING DIAGNOSIS**: Right pectoralis major atrophy in the context of isolated right pectoral nerve mononeuropathy.
**TREATMENT AND OUTCOMES**: Patient was referred back to physical therapy with recommendations to hold off on bench pressing exercise until he demonstrates neurologic recovery. At the one month follow up improved bulk and muscle quivering of his right pectoralis major was seen. He was allowed to pursue low resistance pectoral strengthening with recommendations to continue to avoid any heavy load pectoralis exercise for one to three months after which he can initiate a gradual return to normal activity.

2133 June 1 10:10 AM - 10:30 AM

### Shoulder - Why So Weak? - Track And Field

William L. Patterson Jr.. *Maine Medical Center, Portland, ME.* (Sponsor: William Dexter, FACSM)
*(No relevant relationships reported)*

**History:**
20 yo M right hand dominant decathlete at a division III college presents with left shoulder weakness. Started 2 months prior, the morning after a routine weight lifting workout. Began with an ache in the shoulder followed by a tight feeling with some radiation to the trapezius up the neck, and finally with some weakness lifting and externally rotating the arm that slowly increased over a week then plateaued. He had no paresthesias. The pain slowly subsided and resolved over approximately 3 weeks, but the weakness persisted.
PMHx, PSHx, FMHx are non-contributory, not taking any medications.
ROS: fully negative and has not had any illnesses prior or since.
**Physical examination:**
BP 108/70 mmHg | Pulse 60 | Ht (5'9") | Wt 170 lb | BMI 25.16 kg/m2
Left shoulder exam reveals atrophy of infraspinatus and supraspinatus, non-tender to palpation in neck, shoulder or upper arm. Normal active and passive ROM in all motions of the shoulder and neck. Resisted ROM was painless and yielded 4+/5 strength in external rotation & abduction. Neer's, Hawkin's, AC compression, O'Brien's, labral shear, Yergason's, Speeds, stability testing, Spurling's are all negative. Neurovascular: dermatomes intact to light touch in B/L upper extremities, 2+ reflexes biceps, triceps, brachioradialis, 2+ radial pulses
**Differential Diagnosis:**
Suprascapular nerve impingement, brachial plexitis (Parsonage Turner syndrome), rotator cuff tear(infraspinatus and/or supraspinatus), cervical radiculopathy (C6), thoracic outlet syndrome.
**Tests and Results**:
#Limited bedside MSK US of left shoulder: no obvious entrapment at the spino-glenoid notch.
Patient was referred to Neurology for EMG who then ordered an MRI to rule out cervical radiculopathy.
#EMG of left upper extremity.
Suprascapular nerve - Right was normal. Left had normal latency, but CMAP was distorted. Median nerve normal. Needle exam - abundant acute denervation in infraspinatus, less so in supraspinatus. Both with decreased recruitment. Deltoid muscle demonstrated decreased recruitment with minimal polyphagia.
#MRI CERVICAL SPINE: Normal MRI scan of the cervical spine.
**Final/Working Diagnosis**: Parsonage turner syndrome with primary involvement of the suprascapular nerve.
**Treatment**: PT
**Outcomes**: Strength slowly improving. No pain.

2134 June 1 10:30 AM - 10:50 AM

**Management of a Patient with Lateral Elbow Pain Secondary to Acute Adverse Neural Irritation**

Sean Harris[1], James Gregory[2], Alexis Ortiz, FACSM[3]. *[1]Memorial Hermann, Houston, TX. [2]UT Health, Houston, TX. [3]Texas Woman's University, Houston, TX.* (Sponsor: Alexis Ortiz, FACSM)

*(No relevant relationships reported)*

HISTORY: A 38 y/o female reports to physical therapy with gradual onset of R lateral elbow pain. She received corticosteroid injection to lateral elbow from her PCP, which caused immediate exacerbation of symptoms. Additionally, she started feeling radiating/burning symptoms down anteromedial forearm. Upon initial evaluation, she presented with extremely reduced grip strength (reproduction of radiating pain), loss of full elbow extension, and shooting pain.
PHYSICAL EXAMINATION: Examination revealed full and pain-free cervical ROM, with no reproduction of symptoms. Resting postural assessment revealed increased thoracic kyphosis with segmental hypomobility from T1-6. Elbow assessment revealed bilateral elbow hyperextension of 20deg. Upper-limb tension testing was + for radial and median n. on right, with reproduction of radiating symptoms into forearm. Lateral epicondylalgia tests were all + on right (Cozen's, Mill's, Maudsley's), but did not reproduce radiating symptoms. She had painful supination, with mild reproduction of radiating symptoms. Performing Tinel percussion over supinator during elbow extension/pronation reproduced radiating pain from elbow to medial forearm.
DIFFERENTIAL DIAGNOSIS:
1.Lateral epicondylalgia
2.Cervical radiculopathy
3.Peripheral neuropathy
TEST AND RESULTS:
Elbow anterior to posterior and lateral radiograph
• Congenitally deepened olecranon fossa, resulting in excessive elbow hyperextension
Lateral corticosteroid injection
• Immediate onset of radiating symptoms into medial forearm; no improvement in lateral elbow symptoms
Grip strength measured with hand-held dynamometer
• Pain-free grip on right measured at 15# (50# on L)
FINAL/WORKING DIAGNOSIS:
Lateral epicondylalgia with underlying acute peripheral nerve irritation, and possible distal sensory overlap of radial/median nerves.
TREATMENT AND OUTCOMES:
6 PT sessions over 6 weeks consisting of:
1) Thoracic manipulation
2) Radio-humeral distraction
3) Distal radial nerve sliders
5) Closed-chain tendon loading progression
Outcomes at 6 weeks:
1) Improved Quick DASH from 34 to 3
2) Normal adverse neural testing
3) Pain-free grip improved to 45# on right
4) Return to normal functional activities

## E-15 Clinical Case Slide - **Wrist and Hand**

Friday, June 1, 2018, 9:30 AM - 11:10 AM
Room: CC-101CD

2135 **Chair:** Melody Hrubes. *UIC Sports Medicine, Chicago, IL.*

*(No relevant relationships reported)*

2136 **Discussant:** Oluseun A. Olufade. *Emory University, Johns Creek, GA.*

*(No relevant relationships reported)*

2138 June 1 9:30 AM - 9:50 AM

**Wrist Pain and Hand Numbness -- Football**

Jonathan Harvey. *University of Minnesota Sports Medicine Fellowship, Minneapolis, MN.* (Sponsor: Dr. Suzanne Hecht, FACSM, FACSM)

*(No relevant relationships reported)*

**HISTORY**: 17 yo defensive lineman presents with new onset right hand numbness, tingling, and mild discomfort during a high school football game. He denies any known injuries to the affected extremity during the game but endorses that he uses his hands a lot during play. He had not noticed swelling, redness, or weakness. Denies elbow, forearm, shoulder or neck pain. He described the paresthesias as limited to the back of his hand and thumb. The discomfort is described as generalized pain over the back of his wrist. He denies any prior injury to the hand, wrist, elbow, shoulder, or neck; however, he does tape both his wrists to "prevent injury" during gameplay and recently bought new football gloves. **PHYSICAL EXAMINATION**: Right hand: No deformity, swelling, erythema, or ecchymosis. Bony prominences non-tender to palpation. Notable paresthesias and decreased sensation over the dorsal aspect of the hand with intact sensation of the ulnar side of the hand, palm, and digits. 5/5 strength in intrinsic muscles of hands, grips strength, and thumb strength. No thumb instability. Wrists: Bilateral wrists are wrapped with athletic tape. No obvious deformity or skin changes. 5/5 strength with flexion, extension, eversion, inversion, pronation and supination. Anatomic snuff box was non-tender. Mild discomfort with Finkelstein test and resisted extension of thumb. Neck non tender to palpation with full ROM. **DIFFERENTIAL DIAGNOSIS**: Cheiralgia Parasthetica, DeQuervain's tenosynovitis, Intersection syndrome, Lateral antebrachial cutaneous nerve neuritis, Radial tunnel syndrome,.Brachial plexus injury, Cervical injury **TEST:** Gloves and wrist tape removed with partial improvement of hand/wrist discomfort. **FINAL WORKING DIAGNOSIS**: Cheiralgia Parasthetica "Wartenberg Syndrome" **TREATMENT AND OUTCOMES**: 1. Right wrist tape and football gloves were removed. 2. After evaluation and improvement in symptoms he was released to return to play in the same game without restrictions. 3. One hour later he had complete resolution of paresthesias when re-evaluated at half time 4. Symptoms at halftime could be reproduced with pronation, flexion, and ulnar deviation 5. Discontinued future wrist taping 6. The patient was symptom-free and had a normal exam at 1 week follow-up appointment. 7. He was advised to avoid overtightening of football gloves

2139 June 1 9:50 AM - 10:10 AM

**Bilateral Cubital Tunnel Syndrome in a Female Ice Hockey Player**

Kiran Bojedla, Damian Mosher. *Millcreek Community Hospital, Erie, PA.* (Sponsor: Patrick Leary DO, FACSM)

*(No relevant relationships reported)*

Bilateral Arm Injury ---- Women's Ice Hockey
Kiran Bojedla DO, Millcreek Community Hospital Sports Medicine, Erie, PA
e-mail:Kiran.bojedla@gmail.com
(Sponsor: Patrick Leary DO, FACSM)
HISTORY: A 20 year old female junior ice hockey collegiate athlete presented with bilateral distal arm pain and grip strength weakness, developed while lifting weights during offseason conditioning. Patient had been doing front squats with increasingly heavy loads put onto flexed elbows and wrists. Complained of pain waking her up at night and worsening recently, and with hand numbness/tingling during the day.
PHYSICAL EXAMINATION: Examination in the Training Room revealed bilateral grip strength weakness, left worse than right, numbness on the medial side of the wrists and 4th/5th fingers, and positive Tinel's Sign / Phalen's Test. At the shoulder, strength was 5/5 throughout and ROM was full bilaterally. Symptoms of grip strength weakness and paresthesias worsened over several visits.
DIFFERENTIAL DIAGNOSIS
1. Carpel Tunnel Syndrome
2. Cubital Tunnel Syndrome
3. Central spinal cord lesion
4. Multiple Sclerosis
TEST AND RESULTS:
Electromyelogram: Disruption of ulnar nerve conduction velocity through cubital tunnel bilaterally
Cervical MRI: Possible Tarlov cyst at C5-C6 on left, no stenosis appreciated at any level, no herniations
Chest X-ray: No acute abnormalities
WORKING DIAGNOSIS:
Bilateral Cubital Tunnel Syndrome
TREATMENT AND OUTCOMES
1. Keep arms extended at elbow as much as possible
2. Completely shut down from hockey activities (no skating / stickhandling)
3. Plan for L ulnar nerve release with Orthopedic Surgeon 11/2017
4. RTP to be determined depending on response to therapy

2140 June 1 10:10 AM - 10:30 AM

**Wrist Injury - Tae Kwon Do**

Claire Gross[1], Holly J. Benjamin, FACSM[2], Daniel P. Mass[2]. *[1]MacNeal Hospital, Berwyn, IL. [2]University of Chicago, Chicago, IL.* (Sponsor: Holly J. Benjamin, MD, FACSM)

*(No relevant relationships reported)*

**History:** An 18-year-old right-hand dominant male, nationally-ranked Tae Kwon Do competitor presented with a 4 year history of left wrist pain. Four years prior to presentation, he was kicked on the ulnar wrist while sparring. At that time, he had tenderness over the ulnar styloid and distal physis, no tenderness at the ulnar-carpal

articulation, and full wrist range of motion. Wrist X-Rays were read by radiology as negative for fracture, but interpreted by the sports medicine team as a possible ulnar Salter-Harris I injury in addition to a wrist contusion. He returned to sport after three weeks of relative rest and use of a wrist brace. He presented to clinic four years later due to worsening symptoms that inhibited his level of competition in Tae Kwon Do. He had not sustained any further wrist injuries in the interim. There was increased pain with active range of motion and he felt an occasional click in his wrist and intermittent tingling in his fifth digit.
**Physical Examination:** Left wrist exam demonstrated no gross deformity, swelling, erythema, or ecchymosis. The limb was neurovascularly intact. There was tenderness to palpation of the hook of the hamate and the triangular fibrocartilage complex. Full wrist and hand range of motion. Mild weakness noted in fifth digit flexion and wrist flexion; strength otherwise intact. Wrist extension with ulnar deviation reproduced the patient's pain. There was increased dorsal instability of the ulnar styloid at the distal radioulnar joint (DRUJ) (positive piano key sign).
**Differential Diagnosis:** 1. TFCC tear 2. Post-traumatic arthritis 3. Hook of the hamate fracture 4. Flexor carpi ulnaris strain 5. Ulnar neuropathy at the wrist
**Tests and Results:** MR arthrogram: There is contrast extension into the distal radioulnar joint indicating disruption of the triangular fibrocartilage complex (TFCC). The TFCC appears irregular and demonstrates intermediate signal. These findings were interpreted by the Sports Medicine team to represent concomitant central and peripheral TFCC tears.
**Final Diagnosis:** Central and peripheral TFCC tears
**Treatment and Outcomes:** After consultation with orthopedic surgery, the patient is currently scheduled for arthroscopic debridement of the central tear and repair the peripheral tear of his TFCC.

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2141 June 1 10:30 AM - 10:50 AM

### Forearm Pain- Gymnastics

Melissa Faubert[1], Holly Benjamin, FACSM[2], Daniel Mass[2].
*[1]NorthShore University HealthSystem/University of Chicago, Chicago, IL. [2]University of Chicago, Chicago, IL.*
*(No relevant relationships reported)*

**HISTORY**: 14 year old right handed level 8 gymnast presents with complaints of progressive right greater than left elbow and forearm pain over the past four months. Despite bracing, activity modification and three months of physical therapy she still reported progressive worsening of pain and development of tingling in her hands and forearms. She notes she has a constant feeling of tightness over her anteromedial forearms and pain and tingling of her arm occurs the worst while writing in school or vaulting. Pain and numbness resolve with a few minutes of rest and elbow extension. She does not have any nighttime pain. **PHYSICAL EXAMINATION**: - Well appearing female adolescent - Full ROM of elbow, forearm, wrist and fingers - Sensation intact to light touch in the radial, medial and ulnar nerve distribution bilaterally - 5/5 strength in the radial, medial, ulnar, anterior interosseous and posterior interosseous nerves bilaterally - Mild TTP of proximal forearm and medial elbow bilaterally - Positive compression test at the proximal forearm - Positive Tinel's test over the pronator teres - Positive Tinel's test over cubital tunnel - Negative Tinel's, Durkan's and Phalen's at the wrist bilaterally **DIFFERENTIAL DIAGNOSIS:**- Pronator syndrome - Cubital tunnel syndrome - Chronic exertional compartment syndrome of the forearm - Anterior interosseous nerve syndrome - Brachial plexus neuritis - Cervical radiculopathy **TEST AND RESULTS**: MRI elbow Left: MRI findings normal but noted presence of accessory anconeous epitrochlearis muscle. MRI elbow Right: Normal MRI. **FINAL WORKING DIAGNOSIS**: Pronator syndrome bilaterally. Left arm with accessory anconeous epitrochlearis muscle also causing ulnar neuropathy. **TREATMENT AND OUTCOMES**: Patient's older sister previously had pronator syndrome as well as chronic exertional compartment syndrome for which she underwent median nerve release and fasciotomy. Patient and her parents elected to forgo compartment testing suspecting she also had both conditions. She underwent surgery on her left elbow with a median nerve release, ulnar nerve release and fasciotomy. She is due to have surgery on her right arm for median nerve release and fasciotomy three weeks after her left.

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2142 June 1 10:50 AM - 11:10 AM

### Metacarpal Stress fractures Presenting As Dorsal Hand Pain In A High School Tennis Player: A Case Report

John K. Evans, Keith A. Bengtson, Cara C. Prideaux, Edward R. Laskowski, FACSM. *Mayo Clinic, Rochester, MN.*
*(No relevant relationships reported)*

**HISTORY**:
A 17 year-old right-hand dominant male tennis player presented to the hand clinic for a two week history of right dorsal hand pain. The patient noticed hand pain while at practice the day following a one-day tennis tournament involving three separate matches. Severe pain in the dorsum of the wrist was noted with forehands, serves, and volleys, but was less notable during backhands. The pain was sharp and severe for about three seconds after each hit and then quickly resolved to a pain-free baseline. The patient continued to practice through pain for the following week. He was able to perform all activities of daily living without discomfort. The patient denied swelling, pain in other joints, weakness, and paresthesias.
**PHYSICAL EXAMINATION:**
Examination revealed tenderness to palpation at the base of the second and third metacarpals and pain with stressing the second and third carpometacarpal joints. There was severe pain to use of a tuning fork over the proximal second and third metacarpal. Finger and wrist ranges of motion were full and pain-free, and there was no swelling.
**DIFFERENTIAL DIAGNOSIS:**
1. Wrist extensor tenosynovitis
2. Ganglion cyst
3. Rheumatoid arthritis
4. Metacarpal stress fracture
5. Crystal arthropathy
**TEST AND RESULTS:**
PA, oblique, and splayed lateral radiographs of the right hand: -Negative for fracture; there were no erosions or degenerative change.
Noncontrast MRI of the right hand: -Stress fracture of the right second metacarpal in the proximal shaft with extension to the proximal articular surface; also observed was a stress fracture in the adjacent trapezoid. -Less prominent stress fracture/stress reaction of the right third metacarpal with no cortical break.
**FINAL/WORKING DIAGNOSIS:**
Right second metacarpal proximal shaft stress fracture and right third metacarpal shaft stress fracture/reaction.
**TREATMENT AND OUTCOMES:**
1. Hold from tennis activities for 6 weeks.
2. Racket grip type changed from Western to Eastern grip type.
3. Gradual return to tennis starting 6 weeks after cessation of sport with focus on maintaining optical tennis mechanics and low-intensity groundstrokes.
4. Serves were initiated at 7 weeks after tolerating groundstrokes without discomfort.
5. Full return to sport by 3 months after being able to meet demands of his sport with pain-free high-intensity tennis shots.

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## E-26 Free Communication/Poster - **Water Sports**

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

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2165 Board #1 June 1 9:30 AM - 11:00 AM

### Associations Between Land-Based Performance Assessments and Maximal Effort Combat Swim Force Production

Meaghan Beckner[1], Elizabeth Nagle, FACSM[1], Anne Beethe[1], Takashi Nagai[1], Meghan Schmidt[1], Chris Connaboy[1], John Abt, FACSM[2], Scott Lephart, FACSM[2], Bradley Nindl, FACSM[1].
*[1]University of Pittsburgh, Pittsburgh, PA. [2]University of Kentucky, Lexington, KY.*
*(No relevant relationships reported)*

Combat swimming (CS) requires military personnel dressed in full combat gear to swim while holding or towing additional weight (i.e. ammunition, rucksack, etc.). Reportedly, additional gear can amount to over 40 kg and increases the demand on muscle force production to overcome water resistance. Limited research has explored relationships between limb length, strength, and anaerobic power assessments and CS flutterkick performance during a 30-second maximal effort tethered swim test (TST). **PURPOSE:** To examine relationships between limb length, strength, and anaerobic power assessments and maximum effort CS force production. **METHODS:** Six female (26 $\pm$ 9.2 years, 169.7 $\pm$ 3.9 cm, 67.5 $\pm$ 9.4 kg) and six male (30 $\pm$ 8.0 years, 179.4 $\pm$ 7.6 cm, 80.8 $\pm$ 15.4 kg) skilled swimmers participated in isometric muscular hip strength (HS) testing using a handheld dynamometer, and a 30-second Wingate cycle ergometer anaerobic test (WAnT). Limb length (LL) was measured from the Anterior Superior Iliac Spine to the medial malleolus. For TST, subjects wore full military gear weighing approximately 12 kg, including combat boots and fins, and performed a maximal effort flutterkick in a prone position holding a flotation device for 30 seconds. After testing for normality, correlations between HS, LL, WAnT, and TST were determined using Pearson's correlation ($p<0.05$). **RESULTS:** Absolute Wingate mean power was significantly correlated to TST mean force ($TST_{mf}$) (0.883, $p<0.001$). Correlations were identified between LL and TST peak force ($TST_{pf}$) (right: 0.653, $p=0.021$; left: 0.659, $p=0.020$). There was no significant correlation between isometric peak HS and $TST_{pf}$. **CONCLUSION:** LL and absolute WAnT mean power are associated with CS anaerobic kicking performance more so than isometric HS. Findings should not dismiss the relevance of strength, but promote specificity of the assessment. Identifying significant relationships between power and strength assessments and swimming force during CS flutterkick is important to help to improve training for optimal CS anaerobic performance.
Supported by ONR: N00014-14-1-0022/N00014-15-0069

2166 Board #2 June 1 9:30 AM - 11:00 AM

### Predictors of 2 Kilometer Rowing Ergometer Time Trial Performance

Jason Metz[1], Fredric Goss, FACSM[2], Robert Robertson, FACSM[2], Elizabeth Nagle, FACSM[2], Jonathan Abt[3]. *[1]West Liberty University, West Liberty, WV. [2]University of Pittsburgh, Pittsburgh, PA. [3]University of Kentucky, Lexington, KY.*

*(No relevant relationships reported)*

ABSTRACT

Predictors of performance can aid coaches and trainers in prescribing exercise programs for rowing athletes. To date, most of the prediction models have been developed for runners and cyclists. **PURPOSE:** The aim of this study was to develop a regression model to predict performance of a simulated 2 kilometer rowing ergometer time trial. **METHODS:** A group of mixed gender rowing athletes (n=12) completed in a counterbalanced order a 2 Kilometer rowing time trial and a continuous progressively incremented graded exercise test on a rowing ergometer. Subjects were 23.91±4.99 years old, weighed 79.14±12.85 kg, were 187.38±12.60 cm, had a $VO_2$max of 55.48±10.32 ml/kg/min and had 3.17±2.79 years of rowing experience. Physiological measures were recorded during both testing protocols. **RESULTS:** Maximum Power/Stroke Ratio (r = -0.96, p<0.001), Power/Stroke Ratio at the ventilatory breakpoint (r = -0.90, p<0.001), Maximal Oxygen Uptake (r = -0.84, p<0.001) and Oxygen Uptake at the ventilatory breakpoint (r = -0.82, p<0.001) were found to be strong and significant predictors of 2 kilometer rowing performance. **CONCLUSION:** The four significant predictors of rowing performance suggest training should focus on improving both aerobic capacity and strength.

Statement of Disclosure: This study was not funded and has no conflicts of interest.

2167 Board #3 June 1 9:30 AM - 11:00 AM

### Influence Of Leg, Arm And Trunk Lean Mass On Aerobic Fitness And Performance In Rowers

Kristin Haraldsdottir, Stacey Brickson, Jennifer Sanfilippo, Andrew Watson. *University of Wisconsin, Madison, WI.*

*(No relevant relationships reported)*

Rowing is a full body exercise requiring upper body, lower body, and core strength. It has been shown that total lean mass is a predictor of maximal oxygen consumption ($VO_{2max}$) in athletes. However, the relative contribution of upper extremity, lower extremity and trunk lean mass to $VO_{2max}$ has not been explored. **Purpose:** To determine the relative influence of total lean body mass (LBM), body fat percentage (BF%), upper extremity lean mass (ULM), lower extremity lean mass (LLM) and trunk lean mass (TLM) on maximal aerobic capacity ($VO_{2max}$) and time to exhaustion ($T_{max}$) in female collegiate rowers. **Methods:** 107 female collegiate rowers (ages 18-22) performed maximal progressive rowing ergometer testing to determine $VO_{2max}$ and $T_{max}$. Body mass, LBM, BF%, ULM, LLM, and TLM were determined by dual-energy X-ray absorptiometry. Separate multivariable linear regression models were performed to predict $VO_{2max}$ and $T_{max}$ using LBM and BF% as predictors. When LBM was found to be a separate predictor, separate linear regression models were used to predict $VO_{2max}$ and $T_{max}$ using ULM, LLM and TLM as predictors. **Results:** Subjects were 20.2 ± 1.1 years old, with a $VO_{2max}$ of 3.9 ± 0.5 L/min, $T_{max}$ of 12.7 ± 2.6 minutes, BF% of 23.8 ± 4.8% and LBM of 51.3 ± 6.4 kg. After inclusion in the multivariable model, it was found that $VO_{2max}$ was significantly predicted by LBM ($r^2$= 0.29, p<0.001) but not BF% ($r^2$=0.002, p=0.79). Similarly, $T_{max}$ was significantly predicted by LBM ($r^2$=0.25, p<0.001) but not BF% ($r^2$=0.003, p=0.19). When evaluating the sources of LBM separately, it was found that $VO_{2max}$ was significantly predicted by LLM ($r^2$=0.12, p<0.01), but not ULM ($r^2$=0.08, p=0.68) or TLM ($r^2$=0.09, p=0.17), and $T_{max}$ was significantly predicted by TLM ($r^2$=0.09, p=0.02), but not ULM ($r^2$=0.07, p=0.89) or LLM ($r^2$=0.08, p=32). **Conclusion:** Among female collegiate rowers, whole body LBM is a significant predictor of both $VO_{2max}$ and $T_{max}$. However, LLM is a significant predictor of $VO_{2max}$, while TLM significantly predicts $T_{max}$. This suggests that the trunk muscles play a significant role in the ability to prolong intense rowing exercise, while the legs consume the most oxygen during rowing. These results may be taken into consideration by coaches and athletes when prescribing in-season training to maximize rowing performance.

2168 Board #4 June 1 9:30 AM - 11:00 AM

### Longitudinal Changes in Elite Swimmers' 200 m Freestyle Pacing

Curtis S. Goss, Joel T. Greenshields, Robert F. Chapman, FACSM, Joel M. Stager, FACSM. *Indiana University - Bloomington, Bloomington, IN.* (Sponsor: Joel Stager, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: To understand the evolving strategies of elite competitors and to characterize longitudinal changes in pacing parameters in the 200 m freestyle at recent international competitions. **METHODS**: 416 swims from the top 16 finishers in the 200 m freestyle for men and women at 11 Olympic Games and World Championships from 2000-2017 were analyzed. A mixed linear model was used to characterize pacing with 5 different parameters: linear and quadratic parameters for the effect of lap number, differences between predicted and observed time for the first and last laps, and the residual standard error of the estimate summarizing random and systematic deviations from the model. The mean and the 17-year linear trend of final race time and pacing parameters were evaluated using standardization and non-clinical magnitude-based inferences with standardized thresholds of small, moderate, large, very large, and extremely large effects (0.2, 0.6, 1.2, 2.0 and 4.0, respectively). Optimization plots of final time versus each parameter were created. **RESULTS**: Data are presented as mean linear trend change (%) ±90% confidence interval, unless otherwise specified. Men exhibited a very large decrease in final time (-2.27 s; ±0.55 s), with a moderate increase in linear parameter (1.06; ±1.25) and small decrease in quadratic parameter (-0.1; ±0.25). Women exhibited an extremely large decrease in final time (-3.10 s; ±0.49 s), with a small increase in linear parameter (0.61; ±1.05). The first (0.02; ± 0.06) and last lap (-0.07; ±0.23) parameters both displayed small changes. Optimization plots displayed no clear optimum for each parameter for either sex. **CONCLUSIONS**: The sizable decreases in final time coupled with the apparent changes in pacing parameters suggest that swimmers have not only swum faster times from 2000 to 2017, but seem to have also adopted a "starting fast" strategy, evidenced by the increase in linear parameter over this period. The lack of optima in finishing time versus parameter plots suggests that elite swimmers accomplish elite times with a variety of strategies and that pacing can be optimized for individuals but not populations.

2169 Board #5 June 1 9:30 AM - 11:00 AM

### Variation in Critical Speed and Finite Distance Capacity of Elite Swimmers

Joel T. Greenshields, Curtis S. Goss, Joel M. Stager, FACSM. *Indiana University, Bloomington, IN.* (Sponsor: Joel M. Stager, FACSM)

*(No relevant relationships reported)*

**Purpose**: The purpose of this study was to assess variability in critical speed (CS) and the maximum finite distance capacity above critical speed (D') of elite swimmers using longitudinal performance data.

**Methods:** Top 100 results from the FINA World Rankings from 2011 - 2017 in the 200, 400, 800, and 1500-meter freestyle events were used to produce CS models. Swimmers with a top 100 time in a minimum of three of the four events within a given year were included in the analysis. Linear regression models were calculated using distance as the dependent variable and performance time of the race as the independent variable. From the regression model, D' was expressed as the intercept and CS as the slope of the line. Repeated measures analysis of the log-transformed calculated values provided the typical variation of a D' and CS values.

**Results**: On average, 45 (37-49) men swimmers and 45 (40-54) women swimmers per year were eligible for inclusion in the analysis. Average calculated D' was (M = 25.22 ± 3.60 m; W = 23.51 ± 2.80 m) and CS was (M = 1.62 ± 0.02 $m*s^{-1}$; W = 1.51 ± 0.02 $m*s^{-1}$). The linear trend over the seven-year time period in D' was (M = 3.22; ±8.15 %; W = 2.42; ±7.95 %) and CS was (M = 0.48; ±0.41 %; W = 0.35; ±0.51 %). The within-swimmer variability between-year expressed as a coefficient of variation (CV) with 90 % confidence limit of D' was (M = 25.35; ±2.37 %; W = 29.05; ±3.0 %) and CS was (M = 1.05; ±0.1; W = 1.48; ±0.13 %). The between-swimmer variability expressed as CV of D' was (M = 29.0 %; W = 34.64 %) and CS was (M = 1.41 %; W = 1.74 %). The smallest worthwhile change in D' (M = 2.55 %; W = 2.97 %) and CS (M = 0.14 %; W = 0.17 %) were calculated. All selected distances showed strong correlations between performance time with D' and CS ($r$ > 0.63). The 1500 m distances showed near perfect but inverse correlations between performance time and CS (M: $r$ = -0.96; W: $r$ = -0.99).

**Conclusions**: Changes in performance trends over the seven-year time period can be attributed largely to changes in CS. Potential causes of the large amount of within and between swimmer variations in D' should be explored further in relation to changes in pacing strategies. Additionally, the smallest worthwhile change values of D' and CS provide practical applications regarding the effectiveness of training interventions and athlete progression.

2170 Board #6 June 1 9:30 AM - 11:00 AM

### Fitness-Related Benefits: Land Versus Aqua

Rachel Williams[1], Ryan Swiezy[1], Maddison Patterson[1], Rachel McCormick[1], Blair Bonner[1], Amber Ausley[1], Raechel Santee[1], Aubrey Burgess[1], Virginia Wilson[1], Hayley Grimes[1], Michel Heijnen[1], Tiago Barreira[2], Wayland Tseh[1]. *[1]University of North Carolina Wilmington, Wilmington, NC. [2]Syracuse University, Syracuse, NY.* (Sponsor: Robert Boyce, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** To compare fitness-related benefits between land-based (LAND) versus aqua-based (AQUA) courses. **METHODS:** Informed consent was received from

154 volunteers (N = 76 LAND; N = 78 AQUA) who were asked to exercise within each respective course 2 days per week, 50-min per day, for 15 weeks. Pre- and post-fitness assessments obtained were body composition, muscular endurance, muscular strength, cardiorespiratory endurance, and flexibility. **RESULTS:** Mixed ANOVA was used to investigate mean differences between pre- and post-fitness assessments and between groups. There was a main effect ($p = 0.003$) and interaction ($p = <0.001$) for body composition in which, overall, participants decreased percent body fat, however, paired t-test revealed that LAND (20.4% ± 7.3% to 19.0% ± 7.4%) had a significant reduction in mean percent body fat while AQUA did not (20.1% ± 8.7% to 20.2% ± 8.9%). A main effect for both muscular strength ($p = <0.001$) and muscular endurance ($p = <0.04$) was revealed, but no interactions, therefore, both groups improved on aforementioned variables. Lastly, no significant main effect or interaction for neither cardiorespiratory endurance nor flexibility assessments were revealed. **CONCLUSIONS:** Individuals participating in land-based courses displayed greater decreases in percent body fat when compared to aqua-based courses, whereas both land- and aqua-based displayed improvements in muscular strength and muscular endurance. There were no changes in cardiorespiratory endurance and flexibility within both groups.

2171 Board #7 June 1 9:30 AM - 11:00 AM

## Reliability and Validity of Swimming Flume Protocol to Measure Maximal Aerobic Power of Healthy Adults

Elizabeth F. Nagle, FACSM[1], Takashi Nagai[1], Anne Beethe[1], Mita T. Lovalekar[1], Jacquelyn N. Zera[2], Christopher Connaboy[1], John P. Abt[3], Robert J. Robertson, FACSM[1], Scott M. Lephart[3], Brad D. Nindl, FACSM[1]. *[1]University of Pittsburgh, Pittsburgh, PA. [2]John Carroll University, Cleveland, OH. [3]University of Kentucky, Lexington, KY.*

*(No relevant relationships reported)*

A modality specific swimming protocol to assess maximal aerobic power (MAP) is essential to accurately quantify swimming training and performance. A graded intensity MAP swimming protocol executed in a swimming flume controls swimming speed (i.e. velocity), and may facilitate kinematic and metabolic assessments. **PURPOSE**: To assess: 1) reliability of a swimming flume maximal oxygen consumption ($VO2max_{fl}$) (i.e. MAP) protocol; and 2) validity of a $VO2max_{fl}$ protocol using a swimming pool performance swim (PS) test as the criterion.
**METHODS**: Nineteen healthy males (n=9) and females (n=10) (age, 28.5±8.3 yrs; height, 174.7 ± 8.2 cm; weight, 72.9 ± 12.5 kg; %body fat, 21.4 ± 5.9) performed two swimming flume $VO2max_{fl}$ tests ($VO2max_{fl}$A and $VO2max_{fl}$ B), and one PS test [500 meters (444.7 ± 139.4 seconds)]. Test-retest reliability of $VO2max_{fl}$ ($ml \cdot kg^{-1} \cdot min^{-1}$), HRmax ($b \cdot min^{-1}$), cardiorespiratory efficiency (O2 pulse; $VO2max_{fl}$/HRmax), maximal respiratory exchange ratio (RERmax), ventilation (Vemax) ($L \cdot min^{-1}$), and PS test time was assessed by ICC's (2,1). Test validity was determined by correlating $VO2max_{fl}$A with the PS using Pearson's coefficients.
**RESULTS**: Intra-subject reliability (ICC) for cardiorespiratory responses during the $VO2max_{fl}$A and $VO2max_{fl}$B tests are presented in Table 1. For validity, a moderate correlation was found between $VO2max_{fl}$A and 500 PS (r =-0.478; p<0.05). **CONCLUSIONS**: The VO2max*fl* test employed presently is a reliable and functionally valid assessment of MAP. It is proposed that a swimming flume-based protocol to measure MAP will facilitate mode specific comparisons of test responses with performance outcomes for military, clinical, or athletic populations.

Table 1

| Variable | N | $VO_2max_{fl}$A | $VO_2max_{fl}B$ | ICC | p-value |
|---|---|---|---|---|---|
| $VO_2max_{fl}$($ml \cdot kg^{-1} \cdot min^{-1}$) | 18 | 46.7± 8.6 | 47.9±8.5 | 0.628** | .002 |
| HRmax, ($b \cdot min^{-1}$) | 19 | 172 ± 18 | 174 ± 11.8 | 0.403* | .041 |
| O2pulse ($ml \cdot b^{-1}$) | 19 | 0.3 ± 0.1 | 0.3 ± 0.1 | 0.502* | .014 |
| RERmax | 19 | 1.2 ± 0.3 | 1.1 ± 0.2 | 0.559** | .002 |
| Vemax ($l \cdot min^{-1}$) | 19 | 103.5 ± 20.2 | 111.6 ± 25.3 | 0.671** | .000 |
| PS time (sec) | 16 | 444.7±139.4 | 452.6±53.0 | 0.608** | .005 |
| **p<0.01; *P<0.05 | | | | | |

2172 Board #8 June 1 9:30 AM - 11:00 AM

## Physiological Responses to Swimming Pool and Swimming Flume Maximal Aerobic Power Protocols

Jacquelyn N. Zera[1], Elizabeth Nagle, FACSM[2], Takashi Nagai[3], Mita Lovalekar[2], Christopher Connaboy[2], Anne Beethe[2], John Abt, FACSM[4], Scott Lephart, FACSM[4], Bradley Nindl, FACSM[2]. *[1]John Carroll University, University Heights, OH. [2]University of Pittsburgh, Pittsburgh, PA. [3]Mayo Clinic, Rochester, MN. [4]University of Kentucky, Lexington, KY.*
(Sponsor: Elizabeth Nagle, FACSM)

*(No relevant relationships reported)*

The importance of a swimming specific test of maximal aerobic power ($VO_{2max}$) to assess aerobic fitness, track training adaptations, and predict performance is well established. The ability to incrementally and systematically regulate intensity with changes to flow has made swimming flume tests ($VO_{2max_{fl}}$) a desirable laboratory tool, although few exist due to the complexity and cost of equipment. Pool tests ($VO_{2max_{sw}}$) simulate free swimming and are more cost effective. However, little research has compared these modes. **Purpose:** To examine the relationship between physiological responses to $VO_{2max_{sw}}$ and $VO_{2max_{fl}}$. **Methods:** Fifteen males (n=5) and females (n= 10) (age= 25.1 ± 8.5 years; BMI = 23.5 ± 3.4 $kg \cdot m^2$; body fat = 20.6 ± 7.0%) performed two volitional maximum swimming tests: ($VO_{2max_{sw}}$) a multi-stage swimming pool test of increasing self-regulated intensities and ($VO_{2max_{fl}}$) a graded swimming flume test of increasing flow rates, both previously described in the literature. Oxygen consumption ($VO_2$, $ml \cdot kg^{-1} \cdot min^{-1}$), ventilation (VE, $L \cdot min^{-1}$), heart rate (HR, $b \cdot min^{-1}$), and respiratory exchange ratio (RER) were measured continuously, and ratings of perceived exertion (RPE), blood lactate (BLa; $mmol^{-1}$), and test duration ($T_{time}$; seconds) were measured post-test. Normality was assessed, and a paired samples t-tests or Wilcoxon signed rank test, and Pearson or Spearman correlation coefficients were used, as appropriate. **Results:** $VO_{2max}$ (*p= 0.005*), $VE_{max}$ (*p= 0.008*), RER (*p= 0.011*), and $T_{time}$ (*p=0.001*) were significantly higher, and RPE (*p=0.004*) was significantly lower in the $VO_{2max_{fl}}$. Additionally, no significant differences were detected for $HR_{max}$, and BLa. Finally, strong correlations were reported between the two tests for $VO_{2max}$ (r= 0.908; *p<0.001*) and $VE_{max}$, (r= 0.853; *p<0.001)*, and a moderate correlation for BLa (r= 0.634; *p= 0.020*). There were no significant correlations between the two tests for RER, HRmax, RPE, and $T_{time}$. **Conclusions:** Results indicate that a $VO_{2max_{fl}}$ elicited higher maximal physiological responses compared to a $VO_{2max_{sw}}$, indicating that $VO_{2max_{fl}}$ may provide a better mode for assessing maximal aerobic capacity in swimmers. Future research should explore the swimming flume's flow and propulsion characteristics on kinematics and its impact on the ability to predict performance.

2173 Board #9 June 1 9:30 AM - 11:00 AM

## Changes in Collegiate Swim Anaerobic Performance Between Pre-season and Post-season

Haoyan Wang[1], Guillaume Spielmann[1], Brian Irving[1], Jack Marucci[1], Shelly Mullenix[1], Brian Harrell[2], Rick Sharp, FACSM[3], Neil Johannsen[1]. *[1]Louisiana State University, Baton Rouge, LA. [2]Baton Rouge General Sport Medicine, Baton Rouge, LA. [3]Iowa State University, Ames, IA.*

*(No relevant relationships reported)*

**PURPOSE**: To examine the cyclical nature of collegiate swim training on anaerobic performance.
**METHODS**: Ten NCAA Division 1 swimmers (n=4 women, age 20.3±0.5 y, weight 64.8±12.3 kg; n=6 men, age, 20.0±0.6 y, weight, 82.6±6.9 kg; mean±SD) participated in 3 testing sessions: immediate post-season ($V_1$), mid-offseason ($V_2$), and early season ($V_3$) separated by 8 weeks between $V_1$ and $V_2$, and 14 weeks between $V_2$ and $V_3$. Each testing session was comprised of an in-pool power test consisting of incrementally-loaded 25-m swims at maximal effort. During the test, participants were attached to a pulley system ending with a 20-gallon bucket. Initial load was set at 40 lbs for men and 20 lbs for women, and increased by 20 lbs and 15 lbs respectively after each trial completion. Swimmers were allowed to rest for 3 min after each trial. Speed, work, and power were calculated using the distance traveled per second factoring in the additional weight in bucket. Heart rate (HR), lactate ($La^-$), and rating of perceived exertion (RPE) were assessed within the first minute of each rest period. Two-way RM-ANOVAs (visits×bucket weight) were used to compare the effect of training across the primary outcomes.
**RESULTS**: A main effect of visit was observed for average speed whereby $V_2$ was faster in women ($V_1$: 1.08±0.26 m/s, $V_2$: 1.19±0.18 m/s, $V_3$: 1.11±0.31 m/s; P<0.001) and men ($V_1$: 1.20±0.26 m/s, $V_2$: 1.41±0.29 m/s, and $V_3$: 1.25±0.26 m/s; P<0.001) compared to $V_1$ and $V_3$. In addition, an interaction for speed at higher weights was observed and post-hoc analysis revealed higher speeds during $V_2$ in women at 65 lbs ($V_1$:0.75±0.22 m/s, $V_2$: 0.99±0.06 m/s, $V_3$: 0.73±0.25 m/s; P<0.02) and men at 120 lbs ($V_1$: 0.83±0.09 m/s, $V_2$: 1.45±0.57 m/s, $V_3$: 0.77± 0.14 m/s; P<0.001). A main effect of visit was seen for HR demonstrating a higher average HR during $V_2$ in women (165.3±14.4 bpm) compared to $V_1$ (156.7±17.1 bpm) and $V_3$ (156.2±14.8

bpm; P<0.02). RPE and $La^-$ were not different between the three visits (P>0.05). Total work per stroke was also higher at 65 lbs in women across visits ($V_1$: 11.9±1.5 Nm, $V_2$: 16.8±2.9 Nm, $V_3$: 12.1±1.6 Nm; P<0.04).
**CONCLUSIONS**: Swimmers had better anaerobic performance during mid-offseason while their overall training load was reduced in both women and men. The greater swimming speeds at similar RPE and $La^-$ suggest that the swimmers may benefit from altered training.

## E-27 Free Communication/Poster - **Youth**

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2174 Board #10 June 1 9:30 AM - 11:00 AM

### Acute Cardiometabolic Responses to Medicine Ball Exercise in Children

Avery D. Faigenbaum, FACSM, Jie Kang, FACSM, Anne Farrell, Nicholas A. Ratamess, Nicole Ellis, Ira Vought, Jill Bush, FACSM. *The College of New Jersey, Ewing, NJ.*
*(No relevant relationships reported)*

Medicine ball (MB) exercises are effective for strength and conditioning in adults, but the cardiometabolic demand of this training modality for children is unknown. **PURPOSE**: To examine the acute cardiometabolic responses to MB exercise in children. **METHODS**: 14 children (10.1 ± 1.3 yr) were tested for peak oxygen uptake ($VO_2$) on a treadmill and subsequently (> 48 hours later) performed a progressive 10 min MB protocol of 5 exercises (EX): standing marches (EX1), alternating lunges (EX2), squat swings (EX3), chest passes (EX4) and double arm slams (EX5). A 2.3 kg MB was used for all trials and each MB exercise was performed twice for 30 sec with a 30 sec rest interval between sets and exercises. Participants exercised while wearing a heart rate (HR) monitor and connected to a metabolic system. Comparisons between exercises were made using one-way analysis of variance with repeated measures. **RESULTS:** Peak values for HR and $VO_2$ during the treadmill test were 198.9 ± 8.3 bpm and 54.9 ± 10.1 ml · $kg^{-1}$ · $min^{-1}$, respectively. During the MB protocol, mean HR significantly (p<0.05) increased from 121.5 ± 12.3 bpm during EX1 to 178.3 ± 9.4 bpm during EX5 and mean $VO_2$ significantly (p<0.05) increased from 15.5 ± 2.9 ml · $kg^{-1}$ · $min^{-1}$during EX1 to 34.9 ± 5.1 ml · $kg^{-1}$ · $min^{-1}$during EX5. Mean HR and $VO_2$ values during the MB protocol ranged from 61.1% to 89.6% and 28.2% to 63.5% of HRpeak and $VO_2$peak, respectively. **CONCLUSION**: These descriptive data indicate that MB exercise can pose a moderate-to-vigorous cardiometabolic stimulus in children and may serve as a worthwhile compliment to youth strength and conditioning programs.

2175 Board #11 June 1 9:30 AM - 11:00 AM

### Dynamic Stretching Can Impair performance Of Adolescent Male handball Players For at Least 24 Hours.

Monoem Haddad[1], Mohammad Shoaib Prince[1], Nidhal Zarrouk[2], Karim Chamari[2], David G Behm[3]. *[1]Qatar University, Doha, Qatar. [2]Aspetar, Doha, Qatar. [3]Memorial University of Newfoundland, Newfoundland, NL, Canada.*
*(No relevant relationships reported)*

**PURPOSE**: There are many adult studies reporting static stretch (SS)-induced deficits and dynamic stretch (DS) performance improvements shortly after the intervention. However, there is only a single study examining stretch-induced performance changes with children at 24 hours' post-stretch. The objective of this study was to examine physiological responses of adolescent trained athletes at 24 hours after experiencing SS or DS protocols.
**METHODS**: Ten male adolescent, elite handball players (age: 16±05 years) were tested prior to-, 3 minutes- and 24 hours- following the three conditions (DS, SS, Control). Tests included (i) two 4s MVCs at $60^0$ of knee flexion with 2 min rest, (ii) two isokinetic contractions each at $60^0$/sec and $300^0$/sec with 1 min rest, and (iii) two drop jumps with 30s rest. To simulate a full warm-up, dynamic aerobic activity was instituted before the pre-tests and following the interventions.
**RESULTS**: Three-way repeated measures ANOVAs revealed that 1) both the SS and control conditions exhibited knee extensor $60^0.s^{-1}$ (-8.7 to -16.3%) and $300^0.s^{-1}$ (-10.3 to 12.9%) isokinetic force and power-related deficits at post-test, 2) DS impaired knee flexor $60^0.s^{-1}$ isokinetic force (-9.9 to -10.1%) and power-related (-9.6 to 19.1%) measures at post-test and at 24 hours' post-test, 3) DS (12.07% and 10.47%) and SS (13.7% and 14.6%) enhanced knee flexor $300^0.s^{-1}$ isokinetic force and power-related measures compared to control.
**CONCLUSIONS**: Testing-induced knee extensor isokinetic impairments were counterbalanced by DS, however the hip flexion DS could have produced minor muscle damage decreasing knee flexor forces and power at 600.s-1.

2176 Board #12 June 1 9:30 AM - 11:00 AM

### What Kind Of Scenes And Situations Make Children Find Pleasure In Exercise

Takahiro Nakano[1], Kosho Kasuga[2], Tomoaki Sakai[1], Kazuo Oguri[3]. *[1]Nagoya Gakuin University, Aichi, Japan. [2]Gifu University, Gifu, Japan. [3]Gifu Shotoku Gakuen University, Gifu, Japan.* (Sponsor: Kiyoji Tanaka, FACSM)
*(No relevant relationships reported)*

Recently, the need for acquiring the habit of exercise since childhood is increasing. As its background, the awareness of likes and dislikes pertaining to, and strengths and weaknesses of exercise is sometimes clarified in childhood. In order to resolve the decrease in children's physical fitness, it is necessary to convey children the pleasures of exercise at an early stage. Therefore, educators should promote exercise opportunities that exclude children's awareness of weaknesses and prioritize expressing the pleasures of exercise. Hence, we ought to understand exactly what kind of scene and situation makes children find pleasure in exercise. **PURPOSE:** The purpose of this study was to examine the difference in the kind of scenes and situations that make children find pleasure in exercise between children who like and dislike exercise. **METHODS:** The subjects of this study were 1846 elementary school children who belonged to the 5th or 6th grade. Data from seventeen items related to liking or disliking exercise, scenes and situations that make children find pleasure in exercise, and value of exercise were analyzed. The difference between children who liked and disliked exercise was analyzed using chi-square test. The most sensitive item to distinguish between children who liked and disliked exercise was examined using decision tree analysis. **RESULTS:** The ratio of children who liked exercise was 81.9% in boys and 69.1% in girls. Children who liked exercise understood the value of exercise for health and a good life significantly more than children who disliked exercise. A significant relationship was confirmed between all items related to scenes and situations that make children find pleasure in exercise and like or dislike exercise. The item "it is fun to exercise with many friends" was used to classify children who liked and disliked exercise most sensitively using decision tree analysis. In addition, 90.3% of the children who did not find pleasure in winning the game answered that they disliked exercise. **CONCLUSIONS:** It was confirmed that most of the children who dislike exercise did not understand the value of exercise since childhood. Conveying the pleasures of exercise since childhood was important. However, it was suggested that focusing excessively on winning or losing has the risk of promoting dislike of exercise.

2177 Board #13 June 1 9:30 AM - 11:00 AM

### Development and Volidation of the Chinese Assessment of Adolescent Physical Literacy

Yan Peng[1], Ming Yang[2], Liangqiu Yang[3], Chuandong Wei[1], Jindong Chang[2]. *[1]SiChuan Aerospace Vocational College, Chengdu, China. [2]Southwest University, Chongqing, China. [3]Northeast Normal University, Changchun, China.*
*(No relevant relationships reported)*

**PURPOSE**: China's physical fitness has been declining for nearly 30 years. How to improve the quality of youth fitness into a focus. The Canadian assessment of Physical Literacy (CAPL) provided a path to evaluate Chinese adolescent physical. The purpose of developing and validating an evaluation system of Chinese adolescent physical literacy.
**METHODS**: Through the database of Web of Science, PubMed, and CNKI, the primary institutional resources of Physical literacy at home and abroad were collected, and the index system of adolescent physical literacy was constructed by Delphi method and mathematical statistics way.
**RESULTS**: Using the Likert 5 point scale designed the Chinese Evaluation of physical literacy (CEPL). Using exploratory factor analysis (EFA) method explored the reliability of the CEPL that Cronbach's alpha coefficients were 0.85. Three factors were extracted that the cumulative contribution rate was 60.6%, three elements were verified by the adolescent's physical literacy self-measurement scale of the three dimensions, each coefficient was above 0.82, and the re-test reliability range of three factors was between 0.80-0.82. The version of ESCAPL was composed of four parts, daily behavior, physical ability, knowledge and understanding and motivation, and confidence. The results of the assessment were divided into four grades as follows, Initial level <41.5, Development level 41.5 ~ 62.5, Higher level 62.6 ~ 78.5, and the highest level> 78.5.
**CONCLUSIONS**: The evaluation index system of adolescent physical literacy evaluation is judged by expert two rounds, and the indexes are effective. After the empirical test, the adolescent physical literacy self-test scale and the physical ability measurement table have the high reliability and the validity can be used for the young athletic level measurement and the appraisal. The research was supported by NPOPSS Grant 15CTY011, and Fundamental Research Funds for the Central Universities Grant 1709240.

2178 Board #14 June 1 9:30 AM - 11:00 AM

**Physical Activity Guideline Adherence and Physical Fitness: The NHANES National Youth Fitness Survey**

Matthew P. Smudde, Kelly R. Laurson, Dale D. Brown, FACSM, Karen K. Dennis. *Illinois State University, Normal, IL.*

*(No relevant relationships reported)*

Encouraging regular physical activity (PA) is a major public health objective in the United States for several reasons, including the promotion of physical fitness. As such, the first edition of federal Physical Activity Guidelines for Americans (PAG) was released in 2008. For youth, these PAG include recommendations for aerobic and muscle-strengthening (MS) activity. **PURPOSE:** To examine the association between adherence to PAG and physical fitness in a nationally-representative sample of children and adolescents. **METHODS:** The NHANES National Youth Fitness Survey (NNYFS) collected fitness test and PA questionnaire data on children and adolescents (ages 3-15 years, n = 1,576). Fitness testing was completed for the plank (3-15 years), modified pull-up (5-15 years), handgrip strength (6-15 years), and aerobic fitness (12-15 years) by trained test administrators. Fitness test results were converted into age-specific percentile scores. All subjects reported the number of previous days of the week that included 60 minutes of PA, while 12-15 year olds also reported the number of previous days that included MS activities. Independent *t*-tests were used to compare the mean physical fitness percentile of youth reporting 7 days of 60 minutes of PA to those reporting ≤ 6 days and adolescents reporting 2 or more days of muscle-strengthening activity to those reporting ≤ 1 day. **RESULTS:** Youth reporting 7 days/week of PA had a higher mean relative grip strength (53.8 vs. 46.8 percentile), modified pull-up (53.7 vs. 47.1 percentile), and $VO_2$max (48.9 vs. 40.8 percentile) compared to those with ≤ 6 days/week (all $p < 0.05$). Those participating in MS activity 2 days/week had a higher relative grip strength (54.7 vs. 45.3 percentile), modified pull-up (54.2 vs. 46.8 percentile), plank (54.5 vs. 44.4 percentile), and $VO_2$max (45.7 vs. 39.8 percentile) compared to the ≤ 1 day/week group (all $p < 0.05$). **CONCLUSION:** In this nationally-representative sample, meeting PAG's were associated with measures of aerobic capacity, muscular strength, and muscular endurance. Future prospective research is needed to investigate the impact of changing PA level to meet (or not meet) the PAG on physical fitness.

2179 Board #15 June 1 9:30 AM - 11:00 AM

**Three-Year Tracking of Moderate-to-Vigorous Physical Activity During Structured and Unstructured Play In Youth**

Michael J. Wierenga[1], Kimberly A. Clevenger[1], Rebecca W. Moore[2], Karin A. Pfeiffer, FACSM[1]. *[1]Michigan State University, East Lansing, MI. [2]Eastern Michigan University, Ypsilanti, MI.* (Sponsor: Karin Pfeiffer, FACSM, FACSM)

*(No relevant relationships reported)*

Tracking is the maintenance of a relative position within a group over time. Previous studies indicate that habitual, moderate-to-vigorous physical activity (MVPA) tracks at low to moderate levels in youth, but there is limited research on specific contexts of MVPA, such as during structured and unstructured play. **PURPOSE:** To characterize tracking of MVPA in youth across four time points during a three-year period for both structured and unstructured play. **METHODS:** Youth (N=108), 58.3% female, 6-15 years old, visited the laboratory four times over three years. During each visit, participants engaged in 30 minutes each of structured and unstructured play. Youth wore a uniaxial accelerometer on an elastic belt over their right hip (data collected in 1-second epochs). MVPA minutes were determined using Evenson cut-points (≥574 counts/15-sec). Tracking of MVPA minutes was evaluated using tracking coefficients (Pearson's r) between each pair of time points [classified as low ($r$<0.30), moderate ($r$=0.30-0.60), or moderately high ($r$>0.60)] and intra-class correlations (ICC) via ANOVA. ICCs provided an overall correlation across the four time points [classified as poor (ICC<0.50), moderate (ICC=0.50-0.75), good (ICC=0.75-0.90), or excellent (ICC>0.90)]. Participants were classified into quartiles of MVPA for each visit, and percent agreement and weighted kappa [classified as poor (κ≤0.20), fair (κ=0.21–0.40), moderate (κ=0.41–0.60), good (κ=0.61–0.80), or very good (κ=0.81–1.0)] were calculated. **RESULTS:** Tracking coefficients were non-significant to moderate for structured play ($r$=-0.20-0.30) and moderate to moderately high for unstructured play ($r$=0.38-0.66, $p$'s<0.05). The ICC was classified as poor (0.42) for structured play and excellent (0.80) for unstructured play ($p$<0.05). Percent agreement ranged from 24.0-36.6% for structured play and 30.1-44.3% for unstructured. Weighted kappa for structured play ranged from non-significant to poor (-0.09-0.19), but was fair to moderate (0.24-0.49, $p$'s<0.05) for unstructured. **CONCLUSION:** We found evidence of low to moderate tracking for participation in MVPA during structured and unstructured play. Results suggest that MVPA during structured and unstructured play tracks similarly to habitual physical activity in youth.

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2180 Board #16 June 1 9:30 AM - 11:00 AM

**Association Between Tri-Ponderal Mass Index and FITNESSGRAM Aerobic Capacity Classification in Sixth-Grade Children**

John L. Walker, FACSM[1], Tinker D. Murray, FACSM[1], James Eldridge, FACSM[2], William G. Squires, Jr., FACSM[3]. *[1]Texas State University, San Marcos, TX. [2]University of Texas at the Permian Basin, Odessa, TX. [3]Texas Lutheran University, Seguin, TX.*

*(No relevant relationships reported)*

FITNESSGRAM has established criterion standards for body composition and body mass index (BMI) according to gender and age in children. Standards for aerobic capacity (AC) have also been established to assess cardiorespiratory function. Tri-Ponderal Mass Index (TMI) has been shown to better classify overweight and obesity than BMI in youth. **PURPOSE**: The purpose of this study was to determine the association between TMI and FITNESSGRAM AC classification in sixth-grade children. **METHODS**: Subjects were 528 sixth-grade boys and girls, ages 11-13, who completed each of the FITNESSGRAM components as a part of their yearly assessment. In addition to height and weight, subjects' AC was determined from one-mile run/walk times, age, gender and BMI. 52% percent of these students were classified within the Healthy Fitness Zone (HFZ) for AC. 31% percent of these students were classified as High Risk for AC. **RESULTS**: The correlation between TMI and BMI was .98, and the correlation between BMI and AC was -.75. The correlation between TMI and AC was -.73. Receiver Operating Characteristic (ROC) analysis indicated that a TMI of 13.94 represents the best cut-off score for classifying girls within the HFZ for AC, with 90% classified correctly, and AUC = .96. Also, a TMI of 15.05 represents the best cut-off score for classifying boys within the HFZ for AC, with 90% classified correctly, and AUC = .95. For determining High Risk classification for AC, a TMI of 16.53 represents the best cut-off score for classifying girls as High Risk for AC, with 92% classified correctly, and AUC = .96. Also, a TMI of 17.75 represents the best cut-off score for classifying boys as High Risk for AC, with 93% classified correctly, and AUC = .97. **CONCLUSIONS**: TMI is strongly associated with classification according to FITNESSGRAM AC standards in sixth-grade children. These data suggest that a TMI of 13.94 for girls and 15.05 for boys are the best criteria for HFZ classification for FITNESSGRAM AC. Also, a TMI of 16.53 for girls and 17.75 for boys are the best criteria for High Risk classification for FITNESSGRAM AC. Appropriate evaluation of body size is important since body size has been shown to be highly related to aerobic capacity and performance, especially in weight-bearing exercises.

2181 Board #17 June 1 9:30 AM - 11:00 AM

**The Influence Of Non-cognitive Functional Characteristics At Age 6 On Physical Fitness Characteristics At Age 10**

Kosho Kasuga[1], Takahiro Nakano[2], Kazuo Oguri[3], Tomoaki Sakai[2]. *[1]Gifu University, gifu, Japan. [2]Nagoya Gakuin University, seto, Japan. [3]Gifu Shotoku Gakuen University, gifu, Japan.* (Sponsor: Kiyoji Tanaka, FACSM)

*(No relevant relationships reported)*

Human non-cognitive functioning is developed mostly in early childhood. It may be that physical characteristics during childhood affected by daily exercise behaviors are also affected by non-cognitive functional characteristics in the early childhood. **PURPOSE**: The purpose of this study was to examine the influence of non-cognitive functional characteristics at the age of 6 years on the physical fitness characteristics at the age of 10 years.

**METHODS**: Subjects included 223 children (110 boys and 113 girls) who performed the physical fitness test (eight exercises) at 10 years of age. In order to understand non-cognitive functional characteristics at 6 years of age, a questionnaire of 21 questions consisting of 8 items (self-recognition, motivation, perseverance, self-control, social appropriateness, resilience and coping ability, creativity, and personality) was used. Evaluation of non-cognitive function was carried out by three kindergarten teachers who had the experience of being their homeroom teacher. From the evaluation obtained, grouping was performed with the upper group (UG), the middle group (MG), and the lower group (LG) based on the evaluation value of each non-cognitive function. Statistical analysis of the data was conducted using a one-way ANOVA and multiple comparisons (Tukey's HSD test) to compare physical fitness among the groups.

**RESULTS**: Results of the analysis revealed significant differences in physical fitness in all items except "nervous" among the 21 questions. UG of each item was significantly higher than LG. In particular, there was a very high effect size (ES) in "persistent efforts" (ES: 1.99), "ingenuity" (ES: 1.92), and "ability to pull out" (ES: 1.85).

**CONCLUSIONS**: It was suggested that children with increased non-cognitive functions such as condition judgment ability and tenacity in early childhood have a good effect on physical fitness at school age. *Supported by Grant-in-Aid for Scientific Research (B) (No.16H03271) from Ministry of Education, Culture, Sports, Science and Technology in Japan.*

2182 Board #18 June 1 9:30 AM - 11:00 AM

### A Comparison of Health Related Fitness Variables between Youths in Singapore and Hong Kong

Yew Cheo Ng[1], Govindasamy Balasekaran, FACSM[1], Stanley Sai-Chuen Hui, FACSM[2], Visvasuresh Victor Govindaswamy[3], Jolene Lim[1], Peggy Boey[1]. *[1]Nanyang Technological University, Singapore, Singapore. [2]The Chinese University of Hong Kong, Shatin, Hong Kong. [3]Concordia University Chicago, Illinois, IL.*

*(No relevant relationships reported)*

Physical fitness encompasses health-related fitness (HRF) variables which may reduce cardiovascular risk factors if identified early in youths. **Purpose:** To compare HRF variables between youths in Singapore (SGP) and Hong Kong (HK). **Methods:** A total of 1559 youths from SGP (age: 13.49 ± 1.21 years, height: 159.76 ± 8.94 cm, weight: 51.91 ± 13.38 kg, Body Fat (BF) %: 21.51 ± 10.25 %) and 1530 youths from HK (age: 13.51 ± 0.98 years, height: 160.69 ± 8.40 cm, weight: 52.20 ± 12.43 kg, BF%: 21.16 ± 9.99 %) participated in this study. Body Mass Index (BMI) and BF% were measured by bio-electric impedance analysis. Cardiovascular fitness, lower limb flexibility, arm strength, abdominal endurance were tested using the 15m youth Progressive Aerobic Cardiovascular Endurance Run test (PACER), one-legged sit-and-reach test for both legs (SRT), handgrip strength test for both hands (HS), and 1-minute sit-up test (SUT) respectively. **Results:** Using the Independent T-Test, significant differences were found between SGP and HK youths for height (SGP: 159.76 ± 8.94 cm, HK: 160.69 ± 8.40 cm, $p < 0.0005$), SRT (SGP: 54.14 ± 10.15 cm, HK: 49.59 ± 12.04 cm, $p < 0.0005$), HS (SGP: 25.18 ± 7.77 kg, HK: 26.01 ± 6.96 kg, $p = 0.002$), SUT (SGP: 38.94 ± 11.92, HK: 30.56 ± 10.14, $p < 0.0005$) and PACER (SGP: 40.93 ± 23.90 laps, HK: 35.49 ± 18.44 laps, $p < 0.0005$). There were no significant differences in weight, BMI, and BF% between youths in both countries, with low obesity rates in both countries (SGP: 12.7%, HK: 10.32%). **Conclusion:** Results indicated similar body composition results in both countries. SGP youths had lesser arm strength as compared to HK youths. However, SGP youths had higher abdominal endurance, better flexibility and were more aerobically fit as compared to HK youths. Both SGP and HK youths need to maintain their physical activities to improve their cardiovascular fitness as this will help to reduce cardiovascular diseases in youths in the future.

2183 Board #19 June 1 9:30 AM - 11:00 AM

### Effects of Jump Rope Exercise on Stretch-Shortening Cycle Ability in Elementary School Students

Kazufumi Terada[1], Tatsuki Nakagawa[2], Nobuyuki Miyai[3], Miyoko Utsumi[3], Toshiaki Nakatani[1], Mikio Arita[3]. *[1]Tenri University, Tenri, Japan. [2]Tenri University Graduate School, Tenri, Japan. [3]Wakayama Medical University, Wakayama, Japan.*

*(No relevant relationships reported)*

**PURPOSE**: Not much research has investigated how jump rope exercise can lead to improvements in physical abilities, including stretch-shortening cycle (SSC) ability, in children. This study examined whether the maximum number of jumps elementary school students could perform in a jump rope exercise ("max jump count": MJC below) was associated with their jumping performance, short-distance sprint performance, and other fitness indicators, as well as whether a jump rope training program led to improvements in those abilities.
**METHODS**: Seventy-four elementary school students (34 boys, 40 girls) aged from 6 to 12 years old participated in this study (mean height: 138+11 cm, mean weight: 33+8 kg). In addition to MJC, all students were assessed in terms of 20-m sprint time (ST), rebound jump index (RJI), vertical jump (VJ), and grip strength (GS). For RJI, students were measured with an optical measurement system as they performed five consecutive rebound jumps with both legs: RJI was calculated as jump height divided by ground contact time. Pearson's product-moment correlation coefficients (r) were determined to check for associations between MJC and the other fitness indicators. The training effects of jump rope exercise were investigated by comparing students' performance before and after completing four weeks of training. Students were allowed to decide for themselves how often to jump rope during these four weeks.
**RESULTS**: Before training, students achieved a mean MJC of 93+98 jumps, with a range of 2-459 jumps. A negative correlation was observed between MJC in before training and ST ($r=-0.46$, $p<0.01$). Additionally, positive correlations were observed between it and RJI ($r=0.57$, $p<0.01$), VJ ($r=0.33$, $p<0.01$) and GS (left-hand: $r=0.31$, $p<0.01$; right hand: $r=0.34$, $p<0.01$). Four weeks of training resulted in significant improvements in MJC (+43%, $p<0.001$), RJI (+7%, $p<0.05$), and VJ (+5%, $p<0.01$). However, jump rope exercise frequency did not result in any apparent differences in training effects.
**CONCLUSIONS**: These results suggest that MJC was associated with a variety of physical abilities in elementary school students. However, it could not be clearly demonstrated that jump rope training improve performance indicators related to SSC ability in elementary school students.

2184 Board #20 June 1 9:30 AM - 11:00 AM

### A Comparison Of Health Related Fitness Variables Between The Youths Of Singapore And Bangkok

Govindasamy Balasekaran, FACSM[1], Stanley Sai-Chuen Hui, FACSM[2], Kallaya Kijboonchoo[3], Visvasuresh Victor Govindaswamy[4], Jolene Lim[1], Ng Yew Cheo[1], Peggy Boey[1]. *[1]Nanyang Technological University, Singapore, Singapore. [2]The Chinese University of Hong Kong, Shatin, Hong Kong. [3]Institute of Nutrition, Mahidol University, Salaya, Thailand. [4]Concordia University Chicago, Chicago, IL.*

*(No relevant relationships reported)*

Obesity is identified as a worldwide issue and thus assessing health related components of physical fitness in youths may help in identifying risk factors associated with obesity. **Purpose:** To compare fitness variables between the youths of Singapore (SGP) and Bangkok (BKK). **Methods:** A sample of 1559 (Age: 13.49 ± 1.21 yrs; Height: 159.76 ± 8.94 cm; Weight: 51.91 ± 13.38 kg) youths from SGP and 1098 (Age: 13.95 ± 0.85 yrs; Height: 158.88 ± 7.98 cm; Weight: 53.01 ± 14.13 kg) youths from BKK were recruited for this study. Body composition was measured using a bio-impedance analysis (BIA) machine. A one-legged sit-and-reach test for both legs (SRT), handgrip strength test for both hands (HST), sit-up test (SUT), and 15m youth Progressive Aerobic Cardiovascular Endurance Run (PACER) test was conducted to measure flexibility, arm strength, abdominal endurance, and cardiorespiratory endurance respectively. **Results**: There was a significant difference in body composition between the youths in SGP and BKK, as indicated by their body mass index (SGP: 20.19 ± 4.21 $kg.m^{-2}$, BKK: 20.85 ± 4.64 $kg.m^{-2}$, $p < 0.0005$) and body fat percentage (SGP: 21.51 ± 10.25 %, BKK: 23.43 ± 11.23 %, $p < 0.0005$). Significant differences were found between the youths of both countries for SRT for both legs (SGP: 108.27 ± 20.31 cm, BKK: 103.59 ± 18.25 cm, $p < 0.0005$), HST for both hands (SGP: 50.32 ± 15.53 kg, BKK: 52.20 ± 12.72 kg, $p = 0.001$), SUT (SGP: 38.94 ± 11.92, BKK: 27.19 ± 9.72, $p < 0.0005$), and PACER (SGP: 40.93 ± 23.90 laps, BKK: 30.37 ± 16.26 laps, $p < 0.0005$). **Conclusions:** The youths of SGP had lower body composition, were more flexible, had higher abdominal endurance, and were more aerobically fit compared to the youths of BKK. This indicated a lower risk of obesity and cardiovascular risk in SGP youths as compared to BKK. More research is needed to identify the reasons for these differences which may help youths to continue participating in high levels of physical activity and exercise to reduce cardiovascular risks.

2185 Board #21 June 1 9:30 AM - 11:00 AM

### Assessment Of Quality Of Movement Patterns In Spanish Pediatric Population During Classes Of Physical Education

Miguel García-Jaén[1], Juan M. Cortell-Tormo[1], Iván Chulvi-Medrano[1], Sergio Selles[1], Roberto Cejuela[1], Tamara Rial[2]. *[1]University of Alicante, Alicante, Spain. [2]International Hypopressive and Physical Therapy Institute, Vigo, Spain.*

*(No relevant relationships reported)*

The Functional Movement Screen(FMS) test has become increasingly popular as a tool designed to evaluate the quality of fundamental whole-body movement patterns, for the assessment of the normal function and for identifying limitations and asymmetries in basic functional movements. Although there are already considerable data analyzing FMS outcomes in adults, this research is currently scarce in pediatric population.
**PURPOSE**: This exploratory and descriptive study was undertaken to evaluate the physical functional capacity in school-aged pediatric population, in order to assess the prevalence of asymmetries and confirm feasibility of performing the FMS in a sample of children from Spanish primary school. **METHODS**: 136 elementary school children, 69 girls and 67 boys between 8-13 years old, took part in this investigation (age: 9.96 ± 1.22 years, weight: 39.21 ± 7.01 kg, height: 1.35 ± 0.097 m, BMI: 21.36 ± 2.69). Each participant performed the FMS during the classes of Physical Education in a primary school of Spain. Throughout data collection, information was digitally recorded for later data analysis. Statistical analysis was made using a two-way ANOVA with repeated measures. **RESULTS**: Obtained results showed that girls scored highest in all the FMS tests, compared with boys (14.38±3.078 vs. 11.91±2.58) and these outcomes indicate significant differences between both genders, throughout all studied age range ($P = 0.000$). The mean of total FMS score from all the study participants was 12.76±2.89. **CONCLUSION**: Girls presented higher quality of fundamental movement skills than boys, which indicates more optimal function, and boys scored lowest, which indicates lower quality of basic movement patterns and, therefore, higher prevalence of limitations and asymmetries. The low values of total FMS scores in both genders showed throughout all the age range studied indicate suboptimal physical functional capacity and high prevalence of asymmetries. Finally, the results

of this study highlight that FMS can be a feasible screen test for evaluating functional movement skills and asymmetries in pediatric population, in order to reduce the risks of orthopaedic abnormality arising from suboptimal movement patterns in adult lifespan.

2186 Board #22 June 1 9:30 AM - 11:00 AM

### Impact of Flag Football Intervention on Fitness Outcomes among 9-11 Years Old Chinese Children

Jie Zhuang[1], XinZhao Cao[1], Peijie Chen[1], Yong Gao[2]. *[1]Shanghai University of Sport, Shanghai, China. [2]Boise State University, Boise, ID.* (Sponsor: Weimo Zhu, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: To examine the impact of a 10-week flag football intervention on aerobic fitness, muscular strength and speed among 9-11 years old Chinese children.
**METHODS**: A total of 122 9-11 years old Chinese children were randomly divided into intervention group (IG; n=62) and control group (CG; n=60). The IG received ten-week flag football (FF) lessons (60-90 mins per lesson, twice a week), including throwing and catching balls, positioning, attacks,defending, game rules and games while CG took conventional PE lessons (35 mins per lesson, 3 times a week). Participants took 20-m shuttle run (20-m SRT), jump rope (for muscular power) and 50-meter dash (for speed) tests before and after intervention. $VO_{2max}$ was estimated from 20-m SRT using Pacer equation. Mixed model Repeated Measures ANOVAs were used for data analysis.
**RESULTS**: A significant group-by-time interaction was observed for jump rope test (turns/min), p=0.03: no difference between IG and CG at baseline, but jump rope performance was significant improved among IG while no change among CG after intervention. There was also a significant group-by-time interaction for 50-meter dash (in sec), p=0.013: no difference at baseline between IG and CG, but 50-meter dash performance improved among IG while no change in CG after intervention. Although VO2max and 20-m SRT scores of both IG and CG participants increased from baseline to after intervention, there was no group difference in the improvement, p>0.05.
**CONCLUSIONS**: 10-week FF training effectively improves muscular power and speed among 9-11 years old Chinese children.

Fitness comparison

| Variable | Group | IG | CG | ES |
|---|---|---|---|---|
| 20-m SRT (laps) | Baseline | 25.92±9.18 | 22.67±7.69 | 0.38 |
| | Post | 31.32±9.72 | 26.20±8.03 | 0.57 |
| | ES | 0.57 | 0.45 | |
| $VO_{2max}$ (ml/kg/min) | Baseline | 46.02±2.86 | 45.05±2.68 | 0.35 |
| | Post | 47.37±3.10 | 45.93±2.49 | 0.51 |
| | ES | 0.45 | 0.34 | |
| Jump rope test (times/min) | Baseline | 106.60±29.41 | 107.87±28.30 | 0.04 |
| | Post | 115.30±31.08 | 108.73±32.64 | 0.21 |
| | ES | 0.29 | 0.03 | |
| 50-meter dash (s) | Baseline | 10.11±0.94 | 10.02±0.87 | 0.1 |
| | Post | 9.69±0.82 | 9.89±0.84 | 0.24 |
| | ES | 0.48 | 0.15 | |

2187 Board #23 June 1 9:30 AM - 11:00 AM

### Effect of Injury Prevention Program on Performance Measures in Middle School Boys Soccer Players

Stuart McCrory, Shane Caswell, Nelson Cortes. *George Mason University, Manassas, VA.*

*(No relevant relationships reported)*

Lower extremity injuries are common in boys' youth soccer. Lower extremity injury prevention programs (IPPs) have been shown to be effective in reducing injury risk and increasing performance among high school and adult soccer players. To date, little research has examined the effectiveness of IPPs to change physical performance characteristics among middle school-age (10-14 years) athletes.
**PURPOSE:** To determine the effectiveness of a novel 16 exercise IPP in male middle school soccer players on vertical jump (VJ), single-leg long jump (SLLJ), and single-leg anterior reach (SLAR).
**METHODS:** Students (N=49, 12.6 ± 0.7 years, 1.59 ± 0.1 m, 53 ± 13 kg) playing on 3 separate boys' middle school soccer participated in this study. During the season and at the beginning of each practice session all athletes completed a 16-exercise IPP that lasted 6 weeks. Each IPP session was supervised by the team's coach and the athletic trainer. The IPP involved dynamic movements with the aim of improving physical performance for the athletes including power, core stability, balance, and agility. Performance testing was conducted pre- and post-season and included VJ, SLLJ, and SLAR. The VJ and SLLJ were completed on a turf field with the athletes in cleats to produce a more realistic environment during testing. The SLAR was completed indoors with the athletes standing barefoot on a flat, hard surface. The SLAR and SLLJ tests were normalized to participant's leg length. Paired t-tests were conducted to compare pre- and post-intervention groups (p<.05).
**RESULTS:** A statistically significant improvement in VJ (pre = 41.3 ± 9.8 cm, post = 46.9 ± 13.9 cm; p<.05) and a reduction in SLAR for both right and left limbs (Right pre = 66.8 ± 7.5, post = 63.6 ± 6.2 cm; Left pre = 68.0 ± 6.9 cm, post = 61.2 ± 8.3 cm; p<.05) was attained. No significant differences were found for SLLJ (p>.05).
**CONCLUSION:** The findings suggest that our IPP was effective in improving VJ in middle school soccer players, but was detrimental for SLAR. Coaches and other professionals should ensure that performance improvements are not at the cost of injury risk. Future research should be conducted to determine which aspects of the injury prevention program affects the various tests performed so that more comprehensive and effective IPPs can be implemented.
Supported by the Potomac Health Foundation.

2188 Board #24 June 1 9:30 AM - 11:00 AM

### Season Long Changes in Training Load Metrics for a World Champion Youth Ice-Hockey Team

Brandon Bastianelli, Davor Stojanov, Dakota Burke, Andrea Workman, Kenneth Martel, Stephen Mcgregor. *Eastern Michigan University, ypsilanti, MI.*

*(No relevant relationships reported)*

With increasing use of player worn sensors (PWS) in team sports, previously unknowable information is now within grasp. The team sport of ice hockey presents numerous challenges with regard to the assessment of training load. More specifically, the differences in training load experienced by skaters of different positions is of interest to optimize player development and avoid injury.
**PURPOSE:**
Use (PWS) to measure on-ice physiological exertions and quantify training load differences between forwards (F) and defensemen (D) members of a national junior ice hockey team over the course of a season.
**METHODS:**
19 members of the US National Team Development Program (17.5+.21 y, 1.82+0.8 m, 83.1+7.6 kg) consented to procedures approved by the EMU-HSRC. Zephyr bioharness-3 (Zephyr, MD) PWS measured triaxial accelerations and heart rate for all on-ice practices and games. Exponentially weighted session Dynamic Accelerations (DYNAs) were used to determine Intensity Factor (IF) that was expressed relative to a player's Dynamic Functional Threshold (DFT; 30 min maximal acceleration). Dynamic Training Load (DTL) was calculated using the individualized IF and session duration to reflect training load of a single session. DTL was used as the input for an impulse-response performance model to calculate Chronic Training Load (CTL), Acute Training Load (ATL) and Performance Readiness (PR) over a given period of time. MANOVA statistical tests compared metrics by session type and position for main effects and a Bonferoni *post hoc* in the event of statistical differences (α=.05).
**RESULTS:**
Overall, differences by position were observed with F being higher than D for both DA (.311+.001 v .303+.001) and IF (0.82+.002 v 0.81+.003)(p<.05). No differences were observed, overall, for DTL, CTL, ATL or PR by position. Interactions were also observed for DA and IF by position and session. For F, DA was greater for games than practice, while practices were greater than games for D.
**CONCLUSION:**
F appeared to perform greater accelerations and relative intensities in games and practices than D, but this did not result in significantly different training loads between positions. It also appears as though F exhibited greater accelerations and intensities in games than practices, while D exhibited the converse. Supported by the USA Hockey Foundation

2189 Board #25 June 1 9:30 AM - 11:00 AM

### Season Long Changes in Training Load Metrics for a World Champion Junior Ice-Hockey Team

Dakota J. Burke, Davor Stojanov, Andrea Workman, Kenneth Martel, Stephen McGregor. *Eastern Michigan University, Ypsilanti, MI.*

*(No relevant relationships reported)*

**PURPOSE**: Use player worn sensors (PWS) to measure on ice physiological exertions and quantify training load changes for players on a Junior National ice hockey team over the course of a single season which culminated in a World Championship.
**METHODS**: 19 members of a National Team Development Program (17.5+.21 y, 1.82+0.8 m, 83.1+7.6 kg) consented to procedures approved by the EMU-HSRC. Zephyr BH3 (Zephyr, MD) PWS measured triaxial accelerations (g's) for all on ice practices (P) and games (G). Dynamic Accelerations (DYNAs) were generated from exponentially weighted accelerations and Dynamic Functional Threshold (DFT) from peak 30 min DYNAs within a 2 week moving window. Intensity Factor (IF) was based on session DYNAs relative to DFT. Dynamic Training Load (DTL) for a single session

was calculated using the IF and the session duration. DTL was used as the input for an impulse response performance model to calculate Chronic Training Load (CTL), Acute Training Load (ATL) and Performance Readiness (PR) over a given amount of time. MANOVA was used to compare metrics by session type, (G) vs (P), and by month (M1 - M7) for main effects and Bonferoni *post hocs* in the event of statistical differences (α=.05)
**RESULTS**: **RESULTS:** All training load metrics were different between G and P, by month and an interaction for session by month (p<.05). When P were examined separately, DTL was not different across M1-M4, but declined during M5-M7 (108.5±2.5, 116.3±29.2, and 58.4±2.5, respectively; p<.05) with M7 being lower than M1-M6. IF was highest during M1 (.86+.01) and significantly declined over the season and was lowest at M7 (.74+.01). In contrast, for G, DTL increased for M1 (193.0+1.9) and M2 (200.0+2.2) but were not different for the remainder of the year, while IF peaked at M3 (.83+.01) and was lowest (p<.05) at M7 (.79+.01). For performance modeling metrics, CTL peaked at M3 (p<.05), but despite the reduced DTL for P in M7, CTL, ATL and PR were not different during M7 compared to M6 (p>.05)
**CONCLUSIONS**: In the last month before the World Championships, training loads and intensities of practices were reduced substantially, while game loads remained constant but intensities were reduced. The training loads imparted by games were sufficient to maintain CTL, but ATL was not reduced and PR was not increased leading into the primary objective of the season

2190 Board #26 June 1 9:30 AM - 11:00 AM

### Implementing a Progressive Resistance Training Program in Youth Junior Olympic Women's Gymnastics.

Michael M. Lockard, Tynan F. Gable. *Willamette University, Salem, OR.*

*(No relevant relationships reported)*

Competitive gymnasts in the Women's Junior Olympic (JO) program are highly conditioned, typically training 8-20 hours per week. Training often consists of high-repetition body-weight activities with little variability in the exercises performed. This method of training lacks progressive resistance training (PRT), a cornerstone to adaptation for specific training goals. **PURPOSE**: To investigate the benefits of 10 wks of PRT, 1 day/wk, on muscular strength and power in women's JO child and adolescent gymnasts. A program was implemented for all competitive levels during regular practice, while minimizing time away from normal training. **METHODS**: 47 females aged 7-17 yrs (mean 10.2±2.7 yrs), competing on JO levels 3-10 participated. 15 exercises were each completed for 1 set of 10 reps. Tests for upper- and lower-body power included vertical leap, medicine ball-put, and an arm-ergometer modified Wingate anaerobic test (Arm-WAnT). Analysis: Gymnasts must have attended at least 70% of the training sessions during the 10-week study. Level 3 gymnasts (n=19) underwent the control condition, completing normal body-weight non-progressive conditioning. They were compared to the Level 4 gymnasts who were of similar age and gymnastics training experience. Level 4-10 gymnasts were separately analyzed in a quasi-experimental repeated measures design. **RESULTS**: Compared to the Level 3 controls, Level 4 gymnasts had greater improvement in vertical power (p=0.003), and Arm-WAnT peak power and mean power (p=0.044 and 0.023), but no difference in medicine ball-put distance or Arm-WAnT fatigue index. Gymnasts Levels 4 to 10 similarly improved vertical power (2224±756W to 2473±688W, p<0.001), Arm-WAnT peak power (80.9±30.1W to 93.2±40.6W, p<0.001), and mean power (62.8±23.2 to 70.1±27.3, p<0.001), with no change in medicine ball-put distance or Arm-WAnT fatigue index. **CONCLUSION**: 10-wks of PRT will improve upper- and lower-body power in child and adolescent female JO gymnasts.

## E-28 Free Communication/Poster - Cerebral Blood Flow

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2191 Board #27 June 1 11:00 AM - 12:30 PM

### Ipsilateral and Contralateral Posterior Cerebral Artery Blood Velocities During Handgrip Exercise

Kazuya Suzuki, Takuro Washio, Masato Hatanaka, Hiroki Sakurai, Shigehiko Ogoh, FACSM. *Toyo University, kawagoe, Japan.*

*(No relevant relationships reported)*

Previous studies reported that an increase in the contralateral middle cerebral artery mean blood velocity was larger than mean blood velocity in the ipsilateral side during handgrip (HG) exercise. These findings suggest a significant increase in blood flow for the artery supplying the cortical projection of the exercising limb. On the other hand, the response of posterior cerebral blood flow (CBF) to exercise is significantly different from anterior CBF. However, it remains unknown whether there is different CBF response to HG exercise between ipsilateral and contralateral posterior cerebral arteries. **PURPOSE:** The purpose of this study was to examine the effect of HG exercise on CBF in ipsilateral and contralateral posterior cerebral arteries. **METHODS:** Six healthy male subjects performed HG exercise of the right hand for 3 min at 30% maximum voluntary contraction in a semi-supine position. Arterial pressure and posterior cerebral artery blood velocity (PCAv) were measured by finger photoplethysmography and the Transcranial Doppler Sonography, respectively. Cerebral vascular conductance index (CVCi) was estimated using the ratio of PCAv to mean arterial pressure (MAP). **RESULTS:** MAP significantly increased from rest during HG exercise (+26.9%, P=0.02). During HG exercise, both ipsilateral and contralateral PCAv significantly increased, but there was no significant difference between sides (P = 0.87). Also, CVCi decreased significantly during HG exercise. Similarly, there was no difference in CVCi between ipsilateral and contralateral arteries (P=0.96). **CONCLUSION**: The findings of the present study suggest that the blood flow response in the posterior regional CBF during HG exercise is different from that in the anterior cerebral circulation.

2192 Board #28 June 1 11:00 AM - 12:30 PM

### Age-related Differences in Cerebral Oxygen Diffusive Capacity during Normobaric Hypoxia Exposure

Xiangrong Shi, FACSM, Xiaoli Liu, Hannah Schenck, Shande Chen, James Hall, Sarah Ross, Geoffrey Kline, Robert T. Mallet. *UNT Health Science Center, Fort Worth, TX.*

*(No relevant relationships reported)*

**Purpose**: Cerebral perfusion and oxygen diffusive capacity were enhanced in young adults during hypoxia-induced hypoxemia. This study examined cerebral oxygenation and perfusion in elderly adults during exposure to normobaric hypoxia. **Methods**: Eight elderly (70 ± 2 yr, 4 women) and eight young adults (25 ± 1 yr) were exposed to 5 min 10% $O_2$. During the test, heart rate (HR, electrocardiogram), arterial blood pressure (ABP, NIBP100D), $O_2$ saturation ($SaO_2$, Radiometer), middle cerebral arterial blood flow velocity ($V_{MCA}$, Ez-Dop) and cerebral tissue oxygenation ($ScO_2$, Somanetics 5100C INVOS) were continuously monitored. **Results**: Baseline $SaO_2$, HR, and mean ABP were not significantly different in elderly vs. young subjects ($SaO_2$ 96.9±0.3 vs 97.0±0.3%; HR 71±4 vs 63±2 bpm; ABP 93±3 vs 89±2 mmHg). However, baseline $V_{MCA}$ (43.5±2.2 vs 53.7±1.8 cm/s, P=0.005) and $ScO_2$ (68.6±0.7 vs 75.4±0.9%, P<0.001) were lower in elderly than young adults. During hypoxia exposure, HR was significantly increased with decreases in $SaO_2$; the rate of tachycardia per unit hypoxemia was smaller (P<0.001) in elderly (-0.48 ±0.05 bpm/%) than young (-0.84 ±0.02 bpm/%) group. ABP was not altered during hypoxia-induced hypoxemia in either group. $SaO_2$ during 5-min hypoxia exposure fell appreciably, to 77.5±2.3% and 75.9±1.4% in elderly and young groups, respectively; the rate of decrease in $SaO_2$ per unit time was not significantly different between the groups. However, in terms of unit hypoxemia, the rate of decrease in $ScO_2$ was smaller (P = 0.002) in elderly (0.69±0.01 %/%) than young (0.85±0.03 %/%) adults, while the rates of increase in $V_{MCA}$ were similar between elderly and young groups (-0.28±0.05 vs -0.37±0.07 cm/s/%, P = 0.325). Fractional cerebral oxygen extraction during hypoxemia declined in elderly subjects (P = 0.038), but progressively increased in young adults (P <0.05). **Conclusions:** Aging diminishes cerebral oxygenation and perfusion at rest. During exposure to normobaric hypoxia, elderly adults depend solely on an activated cerebral vasodilation to maintain $O_2$ delivery, but cerebral oxygen diffusive capacity is not enhanced as in young group.

2193 Board #29 June 1 11:00 AM - 12:30 PM

### Cerebral Blood Flow Pulse Is Influenced By Ascending Aortic Flow During Acute Hypotension

Tomoya Suda[1], Ai Hirasawa[1], Takahiro Uechi[1], Kazukuni Hirabuki[1], Noritaka Hata[1], Yuki Sano[1], Takeaki Matsuda[1], Shigeki Shibata[1], Shigehiko Ogoh, FACSM[2]. *[1]Kyorin University, Tokyo, Japan. [2]Toyo University, Saitama, Japan.*

*(No relevant relationships reported)*

**Purpose:** Recently, it has been suggested that cardiac function is one of important physiological factors to determine cerebral blood flow (CBF). However, dynamic relationship between cardiac outflow and CBF is still unknown. The purpose of the present study was to assess the dynamic relationship between arterial blood pressure (BP) or ascending aortic blood flow and CBF.
**Methods:** Six male healhy subjects participated (age, height, and weight; 33±6 yrs, 173±3 cm, and 72±8 kg) in the present study. Continuous beat-by-beat arterial BP was recorded from a finger using the Penaz method. Ascending aortic blood flow velocity (Ao-BFV) and middle cerebral artery blood flow velocity (MCA-BFV) were continuously measured using supra-sternum and transcranial Doppler ultrasound. After 10 min of resting condition, bilateral thigh cuffs were rapidly inflated to 200 mmHg and maintained for 2 min. Then both cuffs were rapidly deflated, and data were subsequently collected for 1 min. The same measurements were performed in the

supine and 45-degree semi-Fowler's positions. Pearson's correlation coefficients were calculated to identify the relationship between relative change of BP or Ao-BFV and those of MCA-BFV among individuals.
**Results:** Correlation coefficient of mean BP and mean MCA-BFV was much larger than that of mean Ao-BFV and mean MCA-BFV in both the supine and semi-Fowler's positions (R=0.615 vs. 0.009 and 0.353 vs. -0.753). In contrast, the correlation coefficient of pulse BP and pulse MCA-BFV was much smaller than that of pulse Ao-BFV and pulse MCA-BFV in the supine position (R=-0.068 vs 0.659), while it was comparable in the semi-Fowler's position (R=0.555 vs 0.435).
**Conclusions:** Dynamic change in mean CBF are likely to be only influenced by mean BP. However, dynamic change in pulse CBF seems to be more influenced by that of pulse ascending aortic blood flow rather than pulse BP especially in the supine position.

2194 Board #30 June 1 11:00 AM - 12:30 PM

### Effect Of Postural Stimulation On Cerebral Hemodynamics

Yuka Ninomiya[1], Tsubasa Tomoto[2], Tomoko Imai[3], Shigehiko Ogoh, FACSM[4], Koki Takahashi[1], Jun Sugawara[2]. *[1]Tokyo Ariake University of Medical and Health Sciences, Tokyo, Japan. [2]National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan. [3]Aichi Institute of Technology, Toyota, Japan. [4]Toyo University, Kawagoe, Japan.* (Sponsor: Shigehiko Ogoh, FACSM)
*(No relevant relationships reported)*

The previous prospective study identified that prolonged sleep could be associated with the increased future stroke risk in an apparently healthy aging population. However, the underlying mechanism is unknown. Chronic excessive pulsatile flow is thought to be a risk for cerebrovascular disease. In the supine posture, stroke volume (SV) is greater than that in upright posture since decrease in hydrostatic pressure increases venous return and consequently cardiac preload.
**PURPOSE**: We determined whether greater SV in the supine posture is associated with the augmented mechanical stress (characterized by cerebral pulsatile hemodynamics) in the cerebral vasculature. **METHODS**: To test this hypothesis, we applied -30 mmHg of lower body negative pressure (LBNP) as mild orthostatic stimulus in 18 healthy men (mean age = 21.9 ± 1.9yrs). TCD-determined MCAV was used to evaluate cerebral hemodynamics. SV was estimated from the radial arterial pressure waveforms using the Modelflow method. **RESULTS**: SV, peak and pulsatile MCA velocity, and PI of MCA velocity were significantly decreased during LBNP stimulation (P<0.05 for all, vs. supine posture), whereas mean MCA velocity and cardiac output remained unchanged. Importantly, the change in SV during LBNP significantly correlated with corresponding changes in peak and pulsatile MCA velocity (r=0.50, P=0.034; r=0.63, P=0.005, respectively). **CONCLUSIONS**: These results suggest that orthostatic stress (or postural change)-induced modified pulsatile component of cerebral hemodynamics (or augmented cerebral vascular stress) are partly due to change in SV. Our findings may partly support the phenomenon that long-time sleep is a risk for cerebrovascular disease.

2195 Board #31 June 1 11:00 AM - 12:30 PM

### Effect Of Muscle Metaboreflex On Anterior and Posterior Cerebral Blood Flow

Shigehiko Ogoh, FACSM[1], Ai Hirasawa[2], Kohei Sato[3]. *[1]Toyo University, Kawagoe-shi, Saitama, Japan. [2]Kyorin University, Tokyo, Japan. [3]Tokyo Gakugei University, Tokyo, Japan.*
*(No relevant relationships reported)*

Previous study demonstrated that post-exercise muscle ischemia (activation of muscle metaboreflex) following leg cycling failed to elevate anterior cerebral blood flow (CBF) despite a higher arterial blood pressure and this result was associated with hyperventilation-related decrease in the partial pressure of end-tidal carbon dioxide. However, the effect of muscle metaboreflex on posterior CBF remains unknown. **PURPOSE**: The purpose of the present study was to test the hypothesis that the response of posterior CBF to activation of muscle metaboreflex is different from that of anterior CBF. **METHODS**: Eleven healthy participants performed one-legged static knee extension exercise at 30 % maximal voluntary contraction for 2 min. The muscle metaboreflex was activated for 2 min by post-exercise muscle ischemia (PEMI). Blood flow to the internal carotid and vertebral arteries (ICA/VA) were evaluated by duplex ultrasonography. **RESULTS**: The both ICA and VA blood flow increased and reached to the peak value at 60 s after the start of exercise (+19±15 and 26±14%, P<0.05, respectively). Thereafter, ICA blood flow gradually decreased to the end of exercise (P<0.05) despite no change in VA blood flow (P=0.710). During PEMI immediately after exercise, both ICA and VA blood flow returned to the baseline level despite a high blood pressure. **CONCLUSIONS**: VA circulation has a low cerebral autoregulation and carbon dioxide CBF reactivity. However, similarly with anterior CBF, VA blood flow was not affected by metaboreflex-induced elevated blood pressure. This phenomenon may be important for protecting posterior cerebral circulation from high blood pressure but the mechanism remains unclear.

2196 Board #32 June 1 11:00 AM - 12:30 PM

### Effect of Acute Sleep Deprivation on Dynamic Cerebral Autoregulation

Masato Hatanaka, Takuro Washio, Hiroki Sakurai, Shigehiko Ogoh, FACSM. *TOYO UNIVERSITY, Kawagoe-shi, Japan.*
*(No relevant relationships reported)*

Sleep disorders increase the risk of cardiovascular disease. For example, previous cohort studies suggested that sleep deprivation contributed to the onset of cerebrovascular disease. However, its physiological mechanism remains unknown. We hypothesized that sleep disorders attenuated dynamic cerebral autoregulation (CA), which is one physiological mechanism of cerebral blood flow regulation.
**PURPOSE:** To test our hypothesis, the present study investigated if there was an effect of acute sleep deprivation on dynamic CA. **METHODS**: Six healthy young men participated in the present study. Each subject was instructed to shorter his individual sleep duration (individual averaged sleep duration minus 2 hours) to created sleep deprivation condition. Following manipulating sleep duration, each subject visited the laboratory to perform experiments in the morning (between 8 and 10 am). Mean arterial pressure (MAP) and middle cerebral artery blood velocity (MCAv) were measured during the experiment. Dynamic CA was assessed by transfer function analysis of spontaneous oscillations between MAP and MCAv in the low-frequency range (LF, 0.07-0.20 Hz) in each subject under these two different sleep conditions: control (averaged sleep duration, 6.5 ± 0.9 h) and sleep deprivation conditions (3.9 ± 0.4 h).
**RESULTS**: Acute sleep deprivation did not change either MCAv or MAP. Also, unexpectedly, there was no difference in the LF phase shift (P=0.46) and gain (P=0.53) of transfer function analysis between conditions, indicating that dynamic CA was not affected by acute sleep deprivation.
**CONCLUSIONS**: In the present study, the manipulated acute sleep deprivation did not change dynamic CA. This finding suggests that an insufficient sleep-induced cerebrovascular disease may be associated with other physiological factors, but two hours less sleep or acute change in sleep deprivation may not be enough to alter cerebral circulation.

2197 Board #33 June 1 11:00 AM - 12:30 PM

### Effect of Sympathetic Activation on Dynamic Cerebral Autoregulation in Posterior Cerebral Circulation

Takuro Washio, Masato Hatanaka, Kazuya Suzuki, Shigehiko Ogoh, FACSM. *Toyo university, kawagoe, Japan.* (Sponsor: Shigehiko Ogoh, FACSM)
*(No relevant relationships reported)*

The previous study reported that cold stimulation-induced acute high sympathetic nerve activity (SNA) impaired dynamic cerebral autoregulation (CA) in anterior cerebral circulation using transfer function analysis. However, the effect of acute change in SNA on dynamic CA in posterior cerebral circulation remains unknown. The posterior cerebral circulation has insufficient sympathetic innervation compared to anterior cerebral circulation; therefore, we hypothesized that the effect of sympathetic activation on dynamic CA in posterior cerebral circulation may be different from that in anterior cerebral circulation.**PURPOSE**: The purpose of the present study was to examine the effect of cold stimulation-induced high sympathetic activation on dynamic CA in posterior cerebral circulation. **METHODS**: Six healthy young subjects participated in this study. Mean arterial pressure (MAP), left middle cerebral artery blood velocity (MCAv) and right posterior cerebral artery blood velocity (PCAv) were measured throughout the experiment. At 90 sec after left hand immersion in cold water (2˚C), dynamic CA was evaluated using thigh cuffs occlusion and release technique. To quantify dynamic CA, the rate of regulation (RoR) was calculated from the change in cerebral vascular conductance index during occluded-cuffs release. **RESULTS**: The cold stimulation increased MAP (mean ± SD; +14.6 ± 10.8 %,P = 0.02), while there was no change in MCAv (P=0.52) and PCAv (P = 0.75) compared with control condition. The RoR in both middle cerebral artery (MCA) and posterior cerebral artery (PCA) was not changed by cold stimulation (MCA and PCA, P=0.26 and P=0.30). In addition, there was no difference in the change in RoR between MCA and PCA (P=0.224). **CONCLUSIONS**: The cold stimulation-induced high SNA did not modify dynamic CA in both anterior and posterior cerebral circulation. These findings suggest that the role of SNA on dynamic CA in posterior cerebral circulation may be similar to anterior cerebral circulation.

2198 Board #34 June 1 11:00 AM - 12:30 PM

**Aerobic Exercise Training and Cerebral Vasomotor Reactivity in Patients with Mild Cognitive Impairment**

Tsubasa Tomoto[1], Takashi Tarumi[2], Jason Chen[1], Evan Pasha[1], Marcel Turner[1], Justin Repshas[1], Rong Zhang[2]. *[1]Texas Health Presbyterian Hospital Dallas, Dallas, TX. [2]University of Texas Southwestern Medical Center, Dallas, TX.*

*(No relevant relationships reported)*

Aerobic exercise training (AET) may improve cerebral blood flow (CBF) regulation and reduce the risk of dementia. CBF is sensitive to changes in the arterial partial pressure of carbon dioxide ($CO_2$), which is assessed as cerebral vasomotor reactivity (CVMR). Currently, the effect of AET on CVMR in patients with mild cognitive function (MCI) is unclear. **PURPOSE**: To determine 1) effects of AET on CVMR in MCI patients, and 2) the reproducibility of CVMR over 12 months. **METHODS**: Seventy MCI patients were randomized to 12 months of moderate-intensity AET or stretching program. CBF velocity (CBFV) via transcranial Doppler, mean arterial pressure (MAP) via plethysmograph, and end-tidal $CO_2$ ($EtCO_2$) via capnograph were measured during hyperventilation (hypocapnia) and with a modified rebreathing protocol (hypercapnia). Cerebrovascular conductance index (CVCi) was calculated by CBFV/MAP, and CVMRs were calculated by $\Delta CBFV/\Delta EtCO_2$ and $\Delta CVCi/\Delta EtCO_2$. In addition, blood pressure response to hypo- and hypercapnia was determined by $\Delta MAP/\Delta EtCO_2$. Cardiorespiratory fitness was assessed by maximal oxygen uptake ($VO_2max$) using a modified Astrand-Saltin treadmill protocol. Intraclass correlation (ICC) was used to test the reproducibility of CVMRs over 12 months. **RESULTS**: Data were available from 16 patients in AET program and 17 patients in stretching program. After intervention, $VO_2max$ significantly increased in AET group compared with stretching group. Mean CBFV, MAP, and $EtCO_2$ at rest remained at similar levels in both groups. Hypocapnic CVMRs increased significantly over time in both groups but no effect of AET or stretching intervention. Hypercapnic CVMRs did not change with treatment or time. The ICCs of $\Delta CBFV/\Delta EtCO_2$ and $\Delta CVCi/\Delta EtCO_2$ were 0.553 ($P<0.001$) and 0.74 ($P<0.001$) during hypercapnia and 0.316 ($P=0.008$) and 0.545 ($P<0.001$) during hypocapnia, respectively. **CONCLUSIONS**: In MCI patients, a 12-month AET program did not alter hypo- or hypercapnic CVMRs compared with stretching group. Although hypercapnia CVMRs were reproducible over 12 months, hypocapnic CVMRs showed lower reproducibility. Supported by the NIH (R01AG033106)

2199 Board #35 June 1 11:00 AM - 12:30 PM

**Cerebral Autoregulation Is Impaired In Recurrent Syncope Patients**

Ai Hirasawa, Tomoya Suda, Kazukuni Hirabuki, Takahiro Uechi, Noritaka Hata, Yuki Sano, Takeaki Matsuda, Shigeki Shibata. *Kyorin University, Tokyo, Japan.* (Sponsor: Shigehiko Ogoh, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: Cerebral autoregulation is a homeostatic mechanism that serves to maintain cerebral blood flow constant over a wide range of perfusion pressure. Syncope is thought to be caused by cerebral hypoperfusion due to the transient blood pressure drop, and thus impairment of cerebral autoregulation may facilitate syncope. A previous study has reported that a past history of syncope is a strong predictor of future syncope recurrence. However, it is unclear whether impaired cerebral autoregulation would be related with recurrent syncope. The purpose of this study was to test our hypothesis that cerebral autoregulation would be impaired in syncope patients with a past history of syncope as compared with those for the first time. **METHODS**: We evaluated cerebral autoregulation in 24 syncope patients for the first time (age; 64±19 years old, male/female; 15/9) and 20 syncope patients with a past history of syncope (age; 52±26 years old, male/female; 11/9). In patients with recurrent syncope, the number of past syncope was 2.9±1.6 times (range 2-7 times). Middle cerebral artery mean blood flow velocity (MCA Vmean) and mean arterial pressure (MAP) were measured by transcranial Doppler ultrasound and tonometry on right radial artery for 3 min in the supine position. In offline analysis after the measurement, the transfer function gain between MAP and MCA Vmean were calculated at very low frequency (0.023-0.07 Hz, VLF) and low frequency (0.07-0.2 Hz, LF) ranges to estimate dynamic cerebral autoregulation. **RESULTS**: LF gain did not differ between syncope patients with a past history of syncope and those for the first time (P=0.23). In contrast, VLF gain was significantly higher in patients with a past history of syncope than in those for the first time (1.81±1.17 cm/s/mmHg vs. 1.09±0.65 cm/s/mmHg, P=0.02). **CONCLUSIONS**: These data suggest that impaired cerebral autoregulation at least in part explains physiological mechanisms underlying recurrent syncope.

2200 Board #36 June 1 11:00 AM - 12:30 PM

**Cerebral Microvascular Reactivity and Neurocognition in Childhood Cancer Survivors**

Donald R. Dengel, FACSM[1], Nicholas Evanoff G. Evanoff[1], Kara L. Marlatt[2], Bryon A. Mueller[1], Karim T. Sadak[1], Alicia S. Kunin-Batson[1], Kelvin O. Lim[1]. *[1]University of Minnesota, Minneapolis, MN. [2]Pennington Biomedical Research Center, Baton Rouge, LA.*

*(No relevant relationships reported)*

**PURPOSE**: To determine the differences in cerebral microvascular reactivity (CVR) and neurocognition between childhood cancer survivors (CCS) and matched controls (CON). **METHODS**: Seven cancer survivors and seven matched [age, sex, and body mass index (BMI)]; healthy cancer-free controls were enrolled in the study. Each participant completed neurocognitive testing (i.e., IQ screening, memory, attention/executive, and fine motor) and a self-report survey of executive/self-regulation skills. A computer-controlled gas-blending device was used to evaluate baseline and manipulate end-tidal carbon dioxide ($P_{et}CO_2$). To alter brain blood flow, a $P_{et}CO_2$ gas challenge consisting of two square wave increases of 10 mmHg above baseline $P_{et}CO_2$ and a ramp protocol that decreased $P_{et}CO_2$ to 32 mmHg and then increased linearly to 50 mmHg over 7 mins was utilized. $P_{et}O_2$ was maintained at 100 mmHg. Each participant underwent brain imaging using a 3T MRI for structural and functional (BOLD) imaging. CVR (%BOLD signal change/mmHg $CO_2$) was computed by using the robust linear least squares fit to the correlation between the two time courses. **RESULTS**: By design, CCS and CON were similar in age (27.1±1.1 vs. 26.0±0.8 y) and BMI (25.2±1.2 vs. 25.2±0.7 kg/m$^2$) (all $p>0.05$). Baseline $P_{et}CO_2$ (37.0±1.1 vs. 38.0±0.9 mmHg, $p=0.34$) was not significantly different between the two groups. Whole brain gray matter CVR was also not significantly different in CCS vs. CON groups for the full sequence (0.36±0.01 vs. 0.35±0.02 %BOLD/mmHg), squares waves only (0.37±0.02 vs. 0.36±0.02 %BOLD/mmHg) and ramp only (0.35±0.01 vs. 0.34±0.01 %BOLD/mmHg) (all $p>0.05$). The CVR variability (dCVR) was increased and model fit ($R^2$) was significantly decreased in CCS compared with CON ($p=0.004$ and $p=0.01$, respectively) in the full sequence, but not in the square or ramp waveforms independently. No significant between-group differences were observed in neurocognitive testing. **CONCLUSIONS**: The data from this study suggest that childhood cancer survivors may have long-term treatment effects on microcirculation of the brain that affect CVR stability. Although this decline in brain microcirculation did not result in neurocognitive deficits, the long-term consequences of this decline in brain microvascular function have yet to be determined.

## E-29 Free Communication/Poster - Cardiovascular, Renal and Respiratory Physiology - Disease

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2201 Board #37 June 1 11:00 AM - 12:30 PM

**Augmented Mechanoreflex In Type 2 Diabetic Rats: Piezo Channels, An Important Part Of The Puzzle?**

Ann-Katrin Grotle, Yu Huo, Audrey J. Stone. *University of Texas at Austin, Austin, TX.* (Sponsor: Philip R. Stanforth, FACSM)

*(No relevant relationships reported)*

Type 2 diabetics (T2DM) have an abnormal cardiovascular response to exercise. The exercise pressor reflex, which is evoked by metabolic and mechanical stimuli arising from the contracting muscle, is a critical cardiovascular regulatory mechanism during exercise and is exaggerated in hypertension, heart failure and peripheral artery disease. A recent study found that T2DM patients have an augmented metaboreflex. However, whether the mechanoreflex is also altered in T2DM is not known. **PURPOSE:** The purpose of the study was to test whether the mechanoreflex is exaggerated in T2DM. Furthermore we tested the contribution of mechano-gated Piezo1 and 2 channels to the mechanoreflex in T2DM. **METHODS**: In unanaesthetized, decerebrated rats we stretched the Achilles tendon for 30 s and measured changes in mean arterial pressure (MAP) and heart rate (HR) in 12 mo old male T2DM rats (BW=546±26 g, glucose=549±28 mg/dl, HbA1c=12.82±0.18%) and healthy male controls (CTL: BW=453±22 g, glucose=229±31 mg/dl, HbA1c=4.6±0.1%). To test the contribution of Piezo channels, we injected GsMTx-4 (10 µg), a known antagonist of Piezo1 and 2 channels, into the arterial supply of the hindlimb and repeated the stretch maneuver. **RESULTS:** We found that the pressor (T2DM: $\Delta MAP=69\pm6$ mmHg, n=5; CTL: $\Delta MAP=13\pm2$ mmHg, n=5) and cardioaccelerator (T2DM: $\Delta HR=28\pm4$ bpm, n=5; CTL: $\Delta HR=5\pm3$ bpm, n=5) responses to tendon stretch were significantly greater in T2DM rats compared to CTL; $p<0.05$. Injection of GsMTx-4 into the arterial supply of the hindlimb reduced the pressor response (before GsMTx-4; MAP: 80±7 mmHg; after GsMTx-4; MAP: 55±9 mmHg, n=2) to tendon stretch by approximately 30%. Likewise, GsMTx-4 lowered the cardioaccelerator response (before GsMTx-4; HR:

31±9 bpm; after GsMTx-4; HR: 12±2 bpm, n=2) by approximately 61%; p<0.05. **CONCLUSION**: We conclude that T2DM significantly exaggerates the pressor and cardioaccelerator response to mechanoreflex activation and that Piezo channels play an important role in evoking the mechanoreflex in T2DM rats.

2202 Board #38 June 1 11:00 AM - 12:30 PM

### Aerobic Exercise Improved Cardiac and Mitochondrial Function in Chronic Heart Failure in Rats

Yungang Zhao[1], Can Li[1], Xiangyao Wang[1], Lili Wang[1], Li Li Ji, FACSM[2]. [1]*Tianjin University of Sport, Tianjin, China.* [2]*University of Minnesota, Minnesota, MN.* (Sponsor: Li Li Ji, FACSM)

*(No relevant relationships reported)*

**Purpose:** The purpose of this study was to investigate whether aerobic exercise can improve cardiac and mitochondrial functions of heart failure induced by pressure overload in rats. We explored the mechanism of adaptational changes at the post-transcriptional level with the experimental model. **Methods:** The rat model of heart failure was accomplished by abdominal aorta constriction (AC). Eight weeks after the operation, the animals were divided into 4 groups: sham control (SC), sham plus training (ST), AC without training, and AC plus training (AT). Training was performed on treadmill at 25m/min, 0º grade for 60 min per day and last for 8 weeks. Heart structural and functional parameters were measured with echocardiography. Mitochondrial respiratory functions were measured with high-resolution respirometry. The miRNAs expression profiles were investigated by Affymetrix® Microarray. RT-PCR was used to validate the expression levels of miRNAs. **Results:** Compared with AC, the cardiac structure index LVID were significantly decreased, while the cardiac functional indexes ejection factor (EF) and fractional shortening (FS) were significantly increased in AT hearts. Mitochondrial state 3 respiration and respiratory control ratio (RCR) decreased significantly in AC vs. SC, whereas the reductions were restored by AT to SC level. Mitochondrial complex I activity in AC was significantly lower than that in SC, but such reduction was not observed in AT. MiR-10a-5p and miR-542-5p levels in AT hearts were significantly higher than those in AC, and some target mRNA of these two miRNAs were related to mitochondrial function and dynamic. For example, Coa 7 and Creb1 were affected by miR-10a-5p, and Tfrc by miR-542-5p. **Conclusion:** Aerobic exercise can ameliorate the pathogenesis of heart failure and improve heart function in experimental animals. This effect is largely achieved by improvement of mitochondrial function, especially complex I function in electron transfer chain. miR-10a-5p and miR-542-5p may be involved in this process through regulating key components of mitochondrial dynamic.

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2203 Board #39 June 1 11:00 AM - 12:30 PM

### Waist Circumference and BMI Are Associated With Cardiovascular Disease Risk Markers In Police Officers

John S. Green, FACSM, Steven E. Martin, Stephen F. Crouse, FACSM. *Texas A&M Univ., College Station, TX.*

*(No relevant relationships reported)*

**INTRODUCTION:** Christou et al. (Circulation. 2005; 111:1904-1914) has shown that body fatness is a better predictor of cardiovascular disease (CVD) risk than aerobic fitness in a cohort of healthy men. We sought to replicate their findings in a cohort of police officers. **PURPOSE:** The purpose of this study is to determine whether fatness or aerobic fitness is more highly associated with selected CVD risk markers in a cohort of police officers. **METHODS:** Six female and 49 male police officers underwent screening for 9 selected metabolic and hemodynamic risk markers for CVD along with a maximal treadmill test to determine aerobic fitness. Waist circumference (WAIST), fat mass (FATMASS), percent body fat (%FAT), and body mass index (BMI) were chosen as indicators of fatness. Multiple linear regression models using WAIST, BMI, FATMASS, and %FAT as dependent variables were used to obtain partial correlation coefficients to determine the independent association of fatness to CVD risk while controlling for fitness and age. **RESULTS:** The regression models for FATMASS and %FAT were not statistically significant. The model for WAIST showed an association with 5 of the 9 risk markers after partialling out the effects of aerobic fitness and age (r=.13 to .27, p<.01). The model for BMI demonstrated similar associations with 4 of the 9 risk markers (r=.10 to .15, p<.05). In contrast, aerobic fitness was not independently associated with any of the risk markers in either of the significant regression models. **Conclusions:** In police officers, body fatness is associated with CVD risk while aerobic fitness is not.

2204 Board #40 June 1 11:00 AM - 12:30 PM

### Pulmonary Artery Sling And Exercise Capacity : A Longitudinal Study In A Young Girl

Merav Zucker Toledano[1], Lea Bentur Bentur[2], Gur Mainzer[3], Ronen Bar-Yoseph[1]. [1]*Rambam Health Care Campus, Haifa, Israel.* [2]*Rambam Health Care Campus, The Bruce Rappaport Faculty of Medicine, Technion–Israel Institute of Technology, Haifa, Israel.* [3]*The Baruch Padeh Medical Center, Poriya, Israel.*

*(No relevant relationships reported)*

Introduction: Pulmonary artery sling is a rare congenital vascular malformation that consists of an anomalous origin of the left pulmonary artery from the posterior aspect of the right pulmonary artery. The anomalous left pulmonary artery crosses the mediastinum posterior to the trachea or carina and anterior to the esophagus, compressing both organs. Respiratory complaints predominates over esophageal symptoms. In asymptomatic patients, surgical repair is controversial. Data regarding exercise capacity and other cardiopulmonary parameters is scarce.
Aim: To evaluate exercise parameters in an early pubertal girl with uncorrected pulmonary artery sling at baseline and 3 years later (late puberty).
Methods: Maximal cardiopulmonary exercise testing (CPET) was completed on a cycle ergometer at age 11 y/o and 14 y/o by a girl with uncorrected pulmonary artery sling. Data was processed and analyzed retrospectively.
Results: Peak oxygen uptake ($VO_2$) was higher in the first test (41.9 ml/kg/min, 119% predicted) than in the second test (30.6 ml/kg/min, 87% of predicted). Maximal and submaximal pulmonary exercise parameters improved in the second test (breathing reserve; 9.7 liters, 15% predicted in the first test vs. 31.5 liters, 39% predicted in the second test and for lowest $VE/VCO_2$ and $VE/VCO_2$ slope; 28.7 and 34.9 vs 25.7 and 27.7 respectively), with no similar expected improvement in cardiovascular parameters (oxygen pulse ($VO_2$/HR) 9.2 ml/beat, 125% predicted in the first test vs. 9.3 ml/beat, 92% of predicted respectively and for $VO_2$/HR slope; 14.1 ml/beat vs. 14.9 ml/beat).
Conclusions: In this case of uncorrected pulmonary sling a deterioration in exercise capacity and cardiovascular exercise parameters was observed over puberty inspite of improvement in pulmonary parameters. Possible mechanisms are maturation dependent abnormal pulmonary sling flow, deconditioning and increased % body fat. To the best of our knowledge this is the first report of exercise evaluation in this unique population. More studies are needed with larger number of patients, including accurate measurement of body composition and characterizing exercise capacity evaluation following surgical repair.

2205 Board #41 June 1 11:00 AM - 12:30 PM

### Pulse Wave Analysis of HbA1C Categorized Prediabetes, Type 2 Diabetes and Normo-Glycemic Populations: A Pilot Study

Jennifer J. Brown[1], Kimberly G. Baskette[2], Corey A. Rynders[3], Aaron I. Vinik[4], Sheri R. Colberg-Ochs, FACSM[2]. [1]*Elizabeth City State University, Elizabeth City, NC.* [2]*Old Dominion University, Norfolk, VA.* [3]*University of Colorado Denver-Anshutz Medical Campus, Denver, CO.* [4]*Eastern Virginia Medical School, Noroflk, VA.*

*(No relevant relationships reported)*

Arterial stiffness is a significant risk factor for cardiovascular events and early detection is key for intervention and monitoring. This pathophysiological process is accelerated in type 2 diabetes (T2D), yet the onset of this condition has a limited body of research.
**PURPOSE**: To evaluate (1) arterial stiffness properties via pulse wave analysis (PWA) across a 4-group spectrum, and (2) determine whether waist-to-height-ratio (WHtR), waist circumference (WC) or body mass index (BMI) serves as the best predictor of early changes in PWA pathophysiology.
**METHODS**: PWA was measured in 52 participants across four groups separated by HbA1c values: 13 normo-glycemic (N, 4.0-5.1), 14 high normal (HN, 5.2-5.6), 10 prediabetes (PD, 5.7-6.4) and 13 with T2D (T2D, ≥ 6.5). Brachial, central and peripheral pressures, central and peripheral augmentation index (AIx) data were collected via Sphygmocor using validated methods after overnight caffeine abstinence and a minimum 4-hr fast. Group differences were evaluated via MANCOVAs. $Hb_{A1C}$, WHtR, WC and BMI data were assessed through regression to determine the best predictor.
**RESULTS**: Significant differences were found between N to T2D and HN to T2D for brachial systolic blood pressure (SBP) [$F(3,46)=2.743$, p<.05], brachial diastolic blood pressure (DBP) [$F(3,46)=3.329$, p<.028] and brachial mean pressures (MP) [$F(3,46)=4.321$, p<.009]. Central DBP and MP differed between N to T2D, and HN to PD and T2D groups [DBP:$F(3,44)=3.874$, p<.015; MP:$F(3,44)=3.303$, p<.029] . Central pulse pressure (PP) and CAIx showed no differences between groups. Peripheral pressures significantly differed between N and both PD and T2D; HN and both PD and T2D groups for peripheral SBP [$F(3,44)=3.007$, p<.040], peripheral DBP [$F(3,44)=4.316$, p<.009] and peripheral MP [$F(3,44)=3.487$, p<.023], but not PP or

PAIx. WHtR and WC were identified as the best predictors of CAIx after adjusting for age and height [$R^2$=.800, $F(5,45)$=16.023, $p$<.0005; adj. $R^2$=.640], while PAIx had no significant predictor.
**CONCLUSIONS**: PWA may be effective for identifying differences in multiple brachial, central and peripheral pressure measures across a novel, pre-defined HbA1C spectrum; however, more research needs to be executed to validate these findings. WHtR and WC, but not BMI, effectively predicts CAIx.

2206 Board #42 June 1 11:00 AM - 12:30 PM

### Insulin Potentiates Neuronal Responses to Chemical Stimulation in Thin Muscle Afferents and Dorsal Root Ganglia

Norio Hotta[1], Kimiaki Katanosaka[1], Kazue Mizumura[1], Jere H. Mitchell, FACSM[2], Scott A. Smith[2], Masaki Mizuno[2]. *[1]Chubu University, Kasugai, Japan. [2]University of Texas Southwestern Medical Center, Dallas, TX.* (Sponsor: Jere H. Mitchell, FACSM)
*(No relevant relationships reported)*

The cardiovascular response to physical activity is abnormally exaggerated in patients with type 2 diabetes mellitus (T2D). Recent studies in patients with T2D have suggested that this exaggerated responsiveness is mediated, in part, by the skeletal muscle metaboreflex. However, the mechanisms causing augmentations in muscle metaboreflex function in this disease remain to be elucidated. Chronic hyperinsulinemia associated with peripheral insulin resistance is one of the pathophysiological characteristics of T2D. Evidence suggests that transient receptor potential vanilloid receptors, which contribute to metaboreflex activation, are more responsive to stimuli in the presence of insulin. Given that metaboreflex afferent fibers reside in skeletal muscle, it is suggested that hyperinsulinemia may underlie the skeletal muscle metaboreflex overactivity manifest in T2D. **PURPOSE**: To examine the impact of insulin on neuronal responses to chemical stimulation in thin muscle afferents and dorsal root ganglia (DRG) of normal healthy rodents. It was hypothesized that insulin potentiates the activity of metabolically sensitive afferent neurons.
**METHODS**: Chemically activated neurons were assessed by single-fiber recordings from rat muscle-nerve preparations in vitro and by whole cell patch-clamp recordings from cultured mice DRG neurons. The magnitude of responses to capsaicin stimulation and the capsaicin activated current were recorded, respectively. **RESULTS:** Compared to control conditions, thin muscle afferent response magnitude was significantly increased by insulin exposure (0.03±0.03 vs. 0.25±0.02 imp, n=3, P<0.05). In DRG cell culture, total charge transfer by capsaicin activated current was largely augmented by insulin administration (403±159 % changes from control conditions, n=3, P=0.11). **CONCLUSIONS**: These data demonstrate that thin muscle afferent as well as DRG neuronal responses to capsaicin are augmented by insulin exposure in normal healthy animals. The data support the concept that chronic hyperinsulinemia may potentiate skeletal muscle metaboreflex function in T2D contributing to the abnormal cardiovascular response to exercise characteristic of this disease. *Supported by the Lawson & Rogers Lacy Research Fund in Cardiovascular Disease and JSPS KAKENHI JP17K01769*

2207 Board #43 June 1 11:00 AM - 12:30 PM

### High Intensity Treadmill Running Reduces Tumour Hypoxia in Mice.

Simon Lønbro, Pernille Byrialsen Elming, Thomas R. Wittenborn, Michael R. Horsman. *Aarhus University Hospital, Aarhus C, Denmark.*
*(No relevant relationships reported)*

**PURPOSE**: Low blood perfusion and hypoxia are characteristic features of tumours and are factors of resistance to radiation and chemotherapy. A few rodent studies have shown that aerobic exercise, that has no severe side-effects, may improve perfusion and reduce hypoxia, however the optimal exercise intensity and timing of the effect on the tumour response during radiation and chemotherapy remain uninvestigated. The aim of our study was to investigate the acute effect of one exercise bout of either low, moderate, or high intensity aerobic exercise on tumour perfusion and hypoxia.
**METHODS**: Two weeks after injection of the C3H mammary carcinoma in the mammary fat pad, 24 female CDF1 mice were allocated to either a control group (no exercise) or three groups performing low (6 m/min), moderate (12 m/min) or high intensity (18 m/min) treadmill running for 30 minutes (n=6 for each group). Just prior to running all mice were injected (i.p.) with Pimonidazole (60 mg/kg) and immediately after exercise they were injected (i.v.) with Hoechst 33342 (10 mg/kg). Exactly 1 minute later the mice were sacrificed, tumours excised, and histological sections prepared. Hypoxia could be determined from the degree of Pimonidazole binding, while analysis of the Hoechst 33342 staining enabled us to analyses perfused vessels in the tumour. The results were statistically compared to similar measurements in the control tumours using a Student's T-test (p<0.05). **RESULTS**: Pimonidazole binding revealed a hypoxic fraction (HF) of 8.7±3.7% in tumours from control animals. This was not significantly changed by low intensity (HF = 8.5±3.2%) or moderate intensity (HF = 10.3±3.7%) running. However, for those mice exposed to the high intensity running schedule, the tumour hypoxic fraction was significantly reduced to 4.3±2.2% (p=0.03). The Hoechst 33342 analyses on tumour perfusion are currently pending. **CONCLUSIONS**: Our data show that mice running at high intensity for 30 minutes elicit an acute reduction in the hypoxic fraction in the tumour when compared to sedentary mice or mice running at both moderate and low intensities. Our future studies will focus on how long the reduction in hypoxia is maintained after running stops and how that exercise regime can be used to improve tumor treatment-response, especially to radiation.

2208 Board #44 June 1 11:00 AM - 12:30 PM

### Preliminary Results of Vascular Function and Aerobic Capacity Profile of Breast Cancer Survivors

Jordan T. Lee, Chad W. Wagoner, Lee Stoner, Kirsten A. Nyrop, Hyman B. Muss, Erik D. Hanson, Aaron Piepmeier, Claudio L. Battaglini, FACSM. *University of North Carolina at Chapel Hill, Chapel Hill, NC.* (Sponsor: Claudio L. Battaglini, FACSM)
*(No relevant relationships reported)*

**PURPOSE**: To describe vascular function and aerobic capacity in breast cancer survivors (BCS) who are within one year of completing primary anti-cancer therapy pre and post a 16-week exercise intervention.
**METHODS**: Applanation tonometry was used to evaluate vascular function (pulse wave velocity, PWV) and cardiopulmonary exercise testing to evaluate aerobic capacity ($VO_{2peak}$) pre and post 16 weeks of progressive aerobic and strength training exercise at a community based exercise program. Descriptive statistics were used to characterize the sample, paired t-tests to assess pre-post change, and Pearson correlations to evaluate associations between PWV and $VO_{2peak}$.
**RESULTS**: Eight BCS, mean age=60 (±8y), BMI=29.5 (±7.4) have been evaluated at baseline. Baseline mean PWV=7.2 (±1.65 m/s) and mean $VO_{2peak}$=17.3 (±3.24 mL/kg/min). Baseline correlation between PWV and $VO_{2peak}$ was moderate ($r^2$=0.42, p=0.083). Mean $VO_{2peak}$ improved (+4.04±1.43, p=0.049) in 3 subjects who have completed the exercise intervention to date. Post-intervention PWV was not evaluable at follow-up.
**CONCLUSIONS**: It has been previously established that aerobic capacity is impaired in BCS compared to age-matched, non-cancer populations. Our findings support this notion (17.3 vs. ~26mL/kg/min healthy; Jones *et al*., 2012). Vascular function in our sample is similar to previously reported values in BCS (Grover *et al.,* 2015) but reference literature is limited. Our approach exploring correlations between vascular function and aerobic capacity following primary cancer therapy is novel and important as it relates to the potential for designing future preventative interventions. Exercise appears beneficial to aerobic capacity. More follow-up data is needed, and is underway, to assess impact of exercise on vascular function. Supported by funding from Breast Cancer Research Foundation of New York.

## E-30 Free Communication/Poster - Vascular Function

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2209 Board #45 June 1 11:00 AM - 12:30 PM

### Seven Days Of Remote Ischemic Preconditioning Augmented Local-heating Induced Vasodilation In Human Skin

Jahyun Kim, Warren Franke, FACSM, James Lang. *Iowa State University, Ames, IA.* (Sponsor: Warren Franke, FACSM)
*(No relevant relationships reported)*

**PURPOSE**: Remote ischemic preconditioning (RIPC), induced by intermittent periods of sublethal ischemia and reperfusion, is a powerful stimulus for adaptations that increase cardioprotection from ischemic-reperfusion (IR) injury. Although RIPC-induced cardioprotection has consistently been demonstrated using animal models, two major clinical trials in humans undergoing cardiac surgery has yielded conflicting results. These different results may be explained by coexisting conditions (e.g., diabetes, obesity, and hypertension) and other factors (e.g., dose of ischemia used to 'precondition' vessels, preexisting ischemia, medications, age, fitness level, etc). Using skin as an alternative human model to study RIPC, we tested cutaneous microvascular responsivity to local heating (Tsk=42oC) before and after repeated RIPC. We hypothesized that seven consecutive days of RIPC will improve the vasodilation response to local heating.
**METHODS**: Nine young participants (26 ± 1 years, 4 male and 5 female) performed RIPC for seven days. Each daily RIPC session consisted of 4 repetitions of upper arm blood flow occlusion by inflating an arm cuff to 220mmHg for 5 minutes followed by deflation for 5 minutes. Before and after the 7-day RIPC training period, laser

speckle contrast imaging (LSCI) was used to measure the speed and number of blood cells moving through the forearm cutaneous microvasculature and reflected as a flux value, thereby providing an index of skin blood flow changes during local heating. Flux and blood pressure measurements were collected during baseline (Tsk=33oC) and local heating of forearm skin (Tsk=42oC). Data are represented as cutaneous vascular conductance (CVC), which was calculated as flux / mean arterial pressure.
**RESULTS**: After seven days of RIPC, the cutaneous vasodilation response to local heating was increased (Pre: 1.17 ± 0.10 vs. Post: 1.51 ± 0.20 CVC, p<0.05). But, baseline values were not different following RIPC (Pre: 0.22 ± 0.03 vs. Post: 0.29 ± 0.40 CVC).
**CONCLUSIONS**: Seven days of RIPC augmented the local heating response in young forearm skin blood flow. These data suggest that endothelial factors contributing to the local heating response in skin may be affected with repeated RIPC.

2210 Board #46 June 1 11:00 AM - 12:30 PM

### The Role of Melatonin In Exercise Enhanced Endothelium-dependent Vasorelaxation In Mesenteric Arteries of SHR

WU Ying, Shi Lijun. *Beijing Sport University, Beijing, China.*
*(No relevant relationships reported)*

**PURPOSE**: To determine if melatonin plays an important role in the hypotensive effects of exercise training. Further, to study the role of melatonin binding to melatonergic receptors in the vasorelaxation of small MAs in SHR.
**METHODS**:Twelve-week-old male normotensive Wistar-Kyoto rats (WKY, n=18) and SHRs (n = 48) were used. SHRs were randomly divided into four groups: SHR sedentary group (SHR-SED, n = 18), SHR sedentary with melatonin receptor antagonist luzindole (Luz) injection group (SHR-SED + Luz, n = 6), SHR exercise group (SHR-EX, n = 18) , and SHR exercise with luzindole injection group (SHR-EX + Luz, n = 6). Luzindole injection groups were injected intraperitoneally (i.p.) with luzindole (1 mg/kg/day in sterile saline) each day. Rats in the exercise groups were subjected to aerobic exercise. Blood pressure and heart rate were measured after exercise. Serum melatonin levels were examined by ELISA. The mechanical properties of small mesenteric arteries were studied with myograph. Western blot and immunofluorescence colocalization were performed to examine the protein expression and distribution of MT1, MT2 receptors and eNOS.
**RESULTS**: Exercise training produced a significant reduction in blood pressure and heart rate in SHR, which was significantly attenuated by intraperitoneal administration of luzindole, a nonselective melatonin receptor (MT1/MT2) antagonist. Serum melatonin levels in the SHR group were significantly lower than those in the WKY group at 8:00-9:00 and 21:00-22:00, and exercise training reduced this difference. Endothelium-dependent vessel relaxation induced by acetylcholine was significantly blunted in SHR compared with age-matched WKY. Both exercise training and luzindole ameliorated this endothelium-dependent impairment of relaxation in hypertension. Immunohistochemistry and Western blotting showed that protein expression of the MT2 receptor and eNOS, as well as their colocalization in the endothelial cell layer in SHR, was significantly decreased; exercise training suppressed this reduction.
**CONCLUSIONS**:These results provide evidence that regular exercise has a beneficial effect on improving endothelium-dependent vasorelaxation in MAs, in which melatonin plays a critical role by acting on MT2 receptor to increase NO production and/or NO bioavailability.

2211 Board #47 June 1 11:00 AM - 12:30 PM

### The Effects Of Acute Bouts Of Whole Body Vibrate On Central Hemodynamics In The Frail Elderly: A Pilot Study.

Katie Burnet. *University of North Carolina at Chapel Hill, Chapel Hill, NC.*
*(No relevant relationships reported)*

**PURPOSE**: Whole body vibration training (WBV) is a promising alternative to conventional exercise therapy in the frail elderly. However, little is known about its effect on the cardiovascular system. The aims of this study were to determine whether an acute bout of WBV: (i) improves measures of central hemodynamics [central systolic blood pressure (cSBP), Augmentation Index (AIx), and Double Product (DP)]; and (ii) can be completed without inducing orthostatic intolerance - a sustained drop in systolic blood pressure (SBP) >20 mmHg or diastolic pressure (DBP) >10 mmHg.
**METHODS**: Nine elderly rest home residents [81.1 years (SD 7.1), 88% F] participated in a randomized cross-over design incorporating WBV and non-vibrational control experimental conditions (CON) on two separate testing day. On each occasion, participants laid supine for their basement measurement, completed their CON or WBV training, then returned to supine for 90-minute post-exercise evaluation.
**RESULTS**: There was no between-day difference at baseline. During training, no interaction or between-condition effects were observed for any variable, but there were moderate-large time effects for cSBP (P=0.001), and DP (P<0.001). Following training, no interaction or between-condition effects were observed for cSBP or DP, but an interaction effect was reported for AIx (P<0.019). Post-hoc analysis revealed a non-significant time effect for CON (P=0.0167, Eta 0.0151) and a significant large increase in AIx for WBV (P=0.020, Eta=0.202). None of the participants exhibited orthostatic tolerance.
**CONCLUSIONS**:WBV is a safe training method for the frail. Future research is warranted to determine the chronic effects on cardiovascular health.

2212 Board #48 June 1 11:00 AM - 12:30 PM

### Effects Of Habitual Isometric Handgrip Exercise On Central Blood Pressure In Older Adults

Takanobu Okamoto[1], Ryota Kobayashi[2], Yuto Hashimoto[1], Hiroyuki Hatakeyama[1]. *[1]Nippon Sport Science University, Setagaya-ku, Tokyo, Japan. [2]Teikyo University of Science, Adachi-ku, Tokyo, Japan.*
*(No relevant relationships reported)*

Central (aortic) blood pressure (BP) is a more important predictor of cardiovascular diseases than peripheral (brachial) BP. Isometric handgrip exercise can effectively decrease peripheral BP. However, effects of isometric handgrip exercise on central BP remain unknown. **PURPOSE:** The present study aimed to determine whether habitual isometric handgrip exercise decreases central BP in older adults with stage 1 and 2 hypertension. **METHODS:** Twenty-four males and females (mean age 63±2 y; ± SEM) with stage 1 and 2 hypertension (brachial systolic or diastolic BP of 140-179 or 90-109 mmHg, respectively) who were not actively involved in regular resistance or endurance training were randomly assigned to a group that did isometric handgrip exercise (IHG) or a control (CON) group. The isometric handgrip exercise comprised four unilateral 2-min isometric contractions at 30% of maximal voluntary contraction using a programmed handgrip dynamometer with 1-min rest periods for five days per week for four weeks. Central systolic BP (cSBP), brachial systolic BP (bSBP), brachial diastolic BP (bDBP), and the augmentation index at a heart rate of 75 beats per minute (AIx75) were non-invasively measured after resting in the supine position for at least five minutes in both groups before (baseline) and after four weeks of training using an automated applanation tonometric system. **RESULTS:** Baseline cSBP, bSBP, bDBP, and AIx75 did not significantly differ between the groups. Consistent with previous studies, bSBP and bDBP after training significantly decreased from baseline from 155±3 to 142±3 mmHg and from 94±3 to 88±2 mmHg, respectively (p<0.05 for both). The cSBP and AIx75 did not change in the CON group, but significantly decreased from baseline after training in the IHG group from 165±4 to 148±4 mmHg and from 88±4% to 82±4%, respectively (p<0.05 for both). The cSBP was significantly lower after training in the IHG than in the CON group (148±4 vs. 159±3 mmHg, p<0.05). **CONCLUSIONS:** These results suggest that isometric handgrip exercise could reduce central BP in older adults with stage 1 and 2 hypertension. Therefore, isometric handgrip exercise might be an effective non-pharmacological therapy for prevention and treatment of cardiovascular disease.

2213 Board #49 June 1 11:00 AM - 12:30 PM

### Arterial Stiffness and Mitochondrial Oxidative Capacity in Obese African Americans

Joshua E. McGee, Terence E. Ryan, Gabriel S. Dubis, Savanna G. Barefoot, Patricia M. Brophy, Damon L. Swift. *East Carolina University, Greenville, NC.*
*(No relevant relationships reported)*

**Arterial Stiffness and Mitochondrial Oxidative Capacity in Obese African Americans**
Joshua E. McGee, Terence E. Ryan, Gabriel S. Dubis, Savanna G. Barefoot, Patricia M. Brophy, Damon L. Swift.
East Carolina University, Greenville, NC
**PURPOSE**: African Americans are at greater risk for arterial stiffness and mitochondrial dysfunction compared to Caucasian Americans. Prior studies report a relationship between arterial stiffness and mitochondrial function in individuals with hypertension or gestational diabetes, but it has not been evaluated in healthier populations or African Americans. This study assessed arterial stiffness and in vivo skeletal muscle mitochondrial capacity in obese African Americans. **METHODS**: Fifteen (47.7 ± 6.9 yrs; 34.6 ± 4.2 kg/m$^2$; 86.7% female) obese African Americans from an on-going exercise training study were analyzed. Mitochondrial capacity was determined via near-infrared spectroscopy (NIRS) and quantified as recovery kinetics of muscle $O_2$ consumption (rate constant) after a short bout of exercise (vastus lateralis), followed by short bouts (5-10 s) of ischemia. Arterial stiffness was assessed as carotid-femoral pulse wave velocity (cfPWV) and aortic augmentation index (AIx). **RESULTS**: No significant correlation was observed between rate constant and cfPWV (r=0.17, p=0.55) or AIx (r=-0.01, p=0.97), but approached significance with mean arterial pressure (r=0.50, p=0.057). Adjusting for age and gender revealed no significant findings between arterial stiffness and mitochondrial capacity parameters. **CONCLUSIONS**: Arterial stiffness was not associated with mitochondrial oxidative capacity. Future studies should consider a larger sample size or greater variance in African American participant demographics (e.g. sedentary status, BMI, gender).

Supported by NIH Grant 1R03DK105297-01A1

2214 Board #50 June 1 11:00 AM - 12:30 PM

### Skeletal Muscle Oxygenation During Plantarflexion Exercise In Young-old And Older-old Adults

Arun Maharaj[1], Salvador J. Jaime[2], Justin Mason[3], Patrick Saracino[3], Arturo Figueroa-Galvez, FACSM[1]. *[1]Texas Tech University, Lubbock, TX. [2]University of Wisconsin - La Crosse, La Crosse, WI. [3]Florida State University, Tallahassee, FL.*
(Sponsor: Arturo Figueroa, FACSM)
*(No relevant relationships reported)*

The aging process is associated with a gradual decrease in exercise performance, leg muscle blood flow and oxygenation, and endothelial vascular reactivity. **PURPOSE**: To examine potential differences in femoral artery flow-mediated dilation (fa-FMD) and calf muscle oxygenation ($HbO_2$) during low-intensity plantarflexion exercise in older adults. **METHODS**: 43 young-old (YO; n=24, 67 ± 1 years) and older-old (OO: n=19, 70 ± 1 years) individuals were included in this study. We measured body fat % and leg lean mass (LLM) by DEXA and handgrip maximal voluntary contraction (MVC) using a dynamometer. $VO_{2max}$ was estimated using a submaximal treadmill test. fa-FMD was assessed by Doppler ultrasound, measuring the relative change in diameter from baseline to peak hyperemic response following 5 min of muscle ischemia. After a 10-min semi-recumbent rest, participants performed three sets (3-min each) of rhythmic plantar-flexion exercise at increasing intensity (20, 30 and 40 pounds) separated by 1-min of rest. Percent changes (%Δ) in muscle $HbO_2$ from baseline to the 3rd min of each set was monitored by near-infrared spectroscopy (NIRS) on the medial gastrocnemius muscle. **RESULTS**: There were no between-group differences in $VO_{2max}$, MVC, LLM, body fat %, and fa-BF ($P$= .07). The OO group had significantly lower fa-FMD compared to the YO group (5.7 ± 1.4 vs 6.7 ± 1.6%, $p <$ .05). During exercise, the OO group exhibited a higher %Δ in $HbO_2$ compared to the YO in sets 2 (-60.0 ± 21.2 vs. -44.7 ± 17.2%, $p <$ .05) and 3 (-66.7 ± 18.8 vs. -52.6 ± 18.2%, $p <$ .05). **CONCLUSIONS**: There was a lower calf muscle oxygenation during low-intensity plantar-flexion exercise performed at the same absolute intensity in OO compared to YO adults. Exercising at a greater relative intensity may explain the lower calf muscle oxygenation in OO adults.

2215 Board #51 June 1 11:00 AM - 12:30 PM

### Assessment of Vascular Function throughout the Menstrual Cycle

Alexandra E. Hirt, Elissa K. Katulka, Megan M. Wenner, Melissa A.H. Witman. *University of Delaware, Newark, DE.*
*(No relevant relationships reported)*

**BACKGROUND:** Fluctuating sex hormones throughout the menstrual cycle, particularly endogenous estrogen, have been documented to correspond with nitric oxide (NO) bioavailability and likely have a cardioprotective effect in premenopausal women. However, the corresponding temporal changes in vascular function are not entirely understood. **METHODS:** Passive leg movement (PLM) is a relatively novel technique assessing NO-mediated vascular function, with a higher degree of NO-dependence than the traditionally used flow-mediated dilation (FMD) technique that could provide additional insight. **PURPOSE:** To assess vascular function throughout the menstrual cycle in premenopausal women using PLM, in addition to FMD. **RESULTS:** Brachial artery FMD tended to be increased during the OV phase (8.8±1%) compared to the EF (7.8±1%) and ML (7.6±1%) phases. The femoral artery PLM AUC response during the ML phase was significantly lower than the EF response (leg blood flow AUC EF: 154±41 mL, OV: 79±24 mL, and ML: 44±15 mL). **CONCLUSION:** These findings support the importance of menstrual cycle when interpreting vascular function data as measured by FMD and PLM.

2216 Board #52 June 1 11:00 AM - 12:30 PM

### Different Restrictive Devices to Achieve Blood Flow Restriction on Pulse Wave Reflection

Erica M. Marshall, Jason C. Parks, Yu Lun Tai, Alaina Glasgow, Leslie Sensibello, Kathryn Geither, J. Derek Kingsley, FACSM. *Kent State University, Kent, OH.*
*(No relevant relationships reported)*

Blood flow restriction (BFR) has mainly been achieved with an automated blood pressure cuff. However, knee wraps to restrict flow are used as a form of practical BFR (pBFR). The effects of resistance exercise with BFR and pBFR on pulse wave reflection is unclear. **PURPOSE**: To examine the effects of BFR, pBFR, and traditional high-intensity (HI) bench press resistance exercise on pulse wave reflection in resistance-trained individuals. **METHODS**: Twenty-three (Age: 23±3yrs) resistance-trained men underwent either bench press with BFR, pBFR [30% 1-repetition maximum (1RM), 4 sets, 30-15-15-15 repetitions, 30sec of rest], HI [70% 1RM, 4 sets, 8 repetitions, 60sec of rest] or a control. Measurements were taken at rest and 10mins postexercise. A 4x2 ANOVA was used to evaluate condition (BFR, pBFR, HI, Control) across time (rest, recovery) on pulse wave reflection. **RESULTS:** There were significant (p=0.0001) increases in heart rate [(BFR: rest: 60±7bpm; recovery: 69±7bpm), (pBFR: rest: 58±10bpm; recovery: 64±11bpm), (HI: rest: 58±12; recovery: 72±13bpm)] such that all three conditions were different compared to rest and the control. There was a significant interaction (p=0.0001) for the augmentation index (AIx) in that during recovery from BFR (rest: 117.9±8.2%; recovery: 126.2±9.0ms), pBFR (rest: 114.9±4.9ms; recovery: 127.9±9.8ms) and HI (rest: 115.6±6.2ms; 122.8±6.4ms) it was elevated compared to rest, and the control. There was also a significant (p=0.0001) interaction for the AIx normalized at 75bpm (AIx@75) [BFR: rest: 8.8±13.3%; recovery: 25.9±9.5%; pBFR: rest: 2.7±8.5%; recovery: 23.3±14.2%; HI: 4.4±12.1%; recovery: 21.2±9.9%)] in that it was augmented during recovery to rest and the control. The subendocardial viability ratio (SEVR) for BFR (rest: 138.4±19.5; recovery: 111.2±11.3), pBFR (152.2±27.5; recovery: 125.5±33.5), and HI (rest: 152.9±37.9; recovery: 111.9±28.7) also demonstrated a significant (p=0.0001) condition by time interaction such that they were elevated above rest in all three resistance exercise conditions, which were different than the control. **CONCLUSION**: These data demonstrate that BFR using an automated cuff or knee wraps has similar effects as traditional high-intensity resistance exercise on pulse wave reflection in resistance-trained men after the bench press.

2217 Board #53 June 1 11:00 AM - 12:30 PM

### Effect of a High Fat Meal on Microvascular Responsiveness Measured using Near Infrared Spectroscopy

Britton C. Scheuermann, Erin C. Garmyn, Morgan M. Monahan, Timothy R. Rotarius, Christopher R. Silette, Barry W. Scheuermann. *The University of Toledo, Toledo, OH.*
*(No relevant relationships reported)*

Studies indicate that the rate of tissue oxygen reperfusion following brief periods of occlusion can detect differences in vascular responsiveness. Consumption of a high fat meal (HFM) has been shown to reduce vascular function in conduit arteries. The extent that consumption of a HFM effects microvascular reactivity has not been examined. **PURPOSE:** To examine the effect of a HFM on microvascular responsiveness in the brachial artery (BA). It was hypothesized that a HFM would slow tissue reperfusion consistent with impaired microvascular function. **METHODS:** Eleven healthy (27.8 ± 3.2 yrs, (± SEM)) men (n=7) and women (n=4) reported to the laboratory following a 12 h fast and no prior exercise. Vascular function in the left BA was assessed using the flow-mediated dilation (FMD). BA images were obtained in B-mode using a linear array probe (operating frequency of 7.0 MHz). Images were captured (10 fps) and analyzed using software that incorporates automated wall detection. %FMD was calculated as the difference between baseline diameter and the maximal diameter measured following cuff release. Near infrared spectroscopy was used to measure changes in oxy- ($HbO_2$) and deoxy-hemoglobin (HHb) in the right forearm. Tissue oxygenation saturation ($StO_2$) was calculated ($[HbO_2]/[HbO_2 + HHb]$). The slope of $StO_2$ reperfusion (S2) following cuff release was measured using linear regression. After Pre-HFM measures were obtained, subjects consumed a HFM consisting of 90 g total fat (63 g saturated fat), 364 mg cholesterol, 17 g carbohydrate, and 139 mg sodium. Measures of %FMD and S2-$StO_2$ were repeated after 2 hours. **RESULTS:** The HFM resulted in a decrease in BA reactivity (Pre-HFM, 6.80 ± 0.79 %FMD; Post-HFM, 4.12 ± 0.55 %FMD; p>0.05). Compared to baseline, the HFM resulted in a lower S2-$StO_2$ slope (Pre-HFM, 3.32 ± 0.18 % a.u./s; Post-HFM, 2.96 ± 0.16 % a.u./s; p<0.05). **CONCLUSION:** This study provides evidence that a HFM reduces the reperfusion rate in the microcirculation, consistent with an impaired vasodilatory response. While there was no correlation between the slowed reperfusion and impaired FMD following the HFM, it may be speculated that differences in measurement site may have contributed, at least in part, to this discrepancy. The mechanism responsible for the slowed reperfusion requires further investigation.

2218 Board #54 June 1 11:00 AM - 12:30 PM

### Different Responses Of Arterial Stiffness And Nitric Oxide Bioavailability To Different Exercise Training Programs

Natsuki Hasegawa[1], Shumpei Fujie[1], Naoki Horii[1], Eri Miyamoto-Mikami[2], Katsunori Tsuji[1], Masataka Uchida[1], Takafumi Hamaoka, FACSM[1], Izumi Tabata, FACSM[1], Motoyuki Iemitsu[1]. *[1]Ritsumeikan University, Kusatsu, Japan. [2]National Institute of Fitness and Sports in Kanoya, Kanoya, Japan.*
*(No relevant relationships reported)*

Aerobic training (AT) and high-intensity intermittent training (HIIT) reduce arterial stiffness, whereas resistance training (RT) induces no change or deterioration of arterial stiffness. Nitric oxide (NO) is produced from L-arginine by endothelial NO synthase (eNOS) in endothelial cells. AT enhances arterial NO-derived vasodilation,

resulting in the reduction in arterial stiffness. However, the underlying molecular mechanism related to different effects of different exercise training on arterial stiffness remains unclear. **PURPOSE**: This study aimed to clarify the different responses of arterial stiffness and NO production to different exercise training in rats and humans. **METHODS**: Animal study; Forty 10-week-old male Sprague-Dawley rats were randomly divided into 4groups; sedentary control (CON), AT (treadmill running for 60min at 30m/min, 5days/wk for 8weeks), RT (ladder climbing, 8-10sets/day, 3days/wk for 8weeks), and HIIT (fourteen 20sec swimming sessions with a weight equivalent to 14-16% of each body weight and 10 sec pause was allowed between exercise sessions, 4days/wk for 6weeks from 12-week-old). Human study; 21 healthy young subjects were randomly divided into 3groups; CON, AT (45min of cycling at 60-70% maximal oxygen uptake [VO2max] intensity, 3days/week for 8-week), and HIIT (6-7×20sec exhaustive cycling at 170%VO2max with 10 sec rest between each sessions, 4days/week for 6-week). **RESULTS**: Animal study; aortic pulse wave velocity (PWV), as an index of arterial stiffness, was significantly reduced in both AT and HIIT as compared to CON and RT ($P<0.05$), whereas there was no difference between RT and CON. Arterial eNOS and Akt phosphorylation and plasma NOx level were significantly elevated in AT and HIIT as compared to CON and RT ($P<0.05$), but did not change in the RT. Arterial eNOS phosphorylation was negatively correlated with aortic PWV ($r=-0.38$, $P<0.05$). Human study; carotid-femoral PWV was decreased and plasma NOx level was elevated by AT and HIIT ($P<0.05$). HIIT-induced reduction of carotid-femoral PWV and elevation of plasma NOx level were equal to that caused by AT. **CONCLUSIONS**: HIIT-induced increase in aortic NO bioavailability may improve central arterial stiffness, as same degree of AT. Supported by Grants-in-Aid for Scientific Research (#17H02182 and #16K13059, M. Iemitsu)

2219 Board #55 June 1 11:00 AM - 12:30 PM

### Estrous Cycle-Mediated Regional Diversity in BK Channel Expression and Function in Arterial Myocytes

Jacob A. Goldsmith, Kirk W. Evanson. *Florida State University, Tallahassee, FL.* (Sponsor: Heidi Kluess, FACSM)

*(No relevant relationships reported)*

Large-conductance calcium ($Ca^{2+}$)-activated potassium (BK) channels are significant regulators of arterial smooth muscle cell (myocyte) membrane potential and arterial contractility. The expression and function of BK channels in ovary-intact female resistance arteries are poorly understood. Moreover, the effects of endogenous steroid levels associated with the estrous cycle on arterial BK channels are unclear. **PURPOSE:** To investigate estrous cycle effects on BK channel expression and function in uterine and cerebral arterial smooth muscle. **RESULTS:** Western blotting and biotinylation of whole uterine arteries revealed an increase in total (~ 39%, n=7) and plasma membrane-localized (~ 64%, n=4-5) β1 subunits during proestrus as compared to diestrus. Patch-clamp electrophysiology demonstrated that BK channel activation (open probability [$P_O$]) was enhanced ~ 5-fold during proestrus in uterine arterial myocytes (diestrus: $P_O$=0.09±0.05 (n=4), proestrus: $P_O$ =0.55±0.10 (n=5); 10μM free $Ca^{2+}$). In contrast, BK channel expression and activation were unchanged during proestrus in cerebral arterial myocytes (diestrus: $P_O$=0.48±0.08 (n=11), proestrus: $P_O$ =0.56±0.09 (n=4); 10μM free $Ca^{2+}$). **CONCLUSION:** These data suggest that endogenous steroids associated with the estrous cycle can alter BK channel expression and function in female resistance arteries. However, the estrous cycle effects on arterial BK channels are region-specific.

2220 Board #56 June 1 11:00 AM - 12:30 PM

### Comparison of Vascular Structure and Function in Obese Children and Youth: A Pilot Study

Nicola R. Hurley[1], Sarah M. Kelly[1], Sinead Murphy[2], Clare McDermott[1], Niall M. Moyna[1]. *[1]Dublin City University, Dublin, Ireland. [2]Temple Street Children's University Hospital, Dublin, Ireland.*

*(No relevant relationships reported)*

Comparison of Vascular Structure and Function in Obese Children and Youth – A Pilot Study

Hurley NR[1], Kelly SM[1], Murphy S[2], McDermott C[1], Moyna NM[1]
*[1]Vascular Research Unit, School of Health and Human Performance, Dublin City University, Dublin 9, [2]Temple Street Children's University Hospital, Dublin*

**Introduction:** Atherosclerotic cardiovascular disease is accelerated by early exposure to established risk factors and their persistence over time. The purpose of this pilot study was to compare vascular structure and function between obese (OB) and normal weight (NW) children and youth.

**Methods:** Five OB (mean ±SD; age 12.2 ± 2.0 yr) and six NW controls (13.5 ± 1.3 yr) made a single visit to DCU following an overnight fast. A blood sample was taken and left far wall (LFW) carotid intima-media thickness (cIMT), changes in brachial artery diameter (BAD) in response to shear stress and glyceryl-trinitrate, and $VO_2$max were measured. Values are mean ±SD.

**Results:** Compared to NW participants, OB participants had a significantly higher BMI (20.85 ± 2.69 vs. 36.62 ± 3.74 kg×m$^2$), waist-hip ratio (0.85 ± 0.06 vs. 0.94 ± 0.08 ), systolic blood pressure (SBP) (110.33 ± 8.33 vs 129.60 ± 2.60 mmHg) and significantly lower $VO_2$max scores (41.08 ± 13.69 vs. 24.72 ± 3.00 mL×kg×min$^{-1}$×). LFW-cIMT was significantly higher in OB than NW (0.06 ± 0.00 vs. 0.05 ± 0.00 mm) and there was no significant group difference in BAD in response to shear stress (OB vs NW; 11.27 ± 7.94 vs. 11.79 ± 4.94 mm) or glyceryl-trinitrate (30.63 ± 10.84 vs. 29.20 ± 12.67 mm). LFW-cIMT was positively related to fasting insulin ($p<0.05$), BMI ($p<0.001$), SBP ($p<0.001$) and inversely related to $VO_2$max ($p<0.003$).

**Conclusion:** cIMT is i) higher in OB than NW children and youth, ii) positively related to SBP and BMI, and iii) inversely related to $VO_2$max.

2221 Board #57 June 1 11:00 AM - 12:30 PM

### The Comparison Of High-intensity Interval Exercise Vs. Continuous Moderate-intensity Exercise On C1q/tnf-related Protein-9 Expression And Flow-mediated Vasodilation In Obese Individuals

Brandon G. Fico[1], Ryan S. Garten[2], Michael C. Zourdos[1], Michael Whitehurst, FACSM[1], Peter J. Ferrandi[1], Katelyn M. Dodge[1], Gabriel Pena[1], Alexandra A. Rodriguez[1], Chun-Jung Huang, FACSM[1]. *[1]Florida Atlantic University, Boca Raton, FL. [2]Virginia Commonwealth University, Richmond, VA.* (Sponsor: Dr. Chun-Jung Huang, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: A recent novel adipocytokine, C1q-TNF-related protein-9 (CTRP9), has been shown to increase activation of endothelial nitric oxide synthase and reduce vasoconstrictors (e.g., endothelin-1). In addition, CTRP9 may play a compensatory role in obesity-related endothelial dysfunction. Although there is limited information regarding exercise-mediated CTRP9, high-intensity interval exercise (HIIE) has been shown to be as or more effective than continuous moderate-intensity exercise (CME) in improving indicators of endothelial function (e.g., brachial artery flow-mediated dilation [BAFMD]). Therefore, the purpose of this study was to investigate the effect of acute HIIE vs. CME on serum CTRP9 and BAFMD responses in obese individuals. **METHODS**: Sixteen young male subjects (9 obese and 7 normal-weight) participated in a counterbalanced and caloric equated experiment: HIIE (30 minutes, 4 intervals of 4 minutes at 80-90% of $VO_{2max}$ with 3 minutes rest between intervals) and CME (38 minutes at 50-60% $VO_{2max}$). Serum CTRP9 and BAFMD, were measured prior to, immediately following exercise, and 1 hour and 2 hours into recovery. **RESULTS**: The concentration of serum CTRP9 was significantly increased immediately following acute HIIE and CME in both obese and normal-weight groups ($p = 0.003$). Furthermore, both significant treatment by time and group by time interactions for BAFMD were observed following both exercise protocols ($p = 0.018$; $p = 0.009$; respectively), with a greater CME-induced BAFMD response at 2 hours into recovery in obese compared to normal-weight subjects. Additionally, a positive correlation in percent change (baseline to peak value) between CTRP9 and BAFMD was found following acute CME ($r = 0.589$, $p = 0.016$). **CONCLUSIONS**: Acute HIIE is as effective as CME to upregulate CTRP9 expression in both obese and normal-weight individuals, although CTRP9 may potentially improve CME-mediated BAFMD. The novel results from this study provide a foundation for additional examination of the mechanisms of exercise-mediated CTRP9 on endothelial function.

2222 Board #58 June 1 11:00 AM - 12:30 PM

### The Effect Of Aquatic Exercise On Arterial Stiffness And Central Blood Pressure

Marina Fukuie[1], Takayuki Yamabe[1], Yosuke Nomura[2], Tatsuya Hashitomi[2], Seiji Maeda[1], Jun Sugawara[3]. *[1]University of Tsukuba, Tsukuba, Japan. [2]Tsukuba Aqualife Laboratory, Tsukuba, Japan. [3]National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan.* (Sponsor: Shigehiko Ogoh, FACSM)

*(No relevant relationships reported)*

**Purposes:** Aquatic exercise is ideal for older adults because it mitigates weight-bearing stress. However, the effect of aquatic exercise on arterial stiffness and central (e.g., aortic) blood pressure (BP), strong determinants of future cardiovascular disease, remains unclear. We determined if aquatic exercise would decrease arterial stiffness and central blood pressure. **Method:** Twelve normotensives middle-aged and older peoples (mean age = 66±9 yrs, 5 men) participated a supervised aquatic exercise training program (90 min, 1 day/week, 3 months) which mainly consisted of walking, stretching, and muscle strengthening in water. Brachial and aortic BP (estimated from brachial BP waveform via general transfer function), and brachial-ankle pulse wave velocity (baPWV; an index of arterial stiffness) were measured before and after the training period. **Results:** Following the training intervention, body mass did not change significantly, whereas brachial and aortic systolic BP significantly decreased (from 116 ± 10 to 109 ± 12mmHg, $P = 0.04$ and from 111 ± 9 to 104 ± 11mmHg, $P = 0.03$, respectively). In addition, baPWV lowered significantly after the training

intervention (from 1355 ± 154 to 1274 ± 168 m/s, P = 0.004). **Conclusion:** The current study firstly demonstrates that regular aquatic exercise, even at a low frequency, could mitigate cardiovascular disease risk in normotensive middle-aged and older people. In the future, we should compare effectiveness of aquatic exercise with that of exercise on land, and study on other populations (e.g., hypertensive patients).

2223 Board #59 June 1 11:00 AM - 12:30 PM

### Oxidant-Antioxidant Balance And Peripheral Vascular Function: The Impact Of Chronic Antioxidant Supplementation

Austin C. Hogwood, Jennifer Weggen, Carson Fralin, David Lee, Matthew Scott, Ryan S. Garten. *Virginia Commonwealth University, Richmond, VA.*

*(No relevant relationships reported)*

Reactive oxygen and nitrogen species (RONS) have been revealed to incur both positive and negative changes to physiological function and adaptation. Specific to the peripheral vasculature, RONS can act to reduce important vasoactive components, such as nitric oxide (NO), or, in some instances, act in vasodilatory capacity as an endothelial-derived hyperpolarizing factor. **Purpose:** This study sought to determine the effects of altering the oxidant-antioxidant balance, via a chronic antioxidant supplementation, on leg vascular function. **Methods:** Five healthy, young male subjects ingested an antioxidant cocktail (500mg vitamin C, 400mg vitamin E, and 200 mg of alpha lipoic acid) twice a day for 28 days. Leg vascular function, measured via passive leg movement (PLM), was performed prior to supplementation (Day 0) and on days 1, 7, 14, 21, 28 after the start of supplementation. An additional testing day was performed 7 days after cessation of the supplementation (Day 35). **Results:** Leg vascular function, measured via PLM-induced leg blood flow (LBF) and AUC, was significantly decreased over time with a 50% reduction in the PLM-induced LBF and 60% reduction in LBF AUC. After a 7-day cessation of supplementation, PLM-induced LBF and LBF AUC returned to baseline. **Conlusion:** This study revealed that 28 days of chronic antioxidant supplementation resulted in a reduction in peripheral vascular function in young healthy individuals that was completely restored after cessation of supplementation. As PLM has been revealed to be highly NO-mediated, this study identifies antioxidant supplementation as a modulator of NO bioavailability potentially through the inhibition of RONS-induced vasodilatory capacity or a reductive stress-like mechanism.

2224 Board #60 June 1 11:00 AM - 12:30 PM

### Racial Differences in Vascular Function in Response to Mental Stress

Bryon M. Curtis, John D. Akins, Jordan C. Patik, Guillermo X. Olvera, Aida Nasirian, Jeremiah C. Campbell, R. Matthew Brothers. *University of Texas at Arlington, Arlington, TX.*

*(No relevant relationships reported)*

African Americans (AA) have a higher prevalence of hypertension and other cardiovascular (CV) complications compared to other populations. While the reasons for this elevated CV disease risk are multifactorial, vascular dysfunction is a key contributing factor. It has been previously shown that mental stress, induced by mental arithmetic, results in a significant increase in forearm blood flow (FBF). This response has been predominantly attributed to a mental stress-induced release and subsequent vasodilatory effect of Nitric Oxide (NO). In this regard, a previous study has reported that AA have an attenuated increase in FBF as compared to Caucasians (CA) in response to mental stress, which may be related to impaired vascular function and thus elevated CV disease risk in AA. However, this study was conducted in a middle-age cohort (mid to late 40's). Whether this attenuation is present in a relatively young and healthy population is unknown. **PURPOSE:** The purpose of this study was to test the hypothesis that the vasodilatory response to mental stress is blunted in a relatively young and healthy AA population. **METHODS:** 6 AA and 6 CA males (AA age: 22 $\pm$ 2.6, CA age: 23 $\pm$ 4.6) participated in this study. All measurements were obtained in the morning following an overnight fast. Brachial artery diameter and blood velocity were assessed using high resolution duplex ultrasound. Mental stress was induced by asking subjects to subtract 7 continuously from a 3-digit number while attempting to report answers at a pace set by a 60 bpm metronome. The 3-digit number was changed at 20 second intervals. FBF was measured during a two minute baseline followed by 3 minutes of mental stress. Vascular function was assessed as the absolute peak blood flow response (ml/min) as well as peak conductance (ml/min/mmHg) during the mental stress. **RESULTS:** The absolute peak flow (AA: 183 $\pm$ 39 ml/min, CA: 307 $\pm$ 127 ml/min; $P = 0.05$) were significantly greater in CA compared to AA. The maximum increase in conductance (AA: 2.03 $\pm$ 0.32 ml/min/mmHg, CA: 3.69 $\pm$ 1.39 ml/min/mmHg; $P = 0.02$) was also significantly higher in CA as compared to AA. **CONCLUSION:** This preliminary data support our hypothesis that vascular function in response to mental stress is attenuated in young healthy AA as compared to their CA counterparts.

2225 Board #61 June 1 11:00 AM - 12:30 PM

### The Effect Of Exercise On Endothelial Function And Glycemic Control In Type 2 Diabetes: Meta-analysis

Yoonjung Park[1], Junghoon Lee[2], Ruda Lee[3], Moon-Hyon Hwang[3], Marc T. Hamilton[1]. *[1]University of Houston, Houston, TX. [2]Korea National Sport University, Seoul, Korea, Republic of. [3]Incheon National University, Incheon, Korea, Republic of.*

*(No relevant relationships reported)*

**PURPOSE**: Vascular endothelial dysfunction induced by hyperglycemia and elevated insulin resistance is a potent risk factor for cardiovascular disease (CVD) and likely contributes to multiple chronic disease complications associated with aging like dementia. The aim of this study was to systematically review and quantify the effects of exercise on endothelial function (EF) in type 2 diabetes (T2D). **METHODS**: Five electronic databases were searched (until June 2017) for studies that met the following criteria: (i) randomized controlled trials; (ii) T2D aged ≥18 years; (iii) measured EF by brachial artery flow-mediated dilation (FMD); (iv) structured and supervised exercise intervention for ≥8 weeks. **RESULTS**: Thirteen cohorts of eight studies (306 patients, average age 59 years) met the inclusion criteria. Exercise training significantly increased FMD (mean ES = 0.41, 95% CI = 0.21 to 0.62, P < 0.001). Low to moderate intensity subgroups and aerobic exercise (AE) subgroups significantly increased FMD more than moderate to high intensity subgroups and combined AE and resistance exercise (RE) subgroups respectively ($P < 0.01$, $P < 0.05$). Exercise training significantly decreased glycated hemoglobin (HbA1c) (mean ES = -0.40, 95% CI = -0.61 to -0.19, P < 0.001). Low to moderate intensity subgroups significantly decreased HbA1c more than moderate to high intensity subgroups ($P < 0.05$). **CONCLUSIONS**: Our results suggest that in patients with T2D, lower intensity exercise has physiological meaningful effects on EF, in support of the emerging concept that the lower efforts of exercise are not necessarily less cardioprotective than higher intensity training.

2226 Board #62 June 1 11:00 AM - 12:30 PM

### High Aerobic Fitness And Muscular Strength Offset Aging-induced Deterioration Of Male Sexual Function

Hiroshi Kumagai[1], Toru Yoshikawa[2], Kanae Myoenzono[2], Nobuhiko Akazawa[3], Seiji Maeda[2]. *[1]Juntendo University, Inzai, Japan. [2]University of Tsukuba, Tsukuba, Japan. [3]Japan Institute of Sport Sciences, Kita-ku, Japan.*

*(No relevant relationships reported)*

**PURPOSE**: Erectile dysfunction (ED) is an impaired male sexual function and associated with depressive symptoms, quality of life and cardiovascular disease in men. The main causes of ED are aging and impaired vascular functions. Vascular functions are positively influenced by physical fitness, such as aerobic capacity, muscle strength and flexibility. However, the relationship between physical fitness and erectile function remains poorly understood. The aim of this study was to investigate the association between physical fitness parameters and erectile function. **METHODS**: In 177 adult males (age; 57 ± 15 [range: 23−82] years, BMI; 22.6 ± 2.6 [range: 17.3−33.6] kg/m$^2$; mean ± SD [range]), we measured peak oxygen consumption ($VO_{2peak}$) as an index of aerobic fitness, handgrip strength (HGS) as an index of muscular strength, and sit and reach as an index of flexibility. Also, we measured serum testosterone levels. Erectile function was assessed by using International Index of Erectile Function-5 questionnaire (IIEF5: descending score indicates worsening of erectile function). **RESULTS**: IIEF5 score was significantly correlated to age ($r_s = -0.56$, $P < 0.01$), height ($r_s = 0.35$, $P < 0.01$), glucose ($r_s = -0.26$, $P < 0.01$), HbA1c ($r_s = -0.43$, $P < 0.01$), testosterone ($r_s = 0.18$, $P < 0.05$), $VO_{2peak}$ ($r_s = 0.52$, $P < 0.01$) and HGS ($r_s = 0.37$, $P < 0.01$), but not sit and reach ($r_s = 0.08$, *n.s.*). Multivariate linear regression analysis revealed that IIEF5 score was significantly and independently associated only with $VO_{2peak}$ and HGS, although age and other factors were included in the regression model as confounders. Furthermore, when the subjects were divided into four groups according to median value of HGS value and $VO_{2peak}$ value, IIEF5 score exhibited the highest value in the group with high-HGS and high-$VO_{2peak}$ and the lowest value in the group with low-HGS and low-$VO_{2peak}$. **CONCLUSION**: These results suggest that the maintenance of high aerobic fitness and muscular strength may offset aging-induced deterioration of male sexual function. Our present findings may provide a novel insight into the role of physical fitness in reducing the risk of ED and contribute to establish a new approach for ED treatment.

2227 Board #63 June 1 11:00 AM - 12:30 PM

### Reproducibility of a Ramping Protocol to Measure Cerebral Vascular Reactivity Using Functional Magnetic Resonance Imaging

Nicholas G. Evanoff[1], Kara L. Marlatt[2], Justin R. Geijer[3], Bryon A. Mueller[1], Kelvin O. Lim[1], Donald R. Dengel, FACSM[1]. [1]*University of Minnesota, Minneapolis, MN.* [2]*Pennington Biomedical Research Center, Baton Rouge, LA.* [3]*Winona State University, Winona, MN.* (Sponsor: Donald Dengel, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** Though individual differences in arterial carbon dioxide and oxygen levels inherently exist, the degree of their influence on cerebral vascular reactivity (CVR) is less clear at the micro-vessel level. The introduction of a partial re-breathing method that independently controls end-tidal carbon dioxide ($P_{et}CO_2$) and end-tidal oxygen ($P_{et}O_2$) has enabled examination of hypercapnic effects on blood oxygen level-dependent (BOLD) magnetic resonance imaging (MRI) signal changes. The purpose of this study was to examine the within- and between-visit reproducibility of BOLD signal changes to an iso-oxic ramping protocol in $P_{et}CO_2$.
**METHODS:** To stimulate changes in CVR, PetCO2 was altered while $P_{et}O_2$ was held constant using a computer controlled prospective gas-blending device. Two fMRI scans, each including a linear change in $P_{et}CO_2$, were performed on the same visit using a 3-Tesla (3T) scanner. This ramp sequence consisted of decreasing $P_{et}CO_2$ to 30 mmHg and then increasing $P_{et}CO_2$ linearly to 50 mmHg over a 7 min period. The protocol was repeated on a separate visit with minimum of 3 days between scanning sessions. Intraclass correlation coefficients (ICC) and coefficients of variation (CV) were calculated to quantify reproducibility.
**RESULTS:** Eleven subjects (6 females; mean age 26.5±5.7 years) completed the full testing protocol. Very good reproducibility was observed for the within-visit ramp wave (Visit 1: ICC = 0.82, CV = 6.5%; Visit 2: ICC = 0.74, CV = 6.36%). Similarly, ramp waves were reproducible between scanning sessions (Scan 1: ICC = 0.74, CV = 6.5%; Scan 2: ICC = 0.66, CV = 6.13%).
**CONCLUSION**: This study demonstrates BOLD signal changes in response to ramp alterations in $P_{et}CO_2$ are reproducible both within- and between-visit MRI scans. Establishment of reproducible methodologies for measuring BOLD signal changes while altering $P_{et}CO_2$ using a ramp protocol will allow researchers to study CVR functionality. Finally, adding a ramping protocol to CVR studies could provide information about linear changes in CVR over a broad range of $P_{et}CO_2$.

2228 Board #64 June 1 11:00 AM - 12:30 PM

### Impact of Acute Aerobic and Resistance Exercise on Postprandial Flow-Mediated Dilation in Overweight and Obese Adults

Conlan J. Varty, Craig W. Berry, Kristina B. Arslain, Kevin D. Ballard. *Miami University, Oxford, OH.* (Sponsor: Helaine Alessio, FACSM)

*(No relevant relationships reported)*

Postprandial hyperglycemia (PPH) transiently impairs brachial artery flow-mediated dilation (FMD) and increases future cardiovascular disease risk. A single bout of aerobic exercise (AE) has been shown to attenuate PPH-induced impairments in FMD in healthy adults for up to 17 hours post-exercise. Studies examining the effects of acute resistance exercise (RE) on postprandial FMD responses are lacking. **PURPOSE**: The purpose of this ongoing investigation is to determine the effects of different exercise modalities on postprandial glucose and FMD responses to an oral glucose tolerance test (OGTT) in overweight and obese adults. We hypothesize that a single bout of exercise performed the prior evening will attenuate PPH-mediated impairments in FMD, independent of exercise modality. **METHODS:** Recruitment for the current study is ongoing. In a randomized, cross-over design, overweight and obese adults [n=4 (3 women); age=21.3±2.1 y; BMI=30.6±4.2 kg/m$^2$; $VO_2$max=31.6±4.5 ml/kg/min; mean±SD] completed three separate trials. Seated rest (control), a single bout of AE (30 min at ~60% $VO_2$max), or a single bout of whole-body RE (6 exercises, 3 x 10-repetition maximum) preceded an OGTT (1 g/kg body weight) by 14-17 hours. Blood glucose and brachial artery FMD were measured prior to and at 30 min intervals for 2 hours following the OGTT. Repeated-measures ANOVA and LSD post-hoc tests were used to evaluate differences within and between trials. **RESULTS**: Brachial artery FMD (8.3%, 9.1%, and 9.4% for control, AE, and RE trials, respectively) and blood glucose did not differ between trials at baseline. A main effect due to time ($P<0.05$) was observed for FMD. Brachial FMD transiently decreased ($P<0.05$) at 30 min post-ingestion in the control (6.1%), AE (6.8%), and RE (6.0%) trials, respectively. A main effect due to time ($P<0.001$) was observed for blood glucose. Relative to baseline, blood glucose increased ($P<0.05$) at 30-120 min post-ingestion in the control (%Δ from baseline = 32-57%), AE (20-53%), and RE (28-45%) trials, respectively. **CONCLUSIONS:** Preliminary findings from our ongoing study in overweight and obese adults suggest that acute AE or RE performed the evening prior to an OGTT does not attenuate postprandial decreases in FMD. **Supported by Miami University Seed Grant and Committee on Faculty Research Grant.**

2229 Board #65 June 1 11:00 AM - 12:30 PM

### Effects of Obese Skeletal Muscle Cells on Endothelial Cell Angiogenesis

Christopher K. Kargl[1], Yaohui Nie[2], Ron T. Garner[1], Sheelagh Evans[1], Zach R. Hettinger[1], Brian Sullivan[1], Tim P. Gavin, FACSM[1]. [1]*Purdue University, WEST LAFAYETTE, IN.* [2]*Harvard University, Cambridge, MA.* (Sponsor: TP Gavin, FACSM)

*(No relevant relationships reported)*

Vascular disease is a leading cause of morbidity and mortality in obesity. Obesity is associated with impaired endothelial cell (EC) angiogenesis. Skeletal myocytes are important regulators of angiogenesis - EC proliferation, migration, and tube formation. **Purpose**: Determine the effects of obesity on skeletal muscle regulation of EC angiogenesis.**Methods**: Primary human skeletal muscle satellite cells were isolated from the vastus lateralis from lean (LN) and obese (OB) subjects and differentiated into myotubes (HSkMC). Conditioned medium (CM) from HSkMC was collected after a two-day incubation period and used to treat Human Umbilical Vascular Endothelial Cells (HUVECs). HUVEC proliferation was assessed via cell counting, cell viability was determined using an MTT assay, and EC tube formation (tube length and branches) was measured in matrigel after a 4-hour incubation.**Results**: After 24-hour treatment, there was no difference in HUVEC proliferation (LN: 23,333 vs. OB: 22,750, cells) or viability (LN: 181.62 vs. OB: 183.52, AU) between LN and OB HSkMC CM. Also, there was no difference in HUVEC tube length (LN: 23,726 vs. OB: 24,046, AU) or branches (LN: 452 vs. OB: 465, AU) between LN and OB HSkMC CM. **Conclusion**: In cell culture, there is no apparent effect of obesity on skeletal muscle regulation of endothelial cell angiogenesis. However, incubating cells (SkM and EC) with high glucose or high fatty acid, metabolic challenges that are present in vivo, may reveal insights into obesity impaired angiogenesis.

2230 Board #66 June 1 11:00 AM - 12:30 PM

### Perfusive and Diffusive Microvascular Oxygen Delivery During Simulated Hypovolemia and Dynamic Forearm Exercise

Shane M. Hammer, Jacob T. Caldwell, Kaylin D. Didier, Andrew M. Alexander, Carl J. Ade, Thomas J. Barstow, FACSM. *Kansas State University, Manhattan, KS.*

*(No relevant relationships reported)*

The maintenance of brachial artery blood flow during dynamic forearm exercise in the face of simulated hypovolemia (via lower-body negative pressure (LBNP)), has been previously demonstrated. The distinct facets of microvascular oxygen delivery (i.e. perfusive and diffusive) during such an event, however, have not been described. **PURPOSE:** We tested the hypothesis that, during dynamic handgrip exercise, the initiation of LBNP would result in no significant changes in the indices of microvascular perfusive or diffusive oxygen delivery (deoxy-[heme] and total-[heme], respectively) in the exercising muscle. **METHODS:** Six men (26.2 ± 1.7 yrs, 85.5 ± 6.2 kg, 177 ± 1 cm) participated in this study. To determine the effects of LBNP in the absence of exercise, LBNP (~30 mmHg) was applied for two minutes following a resting baseline. After recovery to a second resting baseline, subjects performed seven minutes of dynamic handgrip exercise at 20% MVC. During the final two minutes of exercise, LBNP was initiated. Mean arterial pressure (MAP) was measured continuously via calibrated finger photoplethysmography (Finometer Pro, FMS). Absolute concentrations of deoxy-[heme] and total-[heme] of the flexor digitorum superficialis muscle were measured continuously via frequency-domain multi-distance near-infrared spectroscopy (OxiplexTS, ISS). **RESULTS:** MAP (92.4 ± 12.8 mmHg), deoxy-[heme] (83.7 ± 14.5 μM) and total-[heme] (343 ± 48 μM) were not different between resting baselines ($p > 0.05$). While all subjects demonstrated an increase in deoxy-[heme] (99.1 ± 8.6 μM) following the application of LBNP at rest, intersubject variability precluded statistical significance ($p > 0.05$). No significant changes were detected in MAP or total-[heme] ($p > 0.05$). Dynamic handgrip exercise resulted in significant increases in MAP (104 ± 14 mmHg), deoxy-[heme] (121 ± 29 μM) and total-[heme] (367 ± 52 μM) ($p < 0.05$); however, the initiation of LBNP during exercise resulted in no significant further changes in MAP, deoxy-[heme] or total-[heme] ($p > 0.05$). **CONCLUSION:** The absence of any significant changes in deoxy-[heme] or total-[heme] during simulated hypovolemia (i.e. LBNP) suggests that perfusive and diffusive microvascular oxygen delivery to skeletal muscle was preserved at rest and during dynamic handgrip exercise.

2231 Board #67 June 1 11:00 AM - 12:30 PM

### Influence of Short, Disrupted Sleep and High-Intensity Interval Exercise on Brachial Artery Vascular Responses

Zacharias Papadakis[1], Jeffrey S. Forsse[1], Matthew N. Peterson[1], Fernando Gutierrez[1], J. Kyle Taylor[2], Peter W. Grandjean, FACSM[1]. *[1]Baylor University, Waco, TX. [2]Auburn University, Montgomery, AL.* (Sponsor: Peter W. Grandjean, FACSM)
*(No relevant relationships reported)*

Brachial artery flow-mediated dilation (FMD) is a nitric oxide-dependent measure of conduit artery endothelial function that is transiently potentiated by exercise; yet, it is unclear how short, disrupted sleep (SDS) modifies post-exercise FMD responses to a single episode of high-intensity interval exercise (HIIE). **PURPOSE:** To determine the influence of a single night of SDS on brachial artery FMD responses after HIIE. **METHODS:** Fifteen male participants (age 31.1 ± 5.3 yr; weight 83.5 ± 11.4 kg; BMI 25.8 ± 2.7 kg/m$^2$; $VO_2$max 49.1 ± 8.5 ml/kg/min) completed a non-exercise control trial after 9 to 9.5 hrs of reference sleep (REF), HIIE by treadmill running (90% and 40% of $VO_2$reserve in 3:2 min ratio) to expend 500 kcals after reference sleep (REF+EX) and HIIE after 3 to 3.5 hrs of short and disrupted sleep (SDS+EX) in a randomized crossover design. Ultrasound measurements of brachial artery FMD were obtained by the same technician under standardized conditions just before, 1 hr and 4 hrs after exercise. FMD responses were analyzed using 3 (condition) by 3 (sample point) repeated measures ANOVAs. **RESULTS:** FMD was augmented 1 hr after exercise in REF+EX (pre-exercise = 12.5 ± 0.9; 1 hr = 17.2* ± 1.5; 4 hr = 12.5 ± 0.9%) and SDS+EX (pre-exercise = 14.9 ± 1.7; 1 hr = 19.3* ± 2.2; 4 hr = 16.2 ± 2.4%) versus no change in REF (pre-exercise = 12.6 ± 1.4; 1 hr = 11.3 ± 1.0; 4 hr = 13.5 ± 2.1%) ($p < 0.0494$ condition by time interaction). **SUMMARY:** HIIE transiently augments brachial artery FMD and this response is not modified by a single night of short, disrupted sleep.

2232 Board #68 June 1 11:00 AM - 12:30 PM

### Obesity Associated Hypertension in Admitted Patients: Treating Isolated Systolic Hypertension May Be Short Sighted

Kelly L. McKinnie[1], J. Mark VanNess[1], Michelle M. Amaral[1], Greg Roberts[2], Jonathan M. Saxe[2], Lewis E. Jacobson[2], Courtney D. Jensen[1]. *[1]University of the Pacific, Stockton, CA. [2]St. Vincent Hospital, Indianapolis, IN.*
*(No relevant relationships reported)*

The close association of excess adiposity and elevated blood pressure is well documented. The role of obesity as a contributing factor for resistant hypertension, cardiovascular disease, and cerebrovascular disease is recognized. Given that exercise training could be used to treat both obesity and elevated blood pressure when patients are admitted for trauma care, identifying obesity-associated systolic hypertension may help with long-term control of the root causes for these illnesses. **PURPOSE:** To examine the relationship between body composition, blood pressure, and other measures collected on patient admittance. **METHODS:** Data were collected from 2,306 consecutive patients admitted to a Level 1 trauma center between July, 2012 and June 2015. Patients with head trauma or traumatic brain injury were not analyzed. Patients were considered obese if their BMI was ≥ 30. Multiple linear regression was used to examine the effect of obesity on blood pressure. Other significant variables were examined from the database that contributed to the prediction model. **RESULTS:** Significant predictors of systolic hypertension included blood lactate, age, obesity, pulse pressure, pH, %O2 saturation and hemoglobin levels ($R=0.464$; $p<0.001$). Holding all other variables constant, obesity was associated with a 9.7 mmHg increase in systolic blood pressure ($p=0.009$). A mild (3 mmHg) increase in diastolic blood pressure was noted, but was not found to be statistically significant ($p=0.172$). **CONCLUSIONS:** The demonstrated relationship between obesity and systolic blood pressure illustrates the need for integrated blood pressure and obesity treatment with exercise training. Therapeutic exercise focused on weight loss goals will likely ameliorate elevated systolic blood pressure. Weight management discussions are challenging, and often avoided by health professionals, but these data show that concomitant antihypertensive medication with therapeutic exercise training may be warranted for prevention of subsequent cardiovascular and cerebrovascular diseases.

2233 Board #69 June 1 11:00 AM - 12:30 PM

### Changes in Scattering, Absorption, and Resulting Differential Pathlength Factor During Arterial Occlusion and Reperfusion

Lillie M. Huckaby[1], Shane M. Hammer[1], Dana K. Townsend[2], Thomas J. Barstow, FACSM[1]. *[1]Kansas State Universtiy, Manhattan, KS. [2]Wheaton College, Wheaton, IL.*
*(No relevant relationships reported)*

Continuous wave near-infrared spectroscopy (CW-NIRS) has been used to assess microvascular function and the balance between muscle oxygen delivery and oxygen consumption via post-occlusion reactive hyperemia (PORH) tests. However, CW-NIRS relies on the assumption that the scattering and absorption characteristics of the investigated tissue remain unchanged via a constant differential pathlength factor (DPF). **PURPOSE:** We tested the hypothesis that the DFP of forearm tissue would be significantly different among the phases of a PORH test (i.e. baseline, arterial occlusion, and arterial reperfusion). **METHODS:** 5 subjects (22.6 ± 1.8 yrs, 170 ± 5 cm, 66.0 ± 10.8 kg) completed three PORH tests consisting of 1 min of baseline, 5 min of brachial arterial cuff occlusion, and 3 min of recovery following arterial reperfusion. Reduced scattering ($\mu_s$') and absorption ($\mu_a$) coefficients were continuously measured, and later used to calculate a DPF, at wavelengths of 692 and 834 nm ($DPF_{692}$ and $DPF_{834}$, respectively) via frequency domain near-infrared spectroscopy (FD-NIRS) during the entire duration of the PORH tests. The minute averaged DPF response was averaged among the three PORH tests. **RESULTS:** $DPF_{692}$ was significantly greater that $DPF_{834}$ during each minute of the PORH tests ($p < 0.05$). $DPF_{834}$ did not significantly change during any phase of the PORH test from baseline (3.83 ± 0.79; $p > 0.05$). $DPF_{692}$ was significantly less during the final minute of arterial occlusion (4.07 ± 0.69) when compared to baseline (4.67 ± 0.78; $p < 0.001$). Further, following arterial reperfusion, $DPF_{692}$ was significantly greater (4.91 ± 0.78) when compared to the final minute of arterial occlusion ($p < 0.001$), but not different when compared to baseline. **CONCLUSION:** These data demonstrate that the $DPF_{692}$ of forearm tissue does not remain constant across the phases of a PORH test. The assumption of a constant DPF may alter interpretations of data related to microvascular function and the balance between muscle oxygen delivery and oxygen consumption obtained via PORH tests.

2234 Board #70 June 1 11:00 AM - 12:30 PM

### Exercise-levels Of Laminar Shear Stress In Combination Of Aspirin And Celecoxib Normalize An Atherognic Environment

Jan Kretzschmar[1], Heather Grimm[1], Micheal D. Brown, FACSM[2]. *[1]King's College, Wilkes Barre, PA. [2]Auburn University, Auburn, AL.*
*(No relevant relationships reported)*

Optimal vascular function is a hallmark of cardiovascular health. Specifically, the balance of vasoconstricting and vasodilating substances in the vascular bed is recognized as a surrogate measure of the health of resistance vessels. Endothelial Nitrix Oxide Synthase (eNOS) is considered to be one of the best indicators of vasokine balance in these vessels, with high levels of expression being considered to be favorable. Further, the balance of the vasodilating/anti-thrombotic substance prostacyclin and vasoconstricing/pro-thrombotic substance thromboxane in the endothelial cell layer is a further indicator of the overall health of the cardiovascular system. One of the greatest challenges to vascular health and vasodilatory balance is TNFα-mediated inflammation. Uncovering effective strategies that maintain a vascular environment that is more vasodilatory and anti-thrombotic in the face of an inflammatory challenge is favorable. **Purpose:** To test the ability of various anti-thrombotic and pro-vasodilatory treatments, as well as combinations thereof, to prevent disruptions of vascular health of endothelial cells when faced with an inflammatory challenge in the form of TNFα. **Methods:** Human Umbilical Vein Endothelial Cells HUVECs were pre-treated exercise-like levels of laminar shear stress (LSS), aspirin, celecoxib, and their combination prior to a TNFα challenge. Western blot analysis, as well as calorimetric assays were used to determine levels of eNOS and prostacyclin (6-keto $PGF_{1\alpha}$)/thromboxane ($TXB_2$) metabolite ratio, respectively. **Results:** Neither aspirin, nor celecoxib was effective in preventing TNFα-induced reduction in eNOS. Further, aspirin was unable to maintain baseline levels of prostacyclin/thromboxane ratio in the face of the inflammatory challenge. LSS, aspirin/LSS combination, and celecoxib/LSS combination were all able to prevent TNFα-induced reductions in eNOS levels and prostacyclin/thromboxane ratio. **Conclusion:** Effective strategies to maintain a healthy endothelium and therefore resistance vessel health, need to include exercise-levels of shear stress to be effective.

2235 Board #71 June 1 11:00 AM - 12:30 PM

### Abdominal Aorta Compliance and Distensibility Among Youth Ranging from Normal Weight to Severe Obesity

Michelle M. Harbin, Nicholas G. Evanoff, Aaron S. Kelly, Justin R. Ryder, Donald R. Dengel, FACSM. *University of Minnesota, Twin Cities, Minneapolis, MN.* (Sponsor: Donald R. Dengel, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** This study evaluated abdominal aorta stiffness and diameter among youth throughout a range of body mass index (BMI) values. **METHODS:** Non-invasive ultrasonographic measurements of the abdominal aorta were obtained from 190 youth (92 males; mean±SE: age=12.9±0.2 years). Body composition was assessed by dual-energy X-ray absorptiometry. Obesity status was defined using age- and sex-based BMI percentiles: normal-weight (NW) (≥5$^{th}$ to <85$^{th}$ percentile); overweight (OW) and obese (OB) (≥85$^{th}$ to <1.2 X 95$^{th}$ percentile); and severe obese (SO) (≥1.2 X 95$^{th}$ percentile). Analysis of covariance compared differences by obesity status with adjustments made for race, sex, and Tanner stage. Multiple linear regression evaluated the association of sex, age, and percent body fat (%BF) on abdominal aorta elasticity. **RESULTS:** Prior to adjustment, abdominal aorta diameter (aBD) was significantly larger among SO (mean±SE: 11.1±0.4 mm) compared to both OW/OB (9.6±0.3 mm, $p$=0.006) and NW (8.9±0.3 mm, $p$=0.001). Abdominal aorta incremental elastic modulus (aIEM) was higher among SO (1153.0±70.8 mmHg) compared to OW/OB (960.4±48.6 mmHg, $p$=0.044) and NW (846.0±40.9 mmHg, $p$<0.0001). Abdominal aorta diameter distensibility (aDD%) was lower among SO (14.2±0.6%) compared to NW (16.6±0.6%, $p$=0.029). Abdominal aorta cross-sectional distensibility (aCSD) was lower among SO (30.6±1.5%) compared to NW (36.4±1.5%, $p$=0.03). After adjusting for covariates, aBD remained significantly larger among SO compared to OW/OB ($p$=0.018) and NW ($p$=0.001); aIEM was significantly higher among SO compared to NW ($p$=0.002). Adjusted aDD% and aCSD were not significantly different among groups. Age was associated with higher aBD (β=0.41, $p$<0.001), higher aIEM (β=42.92, $p$<0.001), decreased aDD% (β=-0.38, $p$=0.007), and decreased aCSD (β=-0.96, $p$=0.004). Percent body fat was associated with both higher aBD (β=0.06, $p$=0.001) and aIEM (β=7.44, $p$=0.007), while sex was not associated with measures abdominal aorta elasticity and stiffness. **CONCLUSION**: The deleterious effect of obesity on arterial stiffness extends to the abdominal aorta. Higher age and BF%, but not sex, was associated with greater abdominal aorta stiffness.

2236 Board #72 June 1 11:00 AM - 12:30 PM

### Effects Of Different Frequencies Of Electric Muscle Stimulation Of The Lower Limbs On The Vascular Endothelial Function

Hajime Miura, Miduki Ishikawa, Ayako Azuma, Yasuaki Tamura. *Tokushima University, Tokushima, Japan.*

*(No relevant relationships reported)*

The use of electrical muscle stimulation (EMS) has been shown to potentially improve the arterial function as well as the muscle strength. However, few attempts have been made to identify the effects of different frequencies of EMS on the vascular endothelial function. **PURPOSE**: The aim of this study was to evaluate the effects of different frequencies of EMS on the vascular endothelial function in the lower extremities as determined by flow-mediated vasodilation (FMD). **METHODS**: Nine healthy adult men underwent 2 experimental trials (4 and 20 Hz of EMS) in the face-down posture. EMS was applied for 20 min to both lower leg and thigh muscles at 4 Hz sequentially or 20 Hz with duty cycle of 3 sec stimulation/2 sec relaxation. To measure the FMD, a lower limb cuff was inflated to 300 mmHg for 5 min with subsequent deflation. The right popliteal artery diameter was measured using a high-resolution ultrasound device. The FMD was then estimated as the percent change in the arterial diameter over the baseline value at maximum dilation during reactive hyperemia. The blood flow (BF) at the left popliteal artery was also measured using an ultrasound Doppler device. **RESULTS**: In both trials, the FMD and BF were significantly elevated immediately after and at 30 min after EMS compared with at rest (p<0.05). Immediately after each trial, significant differences in the FMD were found between the 4- and 20-Hz trials (7.8±0.6% vs. 6.3±0.8%, p<0.05). There was also significant differences in the BF between the two trials (125.4±20.1ml/min vs. 87.9±17.9ml/min, p<0.05). **CONCLUSIONS**: Acute EMS at 4 Hz resulted in a larger improvement in the vascular endothelial function than EMS at 20 Hz due to a greater BF. These findings suggest that chronic low-frequency EMS might be useful for reducing the risk of cardiovascular disease.

2237 Board #73 June 1 11:00 AM - 12:30 PM

### Exercise-levels Of Laminar Shear Stress In Combination With Aspirin And Celecoxib On Tnf-α Induced Emp Formation

Heather Grimm[1], Jan Kretzschmar[1], Micheal D. Brown, FACSM[2]. [1]*King's College, Wilkes Barre, PA.* [2]*Auburn University, Auburn, AL.*

*(No relevant relationships reported)*

Endothelial Microparticles (EMPs) are increasingly being accepted as an important marker and regulator of vascular homeostasis and atherosclerotic disease state. TNFα is key regulator of the athero-genic process and thereby heart disease. Exercise-mimetic levels of laminar shear stress (LSS), aspirin, and celecoxib have long since been implicated in the prevention and treatment of the athero-genic process. **Purpose:** To determine the effect of combination treatment of exercise-mimetic levels of LSS with aspirin or celecoxib on the prevention of TNFα-induced EMP formation in Human Umbilical Vein Endothelial Cells (HUVECs). **Methods:** HUVECs were challenged with athero-genic levels of TNFα after various athero-protective pre-treatments and combinations thereof. EMPs were analyszed using flow cytometry. Both EMPs indicative of cellular apoptosis (CD31+) and cellular activation (CD62E+) were measured. **Results:** Neither aspirin, nor celecoxib pre-treatment of HUVECs were able to blunt TNFα-mediated production of EMPs indicative of cellular apoptosis and activation. However, exercise-mimetic levels of LSS blunted TNFα-mediated production of EMPs when given in isolation and in combination with aspirin and celecoxib. **Conclusion:** When given in isolation, neither aspirin, nor celecoxib seem effective enough to prevent TNFα-mediated EMP production. Only when HUVECs were treated with combinations of LSS and aspirin or celecoxib could EMP production be blunted. This implicates the powerful potential of exercise to prevent the athero-genic process, especially when compared to commonly prescribed preventative treatments in the form of aspirin and celecoxib.

2238 Board #74 June 1 11:00 AM - 12:30 PM

### Aerobic Fitness is not Protective of Endothelial Function with Menopause

Corinna Serviente[1], Sarah Witkowski[2]. [1]*University of Massachusetts Amherst, Amherst, MA.* [2]*Smith College, Northampton, MA.* (Sponsor: Jane Kent, FACSM)

*(No relevant relationships reported)*

Endothelial dysfunction is a pre-clinical marker for cardiovascular disease (CVD). In most populations, aerobic fitness is protective of endothelial function. Whether this protection remains during and after menopause is unclear. **PURPOSE:** To evaluate differences in endothelial function before and after acute exercise in women at different menopausal stages with disparate levels of aerobic fitness. **METHODS:** Brachial artery flow-mediated dilation (FMD) was evaluated before and after 30min of treadmill exercise (60-64% $VO_{2peak}$) in healthy high (HIGH) and low (LOW) fit perimenopausal (PERI: HIGH, n=12, 50.8±1.0 yr, 49.1±2.5 ml/kg/min; LOW, n=7, 47.3±1.5 yr, 30.1±1.6 ml/kg/min) and postmenopausal (POST: HIGH, n=13, 60.5±1.0 yr, 43.8±1.8 ml/kg/min; LOW, n=8, 58.9±1.4 yr, 28.3± 1.1 ml/kg/min) women. High fit premenopausal (PRE: n=6, 44.6±1.3 yr, 50.5±3.6 ml/kg/min) women were included as a reference group. Data were evaluated with repeated measure ANOVAs and post hoc testing, where appropriate, and are presented as mean±SEM. FMD data in LOW were previously published (Serviente et al., 2016). **RESULTS:** Overall, there was a main effect of menopause on FMD (p=0.024), with lower FMD in POST compared to PERI (p=0.007). There was a main effect of fitness (p=0.031) with lower FMD in HIGH compared to LOW. Within HIGH, PRE had higher FMD than POST (p=0.018), but not PERI (p=0.737). FMD was lower in HIGH vs. LOW POST (4.2±0.8% vs. 6.51±0.5%, p=0.047) before, but not after acute exercise (4.31±0.6% vs. 6.2±1.0%, p=0.103). After acute exercise, FMD was lower in HIGH POST compared to PRE (6.2±1.0% vs. 7.7±1.1%, p=0.011). There was no difference in FMD in HIGH vs. LOW PERI before exercise (7.1±1.5% vs. 6.5±0.5%, p=0.73); however, FMD was higher in LOW after exercise (5.7±0.6 % vs. 8.5±1.1%, p=0.029). **CONCLUSIONS:** While endothelial function does not appear to decline until postmenopause, the protective effect of aerobic fitness is not apparent in perimenopausal or postmenopausal women; although, fitness appears to modulate the response to acute exercise. These data suggest that targets other than aerobic fitness may be important for improving endothelial function, and therefore CVD risk, in menopausal women. **Funding:** ACSM Foundation Doctoral Student Research Grant (Serviente) & UMass Amherst Faculty Research Grant (Witkowski)

2239 Board #75 June 1 11:00 AM - 12:30 PM

### Impact of Remote Ischemic Preconditioning Post-application Delay on Muscle Oxygenation during Subsequent Cycling Intervals

Afton Seeley, Jesse S. Brenman, Kevin A. Jacobs, FACSM. *University of Miami, Miami, FL.* (Sponsor: Dr. Kevin A. Jacobs, FACSM)

*(No relevant relationships reported)*

**INTRODUCTION:** Remote ischemic preconditioning (RIPC) involves brief, repeated bouts of manually-imposed blood flow restriction of the arms or legs. The alternating periods of occlusion and reperfusion lead to endothelial adaptations, capable of enhancing blood flow and oxygen delivery. **PURPOSE:** The aim of this study was to investigate the effect of a lower limb RIPC protocol, with either a 5-min or 45-min post-application delay, on muscle oxygen saturation within that same limb at rest and during short-duration intense cycling. **METHODS:** Subjects included recreationally aerobically trained college-aged students (23± 3 years, 173.5± 5.4 cm, 69.2± 4.0 kg, 15.2± 4.0 % BF, $VO_{2peak}$: 46.6± 1.1 mL•kg$^{-1}$•min$^{-1}$ at 215± 19 W). All subjects randomly completed four experimental trials: RIPC with 5-min delay, RIPC with 45-min delay, SHAM with 5-min delay, and SHAM with 45-min delay. For the RIPC conditions, each subject received 5-min of alternating-leg blood flow occlusion using a blood pressure cuff (220 mmHg) placed on the upper thighs for a total of 40 min. After a 5 or 45-min delay, the subjects completed 5, 1-min cycle sprints separated by 2 min of recovery. The SHAM conditions were identical to the RIPC, however, subjects laid supine for the same 40-min duration with alternating-leg cuff inflation to 20 mmHg. Muscle oxygen saturation was measured continuously using a portable NIRS-based sensor placed over the vastus lateralis (VL). **RESULTS:** RIPC decreased muscle oxygen saturation in the VL in a replicable manner (MD: 29.5± 13.4%, mean occlusion slope: -5.0± 2.4 %•min$^{-1}$, mean reperfusion slope: 38.5± 22.4%•min$^{-1}$) while SHAM conditions left muscle oxygen saturation largely unchanged (MD: 2.9± 1%). Mean VL oxygen saturation (RIPC45:71.9± 0.7%; RIPC5: 67.3± 1.7%; SHAM45: 72.0± 4.4%; SHAM5: 69.9± 3.0%) and preservation of muscle oxygen saturation (MD: RIPC45: -12.4± 6.2%; RIPC5: -14.4± 9.9%; SHAM45: -11.6± 6.4%; SHAM5: -13.0± 7.1%) during high intensity cycling intervals varied minutely between experimental conditions. **CONCLUSIONS:** The muscle oxygenation response during a standard occlusion/reperfusion protocol may lack assumed constancy. Furthermore, the use of RIPC and the length of the delay following RIPC did not greatly alter the muscle oxygenation response to repetitive high-intensity cycling intervals.

2240 Board #76 June 1 11:00 AM - 12:30 PM

### Effects Of Aerobic Exercise Habit On Age-related Arterial Stiffening: A 10-year Longitudical Study

Jun Sugawara, Tsubasa Tomoto, Naohiro Noda. *National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan.*

*(No relevant relationships reported)*

Increased arterial stiffness has emerged as a strong predictor of future cardiovascular events and all-cause mortality. Cross-sectional studies and the relatively short-term exercise intervention studies suggested that regular aerobic exercise can restore and improve arterial stiffness. However, long-term longitudinal studies examining the effects of regular physical activity have been sparse. **PURPOSE**: The aim of this study was to elucidate influences of regular physical activity on age-related arterial stiffening through a 10-year longitudinal study. **METHODS**: A decadal change in brachial-ankle pulse wave velocity (baPWV), an index of arterial stiffness, was evaluated retrospectively among 92 volunteers (63 ± 14yrs, 51 men). Regular physical activity level over the past year was evaluated with a semi-structured interview via a questionnaire. Based on the distribution of aerobic exercise volume, subjects were divided into three groups: engaging <5 METs·h/wk (LO, n=50), 5-15 METs·h/wk (MID, n=24), and >15 METs·h/wk (HI, n=18) of aerobic exercise. **RESULTS**: baPWV was significantly elevated in the LO and MID groups (P<0.0001, for both), whereas it tended to increase in the HI group (P=0.06). The HI group exhibited a significantly smaller decadal increase in baPWV (+0.7±1.4 m/sec) than those in the LO and MID groups (+1.8±1.5 m/sec and +2.0±1.6 m/sec, respectively). These differences remained significant after the adjustment for confounding factors including the baseline baPWV and current age. **CONCLUSIONS**: Our current longitudinal study suggests that regular sufficient aerobic exercise attenuates age-associated increases in arterial stiffness.

2241 Board #77 June 1 11:00 AM - 12:30 PM

### Body Mass Index Does Not Influence the Endothelial Response to Acute Inflammation

Elizabeth C. Schroeder[1], Abbi D. Lane-Cordova[2], Sushant M. Ranadive[3], Tracy Baynard, FACSM[1], Bo Fernhall, FACSM[1]. *[1]University of Illinois at Chicago, Chicago, IL. [2]University of South Carolina at Columbia, Columbia, SC. [3]University of Maryland, College Park, MD.* (Sponsor: Bo Fernhall, FACSM)

*(No relevant relationships reported)*

Acute and chronic inflammation are associated with an increased risk of cardiovascular (CV) events in older adults and reduced endothelial function (flow-mediated dilation; FMD). Obesity is also associated with greater inflammation. Whether this greater inflammatory state in overweight/obese individuals plays a role in the endothelial response during acute inflammation is unknown. **Purpose:** To evaluate the role of obesity status in the endothelial response to acute inflammation in younger (YA) and older (OA) adults. **Methods:** An influenza vaccine was used to induce acute inflammation in 25 YA (13 male, 26±4 yrs) and 56 OA (18 male, 65±5 yrs). Blood pressure, FMD and serum inflammatory markers were measured before vaccination and 24 and 48-hours after. Participants were divided into normal weight (NW) (body mass index, BMI: 18-25 kg/m$^2$) and overweight/obese (O/OB) (BMI >25 kg/m$^2$) for analysis. **Results:** See table. All groups increased IL-6 at 24-hours ($p<0.01$), which returned to baseline at 48. CRP was elevated at 24- and 48-hours in all groups except NW OA (p for interaction = 0.04). Endothelial function (FMD) was reduced at 24- and 48-hours ($p<0.01$) in all groups. During the inflammatory bout, NW and O/OB YA had a greater FMD than both NW and O/OB OA ($p<0.02$). **Conclusion:** It does not appear body mass index influences the endothelial response during acute inflammation in YA or OA. In our sample, these results may be due to the similar baseline level of inflammatory markers between the NW and O/OB in each age category. Future studies are required to further investigate this relationship.

| | YA – Normal Weight | YA – Overweight/ Obese | OA – Normal Weight | OA – Overweight/ Obese |
|---|---|---|---|---|
| n | 15 | 10 | 18 | 38 |
| Age, yrs. | 26 ± 3 | 25 ± 5 | 66 ± 5 | 64 ± 5 |
| BMI, kg/m$^2$ | 21.6 ± 1.9 | 28.1 ± 2.3[1] | 22.4 ± 3.9[2] | 30.5 ± 4.5[13] |
| MAP, mmHg | 79 ± 9 | 88 ± 9 | 89 ± 11[1] | 90 ± 10[1] |
| CRP, mg/L*^ | | | | |
| Baseline | 0.7 ± 0.6 | 1.0 ± 0.7 | 2.7 ± 2.7[1] | 2.9 ± 3.1[1] |
| 24h | 1.6 ± 1.2 | 2.5 ± 1.0 | 2.8 ± 3.0 | 3.9 ± 3.5 |
| 48h | 2.5 ± 2.4 | 3.0 ± 2.4 | 3.7 ± 3.8 | 4.0 ± 3.3 |
| IL-6, pg/mL* | | | | |
| Baseline | 0.8 ± 0.5 | 1.0 ± 0.7 | 1.5 ± 1.3 | 1.7 ± 1.3[1] |
| 24h | 1.4 ± 0.7 | 2.1 ± 1.5 | 1.9 ± 1.2 | 2.4 ± 2.2 |
| 48h | 0.8 ± 0.4 | 1.2 ± 0.9 | 1.6 ± 1.2 | 2.0 ± 2.1 |
| FMD, %*~ | | | | |
| Baseline | 12.9 ± 4.5 | 8.8 ± 2.6 | 6.6 ± 3.9[1] | 6.0 ± 2.5[1] |
| 24h | 9.8 ± 3.1 | 7.2 ± 3.6 | 4.0 ± 3.6 | 5.7 ± 3.1 |
| 48h | 8.9 ± 2.9 | 7.6 ± 3.1 | 4.3 ± 2.3 | 5.0 ± 2.9 |

Data presented as mean ± standard deviation. BMI: Body mass index; CRP: C-reactive protein; FMD: Flow mediated dilation; IL-6: interleukin-6, MAP: mean arterial pressure

[1]$p<0.05$ vs. normal weight young adults; [2]$p<0.05$ vs. overweight/obese young adults; [3]$p<0.05$ vs. normal weight older adults

*overall time effect, $p<0.05$; ~overall group effect, $p<0.05$; ^group*time interaction effect, $p<0.05$

2242 Board #78 June 1 11:00 AM - 12:30 PM

### Evidence of Racial Differences in Microvascular Function Among College-Aged Women

Jordan C. Patik, Bryon M. Curtis, Aida Nasirian, Guillermo Olvera, R. Matthew Brothers. *University of Texas Arlington, Arlington, TX.*

*(No relevant relationships reported)*

Microvascular dysfunction contributes to the development of hypertension and insulin resistance. The black population is at an elevated risk of both conditions relative to other racial groups. Previous studies indicate that college-aged black men, compared to their white counterparts, exhibit impaired microvascular function as assessed by post-occlusion reactive hyperemia (RH). It is unknown whether this racial disparity is present in healthy, young adult black (BW) and white women (WW). Furthermore, whether nitric oxide-mediated cutaneous microvascular hyperemia during local heating

(LH) is different in these populations has not been determined. **PURPOSE**: The purpose of this study was to test the hypothesis that college-aged BW exhibit blunted RH and attenuated LH induced cutaneous hyperemia compared to age-matched WW. **METHODS**: College-aged BW (n=7) and WW (n=7) were studied during the early follicular phase of the menstrual cycle. For RH, brachial artery diameter and blood velocity were measured via Doppler ultrasound before and after 5 min of forearm occlusion. For LH, a microdialysis membrane was inserted in the dermis of the forearm and perfused with Ringer's solution. Red blood cell flux was assessed with laser Doppler after ~40 min of continuous 39ºC LH. Maximal flux was established with 28 mM sodium nitroprusside infusion and 43ºC LH. Brachial BP was measured throughout the protocol and cutaneous vascular conductance (CVC) was calculated as flux / MAP and reported as % of max CVC.
**RESULTS**: WW and BW were matched for age (21 ± 3 vs 20 ± 1 y, P = 0.58) and BMI (23 ± 2 vs 23 ± 3 kg/m$^2$, P = 0.94). There were no differences between WW and BW in baseline blood velocity (23.1 ± 5.7 vs 24.4 ± 11.6 cm/s, P = 0.79) or blood flow (98.9 ± 38.3 vs 114.5 ± 80.7 ml/min, P = 0.65). WW and BW also had similar peak blood velocity (109.2 ± 13.8 vs 109.7 ± 28 cm/s, P = 0.97), peak blood flow (453.7 ± 164.7 vs 482.5 ± 187.7 ml/min, P = 0.77), and total blood flow AUC during the 120 s after cuff release (487.4 ± 178.5 vs 486.8 ± 190.1 ml, P = 0.99). However, compared to WW, BW had a significantly blunted CVC during 39ºC LH (66 ± 17 vs 45 ± 10 %max, P = 0.02).
**CONCLUSIONS**: BW had blunted blood flow responses to LH compared to WW despite similar blood velocity and flow responses during RH. This suggests that LH is more sensitive than RH to early impairments in microvascular function.

2243 Board #79 June 1 11:00 AM - 12:30 PM

### Impact of Aerobic Capacity on Prolonged Sitting-Induced Vascular Dysfunction

Jennifer Weggen, Austin Hogwood, Richard Fralin, Kathryn LaRosa, Austin Michael, Ryan Garten. *Virginia Commonwealth University, Richmond, VA.*

*(No relevant relationships reported)*

Prolonged sitting has been reported to have deleterious effects on lower limb vascular function. High amounts of aerobic fitness are associated with positive vascular adaptations that could potentially provide a protective effect on this sitting-induced vascular insult. PURPOSE: This study examined the effect of aerobic capacity on vascular function after a bout of prolonged sitting. METHODS: Ten young (25 ±3 yrs) aerobically trained subjects (VO2max: 52 ±7 ml/kg –1min –1) and ten young (23 ±2 yrs) sedentary (VO2max: 38 ±5ml/kg –1min –1) subjects matched for age and gender were recruited for the study. During the prolonged sitting session, vascular function, via passive leg movement (PLM), was measured at baseline, 1.5 hours and 3 hours with Doppler ultrasonography. RESULTS: Vascular function data obtained prior to sitting revealed no significant difference between the high (HAC) and low (LAC) aerobic capacity groups. Independent of group, vascular function was significantly reduced after 1.5 and 3 hours of prolonged sitting, determined by Δ Peak LBF and LBF AUC. Interestingly, no significant between–group differences were revealed in Δ Peak LBF or LBF AUC at 1.5 hours [Δ Peak LBF (LAC: –370 ±317 ml·min-1; HAC: –167 ±258 ml·min –1; p>0.05), LBF AUC (LAC: -149 ±201 ml·min –1; HAC: –94.7 ±90 ml·min –1; p>0.05), or at 3 hours [Δ Peak LBF (LAC: –373 ±268 ml·min –1; HAC: -243 ±299 ml·min –1; p>0.05), LBF AUC (LAC: –119 ±202 ml·min –1; HAC: -91 ±132 ml·min –1); p>0.05]. CONCLUSION: This study found that aerobic capacity did not mitigate the vascular dysfunction resulting from prolonged sitting.

2244 Board #80 June 1 11:00 AM - 12:30 PM

### The Effect of Lower Body Aerobic Exercise on Forward and Backward Pressure Wave Amplitude

Joseph M. Stock, David G. Edwards. *University of Delaware, Newark, DE.*

*(No relevant relationships reported)*

In young healthy adults, acute lower body aerobic exercise increases central systolic blood pressure (cSBP) and central pulse pressure (cPP) while a reduction in cSBP and cPP are observed post-exercise. Exercise induces alterations in surrogate measures of wave reflection, augmentation pressure (AP) and index (AI), suggesting that exercise reduces wave reflection. However, wave separation analysis provides a more comprehensive method to examine relative contributions of the forward pressure wave (Pf), backward pressure wave (Pb), and reflection magnitude (RM = Pb/Pf) to central pressure. **Purpose:** To determine the effect of acute exercise on Pf, Pb, and RM using wave separation analysis. **Methods:** Applanation tonometry was performed to record radial artery pressure waveforms in 13 young (25 ± 4 years) male (n=8) and female (n=5) subjects during seated rest, incremental recumbent cycle exercise at 40, 50, and 60% age-predicted HR max, and 5 and 10-minute seated post-exercise. Radial waves were calibrated to respective brachial mean and diastolic pressure. Central pressure waves were synthesized from the calibrated radial pressure wave using a generalized transfer function. Pf, Pb, and RM were derived via wave separation analysis utilizing a modified triangular flow wave. Data were analyzed by repeated measures ANOVA with post-hoc analyses when appropriate. **Results:** As expected, cSBP and cPP were increased during exercise ($p < 0.05$) while AP and AI were reduced ($p < 0.05$). Additionally, cSBP, cPP, AP, and AI were reduced post-exercise ($p < 0.05$). Pf was increased at 40, 50, and 60%HRmax vs rest (27.6 ± 1.0, 38.7 ± 2.8, 44.2 ± 1.9 vs 24.3 ± 1.2mmHg, $p < 0.05$). Pb was increased at 60%HRmax vs rest (15.6 ± 1.3mmHg vs 13.2 ± 0.9mmHg, $p < 0.05$) and was reduced at 10-minute post-exercise vs rest (9.7 ± 0.9 vs 13.2 ± 0.9mmHg, $p < 0.05$). Lastly, RM was reduced at 50, 60%HRmax, 5 and 10-minute post-exercise vs. rest (32.8 ± 1.9, 34.8 ± 2.1, 40.0 ± 1.5, 41.4 ± 1.4 vs 52.7 ± 3.3%, $p < 0.05$). **Conclusion:** RM is reduced during lower body aerobic exercise coupled with an increase in Pf while a decrease in RM is maintained post-exercise as a result of a decrease in Pb. These findings suggest that the increase in exercising cSBP and cPP during exercise is driven by increased Pf while post exercise reductions in cSBP and cPP may be a result of reduced Pb.

2245 Board #81 June 1 11:00 AM - 12:30 PM

### Resistance Exercise on Pulse Wave Reflection and Arterial Stiffness Between Trained and Untrained Individuals

Jason C. Parks, Erica M. Marshall, Yu Lun Tai, Alaina Glasgow, Leslie Sensibello, Kathryn Geither, J. Derek Kingsley, FACSM. *Kent State University, Kent, OH.*

*(No relevant relationships reported)*

Pulse wave reflection [augmentation index (AIx), augmentation pressure (AP)], and arterial stiffness [pulse wave velocity (PWV)] are indicative of cardiovascular health. Acute resistance exercise (RE) alters pulse wave reflection, and arterial stiffness, but responses in resistance-trained individuals is unclear. **PURPOSE:** To examine the responses in pulse wave reflection and arterial stiffness after RE in resistance-trained (RT) versus untrained (UT) individuals. **METHODS:** Twenty-one (RT: n=14; UT: n=7) individuals volunteered. Pulse wave reflection and arterial stiffness were collected at rest, and 10min following a control, or RE consisting of 3 sets of 10 repetitions at 75% 1-repetition maximum (1RM) on the leg press, lat pulldown, leg extension, chest press and leg curl. A 2x2x2 ANOVA was used to examine group (RT, UT) differences across conditions (RE, control) and time (Rest, Recovery). **RESULTS:** The groups were similar ($p > 0.05$) for age, height, and BMI, but not weight ($p < 0.05$). The 1RMs for all exercises, except leg extension ($p = 0.26$), were different between groups. At rest, the groups were statistically different for the tension-time index [TTI (RT: 1999±282ms; UT: 2192±209ms, p=0.04)], diastolic pressure-time index [DPTI (RT: 2817±316ms; UT: 3047±171ms, p=0.003)], and PWV (RT: 5.5±0.7m/s; UT: 6.3±0.4m/s, p=0.0001). There were significant time by condition interactions for aortic pulse pressure (Rest: 34±6mmHg; Recovery: 37±8mmHg, p=0.01), AP (Rest: 5±3mmHg; Recovery: 6±5mmHg, p=0.003), AIx normalized at 75bpm (Rest: 8.7±12.6%; Recovery: 16.4±6.0%, p=0.004), and TTI (Rest: 2084.6±273.4ms; Recovery: 2760.9±463.3ms, p=0.0001) such that they increased during recovery, compared to rest after RE, and the control. There were condition by time interactions for DPTI (Rest: 2889.6±297.0ms; Recovery: 2394.9±458.3ms, p=0.005) and subendocardial viability ratio SEVR (Rest: 138.4±19.3%; Recovery: 86.6±33.0%, p=0.006) such that they increased after acute resistance exercise, compared to rest and the control. There were no significant changes in arterial stiffness. **CONCLUSION**: These data suggest that resistance-trained individuals have reduced workload of the heart and lower arterial stiffness at rest, but are similar to untrained individuals after acute resistance exercise.

2246 Board #82 June 1 11:00 AM - 12:30 PM

### Effect of a High Fat Meal on Blood Flow and Endothelial Function during Passive Leg Movement

Morgan M. Monahan, Zakaria Alyousif, Britton C. Scheuermann, Timothy R. Rotarius, Christopher R. Silette, Barry W. Scheuermann. *The University of Toledo, Toledo, OH.*

*(No relevant relationships reported)*

Passive leg movement (PLM) leads to a significant increase in femoral artery blood flow (FABF). Recent studies suggest that the increase in FABF during PLM is mediated by the bioavailability of nitric oxide (NO) since inhibition of NO attenuates the FABF response. PLM has been gaining popularity as a simple, reliable method for assessing endothelial function. Since the consumption of a high fat meal (HFM) has been shown to induce endothelial dysfunction, investigators have used a HFM to demonstrate the therapeutic benefits of exercise, anti-inflammatories and anti-oxidants on endothelial function. Consumption of a HFM on the FABF response to PLM has not been previously examined but may prove useful in determining endothelial function in healthy and diseased populations. **PURPOSE:** To examine the effect of consuming a single HFM on FABF during PLM. It was hypothesized that consumption of a HFM would attenuate the FABF response compared to control, consistent with impaired endothelial function. **METHODS:** Eight healthy (31.8 ± 4.2 yrs, (±SEM)) men (n=5) and women (n=3) reported to the laboratory following a 12 h fast and no exercise. PLM was accomplished using an isokinetic (Biodex) machine which allowed the lower leg to move through 90° range of motion at 30 cycles/min. Femoral artery blood velocities (FABV) were measured continuously at baseline (60 s) and during PLM

(120 s) using Doppler ultrasound. FABF was calculated using the arterial diameter measured at baseline. Each subject consumed a HFM consisting of 90 g total fat (63 g saturated fat), 364 mg cholesterol, 17 g carbohydrate, and 139 mg sodium and after 2 hrs of rest, subjects returned to the isokinetic machine and completed a second PLM trial. **RESULTS:** Consumption of a HFM did not lead to any differences in baseline FABF (Pre-HFM, 139.1 ± 21.0 ml/min; Post-HFM, 165.8 ± 44.3 ml/min; p>0.05). Similarly, the peak FABF responses were not different (p>0.05) between Pre-HFM (301.1 ± 40.8 ml/min) and Post-HFM (359.3 ± 73.3 ml/min). **CONCLUSION:** In contrast to our hypothesis and in comparison to previous studies demonstrating a decrease in endothelial function following consumption of a HFM, we did not observe blunted FABF during PLM. The reason(s) for this discrepancy is not readily apparent but warrants further investigation if PLM is to be used to assess endothelial health.

2247 Board #83 June 1 11:00 AM - 12:30 PM

### Cardiorespiratory Fitness And Menopausal Symptoms: Effects On Quality Of Life And Cardiovascular Disease Risk

Sarah Witkowski[1], Corinna Serviente[2], Melody Chalvin[2]. *[1]Smith College, Northampton, MA. [2]University of Massachusetts, Amherst, MA.* (Sponsor: Jane Kent, FACSM)

*(No relevant relationships reported)*

Menopausal symptoms lead to reduced quality of life (QOL). Hot flashes have been associated with CVD risk and endothelial function. Aerobic fitness may improve QOL and endothelial function; however, these relationships are still unclear. **PURPOSE:** To determine if aerobic fitness is related to QOL, menopausal symptoms, and endothelial function in peri- (PERI), and post-menopausal (POST) women. **METHODS:** Healthy high- and low-fit PERI (HIGH n=9; LOW n= 6), and late POST (HIGH n=10; LOW n=8) women self-reported QOL (Utian questionnaire) and menopausal symptoms. Women were classified into fitness categories via treadmill $VO_{2max}$ test ($VO_{2peak}$; HIGH 47.3±1.79ml/kg/min; LOW 29.1±0.95ml/kg/min). Brachial artery flow-mediated dilation (FMD) was assessed before and after treadmill exercise (30min, 60-64% $VO_{2peak}$). Associations between menopausal status, symptoms, fitness, and FMD were analyzed using Chi-squared or Fisher's Exact Tests. The influence of fitness, menopausal status and symptoms on QOL was evaluated with a 3x2 ANOVA. **RESULTS:** There was an association between menopausal symptoms and menopausal status (p=0.053, Phi=0.314). Menopausal symptoms were related to fitness (p=0.006) and menopausal status (p=0.029) such that a greater percentage of HIGH PERI women reported symptoms compared to LOW PERI women (HIGH PERI 100% vs. LOW PERI 46%). There was an effect of fitness on overall QOL (HIGH 95.44±2.189; LOW 78.05±2.476, p<0.0001) but not menopausal status or symptoms (p>0.05). High fitness was related to higher QOL for health (HIGH 30.45±0.746; LOW 22.083±0.0853, p<0.0001), occupational (HIGH 27.6±0.999, LOW 24.2±1.13, p=0.032), emotional (HIGH 25.461±0.741; LOW 23.017±0.847, p=0.014), and sexual QOL (HIGH 12.061±0.687; LOW 7.81±0785, p=0.004). There was no difference in pre-exercise (p>0.05), post-exercise (p>0.05), or change in FMD with exercise (p>0.05) in women who did vs. did not experience menopausal symptoms. **CONCLUSIONS:** High aerobic fitness was associated with higher QOL, independent of menopausal status or symptoms. Highly-fit perimenopausal women reported more symptoms compared to low-fit women; however, symptoms did not influence endothelial function or overall QOL in our population. **Funding:** ACSM Doctoral Student Research Grant (Serviente) & UMass Amherst FRG (Witkowski).

2248 Board #84 June 1 11:00 AM - 12:30 PM

### Arginase Activity in Red Blood Cells Is Not Altered with Sub-maximal Exercise.

Mirko Mandić, Anna Strömberg, Adrian Gonon, John Pernow, Eric Rullman, Thomas Gustafsson. *Karolinska Institutet, Stockholm, Sweden.*

*(No relevant relationships reported)*

Nitric oxide (NO) is an important mediator of exercise remodeling. Its role has been highlighted in the promotion of vascular growth as well as in mitochondrial function. While the endothelium has long been thought to be the dominant physiological source of NO, recent work has suggested that red blood cells (RBCs) express the enzyme endothelial nitric oxide synthase (eNOS) and may contribute to total NO production. Within RBCs, the NO production can be decreased by the activity of the enzyme arginase, which competes with eNOS for the substrate L-arginine. **PURPOSE:** The aim of the study was to test the hypothesis that RBC arginase activity is modulated by exercise. **METHODS:** Nine subjects (4 male and 5 females, age; 26±5 years, $VO_2$peak; 54,8±8,1 mL/min/kg) performed a 60-min sub-maximal exercise bout corresponding to 65% of $VO_2$peak. Blood samples were taken at rest (T0), 30 min in to the exercise (T1), directly after exercise (T2), 30 min post-exercise (T3) and 60 min post-exercise (T4). Arginase activity in RBCs was measured by colorimetric determination of urea formed from L-arginine substrate with α-isonitrosopropiophenone as a marker of urea content. **RESULTS:** Contradictory to our initial hypothesis, arginase activity was unaffected by exercise. No changes in urea production (T0; 0.52±0.08, T1; 0.50±0.08, T2; 0.51±0.09, T3; 0.51±0.09 and T4; 0.52±0.08 mM/g Hb, p>0.05) was seen between the resting blood sample and the ones taken during or after exercise. **CONCLUSION:** Arginase activity in RBCs is not modulated by sub-maximal exercise in young healthy subjects. Hence, the increase in eNOS activity and NO production from RBCs with exercise is most likely not explained by a reduced activity of arginase.

2249 Board #85 June 1 11:00 AM - 12:30 PM

### Muscular Strength is Inversely Associated with Central Hemodynamic Load in Young Women.

Keller P. Allison, Wesley K. Lefferts, Jacqueline A. Augustine, Jacob P. DeBlois, Kevin S. Heffernan. *Syracuse University, Syracuse, NY.* (Sponsor: Bo Fernhall, FACSM)

*(No relevant relationships reported)*

Muscular strength is important for overall fitness. Strength is also associated with cardiovascular health; individuals with higher strength have a lower risk of developing hypertension. Muscular strength has been shown to be inversely associated with aortic stiffness, a precursor of hypertension. **Purpose:** Determine the relationship between muscular strength, aortic stiffness, and central hemodynamic load in young women. **Methods:** Seventy-two healthy young women (age 30 ± 14 years, body fat 24.7 ± 8.1 %) underwent muscular strength and vascular testing. Muscular strength was evaluated using a five-repetition maximum bench press and expressed relative to body weight. An aortic blood pressure waveform was derived from the brachial artery via an oscillometric cuff and used to estimate aortic pulse wave velocity (PWV). From this waveform, we also derived measures of central hemodynamic load: augmentation index (AIx@75, at heart rate of 75 bpm), forward wave pressure (Pf) and reflected wave pressure (Pb). Body composition was evaluated using air displacement plethysmography. **Results:** As seen in Table 1, after adjusting for age, mean arterial pressure and body fat, there was a negative correlation between relative strength and Pf (p=0.052), Pb (p<0.05) and PWV (p<0.05). There was a positive correlation between relative strength and AIx (p<0.05). **Conclusion:** Women who have higher relative strength have lower aortic stiffness and lower forward and reflected wave pressure suggesting lower central hemodynamic load. Maintaining strength is important for cardiovascular health in women.

Table 1. Correlation matrix between strength and central hemodynamics controlling for age, mean arterial pressure and body fat

| | Relative Strength | AIx @75 | Pf | Pb |
|---|---|---|---|---|
| AIx@75 | 0.23* | | | |
| Pf | -0.20 | -0.03 | | |
| Pb | -0.23* | 0.21* | 0.80** | |
| PWV | -0.32** | -0.02 | 0.67** | 0.50** |

AIx@75, augmentation index at 75 beats per minute; PWV, pulse wave velocity; Pf, forward wave pressure; Pb, reflected wave pressure (n=72).
**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).

2250 Board #86 June 1 11:00 AM - 12:30 PM

### Comparing Two Low-Intensity Strength Training Modalities on Vasodilatory Capacity in Postmenopausal Women

Salvador J. Jaime[1], Arun Maharaj[2], Stacey Alvarez-Alvarado[3], Arturo Figueroa, FACSM[2]. *[1]University of Wisconsin-La Crosse, La Crosse, WI. [2]Texas Tech University, Lubbock, TX. [3]Florida State University, Tallahassee, FL.* (Sponsor: Arturo Figueroa, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: Dynapenia, the age-related loss in muscle strength, is an emerging risk factor for the development of cardiovascular disease and physical disability. Vasodilatory capacity, both endothelial-dependent reactive (RH) and active hyperemia (AH), are important for adequate blood flow to active muscles. Although high-intensity resistance training (RT) increases mass and strength, there are limited data regarding the effect of low-intensity RT (LIRT) on RH and AH in older adults. We investigated the effects of two low-intensity strength training modalities on RH and AH in postmenopausal women with low muscle strength.
**METHODS**: Thirty-one postmenopausal women were stratified by age, body mass index (BMI), and maximal voluntary contraction (MVC) (age, 65 ± 4 years; BMI, 23.2 ± 2.6 kg/m$^2$; MVC, 17.3 ± 2.7 kg) and randomized into isolated lower-body whole-body vibration training (WBVT) (n=12), LIRT (n=11) or control (n=8) groups for 12 weeks. Brachial and popliteal diameter, mean blood velocity, blood flow during RH (flow-mediated dilation, FMD) and AH after 6-minute walk test, and strength on the leg press (LP), flexion (LFlex), and extension (LExt) were measured at baseline and 12 weeks.

**RESULTS**: WBVT and LIRT similarly improved brachial (systemic) and popliteal (local) vasodilation compared to control ($P < 0.01$). Additionally, WBVT elicited a greater popliteal artery vasodilatory response (4.9 ± 1.4 %, $P = 0.007$) post-6MWT compared to no change in control. LIRT had no effect on post-6MWT popliteal artery vasodilatory response. WBVT and LIRT elicited similar increases in LP and LFlex strength compared to control ($P < 0.01$); however, WBVT induced a greater increase (19.2 ± 3.7%) in LExt strength compared to the LIRT (8.4 ± 2.6%, $P = 0.007$) and control groups. The increases in brachial FMD were correlated to the increases in LExt and LFlex strength ($r = .37$, $P = 0.04$ and $r = .37$, $P = 0.04$; respectively). **CONCLUSIONS**: WBVT and LIRT elicited significant improvements in brachial FMD, which were related to the increases in leg strength. However, despite similar improvements in brachial and popliteal FMD, WBVT may be a more efficacious for improvements of leg post-exercise vasodilation and muscular strength than LIRT in non-obese postmenopausal women.

2251 Board #87 June 1 11:00 AM - 12:30 PM

## Prolonged Standing Increases Lower Peripheral Arterial Stiffness Independent Of Walking Breaks

Aaron R. Caldwell, Benjamin T. Harris, Megan E. Rosa-Caldwell, Marcus Payne, Bryce Daniels, Kaitlin M. Gallagher, FACSM, Matthew S. Ganio, FACSM. *University of Arkansas, Fayetteville, AR.*

*(No relevant relationships reported)*

Prolonged sitting creates an atherogenic environment that causes reductions in arterial function. Standing desks have been promoted as a healthy alternative to sitting, but the cardiovascular benefits of standing desks have not been thoroughly investigated. Physical activity, such as taking walking breaks, increases shear stress, and thereby prevents sitting-induced reductions in arterial function. Therefore, walking breaks, even when compared to standing may provide cardiovascular benefits **PURPOSE:** First, to observe changes in arterial stiffness, as assessed by pulse wave velocity (PWV), with a 2 hour bout of standing. Second, to determine if short, intermittent walking bouts provide a comparative advantage to standing alone. **METHODS:** 20 apparently healthy adults (BMI = 22.9 ± 3.2 kg/m$^2$; Age = 21 ± 5 years old) stood for 2 consecutive hours while being assessed for heart rate (HR), mean arterial pressure (MAP), and central ($C_{PWV}$), upper peripheral ($U_{PWV}$), and lower peripheral ($L_{PWV}$) PWV before, during, and after the standing bout. Subjects participated in two trials in a randomized order. In one trial, the subjects stood at a standing desk immobile for 2 hours. In the other trial, subjects performed 5 minute walking breaks after every 25 minutes of standing for a total of two hours of standing with 4 walking breaks. **RESULTS:** There was no time by trial interaction for any measure of arterial stiffness (p = 0.82, p = 0.21, and p = 0.15; for $C_{PWV}$, $U_{PWV}$, and $L_{PWV}$ respectively). However, from beginning to end of each trial $L_{PWV}$ increased 85 ± 126 cm/s independent of trial (i.e., main effect of time; p < 0.001). There was a non-significant tendency for greater increases in $L_{PWV}$ during the standing (120 ± 142 cm/s) versus the walking trial (50 ± 127 cm/s; p = 0.15). Changes in HR and MAP were not dependent on time or trial (i.e., non-significant interaction time; p = 0.20 & p = 0.39, for HR and MAP, respectively). **CONCLUSION:** Standing for 2 hours leads to increases in peripheral arterial stiffness. Walking breaks during 2 hours of standing did not significantly attenuate these changes. However, the suggestive evidence (p=0.15) for walking breaks to improve $L_{PWV}$ suggests that future studies should investigate longer duration trials and/or longer walking breaks that are applicable to occupational settings, such as assembly-line work.

2252 Board #88 June 1 11:00 AM - 12:30 PM

## Hydrogen Sulfide Does Not Functionally Contribute to Acetylcholine-Mediated Vasodilation in Young Healthy Adults

Sean Shank, Jody Greaney, Lacy Alexander, FACSM. *Penn State University, University Park, PA.* (Sponsor: Lacy M. Alexander, FACSM)

*(No relevant relationships reported)*

Hydrogen sulfide ($H_2S$) is one of several endothelium-dependent vasoactive molecules that contribute to the regulation of vessel function. In the cutaneous vasculature, young adults express enzymes that synthesize $H_2S$, and exogenous delivery of $H_2S$ elicits substantial dilation, suggesting that $H_2S$ may be important for the regulation of vessel function *in vivo*. However, because there are several redundant endothelium-dependent contributors, the functional contribution of endogenous $H_2S$ to dilation in the cutaneous circulation is unclear. **PURPOSE:** To quantify the contribution of $H_2S$ to endothelium-dependent dilation in young adults and pharmacologically determine the primary enzymatic source of $H_2S$ in the microvasculature. We hypothesized that CSE-derived $H_2S$ would mediate a portion of acetylcholine (ACh)-induced dilation. **METHODS:** Four microdialysis fibers were placed in the ventral forearm skin of 10 young adults (22±2 y). Red cell flux was measured (laser-Doppler flowmetry) during graded perfusion of the endothelium-dependent agonist ACh ($10^{-10}$-$10^{-1}$ M) alone and during co-perfusion with D-Penicillamine [10mM DPen; selective inhibitor of the $H_2S$-producing enzyme cystathionine γ-lyase (CSE)], aminooxyacetic acid [8mM AOAA; inhibitor of $H_2S$-producing enzymes CSE and cystathionine β-synthase (CBS)], and a combination of DPen+AOAA. Cutaneous vascular conductance (CVC=flux·mmHg$^{-1}$) was expressed as a percent of maximal CVC ($CVC_{max}$, 28 mM sodium nitroprusside + local heat 43º C). Sigmoidal dose-response curves were generated and the $logEC_{50}$ was used as an index of vessel sensitivity. **RESULTS:** ACh elicited endothelium-dependent dilation in all subjects (82.9±4.3% $CVC_{max}$; P<0.05). CSE inhibition alone or combined CSE/CBS inhibition had no effect on ACh-induced dilation (ACh: -4.1±0.5; DPen -3.2±0.5; AOAA -3.3±0.7; Combo -2.6±0.4; P>0.05). **CONCLUSION:** $H_2S$ does not appear to have a functional role in mediating cutaneous dilation in response to ACh in young adults. Despite the ability to synthesize $H_2S$ it is likely that other redundant mechanisms, including nitric oxide, mask any functional contribution of $H_2S$ to endothelium-dependent agonists in the cutaneous circulation of young adults.

2253 Board #89 June 1 11:00 AM - 12:30 PM

## Associations Between Leg Lean Mass And Arterial Function In Pre-menopausal And Post-menopausal Women.

Stephen Fischer, Arturo Figueroa, FACSM, Youngdeok Kim, Joaquin Gonzales. *Texas Tech University, Lubbock, TX.* (Sponsor: Arturo Figueroa, FACSM)

*(No relevant relationships reported)*

Vascular dysfunction has been associated to sarcopenia, the age-related impairment in skeletal muscle mass, strength, and performance, in postmenopausal women. Previous research has shown inverse relationships between leg lean mass (LM) and arterial stiffness (measured as pulse wave velocity, PWV) or pressure wave reflection (augmentation index, AIx) in men and women. AIx is an appropriate vascular marker in young but not middle-age/older adults, especially in women. **PURPOSE**: To examine the associations between leg LM and arterial function (cfPWV and aortic AIx adjusted to 75bpm (AIx@75) in pre-menopausal (PRE-M) and post-menopausal (POST-M) women. **METHODS**: 47 women (24 PRE-M, age 36 ± 4 years; 23 POST-M, age 69 ± 4 years) participated in this study. Leg LM (expressed as kg/m$^2$) was measured by DEXA. cfPWV and AIx@75 were measured using applanation tonometry. The relationship between both cfPWV and AIx@75 to leg LM were analyzed using multiple linear regression analysis by each group. Results are reported as mean ± SD and unstandardized regression coefficient (*b*). **RESULTS**: cfPWV (9.0 ± 1.3 m/sec vs. 6.9 ± 0.9 m/sec, $p < .001$) and AIx@75 (29.3 ± 5.3% vs. 18.1 ± 8.7%, $p < 0.001$) were significantly greater in POST-M compared to PRE-M. Leg LM was significantly lower in POST-M compared to PRE-M (4.30 ± 0.32 kg/m$^2$ vs. 4.67 ± 0.47 kg/m$^2$, $p = 0.003$). Leg LM was inversely associated with cfPWV ($b = -2.07$, p = 0.02) when adjusted for body mass index (BMI) in POST-M. This inverse association remained after adjustment for brachial systolic blood pressure (BSP), fasting blood glucose (FBG), and waist circumference (WC) ($b = -1.884$, $p = 0.02$). Leg LM was not associated with cfPWV in PRE-M. Leg LM was inversely associated with AIx@75 ($b = -9.95$, $p = 0.01$) in PRE-M when adjusted for BMI. The inverse association remained after adjusting for BSP, FBG and WC ($b = -10.52$, $p = 0.02$). No association was found between leg LM and AIx@75 in POST-M. **CONCLUSIONS**: Our findings suggest that low leg LM may adversely affect pressure wave reflection in PRE-M and aortic stiffness in POST-M. Future studies will be necessary to investigate the potential benefits of strength training on arterial function in non-obese POST-M and PRE-M.

2254 Board #90 June 1 11:00 AM - 12:30 PM

## Increased Serum Irisin Level By Aerobic Training Is Involved In NO Production In Obese Rats

Kenichiro Inoue[1], Shumpei Fujie[1], Natsuki Hasegawa[1], Naoki Horii[1], Kiyoshi Sanada[1], Takafumi Hamaoka, FACSM[2], Motoyuki Iemitsu[1]. *[1]Ritsumeikan University, Kusatsu, Japan. [2]Tokyo Medical University, Shinjuku, Japan.* (Sponsor: Takafumi Hamaoka, FACSM)

*(No relevant relationships reported)*

INTRODUCTIN: Aerobic exercise training reduces arterial stiffness mediated by nitric oxide (NO)-derived vasodilation in obese patients. Irisin is mainly expressed in myocytes and promotes NO release by regulating endothelial nitric oxide synthase (eNOS) expression, leading to vasodilation. Although exercise accelerates irisin secretion, the involvement of irisin in the mechanism of exercise effect on arterial stiffness in obese patients remains unclear. PURPOSE: This study aimed to clarify whether aerobic exercise training-induced elevation of irisin secretion is associated with reduced arterial stiffness with elevation of NO production in obese rats. METHODS: 20-week-old male obese (OLETF) rats were randomly divided into two groups; 8-week sedentary control (CON) and aerobic exercise training (AT; treadmill running for 60min at 25m/min, 5days/week). After 8-week, in each group, we assayed aortic pulse wave velocity (PWV) as an indicator of arterial stiffness, and the aorta and gastrocnemius muscle were isolated after collection of blood. RESULT: Aortic

PWV in OLETF-AT group significantly decreased as compared with OLETF-CON group. Aortic Akt and eNOS phosphorylation and plasma nitrate/nitrite (NOx) level significantly increased in OLEFT-AT group. Additionally, the significant increased muscle FNDC5 protein expression and serum irisin level in aerobic exercise training group were observed. Circulating irisin level was positively correlated with aortic phosphorylation eNOS ($p<0.05$, $r=0.756$) and circulating NOx level ($p<0.05$, $r=0.697$). Additionally circulating NOx level was negatively correlated with aortic PWV ($p<0.05$, $r=-0.695$). CONCLUSION: These results suggest that aerobic exercise training-induced acceleration of irisin secretion may be involved in the reduced arterial stiffness in obese rats. Moreover, as its underlying molecular mechanism, irisin release via increased muscle FNDC5 expression may be involved in aortic eNOS activation, leading to reduction of arterial stiffness via NO-derived vasodilation. Supported by Grants-in-Aid for Scientific Research (#17H02183, #16K13059, M. Iemitsu)

2255 Board #91 June 1 11:00 AM - 12:30 PM

### Cardiovascular Responses To Steady State Exercise In Well-healed Burned Survivors After Six Months Of Exercise Training

Gilbert Moralez[1], Steven A. Romero[2], Matthew N. Cramer[1], Amy N. Adams[1], Manall F. Jaffery[1], Mu Huang[1], Craig G. Crandall, FACSM[1]. *[1]Institute for Exercise and Environmental Medicine Texas Health Presbyterian Hospital Dallas, Dallas, TX. [2]University of North Texas Health Science Center, Fort Worth, TX.* (Sponsor: Craig G. Crandall, FACSM)

*(No relevant relationships reported)*

Aerobic exercise is an important component of rehabilitation in burn survivors, but no studies to date have examined whether burn survivors demonstrate cardiovascular adaptations to long-term training. It is well established that exercise training reduces heart rate at rest and during steady-state exercise in non-burned individuals. **PURPOSE:** To test the hypothesis that six months of aerobic exercise training reduces heart rate at rest and during two workloads of steady-state cycling in well-healed burn survivors. **METHODS:** Ten participants (7 males; aged 43 ± 14 years) with well-healed burn injuries covering an average total body surface area of 52±25% (range: 22-88%) participated in a progressive 6-month aerobic-focused exercise training regimen. Heart rate responses were obtained at rest and during two steady-state submaximal cycling workloads (SS1; 50 W) and (SS2; 75 W) prior to and after exercise training. **RESULTS:** Six months of exercise training tended to decrease resting heart rate (Pre, 77 ± 15 bpm vs Post, 70 ± 11 bpm, P=0.09)**.** During both workloads, heart rate was ~ 10 bpm lower post training (50W: pre 100 ± 26 bpm, post 90 ± 18 bpm, P=0.02; 75W: pre 113 ± 33 bpm, post 101 ± 23 bpm, P<0.01). **CONCLUSION:** These data show that cardiovascular adaptations to long-term aerobic exercise training can be obtained in well-healed burned subjects. Work funded by NIH GM068865

2256 Board #92 June 1 11:00 AM - 12:30 PM

### Repeated Bouts of Passive Limb Movement Result in a Sustained Hyperemic Response in Those with Paraplegia

Keith J. Burns[1], Brandon S. Pollock[1], Jon Stavres[2], John McDaniel[3]. *[1]Walsh University, North Canton, OH. [2]Penn State University, Hershey, PA. [3]Kent State University, Kent, OH.*

*(No relevant relationships reported)*

Previous studies have reported passive limb movement (PLM) could be used as a modality to increase blood flow and tissue perfusion in the paralyzed lower limbs of those with spinal cord injuries. However, the hyperemic response to PLM observed in these studies transient, lasting only 30-45 seconds despite continued limb movement. No studies have sought to determine if this hyperemic response can be sustained by using repeated bouts of PLM interspaced with recovery periods. **PURPOSE**: To investigate the feasibility of repeated bouts of PLM to invoke a sustained hyperemic response in those with paraplegia.

**METHODS**: Nine paraplegics with a clinically confirmed complete injury between the 3rd and 11th thoracic vertebra underwent 5 bouts of PLM. Each bout was 60 seconds in duration and the PLM was performed at a rate of 1 Hz and there was 60 seconds of recovery between each bout. Heart rate (HR), mean arterial pressure (MAP), femoral artery blood flow (FABF) and skin blood flow (SBF) above the vastus lateralis muscle were continually measured.

**RESULTS**: No change in HR ($p=0.81$) or MAP ($p=0.40$) were observed during any of the bouts of PLM. FABF showed a robust and sustained hyperemic response with increases in blood flow of 85±103%, 71±87%, 79±%90%, 76±87% and 88±93% for each of the five bouts of PLM, respectively ($p=0.043$). SBF values rose 497±373%, 465±302%, 503±315%, 523±332% and 582±309% across the five bouts, respectively ($p=0.005$).

**CONCLUSIONS:** With repeated 60 second bouts of PLM interspaced with 60 second recovery periods there is a consistent increase in FABF and SBF which could have implications on improving vascular health and tissue perfusion in the lower limbs in those with paraplegia.

2257 Board #93 June 1 11:00 AM - 12:30 PM

### Effects Of Physical Activity On Sympathetic, Cardiovascular, And Perceptual Responses To A Painful Stimulus

Danna V. Rodriguez Escobar. *Appalachian State University, Boone, NC.*

*(No relevant relationships reported)*

**EFFECTS OF PHYSICAL ACTIVITY ON SYMPATHETIC, CARDIOVASCULAR, AND PERCEPTUAL RESPONSES TO A PAINFUL STIMULUS**

Danna V. Rodriguez Escobar, Taylor R. Goodman, Emma K. Taylor, Abigail S.L Stickford

Appalachian State University, Department of Health and Exercise Science, Boone, NC

**Purpose:** The purpose of this study is to examine sympathetic neural, cardiovascular, and perceptual responses to the cold pressor test (CPT) in physically active and sedentary young women. **Methods:** After pre-health screening and consent, physically active (PA; n=4) and healthy sedentary (SED; n=2) women completed a $VO_2$max test on a cycle ergometer. Subjects returned to the laboratory for autonomic function testing, where arterial blood pressure (SBP; DBP), heart rate (HR), and muscle sympathetic nerve activity (MSNA) were continuously recorded before, during, and following a two-minute CPT. Subjects were asked to rate their pain on a scale of 1-10 immediately following the CPT. **Results:** PA and SED women were similar in age (22.8 ±1.3 vs. 20.5 ±0.7 yr, respectively), BMI (22.7 ±1.9 vs. 23.6 ±1.1 kg/m$^2$), and resting blood pressure (SBP: 115 ±3 vs. 113 ±15 mmHg; DBP: 72 ±8 vs. 75 ±7 mmHg). PA women performed more moderate-vigorous physical activity per week than SED (319 ±136 vs 0 ±0 min/week) and had higher $VO_2$max values (44 ±3 vs. 31 ±5 ml/kg/min). Resting HR (62 ± 11 vs. 76 ± 12 bpm) and MSNA (7 ± 7 vs. 17 ± 1 bursts/min) tended to be lower in PA compared to SED women. During the CPT, PA and SED groups had similar increases in SBP (peak Δ = +26 ±22 vs. +41 mmHg, respectively), DBP (peak Δ = +17 ±5 vs. +22 mmHg), HR (peak Δ = +14 ±4 vs. +10 ±1 bpm), and MSNA (peak Δ = +36 ±15 vs. +28 ±8 bursts/min). SED women reported slightly higher pain ratings than PA (8.8 ±1.1 vs. 7.4 ±1.5). **Conclusion:** Chronic aerobic physical activity appears to be related to lower pain sensitivity; however, both groups displayed similar sympathetic neural and cardiovascular responses to a painful stimulus.

Supported by a grant from the University Research Council at Appalachian State University.

## E-31 Free Communication/Poster - Basic Science and Skeletal Muscle

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2258 Board #94 June 1 9:30 AM - 11:00 AM

### Yap as an Indicator of Nuclear Mechanotransduction in Mature Myofibers

Shama R. Iyer[1], Sameer B. Shah[2], Christopher W. Ward[1], Eric S. Folker[3], Richard M. Lovering[1]. *[1]University of Maryland School of Medicine, Baltimore, MD. [2]University of California San Diego, San Diego, CA. [3]Boston College, Boston, MA.* (Sponsor: E.G. McFarland, FACSM)

*(No relevant relationships reported)*

Mechanical forces transduced through the extracellular matrix to muscle fibers are critical for regulating muscle development, hypertrophy, homeostasis, and response to loading. Force transmitting structures reside not only at the sarcolemma (e.g., dystrophin), but also at the nuclear envelope (e.g., nesprin) for direct nuclear mechanotransduction. YAP/TAZ (Yes-associated protein/transcriptional coactivator with PDZ-binding motif) is touted as a nuclear relay of mechanical signals in many cell types (i.e. epithelial & cardiac cells, osteoblasts, fibroblasts, mesenchymal stem cells, myoblasts), and can induce a wide range of downstream signaling cascades. However, localization of YAP/TAZ to the nucleus in mature skeletal muscle fibers in response to substrate stiffness and cell loading remains unclear. **PURPOSE:** To assess YAP/TAZ nuclear localization in healthy (WT), dystrophin null (*mdx*) and nesprin-1 null skeletal muscle with varying substrate stiffness and loading. We hypothesized that absence of dystrophin and nesprin-1 would prevent YAP/TAZ nuclear localization secondary to reduced mechanotransduction to the nucleus. **METHODS:** We measured

YAP/TAZ nuclear localization in WT (n=4), *mdx* (n=4), and nesprin-1$^{-/-}$ (n=4) isolated myofibers with different substrate stiffness or with 3% cyclic passive stretch for 30 minutes, and in whole muscle after *in-vivo* isometric contractions. **RESULTS:** With increasing substrate stiffness, we found that increased YAP/TAZ nuclear localization occurs in WT (25% increase at 50 kPa compared to 1 kPa, $p<0.05$) and *mdx* myofibers (64% increase, $p<0.05$), but not in myofibers lacking nesprin-1 (15% increase, not significant). Cyclic tensile loading resulted in YAP/TAZ nuclear signaling in WT myofibers, but significantly less in *mdx* myofibers and no signaling in nesprin-1$^{-/-}$ myofibers. A lack of nuclear localization in *mdx* was also observed after isometric contractions *in-vivo*. Interestingly, the centrally located nuclei in the *mdx* displayed YAP/TAZ nuclear translocation after isometric contraction loading. **CONCLUSIONS:** Nuclear mechanotransduction is nesprin-dependent and is impaired in dystrophic muscle, which can further the pathology due to altered nuclear function.

2259 Board #95 June 1 9:30 AM - 11:00 AM

### Skeletal Myotubes From Obese Individuals Display Attenuated Response to Resveratrol Treatment

Alec B. Chaves[1], Sanghee Park[1], Jonas J. Treebak[2], Seongkyun Kim[1], Joseph A. Houmard, FACSM[1]. *[1]East Carolina University, Greenville, NC. [2]University of Copenhagen, Copenhagen, Denmark.* (Sponsor: Joseph Houmard, FACSM)

*(No relevant relationships reported)*

Resveratrol is a polyphenol compound that has been used for the prevention and treatment of obesity-related diseases. Precisely, some studies have indicated that resveratrol improves insulin sensitivity *in vivo*, but these results are inconsistent and have yet to include a severely obese cohort (BMI > 40 kg/m$^2$). Preliminary research indicates that myotubes derived from obese individuals are resistant to the insulin sensitizing effects of resveratrol, but the mechanism remains undefined. PURPOSE: To determine the effects of resveratrol treatment on basal and insulin-mediated glucose metabolism in myotubes derived from lean, healthy and severely obese individuals. METHODS: Primary skeletal muscle cells were isolated from skeletal muscle biopsies taken from age-matched lean (BMI= 21.9 ± 0.7 kg/m$^2$) and severely obese (46.1 ± 3.1 kg/m2) Caucasian women, which were treated with 1μM resveratrol for 24 hours. Radio labeled 1-$^{14}$C glucose was used to measure glucose oxidation (GO) and glycogen synthesis (GS) with or without insulin. Additionally, western blot analysis was conducted on the cell lysate to measure changes in the phosphorylation status of proteins along the insulin signaling cascade. RESULTS: Resveratrol increased insulin-stimulated GS (9.4 ± 0.2 nmol/min/mg vs. 10.3 ± 0.5 nmol/min/mg, $p < 0.05$) and GO (211.69 ± 7.51 pmol/min/mg vs. 234.82 ± 11.52 pmol/min/mg, $p < 0.05$) in severely obese myotubes, but to lower extent when compared to the lean myotubes (GS: 12.8 ± 1.0 vs. 10.3 ± 0.5 nmol/min/mg; GO: 305.78 ± 23.36 vs. 234.82 ± 11.52 pmol/min/mg, for lean and obese, respectively, $p < 0.05$). In agreement, insulin-induced phosphorylation of IRS and AKT was increased by resveratrol in lean, but to a lesser extent in obese myotubes (IRS: 1.9 ± 0.2 vs. 1.3 ± 0.1; AKT: 3.4 ± 0.3 vs. 2.6 ± 2.4, fold increase over non-insulin, non-resveratrol treated condition, for lean vs. severely obese, respectively, $p < 0.05$). CONCLUSIONS: Resveratrol improved insulin-mediated glucose metabolism in myotubes derived from both groups. However, obese myotubes were not able to achieve the same improvements which may be due to underlying defects in the insulin signaling cascade.

2260 Board #96 June 1 9:30 AM - 11:00 AM

### Do Notch and mTOR Correlate for Myotube Formation In C2C12s?

Susan T. Arthur, Brian Q. Thompson, Charlotte McMullen, Josh R. Huot. *UNC Charlotte, Charlotte, NC.*

*(No relevant relationships reported)*

**PURPOSE**: Notch and Mechanistic Target of Rapamycin (mTOR) are important for myogenesis but their interaction is not well studied. The purpose of this project was to determine if Notch affects mTOR to correlate myotube fusion of C2C12s using a Notch inhibitor, Gamma Secretase Inhibitor (GSI) and mTOR inhibitor, Rapamycin. **METHODS**: C2C12s were seeded, proliferated to 90-100% confluence and then differentiated for four days. At the onset of differentiation, C2C12 cells were treated every 12 hours with one of the following conditions: 4 μmoL of GSI, 100 nmoL of Rapamycin, both, or control. At four days post-differentiation, the C2C12 cells were either fixed for immunofluorence and myotube fusion and area were determined, or were collected for western blot analysis for measurement of mTOR signaling protein expression.
**RESULTS**:GSI treatment increased fusion index compared to the other three treatments (fusing nuclei/total nuclei) ($p < 0.0001$). Rapamycin subsided fusion index relative to control ($p < 0.0001$). GSI and Rapamycin also decreased fusion index compared to control ($p < 0.0001$). GSI-treated myotubes displayed elevated p-mTORSer2448 compared to control ($p < 0.05$). Rapamycin and GSI+Rapamycin treated myotubes displayed reduced p-mTORSer2447 expression compared to control and GSI ($p < 0.05$).
**CONCLUSIONS**: Our data suggests that Notch is inhibited and mTOR activated for myotube fusion to occur.

2261 Board #97 June 1 9:30 AM - 11:00 AM

### Serial Passaging Reduces Replication and Fusion Capacity of Primary Human Skeletal Muscle Satellite Cells

Zachary R. Hettinger[1], Yaohui Nie[2], Ron T. Garner[1], Chris K. Kargl[1], Shivam H. Patel[1], Shihuan Kuang[1], Tim P. Gavin, FACSM[1]. *[1]Purdue University, West Lafayette, IN. [2]Harvard University, Cambridge, MA.* (Sponsor: Dr. Tim Gavin, FACSM)

*(No relevant relationships reported)*

Replication and fusion of skeletal muscle satellite cells (SkMSCs) are essential for skeletal muscle maintenance and repair. Advancing age impairs SkMSCs replication potential and fusion capacity, however SkMSCs isolated from older human skeletal muscle do not consistently demonstrate these defects, making it difficult to study SkMSC isolated from aged human muscle. **PURPOSE**: To investigate if serial passaging of SkMSCs can mimic aging associated defects in replication and fusion. We hypothesized that serial passaging of primary human SkMSCs induces replicative senescence and poor fusion capacity in part through inhibition of the cell cycle regulator cyclin-dependent kinase 4 (CDK4) through the activation of CDK inhibitor p16$^{Ink4a}$. **METHODS**: SkMSCs were isolated from vastus lateralis biopsies of young men. SkMSCs were serially passaged every five days and passaging continued until SkMSCs were unable to replicate. Population doubling level (PDL) was calculated using passage specific final and starting SkMSC counts. Expression of the myogenic regulator, myogenin (MyoG) and the regeneration regulator, paired box 7 (Pax7) were analyzed via rt-PCR. Senescence was determined by SA-B-gal staining and fusion capacity determined by immunohistochemical staining. **RESULTS**: Primary human SkMSCs failed to replicate at passage 16 (Pass16) and Pass16 SkMSCs exhibited decreased fusion. PDL was decreased from passage 4 to 16 (Pass4: 3.9 vs. Pass16: 0.6, AU). CDK4 mRNA decreased (Pass4: 1.0 vs. Pass16: 0.4, AU) and p16Ink4a mRNA was increased (Pass4: 1.0 vs. Pass16: 4.9, AU). Pax7 mRNA was unchanged (Pass4: 1.0 vs. Pass16: 1.3, AU), while myoG mRNA was increased (Pass4: 1.0 vs Pass16: 8.6, AU). **CONCLUSIONS**: Serially passaging SkMSCs isolated from young humans mimics an aged phenotype evidenced by impaired replication and fusion. Our findings suggest serial passaging of primary human SkMSC may be used to study aged SkMSCs.

2262 Board #98 June 1 9:30 AM - 11:00 AM

### Effect of Acute Exercise on Skeletal Muscle Exosome Biogenesis

Ron T. Garner[1], Yaohui Nie[2], Timothy P. Gavin, FACSM[1]. *[1]Purdue University, West Lafayette, IN. [2]Harvard University, Cambridge, MA.*

*(No relevant relationships reported)*

Exercise training promotes a wide range of beneficial adaptations. Skeletal muscle is now considered an endocrine organ. Exosomes, small microvesicles, are produced by and participate in the endocrine function of skeletal muscle. Exosome biogenesis is regulated in part by components of the multivesicular body (MVB) processing pathway: hepatocyte growth factor-regulated tyrosine kinase substrate (HGS), signal transducing adapter molecule 1 (STAM), VTA1 homolog (VTA1), and vacuolar protein sorting-associated protein 4A (VPS4a). **PURPOSE:** Determine if exercise induces skeletal muscle exosome biogenesis. **METHODS:** Twelve lean, young men completed acute aerobic cycling at 55% $VO_{2Max}$ for 45 minutes followed immediately by single leg knee extensor resistance exercise (3 sets, 8-12 reps, 55% 1-RM). Vastus lateralis biopsies were obtained prior to (PRE) and 1-hour post aerobic (AEX) and aerobic+resistance (A+REX) exercise. Gene expression for proteins in the MVB pathway was analyzed using rt-PCR. **RESULTS:** There was no effect of exercise on STAM (PRE: 1.0; AEX: 1.03; A+REX: 1.28, AU), VTA1 (PRE: 1.0; AEX: 0.93; A+REX: 1.14, AU), or VPS4a (PRE: 1.0; AEX: 0.93; A+REX: 1.06, AU) . There was a trend for an increase in HGS at 1 hr post-exercise (PRE: 1.0; AEX: 0.97; A+REX: 1.27, AU). **CONCLUSIONS:** There was no effect of acute exercise on the gene expression of components of the exosome biogenesis pathway. However, activation of exosome biogenesis may be evident at different time points post exercise or with greater exercise intensities.

2263 Board #99 June 1 9:30 AM - 11:00 AM

### Differential Musculoskeletal Adaptations to Exercise of the Soleus and Vastus Lateralis: A Pilot Proteomics Approach

Mauricio Martinez, YuanYu Lee, Evan E. Schick, Joshua A. Cotter. *California State University of Long Beach, Long Beach, CA*. (Sponsor: Dr. Vincent J. Caiozzo, FACSM)

*(No relevant relationships reported)*

The vastus lateralis (VL) and soleus (SOL) muscles show vigorous changes when exposed to unloading conditions. There is evidence that the SOL muscle shows an increased sensitivity to loading yet has been shown to be resistant to exercise-induced adaptations. **PURPOSE:** To utilize high-resolution two-dimensional gel electrophoresis combined with mass spectrometry to identify anomalous biomarkers of the SOL muscle. **METHODS:** Biopsy samples of the VL and SOL muscles were obtained from three healthy, inactive individuals (1 male, 21 yrs, 92.5 kg, 167.5 cm; 2 females, 18 and 19 yrs, 66.6 and 71.7 kg, 153.3 and 161.9 cm respectively). Muscle tissue was homogenized in a bead homogenizer and protein quantified with a DC protein assay. Two-dimensional gel electrophoresis was performed and differences in spot abundance between the two muscles were used to select spots of interest. Proteins of the 24 selected spots were subsequently identified by MALDI-TOF MS/MS scanning and Mascot database searching against Swiss-Prot human protein database. **RESULTS:** Results from the 2D gel electrophoresis varied across the three subjects. Proteins identified from spots of greater intensity in the VL were myosin light chain isoforms, actin, adenylate kinase isoenzyme, alpha-crystallin B, ankyrin repeat domain-containing protein, plasminogen receptor, G-protein coupled receptor, and troponin I. The main proteins identified in the SOL were related to myoglobin with a protein phosphatase protein also being identified. Western blotting will be conducted to verify the identified proteins. **CONCLUSION:** This preliminary work has identified differential proteins between the SOL and VL relating to oxygen transport, cytoskeletal components, and energy regulation. Future work should examine changes to the proteome between these two muscle with exercise and unloading.
Supported by NIH Grants UL1GM118979, TL4GM118980, and RL5GM118978.

2264 Board #100 June 1 9:30 AM - 11:00 AM

### Whey Peptides Intake activates mTOR Signaling after Resistance Exercise Independent of Sex and Menstrual Cycle

Ryo Kakigi[1], Noriko Ichinoseki-Sekine[2], Toshiharu Natsume[1], Tomoharu Kitada[1], Toshinori Yoshihara[1], Takamasa Tsuzuki[1], Hiroyuki Kobayashi[3], Shuichi Machida[1], Hisashi Naito[1]. *[1]Juntendo University, Tokyo, Japan. [2]The Open University of Japan, Chiba, Japan. [3]Tsukuba University Hospital, Ibaraki, Japan.*

*(No relevant relationships reported)*

**PURPOSE**: Sex differences are evident in human skeletal muscle as the cross-sectional area of individual muscle fibers is greater in men than in women. In addition, the female steroid hormone fluctuates during menstrual cycle phase. We have recently shown that whey peptides intake after resistance exercise stimulates mammalian target of rapamycin (mTOR) signaling related to protein synthesis in young men. Therefore, the purpose of this study was to determine the effects of sex and menstrual cycle on mTOR signaling following resistance exercise and whey peptide intake. **METHODS**: Young healthy, recreationally active men (n=7) and women (n=16) performed a bout of one-leg isokinetic knee extension exercise (angular degree; 30º/sec, 6 reps. × 4 sets). Immediately after exercise, all subjects took a whey peptide drink (0.19 g/kg). At resting and 1h post-exercise, muscle samples were taken from vastus lateralis using needle biopsy technique. Phosphorylations of mTOR signaling transducers (mTOR, S6K1, 4E-BP1) was analyzed by western blotting. At rest, 30 min and 60 min post-exercise, blood amino acids and insulin concentrations were measured. **RESULTS**: Peak torques during resistance exercise was significantly greater in men than in women ($p<0.05$), but the relative value (% MVC) was the same between men and women. Blood amino acids and insulin concentration were significantly increased at 30 min after whey peptide intake ($p<0.05$), but there was no effect of sex and menstrual cycle. The phosphorylation of mTOR, S6K1 and 4E-BP1 after resistance exercise and whey peptide intake was significantly increased compared with that in the rest ($p<0.05$), but there was no effect of sex and menstrual cycle. **CONCLUSIONS**: Our data suggest that sex and menstrual cycle do not affect mTOR signaling in response to whey peptide intake after resistance exercise in human skeletal muscle. Supported by MEXT-Supported Program for the Strategic Research Foundation at Private Universities, 2014-2018.

2265 Board #101 June 1 9:30 AM - 11:00 AM

### Acute and Chronic Resistance-Training Downregulates Select Line-1 Retrotransposon Activity Markers in Human Skeletal Muscle

Matthew A. Romero[1], C. Brooks Mobley[1], Paul A. Roberson[1], Cody T. Haun[1], Wesley C. Kephart[1], Petey W. Mumford[1], James C. Healy[1], Darren T. Beck[1], Kaelin C. Young[1], Jeffrey S. Martin[1], Christopher M. Lockwood[2], Michael D. Roberts[1]. *[1]Auburn University, Auburn, AL. [2]Lockwood Nutrition, Draper, UT.*

*(No relevant relationships reported)*

Transposable elements or "jumping genes" are mobile genetic elements with the ability to amplify themselves within the genome. This gene mobility lends itself to the possibility of mutagenesis within cells, which is further compounded by the fact that these elements constitute ~50% our genome. Transposable elements, most notably LINE-1, have important implications for both gene regulation and gene expression under a variety of conditions. **PURPOSE:** To better understand the role of LINE-1 in skeletal muscle physiology, we examined if acute and/or chronic resistance exercise affected skeletal muscle LINE-1 retrotransposon activity. **METHODS:** In study 1, 10 resistance-trained males performed three consecutive daily squat sessions. *Vastus lateralis* biopsies were taken Pre, 2 h post (Post1), and 3 days following session 3 (Post2). In study 2, 13 untrained males performed a full-body resistance-training program. *Vastus lateralis* biopsies were taken at weeks 0 and 12. **RESULTS:** Study 1: LINE-1 mRNA content was lower at both Post1 ($p=0.028$) and Post2 ($p=0.013$), while RT activity trended down at Post2 ($p=0.067$). A methylation assay at the LINE-1 promoter, however, did not yield significant results. Study 2: LINE-1 mRNA trended down by week 12 ($p=0.056$) along with RT activity ($p=0.063$) and ORF2p content ($p=0.041$). Although, mRNA was not significantly lower after training, LINE-1 promoter methylation significantly increased at week 12 ($p=0.041$). Interestingly, changes in RT activity versus satellite cell number were inversely associated ($r^2= -0.725$). **CONCLUSION:** Resistance exercise downregulates select skeletal muscle LINE-1 markers and this may be suggestive toward an involvement of LINE-1 in satellite cell activity. Supported by gift monies donated to M.D.R. through Hilmar Ingredients (Hilmar, CA, USA) and Bionutritional Research Group (Irvine, CA, USA), and contract to J.S.M. through NormaTec (Newton Center, MA, USA).

## E-32 Free Communication/Poster - Muscle Physiology Applications

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2266 Board #102 June 1 9:30 AM - 11:00 AM

### A Preliminary Comparison Of Muscle Pennation Angle Measures To Explain Variance In Maximal Force Production

Micheal J. Luera, Carlos A. Estrada, Jesus A. Hernandez Sarabia, Julia Troung, Tyler W. D. Muddle, Jason M. DeFreitas. *Oklahoma State University, Stillwater, OK.*

*(No relevant relationships reported)*

Previous literature has shown that a muscle's pennation angle influences that muscle's force producing capabilities. However, how the pennation angle of mono- and bi-articular muscles are related to single- and multi-joint force production is less clear. **PURPOSE:** To examine the relationships between resting and contracting pennation angles of the biarticular rectus femoris ($RF_{REST}$ + $RF_{CONT}$) and the monoarticular vastus lateralis ($VL_{REST}$ + $VL_{CONT}$) muscles with maximal force production during single and multi-joint isometric tasks. **METHODS:** Eight lower-body resistance trained males (mean ± SD; 27 ± 3 yrs; 102 ± 6.55 kg; 197 ± 7 cm) performed maximal voluntary isometric contractions during the squat ($SQ_{max}$) and knee extension ($KE_{max}$) exercises at knee joint angles of 110° and 150°. The order of the joint angles were randomized. The hip angle was ~105° during $KE_{max}$ and ~110° during $SQ_{max}$. Maximal force (N) was measured with an S-beam load cell. Muscle pennation angles were measured in both the RF and VL at rest and again during the maximal contractions using ultrasound imaging. **RESULTS:** Using multiple regression, $RF_{CONT}$ at 150° was the only variable that contributed significantly to $KE_{max}$ ($R^2 = 0.758$, $p = 0.005$) at the same angle. Interestingly, there were no significant relationships with $RF_{REST}$ or $RF_{CONT}$ during $KE_{max}$ at 110°, or $SQ_{max}$ at both knee joint angles. Furthermore, neither $VL_{REST}$ nor $VL_{CONT}$ were significantly related to either $KE_{max}$ or $SQ_{max}$ at any knee joint angles (all p-values ≥ 0.05). **CONCLUSION:** The finding that $RF_{CONT}$ at 150° being related to $KE_{max}$ at the same angle was the only significant outcome was surprising. However, caution should be applied in the interpretation of this preliminary examination, as

the sample size is underpowered to fully address the research question. Nevertheless, given that KE is a single-joint task, we expected pennation angles of the monoarticular VL to contribute more to the model than the biarticular RF.

2267 Board #103 June 1 9:30 AM - 11:00 AM

**Contribution Of Mono- And Bi-articular Muscle Sizes Of Single- And Multi-joint Maximal Strength**

Jesus A. Hernandez Sarabia, Michael J. Luera, Carlos Estrada, Jason M. DeFreitas. *Oklahoma State University, STILLWATER, OK.*

*(No relevant relationships reported)*

**Contribution of Mono- and Bi-articular Muscle Sizes to Single- and Multi-joint Maximal Strength**

Jesus A. Hernandez-Sarabia[1], Michael J. Luera[1], Carlos Estrada[1], and Jason M. DeFreitas[1].
[1]Oklahoma State University, Stillwater, OK

The strong relationships between the size of monoarticular muscles and strength during single-joint contractions are well established (e.g. biceps brachii and elbow flexion force). However, the contributions of biarticular muscles during multi-joint contractions are less so. **PURPOSE:** To examine the relationships between the size of the vastus lateralis (VL, monoarticular) and rectus femoris (RF, biarticular) muscles with maximal force production during single- and multi-joint isometric tasks. We hypothesized that the size of the biarticular RF would demonstrate a stronger relationship with isometric squat force than VL size, and that VL size would have a stronger relationship with single-joint force. **METHODS:** Eight strength-training men were recruited for this study (M±SD 27 ± 3 yrs). First, three ultrasound images of the right VL and RF were obtained to calculate muscle cross-sectional area (CSA) and thickness. Isometric squats ($SQ_{max}$) and isometric knee extensions ($KE_{max}$) were performed to assess multi-joint and single-joint maximal strength. Both were performed at the same knee joint angle (110°). **RESULTS:** Using multiple regression, RF muscle size was significantly related to $SQ_{max}$ ($R^2 = 0.878$, $p = 0.005$). Interestingly, both RF CSA and thickness contributed to the model. Also of surprise is that VL size did not contribute to $SQ_{max}$. VL thickness was significantly related to $KE_{max}$ ($R^2 = 0.579$, $p = 0.047$), but none of the other measures contributed. **CONCLUSION:** Our primary finding was that RF muscle size contributes significantly to squat force, a multi-joint task, but not to the single-joint, knee extension force. Vice versa, VL size contributed to single-joint force, but not to squat force. While our hypotheses technically were supported, we did expect both muscle sizes to still contribute to the regression model (not either RF or VL only for each task). This lack of contribution to the statistical model by both muscles for each task is likely due to insufficient sample size.

2268 Board #104 June 1 9:30 AM - 11:00 AM

**Flexor Pollicis Brevis Muscle Provides Another Eccentric Contraction Model In Human**

Karina Kozaki[1], Eisuke Ochi[2], Koichi Nakazato[1]. *[1]Nippon Sport Science Univercity, Tokyo, Japan. [2]Hosei University, Tokyo, Japan.*

*(No relevant relationships reported)*

**PURPOSE**: Exercise induced muscle damage (EIMD) impair the skeletal muscle functions. To induce EIMD, many studies have used unaccustomed eccentric muscle contractions (ECs). ECs is frequently applied on biceps brachii or quadriceps muscles in human experiments. Flexor pollicis brevis muscle (FPBM) is a small flexor muscle of thumb MP joint. We examined whether EIMD could be induced into FPBM by forced extension of the thumb MP joint. **METHODS**: Eleven men received description and provided informed consent. ECs was applied by custom-made torque dynamometer. They performed maximal ECs on their FPBM of non-dominant hand. Five subjects (years, 21.8 ± 0.4; height, 171.5 ± 7.1 cm; weight, 68.3 ± 6.9 kg) performed 60 (6 × 10 sets) ECs with 90 deg / s fast joint angular velocity (severe EIMD). Other 6 subjects (years, 21.0 ± 1.3; height, 166.8 ± 3.1 cm; weight, 65.2 ± 2.6 kg) were assigned to 60 deg / s slow joint angular velocity (mild EIMD) of 100 (10 × 10 sets) ECs. Maximal voluntary contraction (MVC), joint range of motion (ROM) and muscle soreness were assessed before, immediately post, and 1, 2 and 5 days after ECs. Muscle soreness was quantified by using of visual analog scale (VAS). Values were statistically analyzed and the significance level was set at $p < 0.05$. **RESULTS**: In the severe EIMD, MVC and ROM are significantly decreased at post compared with pre (MVC, 18%; effect size = 1.30, 95 % CI 0.17 - 2.51; ROM, 14 %; effect size = 0.49, 95 % CI 0.81 - 1.70 $p < 0.05$). Mild EIMD also showed significant deficit of MVC and ROM values after post (MVC, 5 %; effect size = 0.33, 95 % CI 0.83 - 1.45; ROM, 12 %; effect size = 0.61, 95 % CI 0.59 - 1.71; $p < 0.05$). VAS markedly developed at 2 days after ECs in both groups (severe EIMD, pre, 0 cm, 2 days, 3.9 cm; effect size = 3.73, 95 % CI 1.44 - 5.29; mild EIMD, pre, 0 cm; post, 2.46 cm, effect size = 2.53, 95 % CI 0.87 - 3.8; $p < 0.05$). **CONCLUSIONS**: This study showed similar results with previous ECs studies, suggesting that FPBM is another novel ECs model in human.

2269 Board #105 June 1 9:30 AM - 11:00 AM

**Stimulated, but Not Voluntary Critical Torque Differs between Men and Women**

Cameron L. Lohman. *The University of Oklahoma, Norman, OK.* (Sponsor: Chris D. Black, FACSM)

*(No relevant relationships reported)*

Previous studies have demonstrated gender differences in fatigue with women showing small declines in force compared to men. To our knowledge no study has examined whether gender differences exist in critical power or its isometric analog critical torque (CT) which are strong predictors of endurance performance. **PURPOSE:** The purpose of the study was to assess gender differences during voluntary and stimulated assessments of CT. **METHODS:** Nineteen participants (10 women, 9 men) completed 4 assessments of their quadriceps femoris CT over 3 randomly assigned testing visits: 1) voluntary CT assessment (VOL), 2) stimulated CT assessment at 100Hz (STIM100-1), and 3) stimulated CT assessment at 100Hz (STIM100-2) and 15Hz (STIM15). The work to rest cycle was 3:2 (3-sec of contraction to 2-sec of rest) during VOL and 2:2 during the stimulated tests. Voluntary activation (%VA) and twitch-torque (TT) were determined every 30-sec during VOL to determine central and peripheral contributions to fatigue. **RESULTS:** Gender differences were not observed for VOL ($p = 0.55$) with CT occurring at 47.5 ± 9.9% and 43.9 ± 16.3% of MVC, respectively. %VA and TT declined over time during the CT test ($p \leq 0.001$), but no effect for gender was found %VA ($p = 0.76$ for %VA) or TT ($p = 0.31$ for TT). Initial torque values and CT values did not differ for STIM100-1 and STIM100-2 ($p \leq 0.51$). Stimulated CT at 100Hz occurred at a higher percentage of starting torque in women compared to men—33.2 ± 5.8% vs. 26.8 ± 4.9% ($p = 0.02$) and 35.5 ± 7.6% vs. 28.9 ± 5.5% ($p = 0.046$) for STIM100-1 and STIM100-2, respectively. No gender difference was observed during STIM15 ($p = 0.79$). **CONCLUSION:** Unlike previous studies of voluntary endurance exercise, we found no gender differences in VOL CT which was supported by similar central and peripheral fatigue during the CT test. Interestingly, women demonstrated less peripheral fatigue and a consistently high stimulated CT during 100Hz stimulation. However, this gender difference was lost when stimulation frequency was reduced to 15Hz. This finding may indicate the gender difference may be in part mediated by initial torque values and/or the rate of fatigue during exercise.

2270 Board #106 June 1 9:30 AM - 11:00 AM

**Relationship Between Muscle Activation and Force Recovery Following Sustained Maximal Voluntary Isometric Contractions**

Kade E. Kinney[1], Ellen V. Sloan[2], Katherine E. Houle[1], William F. Brechue, FACSM[1]. *[1]A.T. Still University of Health Sciences, Kirksville, MO. [2]University of Tennessee Health Sciences Center, Memphis, TN.* (Sponsor: William F. Brechue, FACSM, FACSM)

*(No relevant relationships reported)*

Previously we observed dissociation of skeletal muscle activation and force recovery following sustained maximal voluntary isometric contractions (MVIC). Fatigue was specifically related to reduced muscle activation within bouts; yet, incomplete recovery of force between bouts occurred with maximal muscle activation, suggesting interference in excitation-contraction coupling. **Purpose:** to investigate time-dependency of nervous system recovery following MVIC. **Methods:** Men (n=29) performed two bouts (B1, B2) of sustained handgrip MVIC preceded/followed by 10-min recovery periods. Force (dynamometer) and surface EMG (sEMG) from the brachioradialis (BR), flexor carpi radialis (FCR), flexor carpi ulnaris (FCU), and flexor digitorum profundus (FDP) were collected continuously (1000 Hz) during bouts. sEMG signals were band pass filtered, rectified, and integrated (iEMG), then normalized (nEMG) to initial B1 iEMG. Force and sEMG were analyzed at 0.5 second intervals every 15 seconds. **Results:** Recovery (B2 initial force >90% of B1) response fell into two groups; recovered (R, n=13) and not recovered (NR; n=16). Force decreased similarly in B1 (R: 77%; NR: 78%) and B2 (R: 79%; NR: 80%), yet initial B2 force was less (22%) than B1 in NR. Fatigue progressed in two-phases; B1 fast-phase decreased more rapidly with slow phase inflection occurring earlier (60 sec; 35% initial force) in R compared to NR (90 sec; 26% initial force). In R, B2 had a similar rate of decline in force and inflection (60 sec; 32% initial force). NR B2 showed a similar rate of decline in force, but inflection occurred sooner (75 sec) at the same level of initial B1 force (22%). Muscle activation (iEMG) during B1 was reduced similarly in R and NR (R: BR: 68%; FCR: 63%; FCU: 73%; FDP: 75%; NR: BR: 61%; FCR: 67%; FCU: 43%; FDP: 57%). During B2, R and NR showed similar decreases as B1, but all muscles except FCR showed lower initial B2 muscle activation compared to B1. **Conclusions:** Fatigue manifested in two phases; fast and slow. Recovery of force following sustained MVIC appears to be related to initial rate of decline of force (fast phase) with earlier onset of phase two. Earlier onset of phase shift may be related to changes in external compressive force and blood flow through the muscle, reducing metabolic perturbation and reflex inhibition of activation.

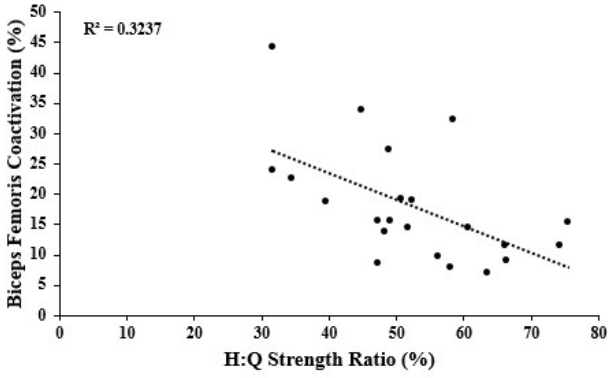
2271 Board #107 June 1 9:30 AM - 11:00 AM

### The Magnitude Of Hamstring Co-activation During A Knee Extension Is Dependent On Knee Flexor Strength

Cameron S. Mackey[1], Ryan M. Thiele[2], Eric C. Conchola[1], Jason M. DeFreitas[1]. [1]*Oklahoma State University, Stillwater, OK.* [2]*Kansas State University, Manhattan, KS.*

*(No relevant relationships reported)*

Involuntary muscle activation of the opposing muscles (antagonists) during agonist muscle actions is referred to as antagonist coactivation. It has been shown that strength training the agonist leads to a decrease in antagonist co-activation. However, it is unknown if the relative antagonist strength plays a role in the magnitude of co-activation. **PURPOSE**: To assess if antagonist coactivation of the knee flexors during a maximal knee extension is related to Hamstring-to-Quadriceps strength ratio (H:Q). **METHODS**: Twenty-two men (M ± SD age = 23.32 ± 3.17 years) visited the laboratory and performed isometric maximal voluntary contractions (MVC) of the knee flexors and extensors. Surface electromyography (sEMG) was recorded from the vastus lateralis (VL) and the biceps femoris (BF). The root-mean-square (RMS) value of the sEMG signal was used to calculate the EMG amplitude, which was then normalized to the RMS obtained during that muscle group's MVC. Pearson's correlation coefficients were used for statistical analysis. **RESULTS**: A significant, moderate, negative correlation (r = -0.569; $R^2$ = 0.324; p = 0.006) was observed between H:Q strength ratio (M ± SD = 52.6% ± 12.2%) and antagonist co-activation of the BF (M ± SD = 18.03% ± 9.48%) (Figure 1). **CONCLUSION**: The results of the present investigation reveal that as hamstring strength increases in relation to the quadriceps, coactivation may be reduced. Since a commonly proposed purpose of antagonist co-activation is to provide joint stability, it is possible that a stronger and stiffer hamstrings muscle group would require less co-activation during a knee extension to stabilize the joint.




2272 Board #108 June 1 9:30 AM - 11:00 AM

### Acute EMD Responses of the Knee Extensors Following Free-Weight Back Squat Protocols

Eric C. Conchola[1], Ryan M. Thiele[2]. [1]*Oklahoma State University, Stillwater, OK.* [2]*Kansas State University, Manhattan, KS.*

*(No relevant relationships reported)*

Electromechanical delay (EMD) may play a significant role in joint stabilization during mechanical loading. Fatigue-related deficits in EMD have been observed when the level of volitional fatigue has been controlled, primarily through isolated muscle actions. However, few studies have assessed EMD responses following bouts of practical compound movements in which joint stabilization is essential. **PURPOSE:** Investigate the effects of EMD following work-matched submaximal back squat protocols during a 30-minute recovery period. **METHODS:** Thirteen resistance trained males (mean ± SD: age = 22.08 ± 2.75 years) visited the laboratory on three separate occasions, separated by seven (±1) days. The first day included determining each participant's one repetition maximum (1-RM) for the back squat, followed by a familiarization trial of maximum voluntary isometric contractions (MVICs) for the knee extensors. Day two and three included performing either an explosive power (EP) (5×16 at 40% 1-RM), or controlled hypertrophic (CH) (5×8 at 80% 1-RM) exercise protocol. Participants performed MVICs prior to each squat protocol, and at each recovery time point (Pre, Post 0, Post7, Post15, Post30). CH repetitions were performed at a cadence of two-second eccentric and two-second concentric phases. The EP repetitions were performed at a cadence of a two-second eccentric phase but the concentric phase was performed as fast as possible. Surface electromyography (EMG) was recorded from the vastus lateralis (VL) and EMD was identified as the time (ms) between onset of VL EMG to the onset of torque during all MVICs. A two-way repeated measures ANOVA (intensity [PE vs CH] × time [Pre vs Post0 vs Post7 vs Post15 vs Post30]) was used to analyze all EMD data. **RESULTS:** No interaction ($P$ = 0.528) nor main effect for intensity ($P$ = 0.202) was observed. There was however a main effect for time ($P$ = 0.039), where only Post0 was lower compared to Pre ($P$ = 0.039). **CONCLUSIONS:** The present findings suggest that work-matched submaximal back squat protocols elicited similar EMD responses for the knee extensors. Specifically, EMD was longer at Post0 compared to Pre. These findings indicate that caution should be exercised following compound movements, regardless of intensity, as acute deficits in EMD may have important injury and performance implications.

2273 Board #109 June 1 9:30 AM - 11:00 AM

### Acute Effect of Localized Vibration on Reducing Masseter Stiffness as Measured by Elastography

Jeffrey Brent Feland, Jonathan Blotter, Cameron Smallwood, Jonothan DiPeri, Blake Cowan, Kylan Vanderpool, Aaron W. Johnson. *Brigham Young University, Provo, UT.* (Sponsor: J. Ty Hopkins, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: The purpose of this study was to determine if the application of localized vibration would reduce masseter muscle stiffness as measured by shear wave elastography (SWE).
**METHODS**: 12 female subjects (21 +/- 1.8. yrs) without any history of TMJ disorder underwent both control (vibrator turned off) and Vibration conditions (randomized) on two different days. Methods: Subjects relaxed in a reclined seated position for 5 minutes before having the baseline masseter SWE measures taken with the jaw in a relaxed position. A GE S8 ultrasound machine with a 9L probe was used under the elastography setting. SWE values were calculated using a minimum of 7 separate .5cm circles within the defined elastography box fit within the muscle borders. 8 total images were assessed and averaged for the calculation of the baseline SWE measure in kPa. Subjects then underwent localized vibration treatment using a Rezzimax™ handheld vibration module with a specialized 2-pronged contact extension. All Subjects underwent 2 x 60-second bouts of vibration at 3 different randomized points (supraorbital margin of both eyes (70 Hz), medial and lateral sides of the base of the neck (105 Hz), and inside the mouth at a point just in front of the mandibular ramus(105 Hz). Post-measures of SWE followed the same protocol as the baseline measures. **RESULTS**: All measures were compared using a general linear model repeated measures ANOVA. A group x time interaction existed $F_{(1,11)} = 31.184$ with a p-value of .000. Mean values for baseline SWE were 16.55 ± 5.59 kPa for Control and 16.57± 6.06 kPa for Vibration. Post-measure means were 15.78 ± 4.73 kPa for Control and 8.05 ± 1.92 kPa for Vibration. A paired samples T-test showed no significant difference in Baseline Control vs Post Control measurements (p = .180) or Baseline Control and Baseline Vibration (p=.984). Baseline Vibration vs Post vibration was significant (p=.000).
**CONCLUSIONS**: Localized vibration to these three spots resulted in acute reductions in masseter stiffness as measured by SWE in normal individuals. Use of localized vibration may be beneficial in reducing tension/stiffness of the masseter muscle in those with chronic TMJ disorder. Future studies should look at it's effect on pain, duration effect, and consider measuring the lateral pterygoid.

2274 Board #110 June 1 9:30 AM - 11:00 AM

### Influence Of Various Forms Of Pressure Stimulation On Skeletal Muscle Condition

Masaki Deguchi, Tomonobu Sakurai. *Toin University of Yokohama, Yokohama, Japan.*

*(No relevant relationships reported)*

**PURPOSE:** We investigated the effect of various forms of pressure on skeletal muscle condition with muscle temperature, muscle stiffness, oxygen saturation and B-mode ultrasound. **METHODS;** Six young male students (age 22.7 ±1.8 y, height 177.1 ± 3.9 cm, weight 69.7 ± 2.1 kg) completed the following intervention protocols in a randomized order on separate days: non-stimulation (C: control condition), Low pressure stimulation (LP), and High pressure stimulation (HP) at the rectus femoral. Subjects kept rest on bed. After the various forms of pressure stimulation or control intervention, muscle temperature, oxygenated saturation, muscle stiffness, B-mode ultrasound. The indicators of muscle condition were measured pre-stimulation, immediately post, 10, 20, and 30 minutes afterward. **RESULTS:** The muscle temperature increase to 10 minute in the HP, and a significant difference was recognized as compared with the C and LP ($p<0.01$). However, no significant difference was observed after 30 minutes. Oxygen saturation showed that the HP tended to be high after stimulation. Muscle stiffness decreased in both HP and LP immediately after stimulation, and the HP showed to return to baseline after 30 minutes from immediately after stimulation, and no significant difference was observed. The LP showed to maintain and a significant difference was observed as compared with the C ($p<0.01$). B-mode ultrasound were analyzed and compared with muscle luminance histograms, and neither HP nor LP showed changes before and after pressure stimulation. **CONCLUSION:** There was no change in the B-mode ultrasound

in both the HP and the LP, and the muscle stiffness decreased. The muscle temperature also increased, but when looking at the oxygen saturation level, only the HP showed a high value, indicating an increase in blood flow rate.

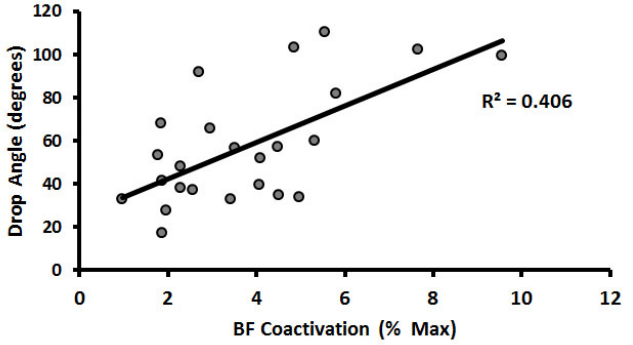
2275 Board #111 June 1 9:30 AM - 11:00 AM

### Antagonist Coactivation During A Reactive Leg Drop In Young And Older Adults

Alejandra Barrera-Curiel[1], Mitchel A. Magrini[1], Ryan M. Thiele[2], Jesus A. Hernandez-Sarabia[1], Ryan J. Colquhoun[1], Patrick M. Tomko[1], Nathaniel D. M. Jenkins[1], Jason M. DeFreitas[1]. *[1]Oklahoma State University, Stillwater, OK. [2]Kansas State University, Manhattan, KS.*

*(No relevant relationships reported)*

It appears that older adults use a coactivation strategy to control body sway and stiffen the joint. However, this strategy might limit reaction times, increasing the risk of falling. **PURPOSE:** Examine the age differences in antagonist coactivation during a reactive leg drop; a lower-body sensory-motor integration test designed to predict fall risk and the ability to recover from a slip. **METHODS:** Thirteen older (74 ± 7 yrs.) and 11 younger (23 ± 3 yrs.) adults were included in this study. For the reactive leg drops, participants were seated in a dynamometer with their dominant leg passively extended to max range of motion supported by an elastic band. Once the participant was completely relaxed, the researcher suddenly released the elastic band allowing the lower leg to free-fall. The participants were instructed to kick up as soon as they felt or saw the drop. Surface electromyography (sEMG) was collected from the biceps femoris (BF). Drop angle (DA) was assessed as the difference in angle between the straight position and the lowest point reached during the limb's free-fall. BF coactivation (%) was quantified as the RMS of the first 50 ms of activation and was normalized to BF sEMG of a maximal voluntary knee flexion. Independent t-tests with a 95% CI were used to identify the differences between groups in BF coactivation. Pearson product-moment analyses were used to determine the relationship between DA and BF coactivation. **RESULTS:** There was no significant differences between the young and old participants in BF coactivation (Younger = 3.16 ± 1.36%; Older = 4.34 ± 2.40%; $p > 0.05$). However, there was a significant relationship between DA and BF coactivation in the older group ($r = 0.719$; $p = 0.006$), as well as when collapsed across both groups ($r = 0.637$; $p = 0.001$; shown below). **CONCLUSION:** Even though BF coactivation was similar between groups, it was negatively associated with DA; suggesting that higher coactivation in the older population may result in a slower motor response time.




2276 Board #112 June 1 9:30 AM - 11:00 AM

### Variations of Acute Bouts of High-Intensity Training Programming Minimally Influence Biomarkers of Growth

Brian Kliszczewicz[1], Chad Markert[2], Emily Bechke[1], Cassie Williamson[1], Michael McKenzie, FACSM[2], Khala Clemons[2]. *[1]Kennesaw State University, Kennesaw, GA. [2]Winston-Salem State Univeristy, Winston-Salem, NC.* (Sponsor: Michael McKenzie, FACSM)

*(No relevant relationships reported)*

Plasma biomarkers of skeletal muscle growth are influenced by the modality, duration, and intensity of an exercise bout. High-Intensity Training Programs (HITP) are prescribed using various modalities, orders, weights, and repetition schemes. The duration of these bouts varies greatly, from shorter bouts of less than 5 minutes to longer bouts of 15 minutes or more. **PURPOSE**: To examine the effects of short- (< 5min) and long- (15min) duration bouts of HITP on markers of skeletal muscle growth. **METHODS**: Ten apparently healthy males (28.1 ± 5yrs) participated in this study. Two HITP sessions (SHORT and LONG) were performed in a randomized crossover fashion. Blood plasma was collected at five time points: PRE, POST, 1HR, 3HR, and 6HR in order to examine growth hormone (GH), insulin-like growth factor (IGF-1), and insulin-like growth factor binding proteins 1 & 2 (IGFBP-1, IGFBP-2). **RESULTS**: The repeated measures ANOVA revealed no trial differences among any of the markers (IGF-1, IGFBP-1 & IGFBP-2) except GH at POST, where the LONG bout produced a greater effect ($p = 0.005$). A repeated measures ANOVA revealed a main time effect in GH ($p = 0.037$), while a posthoc t-test demonstrated elevated GH at 1HR ($p = 0.018$) when compared to PRE, while no time-dependent change ($p > 0.05$) was observed in IGF-1, IGFBP-1, or IGFBP-2. **CONCLUSIONS**: The findings suggest that there are no differences in markers of skeletal muscle growth other than GH between the SHORT and LONG bouts of HITP.

2277 Board #113 June 1 9:30 AM - 11:00 AM

### Impact of Sitting on Different Types of Stability Balls on EMGs During Arm Ergometry

Michelle Nguyen, Charles RC Marks, Hayley MacDonald. *Oakland University, Rochester, MI.* (Sponsor: Jonathan K. Ehrman, FACSM)

*(No relevant relationships reported)*

Past studies have demonstrated that sitting on a stability ball (SB) elevates oxygen consumption ($VO_2$) and leg electromyography (EMG) activity during arm ergometry when compared to chair sitting. In addition, our laboratory has reported that a SB made of stiff material had lower $VO_2$s when compared to a more elastic SB but had not indicated if there was an impact on muscle activity. **PURPOSE:** To determine if the characteristics of a SB also affects muscle activity during arm ergometry. **METHODS:** Twenty apparently healthy young adults underwent rest and two stages of submaximal arm ergometry under three different conditions (order randomized): sitting on a stiff material SB (SMB), same size but elastic material SB (SEB), and a smaller SEB (SSEB). Exercise intensity was determined during a prior day's testing with stage 1 set at 20 to 40 b/min above resting heart rate and stage 2 set at 20 to 40 b/min above stage 1's heart rate. Anterior Deltoid (AD), External Oblique (EO), and Rectus Femoris (RF) EMGs were recorded during the last 10 seconds of each stage. Repeated Measures ANOVA was used to determine SB type effect (alpha= .05) for peak rectified EMG levels. **RESULTS:** There were no significant SB type effects for AD ($P = 0.553$) and EO ($P = 0.963$) EMGs. However, RF had significant ($P = 0.002$) SB type effect. The SMB (Stage 1: 283 ± 229 mv; Stage 2: 370 ± 248 mv) had 19% to 37% lower EMG levels than the SEB (Stage 1: 337 ± 256 mv; Stage 2: 461 ± 305 mv) or SSEB (Stage 1: 361 ± 300 mv; Stage 2: 508 ± 371 mv) EMGs. **CONCLUSION:** A SB made of more elastic material requires more leg muscle activity during arm ergometry and may account for the higher $VO_2$ response noted in previous studies.

2278 Board #114 June 1 9:30 AM - 11:00 AM

### Musculoskeletal Complaints Prevalence And Surface Electromyographic Recordings From Upper Limbs In Surgeons

Fernando Sotelo-Barroso, Karla S. Vera-Delgado, Sergio Márquez-Gamiño, Cipriana Caudillo-Cisneros. *Universidad de Guanajuato, León, Mexico.*

*(No relevant relationships reported)*

**Purpose:** to determine the prevalence of musculoskeletal complaints of the trunk and thoracic limbs and to characterize the electric muscular activity registered superficially in the forearms of physicians having surgical practice.
**Methods:** in a cross-sectional study 43 physicians actively practicing surgical specialties were assessed. After signing an informed consent, to determine the presence of musculoskeletal complaints (MMC) of the cervical and lumbar spine and upper extremity, answered The Nordic Questionnaire. 12 of the participants accepted a second phase, consisting of surface electromyography (EMGs) of the upper limbs (Flexor Digitorum Superficialis) while performing maximal handgrip contractions. Results were analyzed by descriptive statistics, using SPSSv21.
**Results:** the total sample was composed of 32 men, and 11 women, 42.7±9.0 years of age (mean±s.d). 71% of the surgeons declared the presence of at least one MMC. Out of them, the lumbar spine was the most affected (71%), followed by shoulder affection (53%); hand and wrist (45%), and the neck (44%).
In the EMGs analysis, 50% of the participants achieved normal responses, characterized as maximal, minimal response, and peak to peak amplitud. For the right arm 2.26±0.94 mV; 0.10±0.70 mV, and 2.15±0.94 mV, in the same order. The opposite arm displayed 2.29±0.94; 0.18±0.15, and 2.11±0.87, respectively.
**Conclusions**: prevalence of MME in surgeons is high, suggesting surgeons' maladaptation to the surgical environment. The EMGs results corroborate muscular function alterations in a similar proportion to the MMC for hand and wrist.

2279 Board #115 June 1 9:30 AM - 11:00 AM

### Pre-workout Supplementation Does Not Augment Intramuscular MAPK Phosphorylation Immediately Following an Acute Resistance Exercise Bout

Justin X. Nicoll, Andrew C. Fry, Eric M. Mosier. *University of Kansas, Lawrence, KS.*

*(No relevant relationships reported)*

Ingestion of multi-ingredient dietary pre-workout supplements (PWS) are popular, however the molecular responses of PWS have not been investigated. Mitogen-activated protein kinase (MAPK) signaling proteins respond differently depending on resistance exercise (RE) volume, load, and contraction mode. Since RE performance is improved with PWS consumption by increasing repetitions to failure; it is plausible MAPK activation may also be potentiated. **PURPOSE**: To determine if acute RE MAPK phosphorylation is augmented with PWS. **METHODS**: In a randomized, counter-balanced, double-blind, placebo-controlled, within-subject crossover study, ten resistance-trained males ((M±SD, age=22±2.4 yrs, hgt=175±7 cm, body mass=84.1±11.8kg) performed four sets of 8 repetitions of barbell back squats at 75% of their 1-repetition maximum (1-RM) with two minutes of rest between sets and a fifth set of barbell back squats at 60% of 1-RM until concentric failure. A PWS or flavor and color matched placebo (PL) was consumed 60-minutes prior to RE. Muscle biopsies were taken from the vastus lateralis prior to supplementation at rest (BL), and ten minutes post-exercise (POST). Biopsy samples were analyzed for the ratio of (pMAPK/totalMAPK) of extracellular signal-regulated kinase (ERK), c-Jun $NH_2$-terminal kinase (JNK), and p38 via western blotting. Wilcoxon sign-rank tests were utilized to determine pairwise differences from BL to POST and between PL and PWS conditions. Statistical significance was determined at $p \leq 0.05$. Data are expressed as median and interquartile range [$25^{th}$-$75^{th}$]. **RESULTS**: RE increased phosphorylation of JNK (PWS: 7.4 [4.6 - 17.3] vs PL: 8.2 [5.45 - 16.2] fold-change), p38 (PWS: 19.6 [7.4 - 27.3] vs PL: 9.9 [5.7 - 27.8] fold-change), and ERK (PWS: 9.0 [1.5 - 48.3] vs PL: 13.2 [3.8 - 20.5] fold-change) (all $p < 0.005$), with no differences between PWS and PL conditions ($p>0.05$). Repetitions to failure tended to favor the PWS condition (PWS: 20 [17-21] vs PL: 16 [14-22]; p=0.058). **CONCLUSIONS**: RE increased MAPK phosphorylation but was not augmented by PWS in the immediate recovery period. Future studies should investigate if molecular signaling responses are altered at later time periods or after a period of chronic supplementation.

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2280 Board #116 June 1 9:30 AM - 11:00 AM

### Peripheral Fatigue Mechanisms During Voluntary and Stimulated Assessments of Critical Torque

Angelina M. Curiel, Natalie R. Janzen, Jason A. Campbell, Rebecca D. Larson, Christopher D. Black, FACSM. *University of Oklahoma, Norman, OK.* (Sponsor: Christopher D. Black, FACSM)

*(No relevant relationships reported)*

Critical torque (CT) is an integrative measure/concept that represents the "critical" or upper boundary of steady-state work that can be performed without leading to exhaustive fatigue. We have developed a stimulated CT test, but the extent to which the mechanism(s) of torque decline are similar between voluntary and stimulated CT is unknown. **PURPOSE**: The purposes of this study was to determine if the decline in torque production stimulated exercise occurred due to similar mechanism(s) as the decline in torque during voluntary exercise. **METHODS**: Nineteen (Women = 10) participants completed 5 CT assessments over 3 testing visits: 1) voluntary CT (VOL), 2&3) stimulated CT at 100 Hz (STIM100-1 and STIM100-2), 4) stimulated CT at 15Hz (STIM15) and 5) stimulated CT at a frequency that elicited a torque below CT determined at 100Hz (BELOW). Twitch torque (TT), low frequency fatigue (LFF), and M-wave amplitude were measured before, during, and after each protocol. **RESULTS**: Stimulated CT did not differ among STIM100-1 (30.2 ± 6.2%), STIM100-2 (32.3 ± 7.3), and STIM15 (33.9 ± 8.2%; $p \geq 0.127$). VOL (45.3± 13.1%) and BELOW (20.8 ± 5.5%) differed from the others ($p < 0.01$). TT declined to 49% of starting ($p \leq 0.014$) in VOL, to 60% during the 100 Hz protocols ($p \leq 0.018$), but did not decline in STIM15 or BELOW conditions ($p \geq 0.08$). LFF occurred in VOL (0.58 ± 0.8 vs. 0.34 ± 0.1; $p < 0.001$). High frequency fatigue occurred following the stimulated protocols ($p \leq 0.001$). No changes were observed in M-wave amplitude in the VOL, STIM15, or BELOW conditions ($p \geq 0.29$). Significant decreases were observed in STIM100-1 and STIM100-2 with amplitudes declining to 77 ± 30% and 82 ± 28% of pre ($p < 0.01$), respectively **CONCLUSIONS**: Despite differences in peripheral fatigue mechanisms, CT occurred at similar values regardless of whether 100 Hz or 15 Hz stimulation was used. Higher frequency stimulation appears to induce greater deficits in axonal and neuromuscular junction transmission than VOL and lower stimulation exercise. None of the stimulated exercise protocols exactly mimicked the peripheral fatigue profile of the VOL condition, but 15 Hz stimulation was a better approximation than 100 Hz. Further research is needed to develop a stimulated exercise protocol that more closely mimics voluntary exercise.

2281 Board #117 June 1 9:30 AM - 11:00 AM

### Overstretch-Induced Reactive Oxygen Species Formation and Functional Decline in Skeletal Muscle

Li Zuo, FACSM[1], Chia-Chen Chuang[1], Tingyang Zhou[1], Feng He[2]. *[1]Ohio State University, Columbus, OH. [2]California State University, Chico, CA.*

*(No relevant relationships reported)*

Lengthening of skeletal muscle in eccentric exercise is linked with reduced fatigue resistance and muscle injury. Previous study has shown that eccentrically-biased exercise (i.e., downhill run) induced muscle damage is associated with leukocyte apoptosis. However, molecular evidence of reactive oxygen species (ROS) in stretched or eccentric muscle activities induced muscle dysfunction and apoptosis is not clear. **PURPOSE:** To evaluate ROS formation and muscle function in overstretched skeletal muscle in mice and to determine the effects of antioxidant intake on peripheral leukocyte apoptosis following eccentrically-biased downhill running. **METHODS:** Diaphragm muscle strips were isolated from C57BL6 mice and mounted in a contractile chamber. The muscles were either kept at its optimal length (control) or stretched to 30% of the optimal length, followed by a 5-min tetanic contraction. Cytochrome *c* was used to monitor superoxide $O_2^{\bullet-}$ release during contraction. Muscle force was recorded during the contractile protocol. In human eccentric exercise model, 22 subjects were randomly assigned into two groups taking: i) vitamin C (1000 mg/day) and vitamin E (400 IU/day); ii) maltodextrin (placebo) in a double-blinded fashion. Supplementation was administered for two weeks before downhill running exercise and two additional days after the training. At 0, 6, 24, 48h following the trial or prior to the trial, blood samples were collected for anti-apoptosis Bcl-2 assay via ELISA. Data were statistically analyzed as mean ± SE using one-way ANOVA. **RESULTS**: Overstretched diaphragm showed compromised muscle function compared to control (n = 10-13; $p < 0.05$). More ROS were induced in overstretched groups than control during contraction (n = 6-10; $p < 0.05$). In human model, we observed an increase in circulating leukocyte apoptosis and muscle soreness/damage 24-48 hours following exercise. Antioxidant attenuates the decrease in Bcl-2 at 24 hours following acute downhill running. **CONCLUSION**: Overstretched skeletal muscle is subjected to declined contractile function and exacerbated ROS formation. The combination of antioxidants supplementation appears to have a protective role via the attenuation of decrease in anti-apoptotic protein during eccentric exercise.

2282 Board #118 June 1 9:30 AM - 11:00 AM

### Downhill Running Impairs Strength And Activation Of The Elbow Flexors

Kyle J. Brandenberger, Christopher P. Ingalls, Jeff S. Otis, Gordon L. Warren, FACSM, James A. Doyle, FACSM. *Georgia State University, Jonesboro, GA.* (Sponsor: Dr. J. Andrew Doyle, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** The aim of this study was to determine if knee extensor injury induced by 1 h of downhill running attenuated force production in uninjured skeletal muscle (e.g., elbow flexors). **METHODS:** Recreationally active subjects (n = 12) completed a two group (injury vs control) repeated measures design with the injury group running downhill for 1 h and the control group performing only the measurement procedures. Strength and percent voluntary muscle activation were measured using an isokinetic dynamometer and electrical stimulation of the elbow flexors and knee extensors before and after a fatigue protocol at the following time points in relation to the downhill run: 15 min pre, 15 min post, 24 h post, and 48 h post. Blood samples were collected at the same time points to measure IL-1β and TNF-α concentrations. **RESULTS:** Knee extensor strength was significantly reduced by 53.5±9.9% immediately post-injury and remained reduced for up to 48 h in the injury group. Elbow flexor strength was significantly reduced immediately and 24 h post-injury by 13.2±3.9% and 17.3±4.0% respectively in the injury group. Elbow flexor electrically stimulated strength was not found to be different at any time point ($P = 0.561$). Elbow flexor activation was significantly reduced compared to control at 24 and 48 h post-injury by 22.9±9.1% and 13.5±5.7% respectively. No differences were observed in IL-1β or TNF-α between groups. **CONCLUSIONS:** A 1 h downhill run significantly injured the knee extensors. The elbow flexor muscles remained uninjured based on electrically stimulated strength, but voluntary strength of these muscles was impaired due to reduced activation. This suggests an injury to the knee extensors can impair strength in uninjured muscles by reducing voluntary activation. The mechanism behind this reduction remains undetermined.

2283 Board #119 June 1 9:30 AM - 11:00 AM

### Motor Unit Action Potential Amplitude Vs Recruitment Threshold Relationships In Endurance Runners And Sedentary Females

Hannah L. Dimmick, Adam J. Sterczala, Michael A. Trevino, Hannah L. Richardson, Jonathan D. Miller, Trent J. Herda. *University of Kansas, Lawrence, KS.*

*(No relevant relationships reported)*

**PURPOSE:** To examine potential differences in the motor unit action potential amplitude ($MUAP_{AMP}$) vs. recruitment threshold (RT) relationship between female cross-country athletes and healthy controls. **METHODS:** Eight chronically-endurance trained (ET) females (age=20±0.93 yrs; height=166.18±5.93 cm; body mass=54.44±5.47 kg) nine healthy sedentary (SED) females (age=19.7±2.12 yrs; height=167.2±8.9 cm; body mass=66.61±11.9 kg) volunteered for the study. The ET group consisted of NCAA Div. I collegiate cross-country runners that ran 10-20 hrs/week. The SED subjects participated in minimal regimented physical activity in the previous 6 months. Subjects performed three isometric maximal voluntary contractions (MVCs) followed by a 70% isometric trapezoidal muscle action performed at 70% MVC. Surface electromyography was recorded from the vastus lateralis via 5-pin surface sensor array. The EMG signals were decomposed and $AP_{AMP}$ (mV) and RT (expressed as %MVC) were calculated for each MU. For each subject, $MUAP_{AMPS}$ were linearly regressed against RTs with the slope and y-intercept calculated and used for statistical analysis. Two independent samples t-tests were used to examine potential between-group differences in the slopes and y-intercepts from the $MUAP_{AMP}$ vs. RT relationships. Statistical significance was set at $p \leq 0.05$. **RESULTS:** The average RT ranges for observed MUs were 23.4 – 55.7% and 16.1 – 44.4% MVC for the ET and RT, respectively. There were no significant differences between groups for the slopes (ET=0.0035±0.0016 mV/%MVC, SED=0.028±0.0.0021 mV/%MVC, p=0.47) or y-intercepts (ET=-0.032±0.068 mV/%MVC, SED=-0.018±0.0.067 mV/%MVC, p=0.67). **CONCLUSIONS:** Previously, increases in the slopes from the $MUAP_{AMPS}$ vs. RT relationships have been correlated with increases in muscle cross-sectional area following resistance training, which was suggested to indicate MU hypertrophy. The similar $MUAP_{AMP}$ vs RT relationships observed between the cross-country runners and sedentary controls may suggest that chronic endurance training did not result in hypertrophy of higher-threshold MUs of the vastus lateralis.

2284 Board #120 June 1 9:30 AM - 11:00 AM

### The Effect of Compression Garments Worn During Resistance Exercise on Muscle Damage, Fatigability and Hemodynamics

Makenzie Stade, Bria Morse, Evan Schick, Joshua Cotter. *California State University Long Beach, Long Beach, CA.*

*(No relevant relationships reported)*

Use of compression garments during and after exercise has gained notable popularity, yet, their utility in augmenting performance and recovery from resistance exercise remains elusive. **PURPOSE:** To evaluate the effects of wearing compression during resistance exercise on exercise induced muscle damage (EIMD), muscle oxygenation and muscular fatigue. **METHODS**: Ten healthy, untrained individuals ([mean ± SD] 8 females, 2 males, 22.10 ± 2.23 years, 159.09 ± 3.47 cm, 66.22 ±15.93 kg) performed two exercise trials: 1) wearing compression tights and 2) without compression. Exercise trials were randomized and separated by seven days. The exercise protocol consisted of 12 sets of 10 repetitions of knee flexion, at a velocity of 120 degrees per second, in the CON/ECC mode of an isokinetic dynamometer (HUMAC NORM). Muscle oxygenation of the vastus medialis oblique (VMO) was assessed by oxy-hemoglobin (HbO2) and deoxy-hemoglobin (Hb) through near-infrared spectroscopy (NIRS; TRS-21, Hamamatsu). Leg circumference, ratings of perceived muscle soreness (RPMS) and blood samples for creatine kinase (CK) were collected before, immediately after, and 24, 48 and 72 hours after exercise. **RESULTS**: Pre-exercise and inter-set rest period values for Hb, HbO2, total Hb (tHb) and tissue oxygenation index (TOI) were similar between conditions. Intra-exercise Hb and tHb were significantly ($p<0.05$) reduced with compression compared to control. Post-exercise Hb was significantly reduced and TOI was significantly increased ($p<0.05$) with compression compared to control. Main effects for time revealed significant ($p<0.05$) increases in leg circumference, RPMS and CK, however, no differences were observed between conditions. Additionally, a main effect for time revealed significant reductions in average torque (N*m) from the first four sets to the middle four sets and again during the final four sets but there were no differences between conditions. **CONCLUSION**: Lower body compression worn during resistance exercise did not impact muscular fatigue or damage, but venous return and muscle re-oxygenation may have been improved.

2285 Board #121 June 1 9:30 AM - 11:00 AM

### Muscle Architecture, Central Fatigue, and Contractile Properties Do Not Explain Age-Related Differences in Muscle Fatigue

Liam F. Fitzgerald, Margaret M. Ryan, Sydney L. Connor, Julia D. Miehm, Miles F. Bartlett, Jane A. Kent, FACSM. *University of Massachusetts Amherst, Amherst, MA.*

*(No relevant relationships reported)*

High-velocity contractions elicit greater muscle fatigue in older compared with young adults. In general, fatigue can occur due to failure at numerous sites from the central nervous system to the contractile machinery. Additionally, sarcopenia-induced architectural remodeling may place older muscle at a disadvantage for producing power at high contraction velocities. **PURPOSE:** To examine the potential roles of muscle architecture, central fatigue, and contractile properties on age-related differences in high-velocity knee extensor fatigue. **METHODS:** Baseline muscle architecture (thickness, MT; pennation angle, θ; fascicle length, FL) of the vastus lateralis was determined by ultrasonography in 7 young (YW; 21.6±0.4 yrs) and 7 older (OW; 69.6±1.3 yrs) women. Maximal voluntary dynamic (MVDC) and isometric (MVIC), and stimulated (80Hz and 10Hz, each 500ms) contractions were performed before and immediately after a fatigue trial consisting of 120 knee extensor MVDCs ($240° \cdot s^{-1}$, one every 2s). Muscle architecture, central fatigue (fall of MVIC:80Hz torque) and contractile properties (10Hz:80Hz torque ratio; torque half-relaxation time, $T_{1/2}$) were compared across groups using t tests and repeated measures ANOVA. **RESULTS:** Baseline MT ($p<0.01$) and FL ($p=0.01$) were lower in OW than YW, with no age-related difference in θ ($p\geq0.14$). OW fatigued more than YW (to 33±5% and 56±5% initial power, respectively; $p<0.01$), with no evidence of central fatigue in either group ($p\geq0.35$). Failure of excitation-contraction coupling (fall in 10:80Hz ratio) occurred in both groups ($p\leq0.02$), with no group×time interaction ($p=0.36$). $T_{1/2}$ was longer in OW than YW at baseline ($p<0.01$), but no group×time interaction was observed ($p=0.50$). While neither MT nor FL were associated with fatigue ($r^2\leq0.15$), $T_{1/2}$ at baseline was associated with fatigue in OW ($r^2=0.59$) but not YW ($r^2=0.11$). **CONCLUSION:** These results indicate that muscle architecture, central fatigue, and excitation-contraction coupling did not explain the greater muscle fatigue in OW. Notably, $T_{1/2}$ at baseline was predictive of fatigue in OW only, suggesting that slowed torque relaxation may limit older muscle's ability to maintain power output during fast, repetitive contractions.

2286 Board #122 June 1 9:30 AM - 11:00 AM

### Effects Of Lactate Administration On Intracellular pH And Contractile Performance During Rhythmic Muscle Contractions

Yoshinori Tanaka[1], David C. Poole, FACSM[2], Yutaka Kano[1]. *[1]University of Electro-Communications, Tokyo, Japan. [2]Kansas State University, Manhattan, KS.* (Sponsor: David C Poole, FACSM)

*(No relevant relationships reported)*

Skeletal muscle fatigue during heavy or severe intensity exercise is accompanied by decreased intracellular pH ($pH_i$) and accumulation of lactic acid. The role of these perturbations in the fatigue processes are hotly debated with evidence for and against a deterministic role for each in muscle contractile tolerance and intolerance. However, it is unknown whether extracellular lactate level during exercise affects $pH_i$ and contractile performance especially within a mixed fiber type muscle that is a close analog of the human quadriceps with respect to fiber type and oxidative capacity. **PURPOSE:** Using an *in vivo* bioimaging model, we tested the hypothesis that extracellular high lactic acid levels would increase endurance performance without changing $pH_i$ during sustained contractions. **METHODS:** The intact spinotrapezius muscle of adult male Wistar rats was exteriorized and loaded with the fluorescent probe BCECF-AM (10 μM). Isometric (ISO) twitch contractions were evoked at the optimal muscle length via electrical stimulation for 10 min (2 Hz, 9 V, stimulus duration 4 ms). The rats were divided into two groups: buffer solution loading group (CONT, n = 7) and lactate solution loading group (LAC; 20 mM, n = 6). The fluorescence ratio (F500 nm/F445 nm) for $pH_i$ estimation was determined from images captured pre-contraction (-10 min, -5 min) and < 1 min, 5 min, 10 min, 15 min, and 20 min after contraction. **RESULTS:** Muscle tension decreased significantly with time in both CONT and LAC groups. However, LAC muscles elicited a higher tension over almost the entire bout and the time to significant tension reduction was substantially increased in the LAC group (CONT: 2.5 min vs LAC: 7.5 min, $p < 0.05$). In the CONT group, no significant change in $pH_i$ was observed after contractions, whereas a significant decrease in $pH_i$ was observed in the LAC group during 20 min from immediately after muscle contractions. **CONCLUSION:** Within this preparation extracellular high lactic acid and lowered $pH_i$ improved contractile performance substantially.

2287 Board #123 June 1 9:30 AM - 11:00 AM

### Exercise Induced SOD2 asa Predictor of Fatigability in Healthy Adults

Zoe Williams[1], Lisa Chin[1], Rebekah Feng[2], Leorey Saligan[2], Leighton Chan[2], Randall E. Keyser, FACSM[1]. *[1]George Mason Universtiy, Fairfax, VA. [2]National Institutes of Health, Bethesda, MD.* (Sponsor: Randall Keyser, FACSM)

*(No relevant relationships reported)*

Acute aerobic exercise has been reported to increase antioxidant levels in response to an increase in exercise-induced oxidative stress. However, there is limited knowledge regarding the acute exercise effects of serum SOD2 levels on fatigability measures in healthy adults. **Purpose:** The purpose of this study was to determine if physiological determinants of fatigue (such as time to fatigue, TTF; peak oxygen consumption, $VO_2$; peak work rate, WR) are significantly correlated to serum SOD2 levels before, immediately after and 60 minutes after an acute bout of aerobic exercise. **Methods**: Subjects were 19 healthy, adults (13 females, 6 males; age 26.58±9.1 years; BMI 24.2±2.7 kg/m$^2$) enrolled in the National Institutes of Health Fatigue in Healthy Protocol Trial. Subjects completed a treadmill cardiopulmonary exercise test (CPET) to exhaustion during the first visit. On a subsequent visit, subjects performed a vigorous-intensity continuous work rate test on the treadmill to exhaustion, and serum samples were collected immediately before, immediately after and 60 minutes after exercise. Performance fatigability was represented by peak $VO_2$ and peak WR from the CPET, as well as TTF during vigorous exercise. A Human Oxidative Stress Multiplex panel was used to determine serum SOD2 levels. Pearson product-moment correlation analyses were performed on the identified physiologic determinants of interest and SOD2 at various time points. **Results:** Peak $VO_2$ ($r = 0.57$, $p = 0.02$) and peak WR ($r = 0.62$, $p = 0.01$) were significantly correlated to serum SOD2 levels immediately post exercise, while TTF was not significantly correlated to SOD2 at any time point. **Conclusions:** This study suggests that an exercise-induced increase in serum levels of SOD2 may be a predictor of fatigability in healthy adults. Further research and analysis of other physiological fatigability measures is needed to validate these findings. Funding: Intramural Funds from the National Institutes of Nursing Research

2288 Board #124 June 1 9:30 AM - 11:00 AM

### Cross Validation of Different Equations to Predict Knee Extensors Isokinetic Strength in Brazilian Older Women

Juscelia C. Pereira, Silvia G.R. Neri, André B. Gadelha, Martim Bottaro, Ricardo M. Lima. *University of Brasilia, Brasilia, Brazil.*

*(No relevant relationships reported)*

**PURPOSE:** to determine the accuracy of the equations in predicting knee extensors isokinetic strength in Brazilian older women. **METHODS:** A total of 453 elderly women aged 60 to 84 participated in the present cross-sectional study. Quadriceps isokinetic strength was measured using the Biodex System dynamometer, with participants performing two to three sets of four knee extensor contractions at 60°s$^{-1}$, with 30 seconds rest intervals between sets. The highest peak torque (PT) was recorded and compared to the PT predicted by two different equations (Neder et al. and Phillips et al.). Dependent t test, Pearson correlation (r), constant error (CE)/bias and standard error of estimate (SEE) were calculated to examine differences between the measured PT with values estimated by the equations. Concordance analysis was investigated using Bland-Altman technique. Statistical significance was set at $p < .05$. **RESULTS:** The Neder et al. (85.30 ± 18.60 Nm) and Gross et al. (85.00 ± 29.99 Nm) equations provided significantly lower estimates when compared with measured PT (92.26 ± 21.59 Nm) ($p < .001$ for both). Moderate correlations were observed for Neder et al. and Gross et al. in relation to actual values (0.53; 0.50, respectively). The mean ± SD CE/Bias and SEE were high for the prediction equations (Neder et al. = 7.00 ± 19.70 and 18.36 Nm; Gross et al. = 7.30 ± 26.70 and 18.67 Nm, respectively). The 95% limits of agreement of the mean error were similar for the prediction equations, with values varying between 14.0 and 14.6 Nm. **CONCLUSION:** Because of the wide limits of agreement displayed by each studied equation and inflated values for error, the Neder et al. and Gross et al. equations were not accurate to predicting the knee extensors isokinetic strength in Brazilian older women. One possible reason for this finding is that these equations were derived from a wide age range (10 to 80 years), with limited data derived from older women. Future studies are necessary to develop a specific equation for elderly women, aiming to accurately predict isokinetic quadriceps muscle strength.

2289 Board #125 June 1 9:30 AM - 11:00 AM

### The Effects Of Cross-education On Critical Torque And Time To Task Failure

Alwyn Quarshie, Robert E. Hight, Bree S. Baker, Samuel R. Buchanan, Debra A. Bemben, FACSM, Christopher D. Black, FACSM. *University of Oklahoma, Oklahoma City, OK.* (Sponsor: Christopher D. Black, FACSM)

*(No relevant relationships reported)*

Debate exits regarding the extent to which resistance training may alter endurance performance. **PURPOSE:** To determine whether critical torque (CT) and time to failure (TTF) are influenced by a cross-education effect consequent to a 4-week unilateral isometric resistance training protocol. **METHODS**: A seven participant mixed-gender sample was tested prior to and following16 sessions of unilateral isometric resistance training. Sessions consisted of 6 sets of 6 maximal isometric contractions (MVCs) of the dominant plantar flexors. CT and TTF were assessed in the trained and the contralateral, untrained leg across 4 test days structured with a randomized pre-post design. CT was assessed from a 5-minute "all-out" test in which participants completed 60 MVCs at a 3:2 duty cycle. Time to task failure was defined at the point which a submaximal contraction set equal to 30% of the highest MVC could no longer be maintained. Changes in soleus muscle cross-sectional area (CSA) were calculated via peripheral quantitative computed tomography. When one-way repeated measures ANOVAs performed across the final 6 contractions of the CT tests were non-significant, these contractions were averaged to obtain the criterion CT value. Peak force, soleus CSA, CT, and TTF were evaluated independently in each limb using paired-samples t-tests. **RESULTS:** Peak force increased in the trained (25.5 ± 19.7%, $p < 0.01$) and the untrained limb (30.5 ± 16.3%, $p < 0.01$), indicating that cross-education occurred. There were no pre-post differences in soleus CSA in either limb; (trained: 5193 ± 1557 vs. 5139 ± 1504 mm$^2$, $p > 0.05$) or (untrained: 5246 ± 1432 vs. 5255 ± 1544 mm$^2$, $p > 0.05$). Peak force did not differ between the final 6 contractions during any CT test ($p > 0.05$). CT increased in the trained (322 ± 6 N to 402 ± 12 N, $p < 0.01$) and untrained (313 ± 12 N to 390 ± 13 N, $p < 0.01$) limbs, respectively, and TTF was reduced in the trained (410 ± 112 vs. 319 ± 85 s, $p = 0.014$), but not the untrained limb (424 ± 152 vs. 312 ± 79 s, $p = 0.08$). **CONCLUSIONS:** Improvements in strength and CT occurred in both the trained and untrained limbs indicating that strength training may play a role in improving endurance capacity and that this adaptation can occur in a contralateral limb. The decline in time to task failure may be a result of the increased absolute force output required to complete the task.

2290 Board #126 June 1 9:30 AM - 11:00 AM

### Heightened Sensory Signaling Does Not Alter Critical Torque

Darshit S. Patel, Natalie R. Janzen, Robert E. Hight, Christopher D. Black, FACSM. *The University of Oklahoma, Norman, OK.* (Sponsor: Christopher D. Black, FACSM)

*(No relevant relationships reported)*

Peripheral metabolic perturbations have been shown to activate group III and IV sensory afferents and lead to a decrease in central motor drive and an earlier onset of fatigue. Critical power or its isometric analog, critical torque (CT), is an important parameter of aerobic metabolic function and a strong predictor of endurance performance. **PURPOSE**: This study sought to examine the effects of heightened afferent signaling on voluntary CT and electrically stimulated CT. **METHODS:** Eleven participants performed a voluntary (VOL) 5-min all-out and a 5-min stimulated (STIM) isometric knee extension test with contralateral blood flow occlusion (CBFO) following fatiguing exercise and without occlusion (CONTROL). Stimulated CT was also assessed with occlusion applied to the ipsilateral leg (IBFO). Both the VOL and STIM protocols were performed at a 3-sec to 2-sec work to rest cycle. Stimulated contractions were performed at 50 Hz at a current eliciting 25% of MVC. **RESULTS:** There was a significant effect of time ($p < 0.001$) for VOL in both the CBFO and CONTROL conditions with torque declining to a critical level. VOL CT did not differ between the two conditions (360 ± 119 vs. 343 ± 108 Nm; $p = 0.28$). A significant condition x time interaction ($p = 0.009$) was found for STIM. Initial torque did not differ among the conditions ($p = 0.876$), but CT values were lower ($p < 0.001$) in IBFO (19.2 ± 15.8 Nm) compared to CONTROL (57.7 ± 15.6 Nm) and CBFO (62.1 ± 17.7 Nm). The CONTROL and CBFO conditions did not differ ($p = 0.347$). **CONCLUSIONS:** Heightened group III and IV afferent signaling has been shown to increase central fatigue and reduce endurance capacity. Our findings indicate the reduced endurance capacity is not due to reductions in CT—suggesting participants were able to maintain central drive to skeletal muscle. Our findings that stimulated CT fell with IBFO provides further evidence validating our stimulated CT test and it demonstrates its sensitivity to oxygen delivery.

2291 Board #127 June 1 9:30 AM - 11:00 AM

### The Effects of Repeated Shortening or Lengthening Muscle Actions on Knee Extensor Position Sense

Ryan M. Thiele[1], Jason M. DeFreitas[2]. [1]*Kansas State University, Manhattan, KS.* [2]*Oklahoma State University, Stillwater, OK.*

*(No relevant relationships reported)*

The effects of concentric, fatiguing muscle actions on muscle spindle function has been well studied. However, few studies have examined the effects of eccentric muscle actions on proprioceptive function. **PURPOSE:** Investigate the effects of fatiguing shortening or lengthening muscle actions on position matching (PM) tasks of the knee extensors. **METHODS:** Fifteen females (age = 21.67 ± 2.1 yrs.) participated in a familiarization trial, followed by two experimental sessions, separated by seven (±1) days, consisting of either muscle- shortening (Concentric; CON) or lengthening (Eccentric; ECC) contractions of the right limb at 60°·s$^{-1}$ until 70% of peak torque (PT) could no longer be achieved. PM tasks included a randomly chosen limb fixed in a static position to serve as a reference of the contralateral test limb during active position matching tasks. Participants were asked to provide verbal feedback when they had matched the test limb with the reference limb, followed by a 2-second static hold. Four PM efforts were completed, with eyes closed, for each limb at two randomly assigned joint angles of 80° and 165° prior to the experimental protocols (Pre). Subsequent PM tasks were completed immediately after (Post 0) and ten (Post 10) minutes following the experimental protocols. Two separate, three-way repeated measure ANOVAs (condition [CON vs ECC] × limb [right vs left] × time [Pre vs Post 0 vs Post 10]) were used to analyze absolute PM error at 80° and 165°. An alpha value of $P \leq 0.05$ was considered statistically significant for all comparisons. **RESULTS:** A significant condition × limb interaction (p = 0.002) for 80° was observed in which PM error of the right limb was greater during the CON protocol compared to the ECC protocol (p = 0.011). Additionally, no differences in PT were observed for either experimental protocol between Pre and Post 10 (p = 0.097). **CONCLUSION:** These findings suggest that alterations in PM acuity may be more pronounced at joint angles in which passive muscle tension increases (80°), following concentric muscle actions. Furthermore, muscle spindle function may not be disrupted by repeated lengthening muscle actions when the protocol does not induce muscle damage.

2292 Board #128 June 1 9:30 AM - 11:00 AM

### Muscle Acidification And Fatigue Kinetics During Intense Repeated Exhaustive Exercise

Magni Mohr[1], Jonathan Fulford[2], Joanna L. Bowtell[2], Peter Krustrup[3]. [1]*University of the Faroe Islands, Tórshavn, Faroe Islands.* [2]*University of Exeter, Exeter, United Kingdom.* [3]*University of Southern Denmark, Odense, Denmark.*

*(No relevant relationships reported)*

Skeletal muscle and fatigue responses during single high intensity exercise bouts have been examined extensively, while scientific reports on repeated high intensity exercise are limited. **PURPOSE:** To examine effects of muscle acidification on fatigue kinetics during repeated intense exhaustive exercise. **METHODS:** Eight active male participants (age: 26±3 (±SEM) yrs.; $VO_{2max}$: 58±1 $mlO_2 \cdot kg^{-1} \cdot min^{-1}$) completed two exercise trials in random order. Trials consisted of five intense single leg knee-extensor exercise bouts to exhaustion (EX1-5) separated by 5 min recovery, with (ARM) and without (CON) previous intense intermittent arm crank exercise. $^{31}$P-MRS measurements of the quadriceps muscle were undertaken to assess muscle pH and venous blood was drawn. **RESULTS:** Quadriceps muscle pH was lower (P=0.002) prior to the knee-extension exercise in ARM compared to CON (6.948±0.018 vs 7.040±0.010, respectively). In CON muscle pH dropped to 6.370±0.038 in EX1 and was progressively higher (P<0.05) in the following four bouts reaching 6.705±0.045 in EX5. However, in ARM muscle pH reached similar levels in EX1-4 (6.490-6.579) and was elevated only in EX5 (6.637±0.062). Pre-exercise blood lactate concentration was increased (1467±111%, p<0.001) and $pCO_2$ (27.8±14.4%, p=0.045), with concomitant reductions in blood pH (-0.24±0.02, p<0.001) and $HCO_3^-$ (-38.1±2.2%, p<0.001) in ARM compared to CON. Exercise performance was 69±20% shorter (P<0.05) in ARM compared to CON. Performance was attenuated (P<0.05) in ARM during the three first bouts compared to CON. There was a progressive reduction (P<0.05) in exercise performance in CON trial, while no significant differences were observed between the five bouts in ARM. **CONCLUSION:** Prior arm exercise markedly alters fatigue kinetics and muscle acidification during repeated intense knee-extension exercise. Muscle acidification may provoke fatigue during single bout intense exercise scenarios, but appears to play a minor role, when exercise is repeated.

2293 Board #129 June 1 9:30 AM - 11:00 AM

### Interference In Emphasis Of Muscle Actions In The Maximum Dynamic Strength And The Maximum Volume Of Repetitions

Cintia C. Rocha[1], Hiago L. R. de Souza[2], Yuri A. C. Campos[3], Gaspar P. da Silva[4], Miller P. Guimarães[5], Osvaldo C. Moreira[6], Sandro F. da Silva[4]. [1]*Presbyterian College Gammon, LAvras, Brazil.* [2]*Federal University of Triângulo Mineiro, Uberaba, Brazil.* [3]*Federal University of Juiz de Fora, Juiz de Fora, Brazil.* [4]*University of Lavras, Lavras, Brazil.* [5]*Presbyterian College Gammon, Lavras, Brazil.* [6]*University of León and Federal University of Viçosa, Florestal, Brazil.*

*(No relevant relationships reported)*

**PURPOSE:** The present study aimed to investigate the influence of different speeds of muscle actions on the maximum volume of repetitions and maximum dynamic muscle strength. **METHODS:** The study included 9 women. At first, the volunteers performed the anthropometric assessment and the evaluation of maximum dynamic strength through the 1RM test; In the second moment, the volunteers performed three series with 60% of 1RM as many repetitions as possible, with an emphasis on concentric phase of the movement (CP); in the third moment it was conducted the same exercise with emphasis on the eccentric phase of the movement (EP); and in the fourth moment the same procedure was conducted without emphasis on any stage of the movement (CoP). At the end of 3 series of each execution protocol was added the maximum volume of repetitions (MVR), the maximum dynamic strength was assessed 72 hours after each protocol. **RESULTS:** The results showed no statistically significant difference in maximum number of repetitions and maximum dynamic strength among the protocols CP, EP and CoP. The dynamic strength decreased 6% after the EP, the MVR also showed fewer number of repetitions (34.77) compared to other protocols. **CONCLUSIONS:** It was possible to conclude that the realization of protocols of exercises with speed movement that emphasize different muscle actions causes decreased maximal dynamic muscle strength and shows tendency to decrease the MVR when the movement speed prioritizes eccentric actions.

**Financial Support -** FAPEMIG- Fundação de Amparo à Pesquisa de Minas Gerais

## E-33 Free Communication/Poster - **Motor Control**

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2294 Board #130 June 1 11:00 AM - 12:30 PM

### The Effect of Exercise Intensity on the Kinematics of Reach Performance and Brain-Derived Neurotrophic Factor

Jessica F. Baird, Mary E. Gaughan, Heath M. Saffer, Mark A. Sarzynski, FACSM, Troy M. Herter, Stacy L. Fritz, Dirk B. den Ouden, Jill C. Stewart. *University of South Carolina, Columbia, SC.*

*(No relevant relationships reported)*

**PURPOSE**: Acute exercise paired with practice of a motor task has been shown to enhance motor learning beyond task practice alone. However, it is unknown how exercise intensity affects movement kinematics during motor learning. Furthermore, the brain-derived neurotrophic factor (BDNF) response to exercise intensity needs to be examined because increases in BDNF are thought to mediate exercise-enhanced motor learning.
**METHODS**: 48 participants (23.3 ± 3.2 yrs) practiced a 3-dimensional motor learning task, which involved reach movements made to sequentially presented targets. Before task practice, participants were randomized so that 16 participants exercised on a cycle ergometer at a high-intensity, 16 participants exercised at a low-intensity, and 16 participants rested. Exercise intensity was determined as a percentage of max resistance obtained on a cycle-based graded exercise test, and duration was individually modified so that each participant in the low and high intensity groups expended 200 kcals of energy. Blood samples were obtained from all participants before and after exercise (exercise groups) or rest (control group) to assess changes in BDNF.
**RESULTS**: All participants significantly improved performance, as indicated by shorter times to complete the task. In the rest group, shorter times were associated with decreased distance traveled between targets, a spatial component of performance. In contrast, the exercise groups improved by altering temporal components of performance. The high-intensity group had significantly higher reach speeds (peak velocity), and the low-intensity group had significantly earlier peak velocities, an important feature of motor learning ($p < 0.001$ for all group differences). The percent change of the BDNF response was greater for the high-intensity (164.53% ± 465.56)

and low-intensity (152.76% ± 324.75) groups compared to the rest group (37.8% ± 195.65). However, group differences were not significant because of high variability in individual BDNF responses.
**CONCLUSIONS**: An acute bout of exercise facilitates temporal changes in movement kinematics that are associated with improvements performing a sequential target task. Regardless of intensity, the BDNF response to exercise has high inter-individual variability, which needs to be further investigated.

2295 Board #131 June 1 11:00 AM - 12:30 PM

### Agility of Adolescents with Attention Deficit Hyperactivity Disorder Compared with Normal Controls: A Preliminary Investigation

Laurie Simard[1], Tommy Chevrette[1], Julie Bouchard[1], Linda Pacquette[1], Jacinthe Dion[1], Claudia Verret[2], Alain-Steve Comtois[3], Jacques Leroux[4]. *[1]UQAC, Chicoutimi, QC, Canada. [2]UQAM, Montréal, QC, Canada. [3]UQAM, Montreal, QC, Canada. [4]HRDP, Montreal, QC, Canada.*

*(No relevant relationships reported)*

**PURPOSE**: Motor delay (MD) has been shown in children with Attention-Deficit/ Hyperactivity Disorder (ADHD), such as agility. Agility is involved in everyday movements and is essential to the development of sports skills. Recent imaging studies have shown delayed of the cerebral cortex development of near three years in children with ADHD, which could explain MD. This study aims to evaluate Agility in ADHD male adolescents compare to normal controls, group-matched for age. Moreover, if MD in agility is still observable in ADHD, to determine which group age they can be compared with. **METHODS**: This study included 40 adolescents; 20 with ADHD (ADHD-gr; age 13.8 ± 0.9 yr) and 20 normal controls (Control-gr; age 13.5 ± 1.0 yr). First, both groups were compared using the UQAC-UQAM Gross motor tests battery for agility: Shuttle, Circle, Side-stepping, and Slalom run. Agility scores (sec.) were compared between groups using One-way ANOVA. Then, descriptive comparisons were performed using results of the 50th percentile in 8 yr children (P50-8) and in 12 yr (P50-12) for each agility tests.
**RESULTS**: Adolescents with ADHD were significantly slower when compared to control in Shuttle Run (11.2 ± 1.3 vs. 6.6 ± 3.1 sec., p<0.001) and Circle Run (22.3 ± 2.9 vs. 19.5 ± 2.2 sec., p<0.001). Results tending to be slower for Side-stepping, and Slalom Run but did not reach significance. When compared to norms across age group, ADHD-gr scores (sec.) were aligned to P50-8 and slower then P50-12 for all agility tests. However, as expected, the scores (sec.) of Control-gr, were aligned or better to P50-12.
**CONCLUSIONS**: In this study, motor delay in agility is still observable in a group of adolescents with ADHD. It seems to have a delay of about 5 years between groups (ADHD vs Control) for all tests measuring agility. Further research is needed to clarify motor delay in adolescents with ADHD for all determinants of gross motor skills (agility, coordination, segmental velocity, balance, and reaction time).

Agility Score Test of Adolescents with ADHD Compared to Normal Controls

| Agility Tests (sec.) | 50th percentile for 8yrs | 50th percentile for 12yrs | N | ADHD | Control | p |
|---|---|---|---|---|---|---|
| Shuttle Run | 11.3 | 10.3 | 36 | 11.2±1.3 | 6.6±3.1 | 0.00* |
| Side-stepping Run | 11.4 | 10.1 | 38 | 11.3±2.3 | 10.5±1.4 | 0.21 |
| Circle Run | 22.3 | 20.3 | 40 | 22.3±2.9 | 19.5±2.2 | 0.00* |
| Slalom Run | 20.1 | 16.8 | 40 | 18.9±2.3 | 17.5±2.3 | 0.15 |

2296 Board #132 June 1 11:00 AM - 12:30 PM

### A Muscle's Functional Role Influences Movement Accuracy Before and After Eccentric Exercise

Kurt W. Kornatz[1], Vasanth Subramanian[2], Yu-Kai Chang[3]. *[1]Winston-Salem State University, Winston-Salem, NC. [2]Rosalind Franklin Univerisity of Medicine and Science, North Chicago, IL. [3]National Taiwan Sport University, Taoyuan City, Taiwan.* (Sponsor: Michael McKenzie, FACSM)

*(No relevant relationships reported)*

Eccentric muscle contractions, especially if unaccustomed and intense, can cause fatigue and muscle damage that contributes to acute decrements in motor performance. Because performance of motor tasks requires the precise coordination of agonist and antagonist musculature, the effect of the eccentric activity on accuracy will likely depend on the damaged muscle's functional role as an agonist or antagonist in the task. **PURPOSE:** To compare the effect of fatiguing eccentric exercise (EE) on the accuracy of aiming movements when the EE muscle group's function is that of an agonist or antagonist. **METHODS:** 16 untrained subjects (9 M, 7 F; 27 ± 3 yrs.) completed discrete horizontal pointing movements between 2 targets (13mm diameter) that required 40° of elbow movement. Twenty elbow-extension and 20 elbow-flexion pointing movements were performed with their right arm before and immediately after eccentric exercise of the elbow extensor muscles standardized by isokinetic dynamometry. Movement accuracy was quantified by the incidence (overall accuracy) and duration to initiation (magnitude of error) of secondary submovements that were identified by zero crossings in the tangential velocity and acceleration profiles. **RESULTS:** When the exercised muscles performed the pointing task as the agonist (i.e. extension movements), movement times (MT) were longer and peak velocity (PV) decreased after EE compared with before EE (MT= 222 ± 40, 248 ± 37ms, $p<0.05$; PV= 3.4 ± 0.6, 3.1 ± 0.6m/s, $p<0.05$). However, when the exercised muscle was the antagonist (i.e. flexion movements), MT and PV remained unchanged. There were more trials with no corrective submovements (i.e. more accurate) for the extension compared with flexion movements before EE (92% vs. 62%, $p<0.001$), but there was a greater decline in accurate trials after EE for the extension movements (78% vs. 41% decline $p<0.0001$). Furthermore, although initially similar, the duration of the primary submovement was shorter (further from target) after EE for the movements in which the agonist was the exercised muscle compared with an antagonistic role (62% vs. 73% of total movement time, $p<0.001$). **CONCLUSIONS:** There is a greater effect of EE-induced muscle fatigue and damage on movement kinematics and accuracy when the muscle's functional role is agonistic.

2297 Board #133 June 1 11:00 AM - 12:30 PM

### Alterations In Spinal Excitability And Descending Drive Following Cross-education

Robert E. Hight, Alwyn T. Quarshie, Samuel R. Buchanan, Bree S. Baker, Debra A. Bemben, FACSM, Christopher D. Black, FACSM. *University of Oklahoma, Norman, OK.* (Sponsor: Christopher D. Black, FACSM)

*(No relevant relationships reported)*

For over a century, there has been considerable interest in the so-called cross-education phenomenon, whereby training one limb augments performance in the contralateral untrained limb. The underlying adaptation(s) in the nervous system have yet to be fully elucidated. **PURPOSE:** To investigate contralateral neural adaptations via evoked spinal and supraspinal reflexes, EMG amplitude ($EMG_{rms}$), and voluntary muscle activation (%ACT) following a 4-week unilateral isometric resistance training program. **METHODS:** Seven untrained men and women completed a unilateral resistance training program which consisted of 6 sets of 6 maximal voluntary isometric contractions (MVCs) across 4-weeks (16 sessions) using the dominant plantar flexor muscle group. Prior to and following training, a battery of tests were conducted in both limbs. Surface EMG was recorded from the soleus, medial gastrocnemius, lateral gastrocnemius, and tibialis anterior muscles while transcutaneous electrical stimulation was applied over the tibial nerve across a range of intensities to determine maximal H-reflex ($H_{max}$) and M-wave amplitudes ($M_{max}$). Participants then performed 3, 3-second MVCs. During each contraction, a single, 1-ms supramaximal stimulus (150% $M_{max}$) was applied 2.5 seconds into the contraction to evoke a V-wave and interpolated torque with control twitches occurring 2 and 4 seconds following relaxation. The V-M ratio and %ACT were measured simultaneously during each MVC. **RESULTS:** Peak torque increased 26 ± 20% ($p < 0.01$) and 31 ± 16% ($p < 0.01$) in the trained and untrained limbs, respectively. Following training, there was an increase in the soleus V-M ratio in the untrained (32 ± 21% vs. 38 ± 19%, $p = 0.01$), but not the trained limb ($p > 0.05$). %ACT was not altered post training in either limb—96.9 ± 3.9 vs. 95.5 ± 3.4 ($p = 0.56$) and 95.7 ± 3.7 vs. 92.9 ± 4.2 ($p = 0.10$) No differences were found in the MG, LG, or TA V-M ratio for either limb ($p > 0.05$). Additionally, there were no changes in $H_{max}/M_{max}$ and $EMG_{rms}$ from pre to post training in either limb ($p > 0.05$). **CONCLUSIONS:** Our findings indicate significant cross-education of the contralateral limb. It is likely that increases in supraspinal activity (i.e. descending drive), rather than changes in spinal excitability or voluntary activation, are responsible for the contralateral torque increase.

2298 Board #134 June 1 11:00 AM - 12:30 PM

### Acute Effects of Unilateral Static Stretching on Contralateral Limb Range of Motion and Isometric Strength

Xin Ye[1], Benjamin Killen[2], Krista Zelizney[3]. *[1]University of Mississippi, University, MS. [2]University of Mississippi Medical Center, Jackson, MS. [3]Florida International University, Miami, FL.*

*(No relevant relationships reported)*

Static stretching (SS) is an effective exercise technique often used in sports performance and rehabilitation fields to improve one's range or motion (ROM). However, its effects on non-intervened contralateral limb's performance remain equivocal.**PURPOSE**: To examine the acute effects of unilateral hamstrings SS on the contralateral hip flexion passive ROM and the strength performance. **METHODS**: Twenty-three healthy young adults (male: n = 13, mean ± SD age = 26 ± 3 years; height = 176.9 ± 6.6 cm; body weight = 84.2 ± 12.5 kg; female: n =10, mean ± SD age

= 27 ± 2 years; height = 164.1 ± 3.5 cm; body weight = 59.3 ± 11.4 kg) participated in a 2-visit investigation which consisted of a familiarization visit and an experimental visit. During the experimental visit, 10 sets of 30-second SS were performed with the subjects' dominant hamstring muscles. Before (Pre-) and after (Post-) the SS intervention, the contralateral hip flexion passive ROM, the isometric strength of the contralateral knee flexors, along with the surface electromyography (EMG) were measured. Separate paired sample t-tests were used to examine the potential changes in the dependent variables described above.
**RESULTS**: The SS significantly increased the contralateral hip flexion passive ROM (Pre = 64.70 ± 19.19º vs. Post = 73.48 ± 22.60º, $p < 0.001$). In addition, the isometric strength of the contralateral knee flexor significantly decreased (Pre = 326.63 ± 91.81 N vs. Post = 310.44 ± 92.08, $p = 0.004$). For both biceps femoris ($p = 0.065$) and semitendinosus ($p = 0.083$) muscles, there were decreasing trends toward significance for the normalized EMG amplitude.
**CONCLUSIONS**: Prolonged unilateral SS intervention improved the contralateral hip flexion passive ROM but decreased the strength performance. In addition to the possible increased stretch tolerance, the high intensity and duration static stretches might have also induced the crossover inhibition of the spinal motoneurons, thereby reducing the neuromuscular performance of the contralateral muscle.

2299 Board #135 June 1 11:00 AM - 12:30 PM

### Symmetry Loading After Knee Injury Appear Different During Leg Press And Squat Activities

Thomas W. Kernozek, FACSM[1], Becky Heinert[2], Drew Rutherford[1], Jeremie Schiedermayer[1], Douglas Baumann[1]. [1]*University of Wisconsin-La Crosse, La Crosse, WI.* [2]*Gundersen Health System, La Crosse, WI.*

*(No relevant relationships reported)*

Patients post ACL R or meniscal repair often display weight bearing asymmetry post surgically during movement performance. PURPOSE: To determine if real-time force feedback can be used to increase weight bearing symmetry post-surgery immediately and has delayed retention during a leg press and squat exercise. METHODS: Fourteen patients were tested using load sensors under each foot while exercising on a leg press machine and while performing weight bearing squats. These load sensors depicted the magnitude of force normal to the foot at 62.5 Hz. During the pre-test, data were collected as patients performed the leg press and squat exercises blinded to any feedback. During training, data were streamed in a bar graph to a display in front of the patient with therapist instructions to attempt to maintain equal weight on each leg. After the training, each patient performed a post-test with no feedback. One week later, they had a delayed retention. A two way repeated measures analysis of variance was used to examine mean weight bearing asymmetry for each exercise (leg press and squat) across time (pre-test, post-test, and delayed retention). RESULTS: There was a main effect for exercise ($p<0.05$), no main effects for time ($p>0.05$) and there was an exercise by time interaction ($p<0.05$). Overall, during the leg press there was more weight bearing asymmetry compared to the squat (30% greater). The interaction showed that the leg press had nearly 9% improvement over the time compared to pre-test while the squat showed symmetry improvement of 19% post-test but delayed retention was poor. CONCLUSION: Weight bearing asymmetry appears different for different tasks (leg press vs. squats). It appears the feedback can produce immediate changes in symmetry but retention appears different for different tasks.

2300 Board #136 June 1 11:00 AM - 12:30 PM

### Is Aiming a Handgun Like Pointing a Finger?

Kyle J. Kelleran[1], Steven Morrison[2], David P. Swain, FACSM[2], Daniel M. Russell[2]. [1]*Bridgewater College, Bridgewater, VA.* [2]*Old Dominion University, Norfolk, VA.* (Sponsor: David Swain, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** In aiming at a target, humans produce small involuntary fluctuations in the aiming limb that may hamper performance. While often studied in the vertical axis, these fluctuations occur in all axes. The current study compared vertical (VT), mediolateral (ML), and anterior-posterior (AP) tremor amplitude during finger pointing and handgun aiming. **METHODS:** Twenty volunteers, in a counterbalanced order, pointed their finger or aimed a training handgun for 10 seconds at a bullseye target 6.4 meters away. Participants performed five trials per condition. Accelerometers were affixed to the upper arm (UA), forearm (FA), hand (HA), and finger/gun barrel (GF). Amplitude (RMS) and regularity (ApEn) of the acceleration signals were computed. **RESULTS:** Compared to finger pointing (RMS: 0.238±0.146, APEN: 1.373±0.138), accelerations at the distal segment were significantly lower and more regular during the handgun aiming condition (RMS: 0.202±0.111, APEN: 1.112±0.146). Significant interactions were present between condition (pointing, aiming) and limb segment in each direction. The amplitude of tremor in the UA and FA segments were similar for pointing and aiming in all three directions ($p$'s>0.05). Handgun aiming resulted in smaller amplitude tremor at the GF in both VT and ML directions and HA in the ML direction, but larger amplitude at the HA in the AP direction ($p$'s<0.05). Aiming increased regularity (decreased ApEn) at the GF in VT direction, both FA and GF in ML direction, and at the UA and HA in AP direction ($p$'s<0.05). Pointing was more regular than aiming only for the HA in the VT direction ($p<0.05$). For all other directions and segments RMS and ApEn were similar between pointing and aiming ($p$'s>0.05). **CONCLUSION:** Aiming with the mass of a gun in the hand has primarily a damping effect on the amplitude of tremor in the distal segments as well as resulting in more regular movements. Greater regularity in the VT axis of the HA during pointing suggests increased control of VT across the wrist in this task. Overall, these results suggest that aiming with a gun and pointing with a finger are similar tasks except for the added mass.

2301 Board #137 June 1 11:00 AM - 12:30 PM

### Motor Cortex Function in Symptomatic and Asymptomatic Individuals Following Mild Traumatic Brain Injury

Alia L. Yasen, Eli K. Edwards, Geeta Eick, Kirstin Sterner, Anita D. Christie. *University of Oregon, Eugene, OR.* (Sponsor: David Gabriel, FACSM)

*(No relevant relationships reported)*

While most individuals who suffer a mild traumatic brain injury (mTBI) recover within 1-2 weeks, approximately 10-15% have symptoms persisting beyond 3 months. The underlying physiology of this difference in symptom recovery remains unknown. **PURPOSE:** The aim of this study was to determine if measures of motor cortex excitability, inhibition, and associated neurotransmitters differ between individuals with and without history of mTBI or chronic symptoms from mTBI. A secondary aim of this study was to investigate the occurrence of the APOE4 allele, a suggested predictor of mTBI outcome, in each group. **METHODS:** Thirty five participants were assigned to one of four groups: (i) without history of mTBI (Control, n=10), (ii) within 72-hours of diagnosis of mTBI (Acute, n=9), (iii) with history of mTBI and no remaining symptoms (Chronic Control, n=10), and (iv) with chronic symptoms from mTBI, lasting at least 3 months post-injury (Chronic, n=6). Measures of glutamate and GABA concentrations in the primary motor cortex were obtained using proton magnetic resonance spectroscopy ($^1$H-MRS). Transcranial magnetic stimulation (TMS) was used to assess corticomotor excitability with the amplitude of the motor evoked potential ($MEP_{amp}$), and intracortical inhibition through the duration of the cortical silent period (CSP). **RESULTS:** Glutamate ($p$=0.88) and GABA ($p$=0.11) concentrations in M1 did not differ across groups. $MEP_{amp}$ and CSP duration did not differ across groups ($p$= 0.07 and $p$=0.15, respectively). Four of the 21 participants who provided a sample for APOE genotyping were carriers of the E4 allele (2 Controls and 2 Chronic Controls), while 17 were not (7 Control, 7 Acute, 7 Chronic Control, 1 Chronic). **CONCLUSION:** The lack of differences in glutamate, GABA, and corticomotor excitability and inhibition across groups suggests that motor cortex function may not explain the physiology underlying difference in symptom recovery post-mTBI. Further data are required to fully understand the role of APOE4 in recovery from mTBI.

2302 Board #138 June 1 11:00 AM - 12:30 PM

### Physical Functionality In Mexican Elderly With Gerontological Care

Karla S. Vera-Delgado, Sergio Márquez-Gamiño, Francisco J. Alcantar-Aranda, Fernando Sotelo-Barroso, Cipriana Caudillo-Cisneros. *Universidad de Guanajuato, León, Mexico.*

*(No relevant relationships reported)*

It has been reported that Mexico has 1,137,647 of elder people, out of approximately 120 million inhabitants. Of them 26.3% have limitation in their activities. Older adults have the greatest risk of falls, because of the physical functionality (PF) reduction, both associate with sarcopenia. PF is defined as the capacity of the person for daily life and instrumental activities. To our knowledge no studies on PF have been done in Mexican Elderly. **Purpose:** to evaluate physical functionality in older Mexican adults. **Methods:** this study was performed in a first served basis including older Mexican individuals affiliated to a public gerontological system of attention. Anthropometric evaluations were carried out, including weight, height, abdominal and hip circumferences. Additionally, electric bioimpedance was used to determine muscular and bone mass. Physical functionality was assessed through the Short Physical Performance Battery Protocol and Score Sheet (SPPB) test. The data were analyzed by descriptive statistics. Results are reported as mean ± SD. **Results:** 186 older people (60 years and over) were evaluated, 154 women and 32 men. The average age was 69.76 ± 6.31 years for females, and 71.31 ± 7.21 years for males. Women mean weight (in kg) was 66.25 ± 11.36; height (in m) 1.51 ± 0.05. By the other side, men weighted 71.63 ± 12.59 Kg, and 1.65 ± 0.07 m. The march speed (m/s) was 0.83 ± 0.23 for woman and 0.97 ± 0.18 for men. In the timed up and go test females got 9.43 ± 3.23 s while men 7.90 ± 3.26 s. Repeated chair stand reported in the same order 16.61 ± 5.92 s vs. 14.54 ± 3.85 s. The speed of march is reduced in 78.50% of women, as in 51.72% of men. The dynamic equilibrium test revealed 56.26% of men, and only 51.07%

women in normal values. **Conclusion:** older Mexican adults, with gerontological care exhibits reduced Physical Functionality, with similar levels to data reported from other populations.

2303 Board #139 June 1 11:00 AM - 12:30 PM

### Relationship Between Muscle Activity And Isometric Force During Submersion In Shallow Water.

John Mercer, FACSM, Bryan Avendano, Andy Do, Leland Barker. *University of Nevada, Las Vegas, Las Vegas, NV.*

*(No relevant relationships reported)*

Shallow and deep water running are used by athletes as either substitute or in addition to running on land. However, it is not clear if the relationship between the ability to generate force and electromyography (EMG) is influenced by water submersion. **PURPOSE**: Compare isometric force-EMG relationship during on land and submersion in shallow water.
**METHODS**: Participants (n=4; 29.7±20.2 yrs, 1.80±0.1 m, 82.2±24.3 kg) were fit with leads to measure rectus femoris (RF) EMG using a telemetry EMG system (Noraxon, 1000 Hz) while wearing a drysuit. Participants sat in a chair with the ankle secured in a cuff and knee angle at 90 degrees of flexion. One end of the cable was attached to the cuff and the other to a linear force transducer which was always above water level. The transducer measured the tension force created with the cable that resisted knee extension. The chair was portable and was used on the deck of a pool and in shallow water. Force data were recorded concurrent with EMG data. Participants completed four 5-sec isometric knee extension conditions ranging from submaximal to maximal effort. The maximal effort condition was always done first with submaximal efforts targeting 25%, 50%, and 75% of maximal effort with real time verbal feedback provided. Participants always completed these conditions on land first then in water submerged to about the xiphoid process while sitting. Rest was provided as needed between conditions. EMG data were processed by removing any offset and full-wave rectifying. Force and EMG data were each averaged over the last 1-sec. Force-EMG plots were generated for each participant for on land and in water data sets and fit with linear lines of best fit. The y-intercepts and slopes were recorded and each compared between on land and in water using paired t-tests ($\alpha$=0.05). A group line of best fit was also calculated for descriptive purposes. **RESULTS**: The group linear line of best fit for Force-EMG during Land was EMG=2.3005(Force) + 4.9007 ($R^2$ = 0.9819) and during water was EMG=2.1759(Force) - 4.7535 ($R^2$=0.9874). Using individual data sets, neither the slope (p=0.133) nor y-intercept (p=0.131) were different between on land and in water. **CONCLUSIONS**: The relationship between knee extension force and EMG was the same while on land and in the water.

2304 Board #140 June 1 11:00 AM - 12:30 PM

### Muscle Activation and Motor Unit Behavior in the First Dorsal Interosseous of Children and Adults

Jonathan D. Miller, Adam J. Sterczala, Mandy E. Wray, Hannah L. Dimmick, Michael A. Trevino, Trent J. Herda. *University of Kansas, Lawrence, KS.*

*(No relevant relationships reported)*

**PURPOSE:** To examine motor unit (MU) behavior in the first dorsal interosseous (FDI) in children (CH) and adults (AD) during submaximal contractions. **METHODS:** Nineteen CH (11 male age=9.0±0.8 years, 8 female age=9.0±0.9 years) and 13 AD (6 males age=21.0±2.53 years, 7 females age=24.6±5.9 years) completed three maximum voluntary contractions (MVC) and 2 repetitive isometric contractions at a force of 30% MVC that was held for 40 s with 6-10 s rest between contractions. Surface EMG amplitude values from the 30% MVCs were normalized (N-EMG) to peak EMG amplitude from the MVC. For each MU, recruitment thresholds (RT) and mean firing rates (MFR) were recorded. MFRs and N-EMG were averaged in 10 s epochs at beginning (T1), middle (T2), and end (T3) of repetition 1 and repetition 2 (T4, T5, and T6). For each subject, MFR vs. RT relationships were calculated for each epoch. Two-way mixed factorial ANOVAs (group [CH vs. AD] × time [T1 vs. T2 vs. T3 vs. T4 vs. T5 vs. T6]) were used to analyze N-EMG and the slopes and y-intercepts from the MFR vs. RT relationships. **RESULTS:** N-EMG was greater for CH than AD when collapsed across time (P=0.006). The MFR vs. RT relationships changed in a time-dependent manner such that the y-intercepts decreased (P=0.044), however, there was no change in the slopes (P=0.072). No between group differences for slopes (P=0.360) or y-intercepts (P=0.063) suggested that MFR vs. RT relationships were similar between groups. **CONCLUSIONS:** CH required twice the level of muscle activation in comparison to the AD to complete the task. However, the MFR vs. RT relationships were similar between groups and changed in a time dependent manner.

Table 1. Mean±SDs for each ANOVA. *Indicates a main effect for group. †Indicates a main effect for time.

| Time point | | T1 | T2 | T3 | T4 | T5 | T6 |
|---|---|---|---|---|---|---|---|
| N-EMG (%MVC)* | CH | 59.6± 33.7 | 57.9± 35.6 | 60.3± 38.7 | 61.5± 33.3 | 58.7± 30.3 | 62.1± 34.8 |
| | AD | 26.6± 5.9 | 26.4± 5.9 | 27.0± 5.6 | 29.3± 5.5 | 27.4± 5.6 | 28.1± 4.6 |
| MFR vs. RT | | | | | | | |
| Slope (pps/ %MVC) | CH | –0.804± 0.18 | –0.776± 0.19 | –0.771± 0.20 | –0.704± 0.20 | –0.686± 0.19 | –0.676± 0.19 |
| | AD | –0.707± 0.14 | –0.671± 0.13 | –0.667± 0.14 | –0.699± 0.15 | –0.673± 0.15 | –0.670± 0.15 |
| | | | | | | | |
| Y-intercept (pps)† | CH | 31.6± 5.0 | 30.9± 5.1 | 30.8± 5.2 | 29.7± 6.8 | 29.2± 6.3 | 29.0± 6.3 |
| | AD | 26.7± 4.8 | 26.1± 4.5 | 25.6± 4.8 | 26.3± 5.6 | 25.9± 5.4 | 25.7± 5.4 |

2305 Board #141 June 1 11:00 AM - 12:30 PM

### An Evaluation Of The Foot Tapping Test (ftt) In A Health Population

Brian A. Pribble, Daniel J. Larson, Christopher D. Black, Daniel J. Blackwood, Jacob Rookard, Rebecca D. Larson. *University of Oklahoma, Norman, OK.*

*(No relevant relationships reported)*

Simple in nature, the foot tapping test (FTT) has potential as an objective measure of upper motor function. Despite this, the reliability of the FTT has not been well identified. Furthermore, it is uncertain as to how to best measure the FTT as number of foot taps may vary upon counting methods. In order to make the FTT more clinically relevant, more research must be done on the FTT in healthy individuals in order to determine if it is a reliable measure of foot tapping ability. **PURPOSE:** The purpose of the study was to investigate reliability measures of the FTT in a healthy population using a variety of different measurement and counting methods. By identifying the reliability of the different measurement methods we hope to be able to make recommendations for future FTT research. **METHODS:** 20 healthy individuals, ages of 18-31, completed a series of foot tapping trials over 4 visits. While seated, subjects tapped their foot repeatedly for 10 seconds while researchers counted the number of foot taps. Starting foot was randomized for each visit and tested twice with shoes ON and twice with shoes OFF (8 trials * 4 visits = 32 trials per subject). The number of foot taps was determined for each trial via visual inspection, video playback (slowed and normal speed), and with the use of a force plate. The mean values of the FTT trials were compared across days, dominant vs. non-dominant foot, the shoes ON/OFF conditions, and with the different counting methods. **RESULTS:** Significant differences were found in foot tapping rates in the shoes ON (mean: 54.3 taps) vs shoes OFF (mean: 53.4 taps) and dominate vs. non-dominant (mean: 51.1 taps) foot analyses ($p<0.05$). Furthermore it was found that a significant difference in the mean number of foot taps existed between visit 1 (mean: 51.2 taps) and visits 2, 3, and 4 (mean: 54.3, 53.5, and 46.7 taps respectively) ($p>0.05$). It was found that the FTT exhibited high test-retest reliability (Pearson r >0.80) and high Cronbach's alpha (alpha >0.80) across the live, slowed video counts, and force plate measurements. **CONCLUSION:** It was found that the FTT exhibits a high level of reliability across the live, slowed video, and force plate measures with both the shoes ON and shoes OFF. Given the observed reliability, the use of force plate with the FTT offers an attractive alternative to live counting or video playback methods.

2306 Board #142 June 1 11:00 AM - 12:30 PM

### Association Between Motor Control Activation And Excitability Of The Quadriceps: An fMRI And TMS Study

Adam S. Lepley[1], Lindsey K. Lepley[1], Julie P. Burland[1], Steven M. Davi[1], Dustin R. Grooms[2]. [1]*University of Connecticut, Storrs, CT.* [2]*Ohio University, Athens, OH.*

*(No relevant relationships reported)*

Various neurophysiological assessments indicate that musculoskeletal injury causes alterations in nervous system function. Functional magnetic resonance imaging (fMRI) and transcranial magnetic stimulation (TMS) have been used as non-invasive assessments of motor cortex activation and excitability, respectively. Each of these tools provide unique insight on neurophysiology and it is unknown how musculoskeletal injury may influence the relationship between nervous system activity and excitability. **Purpose:** Investigate relationships between motor cortex activation (fMRI) and motor cortex excitability (TMS) of the quadriceps muscle. **Methods:** Twenty participants volunteered; 10 healthy controls (age, 23.2±1.61y; height 167.92±9.46cm; mass 66.27±11.7kg) and 10 with a history of unilateral anterior cruciate ligament reconstruction (ACLR; age 22.4±1.95y; height 166.37±7.11cm;

mass 65.62±12.10kg; yrs from surgery, 5.88±1.86). Motor cortex activation ($M1_{act}$) was assessed during unilateral knee extension-flexion using a 3T Siemens MRI and the peak voxel signal intensity was extracted for analysis. Motor cortex excitability was assessed during active contractions using motor evoked potentials (MEP) elicited at 120% of active motor threshold via TMS. Outcomes were assessed on the left limb of all participants. Pearson product moment correlations were performed to determine the association between $M1_{act}$ and MEP on the entire cohort, and individually for the healthy and ACLR groups. Alpha level was set at $p \leq 0.05$. **Results:** For the entire cohort, $M1_{act}$ was significantly associated with MEP ($r = 0.459$, $p = 0.04$). For healthy controls, $M1_{act}$ was significantly associated with MEP ($r = 0.707$, $p = 0.02$). There were no significant relationships among the ACLR group ($p > 0.05$). **Conclusions:** Greater brain activation is associated with greater brain excitability in healthy controls, however no significant relationships were found for ACLR participants. For healthy individuals, cortical activity and excitability increase concurrently to engage the quadriceps during contraction. However, our ACLR data indicate that alterations in neural pathways following joint injury may influence the interaction between brain activation and excitability, providing an area for future investigation.

2307 Board #143 June 1 11:00 AM - 12:30 PM

### A History Of Sports-Related Concussions Does Not Influence Oculomotor Control

Kristen Neitz[1], Brian Szekely[1], Sydni Wilhoite[1], Peter Chrysosferidis[1], Barry A. Munkasey[1], Nicholas G. Murray[1], Doug W. Powell[2]. *[1]Georgia Southern University, Statesboro, GA. [2]University of Memphis, Memphis, TN.*

*(No relevant relationships reported)*

Recent research indicates that among those who have a history of multiple sport-related concussions (SRC) may have greater postural instability when compared to those that do not have a history of prior SRC. However, little is known regarding the effect on those who experienced multiple SRC on the visual system, specifically oculomotor control. **Purpose**: To investigate the effect that a prior history of SRC has on oculomotor control within 24-48 hours following SRC. **Methods**: Twenty-seven (13 female and 14 male; 20 ± 2 yrs) collegiate NCAA Division I athletes with SRC completed two trials of the sport-like antisaccade task (SLT) within 24-48 hours post-injury. Participants were sorted into three equal groups: no history SRC (NON), a history of one SRC (C1) and a history of two or more SRC (C2). During play of the SLT, all participants were instructed to minimize eye movements away from a central fixed area, while simultaneously swaying in a medial-lateral direction to direct an on screen avatar to meet the demands of the task. Raw ocular point of gaze coordinates were tracked using a monocular eye tracker (240Hz, Argus Science, H7, Medford, MA) that was synced with an 8 camera motion capture system (100Hz, Vicon Motion Ltd., Version 1.8.5, Oxford, USA) during the sport-like antisaccade task and further analyzed using a custom algorithm. A multivariate ANOVA analyzed resultant distance (RD), mean horizontal excursion velocity (HV) and prosaccade errors (PE) by groups (NON, C1, and C2). Mean and standard deviation values for RD, HV and PE were calculate for analysis. **Results**: No significant omnibus results were noted between the groups for RD (NON=5.780 pixels ± 1.527), (C1=4.953 pixels ±2.168), (C2=4.665 pixels ±1.305); p=0.370), HV (NON 9.912 pixels/second ±4.484), (C1= 7.250pixels/second ±2.458), (C2=8.05pixels/second ±2.363); (p=0.225), and PE (NON=3.370±3.924), (C1=1.629±1.635), (C2=2.167±2.324); (p=0.414). **Conclusion**: These data suggests that oculomotor control as measured by the SLT may not be sensitive to differentiated between those that have a prior history of SRC and those that do not have a prior history of SRC.

2308 Board #144 June 1 11:00 AM - 12:30 PM

### Influence of Sex and Cross-Sectional Area on Motor Unit Recruitment Patterns of the Vastus Lateralis

Michael A. Trevino[1], Trent Herda[2], Jonathan Miller[2], Adam Sterczala[2], Hannah Dimmick[2]. *[1]Georgia Southern University, Armstrong Campus, Savannah, GA. [2]University of Kansas, Lawrence, KS.*

*(No relevant relationships reported)*

**PURPOSE**: Strong relationships have been reported between the increases in muscle cross-sectional area (mCSA) and motor unit action potential sizes ($MUAP_{SIZES}$) for the vastus lateralis (VL). To date, it is unknown if sex-related differences in muscle cross-sectional area are correlated with the slopes and y-intercepts for the $MUAP_{SIZE}$ vs. recruitment threshold (RT) relationships.
**METHODS**: Ten males (21.10±1.97 yrs) and ten females (23.70±6.27 yrs) with no participation in any form of structured exercise for the previous 3 years volunteered for this investigation. Ultrasonography was used to examine mCSA, muscle echo intensity (mEI), and subcutaneous fat (sFAT) for the VL. Surface electromyographic decomposition techniques were applied to assess $MUAP_{SIZE}$ in relation to RT of the VL during isometric muscle actions at 40% and 70% of maximal voluntary contraction (MVC). Linear regressions were performed for each subject for the 40% and 70% MVC to determine the y-intercepts (millivolts [mV]) and slopes (mV/%MVC) for the $MUAP_{SIZES}$ vs. RT relationships. Separate two-way mixed factorial ANOVAs (sex [male vs. female] x intensity [40% vs. 70%]) were used to examine possible differences in the y-intercepts and slopes from the $MUAP_{SIZE}$ vs. RT relationships. In addition, independent samples *t*-tests were used to examine differences in mCSA, mEI, and sFAT between sexes. Furthermore, Pearson's product moment correlation coefficients were calculated comparing mCSA, sFAT, mEI of the VL with the slopes and y-intercepts from the 40% and 70% MVCs.**RESULTS**: The males had greater mCSA ($P = 0.002$) and slopes for the $MUAP_{SIZE}$ vs. RT relationships ($P = 0.001$), whereas the females had greater sFAT ($P = 0.003$) and mEI ($P = 0.001$) for the VL. In addition, all relationships between ultrasound parameters and the slopes for the 40% and 70% MUAP size vs. RT were significant ($P < 0.001$ - 0.020), with the greatest amount of variance explained by mEI ($r = -0.657$ to -0.687).
**CONCLUSIONS**: The slopes for the $MUAP_{SIZE}$ vs. RT relationships are dependent on the physical properties of the muscle as measured by ultrasound. In addition, the sex-related differences in mCSA, mEI, and $MUAP_{SIZE}$ in relation to RT suggests greater muscle fiber sizes of the higher-threshold MUs for the males.
Supported by a National Strength and Conditioning Association Foundation Grant.

2309 Board #145 June 1 11:00 AM - 12:30 PM

### Simple Low-Cost Virtual Reality to Improve the Responsiveness of Clinical Balance Assessment

Janet E. Simon, Matt Rausch, Chad Starkey, Dustin Grooms. *Ohio University, Athens, OH.*

*(No relevant relationships reported)*

Concussions commonly affect postural stability, which incorporates the visual, vestibular, and somatosensory system. Postural stability post-concussion is commonly quantified via the Balance Error Scoring System (BESS). However, the BESS may not sufficiently challenge postural stability in an athletic population allowing potential deficits to go unquantified. Virtual reality (VR) devices may be capable of providing an increased visual-vestibular integration challenge to improve BESS responsiveness.
**PURPOSE:** Determine if a low cost and clinically applicable VR modification to the standard BESS can provide a superior challenge to postural stability than the traditional BESS.
**METHODS:** Twenty-eight adults (mean age 23.36 ± 2.38 years, mean height 1.74 m ± 0.13, mean weight 77.95 kg ± 16.63) were recruited. All individuals performed the standard BESS test and a VR modified BESS (VR-BESS) on a force plate. All participants completed a familiarization session to practice the traditional BESS and VR-BESS. Participants then performed two trials of the traditional BESS or VR-BESS in a counter-balanced randomized order. The VR-BESS used a headset (Google Cardboard) and phone (LG V10) to display a rollercoaster ride (FIBRUM) to induce a visual and vestibular challenge to postural stability. BESS postural control errors and center of pressure (CoP) velocity were averaged for the two trials and used for analyses. Separate repeated measures ANOVAs were conducted for the BESS errors and CoP velocity. Post hoc testing was conducted for the condition by stance by surface interaction with an alpha level set at $p<0.05$ with a Bonferroni correction for multiple comparison analyses.
**RESULTS:** The overall repeated measures ANOVA was significant for BESS errors ($F_{(2,26)=}6.37$, p=.003) and CoP velocity ($F_{(2,26)=}5.19$, p=.008).The VR-BESS significantly increased total errors (20.93 vs. 11.42, $p<0.05$) and CoP velocity summed across all stances and surfaces (52.96 cm/s vs. 37.73 cm/s, $p<0.05$) beyond the traditional BESS.
**CONCLUSION:** VR-BESS provides a standardized, efficient, and effective way to challenge postural stability to a greater extent than the traditional BESS. With technology quickly advancing and becoming less expensive, this modification may be immediately incorporated into balance training and assessment.

2310 Board #146 June 1 11:00 AM - 12:30 PM

### Movement Variability and Accuracy Within the Temporal and Spatial Domains When Provided a Vibrotactile Stimulus

Matthew E. Holman, Benjamin J. Darter. *Virginia Commonwealth University, Richmond, VA.*

*(No relevant relationships reported)*

Different means of informing body movements can include visual, auditory, and vibrotactile (VT) stimuli. Each method may guide movements within the temporal (TEMP) and spatial (SPAT) domains in varying ways. As VT stimuli has become more accessible, it is important to understand how users interpret this method of instruction to promote patterned movements. **PURPOSE**: Determine the effects of VT stimulus pattern speed on TEMP and SPAT movement variability (VAR) and accuracy (ACC).
**METHODS**: Sixteen young healthy subjects were recruited. Participants completed a continuous wrist flexion and extension activity. The task involved matching wrist motion with two different VT pattern speeds (FAST, SLOW) provided via motors attached to the forearm. An electrogoniometer captured wrist movement. Five 20s trials with 2min rest periods were completed for the two speeds. Flexion/extension movements were combined for further analysis. Absolute (*STDEV*) and relative (*CV*) VAR, and ACC (mean absolute error) for TEMP and SPAT domains were calculated

within individuals. 5x2 linear mixed models accounting for repeated measures compared the variables across pattern speeds and trial numbers. Post-hoc Tukey HSDs identified differences for trial effects. **RESULTS**: No significant interactions were found in either domain. Significant pattern speed effects were observed in the TEMP domain for VAR (*STDEV*: FAST 0.07s, SLOW 0.13s, $p < .05$; *CV*: FAST 12.9%, SLOW 16.8%, $p < .05$), and ACC (FAST 0.05s, SLOW 0.10s, $p < .05$). VAR in the both domains and TEMP ACC changed significantly over the 5 trials (*all*, $p < .05$; ACC SPAT, $p > .05$). Post-hoc tests revealed trial 1 to be different from all subsequent trials for TEMP and SPAT VAR (*STDEV* TEMP: #1: 0.15s, #5: 0.08s, $p < .05$; *STDEV* SPAT: #1: 7.7deg, #5: 4.7deg, $p < .05$; *CV* TEMP: #1: 20.8%, #5: 13.2%, $p < .05$; *CV* SPAT: #1: 11.9%, #5: 5.9%, $p < .05$), and ACC TEMP (#1: 0.11s, #5: 0.07s, $p < .05$). **CONCLUSIONS**: VT stimulus appears capable of producing a desired continuous wrist movement at multiple pattern speeds. TEMP VAR was lower and TEMP ACC was higher for the FAST speed, while SPAT measures did not differ between speeds. Lower TEMP and SPAT VAR, and higher TEMP ACC were observed by trial 2, with improved performance maintained in the remaining trials. A lack of change in SPAT ACC may reflect limited SPAT guidance provided to subjects.

2311 Board #147 June 1 11:00 AM - 12:30 PM

### The Effects of Resistance Training on Motor Unit Firing Rates and Muscle Activation

Adam J. Sterczala[1], Jonathan D. Miller[1], Mandy E. Wray[1], Hannah L. Dimmick[1], Michael A. Trevino[2], Trent J. Herda[1]. *[1]University of Kansas, Lawrence, KS. [2]Armstrong State University, Savannah, GA.*

*(No relevant relationships reported)*

**PURPOSE**: To examine the effects of lower body resistance training on motor unit (MU) firing rates and recruitment in the vastus lateralis.
**METHODS**: Seventeen recreationally active men (20.7 ± 1.9 years; 178.9 ± 7.8 cm; 76.8 ± 9.9 kg) completed three lower body resistance-training sessions per week for eight weeks. Exercise intensities and volumes were programmed according to a linear periodization model. Pre- and post-training, MU behavior of the VL was analyzed during isometric knee extensions performed at 40% maximal voluntary contraction (MVC) torque. Electromyographic (EMG) signals were collected via a 5-pin surface sensor array and decomposed to yield a mean firing rate (MFR) at steady torque and MU action potential amplitude ($MUAP_{AMP}$) for each MU. For each contraction, an exponential model was applied to the MFRs and $MUAP_{AMPs}$ and the B and A terms were calculated. EMG amplitude ($EMG_{RMS}$) recorded during the steady torque region of the submaximal contractions was normalized to the peak $EMG_{RMS}$ of the respective visit's MVC. Possible differences in the A and B terms of the MFR vs. $MUAP_{AMP}$ relationship and normalized $EMG_{RMS}$ were analyzed via paired samples t-tests.
**RESULTS**: Post-training, subjects demonstrated similar B terms ($p = 0.278$; PRE: -4.06 ± 0.51 pps/mV; POST: -4.41 ± 1.36 pps/mV), which indicated a similar decline in MFR with increases in $MUAP_{AMP}$. However, there was an observed increase in the A terms ($p = 0.005$; PRE: 24.93 ± 2.79 mV; POST: 27.80 ± 4.57 mV) indicating an increase in MFRs for a given $MUAP_{AMP}$ post-training. Additionally, subjects demonstrated reduced normalized $EMG_{RMS}$ post-training ($p = 0.029$; PRE: 37.9 ± 8.0% ; POST: 33.6 ± 8.7%) suggesting reduced muscle activation.
**CONCLUSIONS**: $MUAP_{AMP}$ is an indirect measure of MU size, thus the larger A terms suggest that similarly sized MUs had greater firing rates post-training. $EMG_{RMS}$ is influenced by MU firing rates and recruitment, therefore, the decrease in normalized $EMG_{RMS}$ despite increases in firing rates suggest decreased MU recruitment. Thus, resistance-training induced firing rate increases allowed subjects to produce the same relative torque with fewer active MUs. Given that later recruited MUs are more fatigable, the reduced MU recruitment could delay fatigue during submaximal contractions.

2312 Board #148 June 1 11:00 AM - 12:30 PM

### Reproducibility Of Isokinetic Strength Assessment Of Knee Extensors And Flexors Adopting Concentric And Eccentric Contractions

João Pedro Duarte[1], João Valente-dos-Santos[1], Daniela Costa[1], Paulo Sousa-e-Silva[1], Diogo Martinho[1], Edilson Cyrino[2], André Seabra[3], Rui Soles-Gonçalves[4], Manuel Coelho-e-Silva[1]. *[1]University of Coimbra, Coimbra, Portugal. [2]Londrina State University, Paraná, Brazil. [3]University of Porto, Porto, Portugal. [4]Polytechnic Institute of Coimbra, Coimbra, Portugal.*

*(No relevant relationships reported)*

**PURPOSE**: The reproducibility of isokinetic strength assessment for testing knee extensors (KE) and knee flexors (KF) was determined. The examination was performed on single measurements (peak torques) and also on conventional and functional ratios obtained from concentric (cc) and eccentric (ecc) contractions of the above mentioned muscle groups.
**METHODS**: The sample was composed of 26 male adult athletes (aged 18.6-33.9 years) who completed two test sessions of five repetitions of reciprocal concentric and eccentric extensions and flexions at $60^{o}.s^{-1}$. Intra-individual differences were tested using paired *t*-test and effect size was determined using cohen's d-value. Cefficients of variation (%CV) and Intra-class correlation (ICC) were also calculated.
**RESULTS**: Regarding peak torques, intra-individual mean differences were trivial for KEecc (t=0.176, p=0.86, d=0.08), small for KEcc (t=2.001, p=0.06, d=0.53) and KFecc (t=0.797, p=0.43, d=0.35) and moderate for KFcc (t=2.062, p=0.05, d=0.65). Although values of ICC (between 0.961 to 0.993), technical errors of measurement (TEM) ranged from 5.2 to 8.1 N.m and %CV fluctuated between 18.6% and 23.8%. Similar statistics were determined for conventional ratio (KFcc/KEcc: t=1.026, p=0.32, d=0.01, TEM=0.1, %CV=13.1%, ICC=0.956), functional extension ratio (KFecc/KEcc: t=1.911, p=0.07, d=0.01, TEM=0.1, %CV=14.9%, ICC=0.950 and functional flexion ratio (KFcc/KEecc: t=2.006, p=0.06, d=0.01, TEM=0.1, %CV=16.3%, ICC=0.977).
**CONCLUSIONS**: The current study showed an apparent reasonable reliability for the isokinetic peak torques of knee extensors and knee flexors. Derived ratios showed higher values for %CV. Note, however, that the composite scores were obtained from information of the extensors and flexors at different angles and future research is recommended to assess the reproducibility of functional ratios using the torque of the numerator (knee flexor) at the specific angle of the knee extensor peak torque angle (denominator). Funding (FCT): SFRH/BD/101083/2014, SFRH/BPD/100470/2014, SFRH/BD/121441/2016 and CIDAF (UID/DTP/04213/2016).

## E-34 Free Communication/Poster - **Posture and Balance**

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2313 Board #149 June 1 11:00 AM - 12:30 PM

### Integration of a Complex Balance Task into a Concussion Management Protocol Specific to Dancers

Caroline J. Ketcham, Corinne M. Kenny, Lauren W. Kearns, Eric E. Hall, 27244, FACSM. *Elon University, Elon, NC.* (Sponsor: Eric E. Hall, FACSM)

*(No relevant relationships reported)*

Mechanisms for concussions in dance include drops from lifting, falls from stage sets, and contact with the floor or fellow dancers that happen during class, rehearsal, or performances. Despite the recent awareness of sports-related concussions, there are gaps in knowledge regarding dance-specific concussions and what a "return to dance" protocol should look like for dancers. Although dance is not a high-impact sport like football or rugby, concussions still occur and can be calamitous for a collegiate and professional dancer's career. Balance tests, standard in concussion management protocols, are useful tools for evaluating the motor domain of balance functioning and are considered reliable and valid assessments of athletes suffering from concussions. **PURPOSE:** Develop and investigate a complex balance task to integrate into a concussion management protocol specific to dancers. **METHODS:** 31 participants, pre-professional dancers (n=12) and recreational dancers (n=19), completed an multipart evaluation to assess static and dynamic balance. They were tested using the Balance Error Scoring System (BESS) test which assessed static balance through performing 3 stances on 2 surfaces (ground and Airex Balance Pad). The modified Dance BESS (DBESS) test assessed static and dynamic balance of the participants through performing 10 dance movements on 3 surfaces (ground, Airex Balance Pad and foam balance beam). Participants were monitored and scored for errors on each balance test. **RESULTS:** Pre-professional dancers and recreational dancers were not significantly different for static balance on the BESS and DBESS ($p>0.05$). There was significant difference between the pre-professional dancers and recreational dancers ($p<0.05$) for the dynamic balance conditions in the Dance BESS. **CONCLUSIONS:** More skilled dancers show greater differences with dynamic balance conditions. Thus, creation of more dynamic balance tasks would be useful for baseline and post concussion testing and aid in the overall tracking during the concussion rehabilitation period for dancers.

2314 Board #150 June 1 11:00 AM - 12:30 PM

### Effects of Backpack Load and Load Height on Arm Reaching Ability in Several Directions

Patrick O'Malley, Matthew D. Beekley, FACSM. *DePauw University, Greencastle, IN.*

*(No relevant relationships reported)*

**PURPOSE**: The ability to reach with the arm has not been examined during load carriage with a backpack, or with the load distributed high or low in the backpack.
**METHODS**: Arm reach was tested using the Functional Reach Test (Forward), Multi-directional Reach Test (Backward, Right, Left), Upward Reach Test (Upward) at a 50° angle, and Forward Reach to the Floor Test (Low). Subjects were healthy males (n=7)

and females (n=2), 19-21 years, who wore a hiking backpack and performed using the dominant arm. Subjects were tested with no backpack, and then (in random order on different days) with the backpack empty, or load (weight) equivalent to 10, 30, and 50% of bodyweight in the bottom of the backpack. Trials were repeated with the load high in the backpack using a custom designed box. Three trials were completed for each reach. Mean values were analyzed with repeated measures ANOVA and Tukey's post-hoc test with significance level $p < 0.05$.
**RESULTS**: (Data are presented as reach in cm normalized for arm length, mean ± SD). When compared to no backpack, load high (30, 50% BW) in the backpack resulted in significant reductions in arm reach (all directions; Low = 140.5±13.8 vs 124.3±6.7, 115.5±7.7; Upward = 165.1±10.7 vs 159.9±9.3, 155.3±12.9; Left = 196.2±8.5 vs 181.6±7.3, 173.4±4.5; Right = 194.0±8.9 vs 181.7±8.0, 175.5±8.4; Backward = 180.2±9.1 vs 160.9±5.7, 153.5±7.9; Forward = 218.2±10.8 vs 208.9±8.1, 200.9±10.1) and load low (all loads) in the backpack resulted in significant reductions in arm reach for backward reach only (180.2±9.1 vs 176.8±8.1, 169.5±9.5, 164.5±1.3). When compared to empty backpack, load high (30, 50% BW) in the backpack resulted in significant reductions in arm reach (all directions; Low = 137.1±1.1 vs 124.3±6.7, 115.5±7.7; Up = 163.9±10.6 vs 159.9±9.3, 155.3±12.9; Left = 194.3±8.6 vs 181.6±7.3, 173.4±4.5; Right = 194.7±8.7 vs 181.7±8.0, 175.5±8.4; Backward = 177.9±7.4 vs 160.9±5.7, 153.5±7.9; Forward = 215.1±11.3 vs 208.9±8.1, 200.9±10.1) and load low (50% BW) in the backpack resulted in significant reductions in backward reach only (177.9±7.4 vs 164.5±1.3).
**CONCLUSIONS**: Backpack load weight and height differentially affects arm reach.
This project was funded in part by the Douglas A. & Phyllis G. Smith Student Faculty Collaborative Research Fund.

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2315 Board #151 June 1 11:00 AM - 12:30 PM

### Muscle-specific Cortical Adaptations To Balance Training With Electromyographic Biofeedback In Able-bodied Individuals

Alan R. Needle, Rachel A. Sledge, J. Horton Doughton, Mark C. Zrull. *Appalachian State University, Boone, NC.*
*(No relevant relationships reported)*

The use of electromyography biofeedback (EMG-BF) is frequently incorporated among patients with neurological and musculoskeletal injury to restore neuromuscular function and improve real-time awareness of muscle function. Its effects on central nervous system function are not well documented in lower leg models, leaving its efficacy in certain populations unclear. **PURPOSE**: This study aimed to measure reflexive and cortical excitability before and after a balance training intervention with and without EMG-BF. **METHODS**: Nineteen healthy participants volunteered for this study (183.0±20.1cm; 69.0±13.1kg; 21.1±2.3yrs). Reflexive excitability was assessed using the Hoffmann reflex from the tibialis anterior (TA), peroneus longus (PL), and soleus (SOL) through peripheral stimulation of the sciatic nerve in the popliteal fossa to obtain $H_{max}$:$M_{max}$ ratios. Cortical excitability was assessed via transcranial magnetic stimulation to quantify motor evoked potential (MEP) size at 110 percent of TA resting motor threshold. Neural excitability was measured before and after two 30-minute balance training sessions. The control group (n=9) performed only balance training while the experimental group (n=10) received balance training with EMG-BF to maintain 30 percent of maximal PL contraction. Differences before and after training across groups were assessed using factorial analysis of variance ($\alpha$=0.05). **RESULTS**: No differences between groups were observed for reflexive excitability (F=0.00, p=0.96). No MEP size differences were observed for TA (F=0.63, p=0.45) or PL (F=0.53, p=0.48); but a significant time by group interaction was observed for SOL (F=4.315, p=0.044). EMG-BF decreased SOL MEP size after training (0.083%$M_{max}$ to 0.048%$M_{max}$). **CONCLUSIONS**: EMG-BF with short-term balance training decreased cortical excitability to SOL compared to balance training alone, perhaps representing reciprocal inhibitory mechanisms to the postural plantarflexors. These findings may have implications when considering interventions for dystonic or spastic populations.

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2316 Board #152 June 1 11:00 AM - 12:30 PM

### Anthropometrics are Associated with Static Balance Performance in Intercollegiate Athletes

Amanda Robertson, Timothy Sell, FACSM, Mallory Faherty. *Duke, Durham, NC.* (Sponsor: Timothy Sell, FACSM)
*(No relevant relationships reported)*

Balance has been identified as a risk for lower extremity musculoskeletal injury (LEMSI). Anthropometric measurements (AM) may affect static balance (SB) performance. Understanding the relationship between AM and SB may affect how measures of balance are utilized in predicting risk of LEMSI. **PURPOSE:** To determine if sex and AM including height, mass, and BMI are predictive of SB performance in intercollegiate athletes. **METHODS:** A total of 190 intercollegiate athletes participated in the study (Males: 138, Females: 52; Age: 19.5 ± 1.3 years, Height: 181.9 ± 10.1 cm, Mass: 79.6 ± 15.2 kg). Ground reaction forces were collected utilizing a force plate during a test of single-leg SB under eyes open (EO) and eyes closed (EC) conditions. The variability (standard deviation) of the ground reaction forces for each direction (anterior/posterior (AP), medial/lateral (ML), and vertical (V)) and the resultant (R) was calculated in order to explain the subject's overall static postural stability under each condition. Data from three trials for each condition were averaged for analysis. A stepwise regression analysis procedure was utilized to determine if AM and sex would significantly predict each of the calculated variables. Significance of <0.05 was set *a priori* for inclusion of predictor variables in the final regression equation. **RESULTS:** The final regression equations revealed that AM were predictive of performance ($p<0.05$ for all) across all the variables analyzed but sex was not. Height was predictive of worse EO SB performance (AP, ML, V, R). BMI was predictive of worse EO SB performance (AP, ML). Height was predictive of improved EC SB performance (AP, V, R). Mass was predictive of worse EC SB performance (AP, ML, V, R). BMI was predictive of improved EC SB performance (AP, ML, V, R). **CONCLUSION:** These findings indicate that AM predicts performance during SB measures with EO and EC. These results would indicate that prospective risk factor analysis studies may need to account for AM when determining if SB is a predictor of LEMSI.

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2317 Board #153 June 1 11:00 AM - 12:30 PM

### Cognitive Dual-tasking Augments Age-differences In Dynamic Balance While Walking On A Narrow Beam

Azusa Uematsu[1], Kazushi Tsuchiya[2], Hajime Yokei[3], Shuji Suzuki[3], Tibor Hortobagyi, FACSM[4]. *[1]Dokkyo Medical University, Shimotsuga-gun, Japan. [2]Yamagata Prefectural University of Health Sciences, Yamagata, Japan. [3]Waseda University, Tokorozawa, Japan. [4]University of Groningen, Groningen, Netherlands.* (Sponsor: Tibor Hortobagyi, FACSM)
*(No relevant relationships reported)*

Beam walking is a measure of dynamic balance. We tested the idea that cognitive dual-tasking during beam walking could be an effective method to detect age-related differences in dynamic balance.**PURPOSE**: To determine the effects of age and cognitive dual-tasking on dynamic balance measured during narrow-beam walking. **METHODS**: 16 old (7M, 71.2 ±3.5 y, foot width: 9.2 ±0.5 cm, MMSE score ≥ 27) and 20 young (10M, 22.0 ±1.5 y, foot width: 9.3 ±0.8 cm) healthy volunteers participated in the study. Subjects walked on a 4-m long and 2-cm high beam with a width of 4, 8, and 12 cm, arms crossed in front of the chest. Subjects completed 3 walking trials with or without performing a calculation task. We recorded the gait trials from the subject's right side with a digital video camera at 60 Hz, and computed walking distance, step number, and average step length. Average of 3 was used for the statistical analyses. **RESULTS**: There was a Group (old, young) by beam width (4, 8, 12 cm) by task (dual task, no dual task) interaction ($F = 4.0$, $P < 0.05$). In the young group, beam-walking distance decreased similarly with descending beam width while no dual-tasking (12 cm: 3.88, 8 cm: 3.62, 4 cm: 2.49 m) and dual tasking (12-cm: 3.87, 8-cm: 3.76, 4-cm: 2.59 m). In the old group, beam-walking distance decreased substantially and most in the narrowest beam width during no dual-tasking (12-cm: 3.85, 8-cm: 3.72, 4-cm: 1.46 m) but decreased extremely in both narrower widths during dual-tasking (12-cm 3.91, 8-cm: 2.63, 4-cm 0.66 m). Further, only in the old group, the distance walked was shorter while dual-tasking compared with no dual-tasking at 8 and 4 cm beam widths (both $P < 0.01$). Depending on beam width, step length decreased in the young while both step number and step length decreased in the old group. **CONCLUSIONS**: Beam width but not dual-tasking affected young adults' dynamic balance whereas both beam width and dual-tasking affected substantially and interactively old adults' dynamic balance as quantified by beam distance walked and stride properties. These results suggest that, if validated and cognitive performance also quantified, dual task beam walking could be a sensitive measure of dynamic balance and motor-cognitive function in aging. Supported by JSPS KAKENHI Grant Number 16K21320.

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2318 Board #154 June 1 11:00 AM - 12:30 PM

### Association between Y Balance Test Performance and Noncontact Lower Extremity Injury in High School Athletes

MARY NADELEN, Emily Hildebrand, Kyle Leppert, Peter Lisman. *TOWSON UNIVERSITY, TOWSON, MD.*
*(No relevant relationships reported)*

The Y Balance Test (YBT) is an assessment of dynamic balance that requires participants to maintain a single-leg stance while performing three lower extremity reaching tasks. Research has shown that an anterior reach distance difference ≥ 4cm and a normalized composite score (CS) ≤ 89.6% are associated with an increased risk of non-contact lower extremity (NCLE) injury in collegiate athletes; however, few studies have examined this relationship in high school (HS) athletes. **PURPOSE:** To determine the association between YBT performance (asymmetry and CS) and NCLE injury in HS athletes. **METHODS:** A total of 88 HS male athletes (16.3 ± 1.4yrs; 179.6 ± 6.9cm; 82.7 ± 15.2kg) underwent YBT prior to the start of the 2016 season: football (n=53), lacrosse ( n=25), or baseball (n=10). An injury history questionnaire was completed to identify previous history of lower extremity injury. Incidence of NCLE injuries was tracked throughout the season. All participants performed 3

maximum anterior (ANT), posteromedial (PM) and posterolateral (PL) reaches on each leg. Right-to-left (R/L) side reach distance differences were calculated in cm while the CS was calculated for each leg as (ANT + PM + PL / (3 X limb length) X 100. Receiver Operating Characteristic (ROC) curves were first calculated by paring ANT, PM, and PL reach distance differences and CS with NCLE injury. Since ROC curves were unable to maximize sensitivity and specificity for any YBT measure, further analysis was conducted using cutpoints previously shown to be associated with injury. Logistic regression models adjusted for previous history of injury, sport, and age were used to examine the association between YBT measures and NCLE injury. **RESULTS:** Mean R/L reach differences for ANT, PM, and PL directions were 3.2 ± 2.9, 4.6 ± 3.5, and 4.7 ± 4.2cm, respectively. Mean CS was 86.8 ± 8.0%. No significant associations were found between NCLE injury and R/L side reach distance differences ≥ 4 cm for any direction or CS ≤ 89.6%. Though not statistically significant, the odds for sustaining a NCLE injury was 2.1 and 1.3 times higher for those with PM (95% CI = 0.45-2.11; $p$=0.34) or ANT (95% CI = 0.26-5.82; $p$=0.78) asymmetry ≥ 4cm in comparison with those with asymmetry < 4cm. **CONCLUSION:** YBT performance was not associated with the incidence of NCLE injury in this sample of HS athletes.

2319 Board #155 June 1 11:00 AM - 12:30 PM

### Influence of Inflatable Anti-fatigue Mats on Center of Pressure Displacement during Prolonged Standing

Sean E. Higinbotham[1], Adam E. Jagodinsky[1], John W. Fox[2], David C. Grieshaber[1]. [1]*Illinois State University, Normal, IL.* [2]*Methodist University, Fayetteville, NC.* (Sponsor: David Thomas, FACSM)

*(No relevant relationships reported)*

**INTRODUCTION**: Many workers are exposed to prolonged periods of standing, which has been linked to musculoskeletal pain, discomfort and other serious health conditions. Additionally, standing desks that do not promote regular bouts of movement may also lead to prolonged standing exposures and increase the risk for pain and discomfort. Traditional foam anti-fatigue mats have been shown to increase foot pressure displacement during prolonged standing and mitigate factors associated with pain and discomfort. However, the purported efficacy of novel inflatable anti-fatigue mats to promote foot pressure displacement has not been investigated. **PURPOSE**: The aim of this study was to evaluate the effect of inflatable anti-fatigue mats on center of pressure (COP) displacement compared to foam mat and hard surface conditions during prolonged standing. **METHODS**: 18 healthy individuals (Ht: 1.77±0.11m, Wt: 79.41±19.60kg, Age: 20.5±1.6yrs) stood for one hour on one of three floor conditions: Inflatable mat (IM, 3psi), foam mat (FM; EVA foam, 16mm), and hard surface (HS; force platform). Participants were instructed to stand normally at a standing desk and perform office work tasks with their feet inside the dimensions of the force platform. COP data were collected (1000Hz) for one minute at 0, 15, 30, 45 and 60min. COP data were normalized to foot position, and root mean square COP displacement (RMS) and velocity (RMSv) in the medial-lateral (x) and anterior-posterior (y) directions were calculated as the dependent variables (DV). For each DV a mixed ANOVA was conducted to investigate the between group (condition) and within group (time) differences. **RESULTS**: A significant main effect of condition was observed for RMSy variable [F (2, 15) = 8.24, p = .004, partial $\eta^2$ = .52]. Post-hoc tests revealed that IM (2.35±1.10mm) yielded significantly more RMSy than FM (1.13±0.47mm) (p=.016) and HS (0.92±0.32mm) (p=.005). **CONCLUSION**: The results reveal that inflatable anti-fatigue mats induce greater COP displacement in the anterior-posterior direction compared to hard surfaces and traditional foam mats during one hour of standing. Further research is needed to investigate the relationship between COP displacement and pain/discomfort measures when an inflatable mat is utilized during prolonged standing.

2320 Board #156 June 1 11:00 AM - 12:30 PM

### Effects of Stroboscopic Vision on Reactive Balance

Kyung-Min Kim[1], Joo-Sung Kim[1], Dustin Grooms[2]. [1]*University of Miami, Coral Gables, FL.* [2]*Ohio University, Athens, OH.* (Sponsor: Arlette Perry, FACSM)

*(No relevant relationships reported)*

Stroboscopic Vison (SV) is characterized by intermittent visual obstruction via the use of goggles with lenses that can switch between opaque and transparent. Recently, SV was found to disrupt balance during upright posture. However, the strength of this tool is that visual feedback can be perturbed during more complex reactive maneuvers that require environmental interaction, but no study has quantified the SV effect on reactive balance control. **PURPOSE:** To determine effects of SV on reactive balance. **METHODS:** Nineteen healthy subjects (9 males, age=22±2.2yrs, height=170.8±9.2cm, mass=68.9±14.2kg) participated. All participants performed the Motor Control Test (MCT) with and without SV (random order), created by specialized eyewear that intermittently cycled between opaque and transparent for 100 milliseconds at a time. MCT assesses reactive balance by measuring the time between onset of external perturbation and initiation of reaction to recover balance: the shorter reaction time equates to the better reactive balance. The 6 MCT tasks are completed in a bilateral stance, and involve posture recovery after the support surface quickly moves in either anterior or posterior directions at 3 different distances: small, medium, large, which were scaled according to participant's height. Reaction time in milliseconds (ms) was averaged across three trials of all tasks for analysis. Separate two-way (2 visual conditions, 2 limbs) repeated ANOVAs were performed for each size of perturbation in either direction, with the alpha level set at <.05. **RESULTS**: There were no significant interactions across perturbation levels or directions: posterior-small (P=.99), posterior-medium (P=.42), posterior-large (P=.77), anterior-small (P=.99), anterior-medium (P=.75), anterior-large (P=.79). Similarly, there were no significant main effects for visual condition and limb (P>.05): for display of descriptive data for SV effects, posterior (SV:128.5±9.9, No-SV:131.6±12.0ms) and anterior (SV:131.6±15.9, No-SV: 130.2±16.6ms). **CONCLUSION**: SV did not significantly delay reactive balance to surface perturbations. This indicates that reactive balance is likely modulated by proprioceptive inputs and is less dependent on visual feedback than maintaining upright stance without surface perturbation.

2321 Board #157 June 1 11:00 AM - 12:30 PM

### The Effects of Concussion History on Postural Control

Brian J. Szekely[1], Sydni V. Wilhoite[1], Peter Chrysosferidis[1], Kristen L. Neitz[1], Douglas W. Powell[2], Barry A. Munkasy[1], Nicholas G. Murray[1]. [1]*Georgia Southern University, Statesboro, GA.* [2]*University of Memphis, Memphis, TN.*

*(No relevant relationships reported)*

Postural deficits have been extensively noted in sport-related concussions. There have been postural instabilities in concussed athletes anywhere from 24 hours, up to six months. Altered postural control has been noted in those that have a history of concussion when compared to those that do not. However, there is sparse literature that assesses the effect of those with a history of concussion on postural control at the 24-48 hour mark post-concussion. **Purpose:** To investigate how postural control is affected by previous concussions in Division I athletes. **Methods:** Twenty-one Division I athletes (7 no history [NON], 7 with a previous concussion [CONC1], and 7 with 2 or more concussions [CONC2]) participated in this study. The participants performed 3 trials of quiet stance in the eyes open (EO) and eyes closed (EC) conditions for 30 seconds each on a force platform (1000 Hz). The Data were analyzed with Peak Excursion Velocity (PEV) and Root Mean Square (RMS) in the anteroposterior (AP) and mediolateral (ML) directions with a custom MATLAB software. The data was then statistically analyzed with SPSS *v.23*. Two 3x2 MANOVAs were run by direction for group comparisons. **Results:** Overall model showed significant differences for the AP direction ($F(26,12) = 2.424$; $\eta^2 = 0.528$; $p = 0.029$), but not the ML direction. Follow up assessments revealed that CONC2 ($0.094 \pm 0.021 m*s^{-1}$) swayed faster than both NON ($0.057 \pm 0.015 m*s^{-1}$; $p < 0.01$) and CONC1 ($0.058 \pm 0.011$ $m*s^{-1}$;$p < 0.05$) during EC. Also, NON ($0.004 \pm 0.001$m) swayed less than CONC2 ($0.006 \pm 0.001$m) in EC ($p < 0.05$). Furthermore, NON ($0.003 \pm 0.001$m) swayed less than CONC1 ($0.005 \pm 0.001$m) and CONC2 ($0.005 \pm 0.001$ m; $p < 0.05$) in the EO condition. **Conclusion:** These data suggest that among those who have a history of 2 or more sport-related concussions (SRC) postural control is unstable when compared to those who do not have a history of SRC. The deficits in the AP direction may suggest that due to the increased degrees of freedom, the athletes that have multiple concussions may lack the ability to control their postural sway around their ankle.

2322 Board #158 June 1 11:00 AM - 12:30 PM

### Both Slower Sensory Response Time and Electromechanical Delay Explain Age-related Differences in the Reactive Leg Drop

Mitchel A. Magrini[1], Alejandra Barrera-Curiel[1], Ryan M. Thiele[2], Jesus A. Hernandez-Sarabia[1], Ryan J. Colquhoun[1], Patrick M. Tomko[1], Nathaniel D.M. Jenkins[1], Jason M. DeFreitas[1]. [1]*Oklahoma State University, Stillwater, OK.* [2]*Kansas State University, Manhattan, KS.*

*(No relevant relationships reported)*

The reactive leg drop (RLD) is a test designed to assess the rapid sensory-motor integration necessary to recover from a slip and avoid a fall. The lowest drop angle from the RLD has shown to be sensitive to age-related changes, but the underlying mechanisms for this are unknown. **Purpose:** The purpose of this study was to examine the various subcomponents of a RLD to elucidate the underlying mechanisms of age differences. **Methods:** Fourteen older adults (OA: mean 74 yr) and 15 young adults (YA: mean 24 yr) participated in a familiarization session followed immediately by a testing session. For the RLDs, each participant was seated with their leg passively raised to full extension and supported by an elastic band held by the investigator. Each participant performed the Jendrassik maneuver with the upper body while their eyes were closed. Once their leg was relaxed, the researcher would then abruptly release the band allowing the lower leg to free-fall. The participants were instructed to kick up to full extension as fast as possible once they felt the lower leg dropping. Drop angle, measured with an electro-goniometer secured to the knee, was measured

as the difference in angle between the start position and the lowest point achieved prior to kicking back up. Surface EMG was recorded from the vastus lateralis (VL) muscle during the RLDs. The RLDs were divided into 2 subcomponents: 1.) Sensory Response Time (SRT), calculated from the start of the drop (as shown in the goniometer signal) to the onset of VL EMG; and 2.) Electromechanical Delay (EMD), measured as the time between the onset of VL EMG to the time point when the leg started to move back up (i.e. onset of concentric portion). Separate independent t-tests with a Bonferroni correction (alpha: $p \leq 0.016$) were used to analyze the differences between YA and OA. **Results:** As expected, there were significant group differences in drop angle ($p = 0.0006$). Interestingly, both subcomponents, EMD (YA: 127.9 ± 22.8 ms, OA: 160 ± 24.9 ms; $p = 0.0004$) and SRT (YA: 94.9 ± 28.6 ms, OA: 140 ± 59.3 ms; $p = 0.0004$), showed significant differences
between YA and OA. **Conclusion:** Both sensory response time and electromechanical delay are mechanisms that explained age-related differences in RLD performance. As such, both variables may separately play significant roles in slip recovery and fall avoidance.

2323 Board #159 June 1 11:00 AM - 12:30 PM

### Postural Control of Voluntary and Involuntary Sway Movements in Healthy Young Adults

Zhengquan Chen[1], Jia Han[1], Gordon Waddington[2], Roger Adams[2], Judith Anson[2]. [1]*Shanghai University of Sport, Shanghai, China.* [2]*University of Canberra, Canberra, Australia.*

*(No relevant relationships reported)*

**PURPOSE**: Control of postural sway is essential for high level sport performance. Structural and situational factors can affect involuntary sway, so a measure of voluntary sway movement sensitivity is needed. This study set out to evaluate the reliability of a novel device to measure voluntary lateral sway when standing, and to test the hypothesis that enhanced voluntary lateral sway discrimination ability is associated with better control of involuntary postural sway.
**METHODS**: 44 healthy young adults (21M, 23F, mean age 23.8) were recruited. During the voluntary lateral sway test, the participants were asked to discriminate between four possible medial-lateral sway extents. Movement extents were made commencing from the neutral standing position and moving either left or right until contact on a physical stop at the greater trochanter (Extent 1=4cm, Extent 2=4.5cm, Extent 3=5cm, and Extent 4=5.5cm). The involuntary postural sway control test required the participants to stand as still as possible on a force plate.
**RESULTS**: Voluntary lateral sway extent AUC discrimination scores (SD) for Day 1 and Day 8 were 0.679 (0.056) and 0.682 (0.040) for voluntary sway to the left, and 0.645 (0.059) and 0.644 (0.063) for sway to the right. There was no significant difference in AUC scores between Day 1 and Day 8 ($p>0.05$). ICC(3,1) values were 0.706 for sway to the left and 0.871 for sway to the right, representing good to excellent test-retest reliability. Left and right voluntary lateral sway discrimination scores were significantly correlated ($r=0.669$, $p<0.01$), however there was no significant relationship between voluntary lateral sway AUC scores and postural sway displacement scores (all $r<0.14$, $p>0.05$). Repeated Measures ANOVA showed significant linear deterioration in extent discriminability across the 3 pair-wise voluntary lateral sway AUC scores ($F=6.094$, $p=0.019$), indicating that as sway extent increases, discrimination sensitivity decreases.
**CONCLUSIONS**: Voluntary lateral sway measurement showed good to excellent test-retest reliability. Because of the low correlations, voluntary postural sway and involuntary postural sway appear to be subserved by different neural mechanisms. Voluntary lateral sway sensitivity is magnitude dependent, with greatest sensitivity in the most-used sway region.

2324 Board #160 June 1 11:00 AM - 12:30 PM

### Relationship Between The Sport-like Antisaccade Task And Postural Control Following Sport-related Concussion

Nicholas G. Murray[1], Brian Szekely[1], Sydni Wilhoite[1], Kristen Neitz[1], Peter Chrysosferidis[1], Douglas Powell[2], Barry A. Munkasy[1]. [1]*Georgia Southern University, Statesboro, GA.* [2]*University of Memphis, Memphis, TN.*

*(No relevant relationships reported)*

Postural instability and visual system dysfunction are two of the most prevalent signs immediately following a sport-related concussion. However, little is known regarding the relationship between postural control and visual system assessments in a population of sport-related concussion. **PURPOSE:** To investigate the relationship between postural control center of pressure metrics and eye movements during the sport-related antisaccade task in a group of healthy matched controls (CON) and sport-related concussions (SRC) within 24-48 hours post-injury. **METHODS:** 37 SRC NCAA Division I athletes (23 females, 14 males) and 37 sport matched CON (23 females, 14 males) between the ages of 18-25 yrs completed two trials of the sport-like antisaccade task (SLT). During play, all participants were instructed to minimize eye movements away from a central fixed area, while simultaneously swaying in a medial-lateral direction to direct an on screen avatar to meet the demands of the task. Monocular raw point of gaze coordinates (240Hz, Argus Science) where recorded in coordination with a synced 8 camera motion capture system (120Hz, Vicon) while raw center of pressure (1000Hz, AMTI) coordinates were collected simultaneously and further analyzed using a custom algorithm. Pearson product correlations examined the relationship between the gaze variables Resultant Distance (RD), Prosaccade Errors (PE), Mean Horizontal Velocity (HV), Microsaccades (MS) to center of pressure Root Mean Square (RMS) and Peak Velocity (PV) in the anteroposterior (AP) and mediolateral (ML) directions within each group. **RESULTS:** In the SRC group, a significant moderate positive correlation between RD (4.71±1.35 pixels) and RMS in the AP direction (0.011±0.002 meters) ($r=0.361$, $p=0.028$) was observed. No other significant relationships were observed between any other gaze and posture variables in the SRC group. In the CON group, no significant relationships were observed between any gaze and posture variables. **CONCLUSION:** These results suggest that as SRC gaze travels a greater RD, their postural sway increases in the AP direction during the SLT. However, the lack of any other significant relationship may indicate that these assessments are measuring two separate neuronal constructs.

2325 Board #161 June 1 11:00 AM - 12:30 PM

### Repetitive Trunk Loading Leads to Faster Trunk Movement in Response to External Perturbation

Michael W. Olson, FACSM[1], Li Li, FACSM[2]. [1]*Southern Illinois University Carbondale, Carbondale, IL.* [2]*Georgia Southern University, Statesboro, GA.*

*(No relevant relationships reported)*

**PURPOSE**:The purpose of this study was to examine the responses of trunk movement patterns to mechanical perturbation before and after two different repetitive trunk flexion-extension loading schemes. Spatial and temporal biomechanical parameters were studied to further understand the ability of the trunk to recover from anterior directed perturbations.
**METHODS**: Eighteen male (n=9) and female (n=9) participants (21.7 ± 2.3 yrs, 1.75 ± 0.08 m, 72.5 ± 12.0 kg) were recruited. They participated in active and passive trunk flexion-extension loading, performed at least 7 days apart. Participants performed 60 trunk flexion-extension repetitions in each condition. Participants either volitionally moved their trunks (active condition) or relaxed during dynamometer controlled movements (passive condition). Trunk perturbations occurred before and immediately after two 30-repetition sessions. Temporal measures included perturbation onset to initial trunk movement ($T_D$), movement initiation to peak trunk velocity ($V_{P)}$ ($T_{MIPV}$), and perturbation onset to $V_P$ ($T_{PPV}$). Recovery measures included peak recovery velocity ($V_{PR}$), recovery time ($T_R$), velocity slope ($V_S$), and recovery slope ($R_S$). Repeated measures ANOVA was used to analyze the data. Alpha level was set at 0.05.
**RESULTS**: There was no sex by session interaction observed. Significant sex differences were present for $T_{MIPV}$ (Male 112.4 ± 74.6 ms, Female 96.5 ± 44.6 ms, $p < 0.02$), $V_{PR}$ (Male -12.0 ± 8.6 deg/s, Female -15.6 ±13.0 deg/s, $p < 0.01$), and $V_S$ (Male -273.3 ± 215.9 deg/s/s, Female -332.4 ± 363.8 deg/s/s, $p < 0.05$) measures. Differences between loading sessions were present for $T_{PPV}$ (Block1: 212.8 ± 239.6, Block2: 168.3 ± 46.7, Block3: 171.7 ± 82.1 ms, $p < 0.039$), and $R_S$ (Block1: -6.65 ± 5.6, Block2: -4.76 ± 3.7, Block 3: -5.28 ± 5.2, $p < 0.02$).
**CONCLUSIONS**: Distinct sex and time-dependent modifications to the kinematics parameters are attributed to the altered mechanical behavior of the lumbar tissues as well as volitional loading by the trunk extensors. Overall, results indicate repetitive loading leads to lower resistance to perturbation, but faster recovery from perturbation although no differences to active or passive repetitive loading were observed.

2326 Board #162 June 1 11:00 AM - 12:30 PM

### Construct Validity of Three Clinical Tests of Core Neuromuscular Control

Travis R. Pollen[1], Eric J. Folkins[2], Jason H. Mohring[1], Brian W. Noehren, FACSM[3], David Ebaugh[1], Sheri P. Silfies[1]. [1]*Drexel University, Philadelphia, PA.* [2]*University of the Sciences, Philadelphia, PA.* [3]*University of Kentucky, Lexington, KY.*
(Sponsor: Brian W. Noehren, FACSM)

*(No relevant relationships reported)*

**PURPOSE:** To determine construct validity of three clinical tests of core neuromuscular control (CNC). **METHODS:** 15 healthy adults (8 females, age = 26 ± 3 years, height = 1.69 ± 0.07 m, mass = 69.1 ± 10.2 kg) performed 3 clinical tests: unilateral hip bridge endurance (UHBE; mean time in position for left and right sides, 1 trial per side), double leg lowering (DLL; mean degree of hip flexion, 3 trials), and a newly developed seated trunk proprioception test using a wobble board (STP; mean time to first error, 5 trials). Biomechanical tests of static and dynamic CNC were assessed via an unstable chair on a force plate. Static control (SC) was determined by ability to maintain seated balance with eyes closed (3 trials), with performance assessed by a 95% confidence ellipse area (SC CEA; $mm^2$) and mean velocity (SC MVEL; mm/s) of the center of pressure (COP). Dynamic control (DC) was assessed during 4 trials of a speed and accuracy target acquisition task where

targets were located along the vertices of an octagon. DC performance was assessed by precision control (movement around select targets prior to acquisition) (DC CEA; $mm^2$) and directional control (perpendicular distance off direct COP path to target) (DC OFF; mm). One-tailed Spearman's rho (ρ) was used to assess relationships between clinical and biomechanical variables. Interpretations of the correlations were as follows: 0.25 to 0.50 (fair) and 0.50 to 0.75 (moderate to good). **RESULTS:** Significant fair to good correlations were found between CNC clinical tests and both SC and DC biomechanical variables: SC CEA and UHBE and DLL; SC MVEL and UHBE; DC CEA and UHBE and DLL; and DC OFF and all clinical tests (Table). **CONCLUSION:** The data suggest the UHBE, DLL, and STP demonstrate construct validity for measurement of CNC, with individual clinical tests explaining 21-43% of the variance in performance on the biomechanical tests. These data provide preliminary support for the use of these clinical tests as measures of CNC.

Descriptive statistics and Spearman's ρ between clinical and biomechanical core tests

| -- | -- | Static Control | | Dynamic Control | |
|---|---|---|---|---|---|
| -- | Median ± IQR | CEA | MVEL | CEA | OFF |
| UHBE | 24.3 ± 26.9 s | ρ = -0.50, *p* = 0.03 | ρ = -0.61, *p* = 0.01 | ρ = -0.56, *p* = 0.02 | ρ = -0.47, *p* = 0.04 |
| DLL | 75 ± 28° | ρ = 0.49, *p* = 0.03 | ρ = 0.04, *p* = 0.45 | ρ = 0.66, *p* < 0.01 | ρ = 0.54, *p* = 0.02 |
| STP | 3.7 ± 4.5 s | ρ = -0.43, *p* = 0.05 | ρ = -0.11 , *p* = 0.35 | ρ = -0.28, *p* = 0.15 | ρ = -0.46, *p* = 0.04 |

## E-35 Free Communication/Poster - **Injury**

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2327 Board #163 June 1 9:30 AM - 11:00 AM

### Descriptive Epidemiology Of Injuries In National Collegiate Athletic Association Water Polo: 2012/13 - 2015/16

Erin B. Wasserman, Sarah N. Morris, Kelsi L. Jones, Christy L. Collins. *Datalys Center for Sports Injury Research and Prevention, Indianapolis, IN.*

*(No relevant relationships reported)*

Water polo is a contact sport, but it also involves repetitive motion, increasing risk of overuse injuries. However, little is known about the injury incidence in water polo; previous reports have focused on specific diagnoses or a single tournament. **PURPOSE**: Describe injury incidence, common diagnoses, and outcomes in men's and women's National Collegiate Athletic Association (NCAA) water polo. **METHODS**: Athletic trainers reported injury and athlete-exposure (AE) data as part of the NCAA Injury Surveillance Program. Data for men's water polo were reported across 4 team-seasons from 2014/15 - 2015/16. Data for women's water polo were reported across 6 team-seasons from 2012/13 - 2015/16. Injuries occurred during a school-sanctioned practice or competition and required medical attention. Injury frequencies, rates per 1,000 AEs and 95% Confidence Intervals (CI) were calculated. **RESULTS**: In men's water polo, 26 injuries were reported in 9,964 AEs (2.61/1,000 AEs, 95% CI:1.61-2.61; 6.5 injuries/team/season). In women's water polo, 36 injuries were reported in 15,000 AEs (2.40/1,000 AEs, 95% CI:1.62-3.18; 6 injuries/team/season). The most common mechanism of injury for both men and women was player contact (men:13/26, women:18/36), followed by ball contact in women (9/36) and overuse in men (4/26). Among men, 23 of 25 injuries with a known outcome resulted in time loss >24 hours compared to 28/36 among women. Concussions comprised nearly half of reported women's injuries (17/36), but only 2/26 reported men's injuries were concussions. **CONCLUSIONS**: Although water polo is a contact sport with repetitive motion, preliminary data indicate that injury rates are low relative to other contact sports. Injury rates are similar between men's and women's water polo, but a larger proportion of reported women's water polo injuries are concussions. Further research is needed to determine if the reporting of injuries varies by gender or if there is a true difference in concussion incidence.

The Injury Surveillance Program is funded by the NCAA. The content of this abstract is solely the responsibility of the authors and does not necessarily represent the official views of the NCAA.

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### Comparison of Orthopedic Injuries in American Flag Football to American Tackle Football.

Ajit Vakharia[1], Michael Mijares[2], Rushabh M. Vakharia[3], Tsun Law[3], Fernando Manalac, Jr[3], Martin Roche, Jr[3]. *[1]Morehouse School of Medicine, Atlanta, GA. [2]University of Miami, Miami, FL. [3]Holy Cross Hospital, Fort Lauderdale, FL.*

*(No relevant relationships reported)*

**Purpose:** Comparison of American Flag Football (AFF) to American Tackle Football (ATF) with respect to their injuries is not well documented. The purpose of this study was to compare Orthopedic injuries between the two sports.
**Materials and Methods:** A retrospective analysis of patients having injuries from AFF or ATF were identified from 2009 – 2016, using the Pearl Diver database (Pearl Diver Technologies, West Conshohocken, PA USA). International Classification of Diseases, ninth and tenth edition (ICD-9 and ICD-10) were used to query our cohort. Our query found patients having injuries in AFF (ICD-9-D-E0070;ICD-10-D-Y9361) and ATF (ICD-9-D-E0071;ICD-10-D-Y9362). The sample size was further narrowed searching for fractures of the upper (FUE) and lower extremities (FLE), dislocations (DI), sprains and strains (S&S), and concussions (CO). Statistical analysis was done between the sports.
**Results:** 7,896 (696 = AFF; 7,200 ATF) patients with injuries were found. 15-19 (n = 3,169) was the most injured age group in AFF and ATF. Fractures of middle or proximal phalanx/phalanges of hand was the most common FUE in AFF (n = 54), whereas fractures of distal end of radius was predominant in ATF (n = 263). Fractures of the ankle were the most common FLE in both groups (AFF = 11; ATF = 155), along with tear of the medial cartilage of the knee (AFF = 19; ATF = 170). Sprains of the cruciate ligament of the knee was commonly seen in AFF patients (n = 42); whereas in ATF patients, ankle sprains of unspecified sites were commonly seen (n = 383). Concussion rates were higher in the ATF group (n = 883) compared to AFF (n = 47), with 15-19 (n = 484) year olds comprising 54% of concussions in ATF, followed by 10- 14 years olds (n = 399, 46%). Statistical analysis found a p-value of 0.01 when comparing injuries between AFF and ATF.
**Conclusion:** Appropriate protection such as ACL injury prevention program, ankle taping or bracing, and training should be given when engaging in either sport. Children and adolescents interested in seeking to play either AFF or ATF should: be properly equipped, perform an injury prevention program prior to play, seek appropriate medical counseling prior to and after injury, and be educated of the potential sequelae from playing these sports.

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### Sport-related Injuries In Elite Para Powerlifters: A Prospective Analysis Of 1410 Athlete-days At The Rio 2016 Summer Paralympic Games

Kimberly E. Ona Ayala, B.A., Patrick Huang, B.A., B.S., Yetsa A. Tuakli-Wosornu, M.D., M.P.H.. *Yale School of Medicine, New Haven, CT.*

*(No relevant relationships reported)*

PURPOSE: To describe the injury epidemiology of Para powerlifters during the Rio 2016 summer Paralympic Games. METHODS: This cohort study was a sub-analysis of the comprehensive WEB-IISS study (WEB-based Injury and Illness Surveillance System) carried out at the Rio 2016 Paralympic Games by the International Paralympic Committee (IPC) Medical Committee. The WEB-IISS survey was administered to the Chief Medical Officers of each Para powerlifting federation daily. Injury data was prospectively collected and securely housed by the IPC. The main outcome measures were injury incidence rate (IR; number of injuries per 1000 athlete-days) and injury incidence proportion (IP; number of injuries per 100 athletes), assessed against demographic data, type of injury, and anatomic location of injury. RESULTS: 141 athletes participated in the 7-day Para powerlifting competition period, accounting for 1410 athlete competition days of exposure. Overall IR was 15.6/1000 athlete days (95% CI; 9.1 - 22.1) while IP was 15.6 injuries/100 athletes. Most injuries were chronic overuse in nature (63.6%). The most commonly injured anatomical region was the shoulder (45.5%; IR=10.1), followed by the neck (13.6%; IR=3.0), and the chest and elbow (each 9.1%; IR=2.0). There were no significant differences in injury patterns between male and female powerlifters [IRR=0.8 (95% CI; 0.3-2.0)]. The oldest age group (age 35-75) had the highest IR [IR=21.8 (95% CI; 11.4-32.2), followed by the middle age group (age 26-34) [IR=10.0 (95% CI; 1.2-18.8)]. CONCLUSIONS: Data from this study indicate that 1. IRs were lower than those reported at the London 2012 Paralympic Games, 2. chronic overuse injuries, as opposed to acute traumatic, remain most common among elite Para powerlifters at Games-time, 3. the shoulder remains the most commonly injured anatomical site, 4. age was a significant risk factor for injury in Rio, which was not shown in London. Comparative data can be collected at future Games' settings and in combination with current data, used to inform injury prevention programs. As upper extremity injuries impact Para powerlifters' ability

to participate in sport as well as activities of daily living, this study helps open an important door for the development of injury prevention protocols in this high-risk Para sport.

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### Injuries Related To Fitness Trends: Is CrossFit The Newest Contributor?

Nicole D. Rynecki, Brianna L. Siracuse, Joseph A. Ippolito, Kathleen S. Beebe. *Rutgers New Jersey Medical School, Newark, NJ.*

*(No relevant relationships reported)*

**Purpose:** Over the past decade, high intensity interval training (HIIT) and high intensity power training (HIPT) have become popularized by programs like CrossFit. The objective of this study was to determine injury incidence coinciding with increased popularity of CrossFit and identify ways physicians can advise patients prior to participation.
**Methods:** The National Electronic Injury Surveillance System (NEISS) was queried from 2007 through 2016 to estimate injury incidence related to exercise equipment most frequently utilized in programs like CrossFit. Injury incidences were calculated and compared between 2007-2011 and 2012-2016. Over the same time period, Google Trends was used to determine the popularity of CrossFit
**Results:** There were an estimated 3,988,903 injuries, mostly in males (58%) aged 20 to 39 years (39%). Most commonly, injuries were in the lower extremity (35.3%), trunk (28.5%), and upper extremity (19.6%). From 2012-2016 versus 2007-2011, there was a 144% increase in all injuries including a 159% increase in trunk injuries, a 137% increase in lower extremity injuries, and a 132% increase in upper extremity injuries. There was also a 127% increase in lower extremity strains and a 124% increase in upper extremity strains. Additionally, knee and ankle sprains increased 125%. These increases in injury incidence correlated with a 203% increase in CrossFit interest.
**Conclusion:** Given increases in injuries related to high-intensity workout programs like CrossFit, athletes should be educated on how to minimize preventable injuries. With particularly high rates of knee and ankle sprains and strains, neuromuscular training and pre-strengthening programs as previously demonstrated among young athletes may be particularly worthwhile in prospective participants. Physicians must be up to date with current fitness trends to best advise patients appropriately.

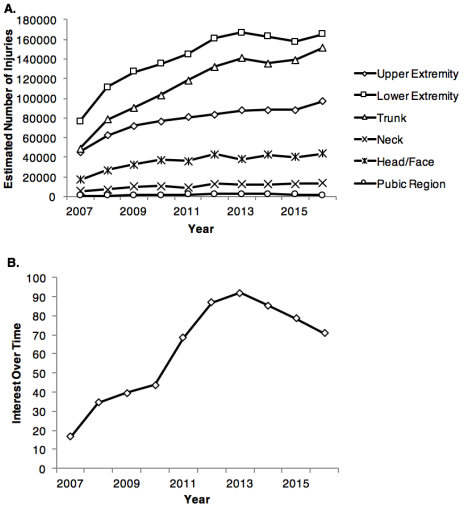


**Figure 1.** 1A shows the estimated number of injuries by body region caused by exercise, exercise equipment, and weight lifting by year recorded by the National Electronic Injury Surveillance System from 2007 through 2016. 1B shows the popularity of CrossFit by year using Google Trends data from 2007 to 2016.

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### Epidemiology Of Upper Extremity Injuries In The National Collegiate Athletic Association: 2009/10 - 2015/16

Christy Collins, Erin B. Wasserman. *Datalys Center for Sports Injury Research and Prevention, Inc., Indianapolis, IN.*

*(No relevant relationships reported)*

Participation in sports places athletes at risk of sustaining an upper extremity injury. These injuries may be acute, resulting from a single traumatic event, or associated with repetitive motions and overuse. Previous studies have examined upper extremity injuries; however, most have focused on specific sports, body parts, diagnoses, or mechanisms of injury.
**PURPOSE**: To describe the epidemiology of upper extremity injuries in National Collegiate Athletic Association (NCAA) sports.
**METHODS**: Athletic trainers participating in the NCAA Injury Surveillance Program reported athlete-exposure (AE) and injury data for 25 collegiate sports during the 2009/10-2015/16 academic years. Upper extremity injuries, including those to the shoulder/clavicle, upper arm, elbow, forearm, wrist, and hand/finger, occurred during a school-sanctioned practice or competition, and required medical attention. Injury frequencies, rates per 1,000 AEs and 95% Confidence Intervals (CI) were calculated.
**RESULTS**: The overall rate of upper extremity injuries was 1.07 (95% CI:1.04-1.10) per 1,000 AEs. Men's ice hockey (2.88; 95% CI:2.73-3.04), wrestling (2.64; 95% CI:2.35-2.94), and football (2.11; 95% CI:2.03-2.18) had the highest rates while men's (0.00) and women's (0.02) cross country had the lowest. Overall, 57.9% of upper extremity injuries occurred during practice. Nearly half (46.6%) were to the shoulder/clavicle, followed by hand/finger (24.8%). The most common diagnoses were sprain (27.7%) and strain (18.4%). Player contact (36.9%) and overuse (18.6%) were the most common mechanisms. 17.7% of injuries resulted in a time loss of 7 or more days, and 10.6% were recurrent.
**CONCLUSIONS**: While upper extremity injuries occur across a wide variety of collegiate sports in both competition and practice, the sports with the highest rate of injury were contact/collision sports. Many upper extremity injuries were not severe; however, nearly one in five kept the athlete out of play for a week or more. More research is needed to determine how to effectively reduce the incidence of upper extremity injuries among all collegiate athletes. The Injury Surveillance Program is funded by the NCAA. The content of this abstract is solely the responsibility of the authors and does not necessarily represent the official views of the NCAA.

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### Ten-year Trends In Major Trauma Or Death Resulting From Sport And Recreation In Victoria, Australia

Christina L. Ekegren, Ben Beck, Pamela Simpson, Belinda J. Gabbe. *Monash University, Melbourne, Australia.*

*(No relevant relationships reported)*

Sports injuries which result in major trauma or death are associated with significant health-care burden and societal costs. Understanding changes in injury trends, and their drivers, is needed to implement policy aimed at risk reduction and injury prevention. To date, there has been no population-level reporting on trends in serious sport and recreation injuries anywhere in Australia over such an extended period, nor any studies of this length capturing comprehensive data on all sports-related major trauma internationally. **PURPOSE**: The aim of this study was to describe the incidence of sport and active recreation injuries resulting in major trauma or death for a 10-year period from July 2005-June 2015 in Victoria, Australia. **METHODS**: All sport and active recreation-related major trauma cases and deaths in Victoria, a state of Australia, were extracted from the population-level Victorian State Trauma Registry and the National Coroners Information System, over a 10-year period. Poisson regression analysis was used to examine trends in the incidence of sport and active recreation-related major trauma and death.
**RESULTS**: There were 2,847 non-fatal major trauma cases and 614 deaths (including 96 in-hospital deaths) over the 10-year study period. The highest frequencies of major trauma cases and deaths were in cycling, motor sports and equestrian activities. The participation-adjusted major trauma and death rate was 12.2 per 100,000 participants per year. There was an 8% increase in the rate of major trauma (IRR=1.08, 95%CI, 1.06, 1.10; $p<0.001$), and a 7% decrease in the death rate (IRR=0.93, 95%CI: 0.90, 0.97; $p<0.001$). Out of all sports, there were significant increases in the rate of major trauma (including deaths) in equestrian activities, motor sports and cycling.
**CONCLUSIONS**: The rate of major trauma due to participation in sport and recreation has increased over the past 10 years in Victoria, which was largely attributable to equestrian activities, motor sports and cycling. Study findings highlight the need to prioritize investment in the prevention of trauma in these activities.

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### Epidemiology of Lower Extremity Musculoskeletal Injury in US High School Girls' Soccer and Basketball

Daniel R. Clifton[1], R. Dawn Comstock[2], Thomas Best[3], Ajit Chaudhari[1], Andrew Persch[1], Jingzhen Yang[4], James A. Onate[1]. *[1]The Ohio State University, Columbus, OH. [2]University of Colorado-Anschutz, Aurora, CO. [3]University of Miami, Coral Gables, FL. [4]Nationwide Children's Hospital, Columbus, OH.*

*(No relevant relationships reported)*

Sports with rapid directional changes and the potential for player contact (e.g. soccer and basketball) have relatively high risk of lower extremity (LE) musculoskeletal

(MSK) injury. Effectively reducing the risk of LE MSK injury in high school girls' soccer and basketball may require sport-specific interventions, but minimal research has compared patterns of injury in these sports.
**PURPOSE**: Describe the epidemiology of LE MSK injuries in high school girls' soccer and basketball athletes.
**METHODS**: Data from the 2012/2013 through 2015/2016 academic years were collected from High School Reporting Information Online (HS-RIO). Certified athletic trainers (ATs) from participating high schools reported injury incidence and athlete exposures (AE). Injury was defined as an event causing an athlete to seek care from an AT or physician and resulting in at least one missed practice or competition. AE was defined as one athlete's participation in one practice or competition. Injury rates per 1000AE were calculated. Injury proportions were calculated to assess distributions of injuries by body part, diagnosis, injury mechanism, and time loss. Injury rate ratios (IRR) and injury proportion ratios (IPR) were calculated to compare differences between sports. IRRs and IPRs with 95% confidence intervals (CI) not including "1.00" were considered statistically significant.
**RESULTS**: The injury rate was higher in soccer than basketball (IRR = 1.31, 95%CI = 1.19, 1.44). The most common injuries for both sports were sprains and strains (73.86% basketball; 68.96% soccer); most injuries affected the ankle (47.20% basketball; 35.03% soccer) and knee (32.64% basketball; 29.38% soccer). The proportion of injuries affecting the hip (IPR = 1.74, 95%CI = 1.06, 2.88) or thigh/upper leg (IPR = 1.97, 95%CI = 1.44, 2.70) was greater in soccer than basketball. Injuries for both sports were most commonly caused by player contact (27.70% basketball; 40.80% soccer) or noncontact mechanisms (41.35% basketball; 34.15% soccer).
**CONCLUSIONS**: Injury patterns were similar between sports suggesting both sports should emphasize preventing sprains and strains affecting the ankle and knee, specifically those resulting from player contact or noncontact mechanisms. Additional efforts are needed to prevent hip and thigh/upper leg injuries in soccer.

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### Opiate Knowledge Among High School Athletes

Elton Li[1], Adam N. Van Horn[1], Jacob W. Poynter[1], Jonathan Im[1], Jennifer Heronema[2], Carol Janney[1]. *[1]Michigan State University College of Human Medicine, East Lansing, MI. [2]The Legacy Center, Midland, MI.*

*(No relevant relationships reported)*

Opiate use and abuse amongst adolescents has become an epidemic in the United States. Use of prescription pain medication is of particular concern for adolescent athletes due to their propensity for injury and need for pain control either acutely or post-surgically.
**Purpose:** To evaluate changes in opiate knowledge of high school (HS) athletes after a national opiate education program.
**Methods:** Fall (HS) sport teams separately attended 45-min, multi-media presentations, focused on opiate education. Athletes completed an anonymous survey before and after the educational program. Paired T-tests were performed.
**Results:** Overall, 491 of 504 HS athletes completed surveys (males= 310 and females=181). HS athletes represented 9-12 grades (n=126, 152, 115, and 111, respectively). Participating sports teams included football (n=174, M), cross-country (n=81, M&F), soccer (n=65, M), pompon (n=64, F), swimming (n=50, F), tennis (n=31, M), volleyball (n=30, F), and golf (n=9, F). During the last year, 42% of athletes reported an injury that prevented them from playing sports, 46% of athletes had taken a pain medication, and 41% have taken pain medication prior to a game. Prior to the program, 72%, 63%, 57%, and 78% of HS athletes correctly identified codeine, Norco, tramadol and heroin, respectively, as opiates, while 34%, 41%, and 44%, incorrectly classified marijuana, Tylenol, and Molly (street name for Methylenedioxymethamphetamine, or MDMA), respectively, as opiates. After the program, athletes had significantly improved their knowledge in recognition of common opiates ($p<0.01$) and opiate overdose symptoms ($p<0.01$). Prior to the program, 32% (SEM 2.4%) felt that they were aware of community resources available for those who misuse opiates vs. 88% (SEM 1.5%) ($p<0.01$) after the program.
**Conclusion:** HS athletes attending a brief opiate educational program significantly improved their knowledge in recognizing opiates and overdose symptoms, as well as community resources available for those who misuse opiates. Our results suggest, that increasing knowledge of opiates in teen athletes is critical to a successful prevention strategy.

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### Anterior Cruciate Ligament Injuries in Missouri High School Male and Female Soccer Athletes

Aaron D. Gray, Scott Miller, Seth L. Sherman, Emily Leary, Brad W. Willis. *University of Missouri, Columbia, MO.*

*(No relevant relationships reported)*

**Purpose:** To investigate the incidence of anterior cruciate ligament (ACL) injury in Missouri High School male and female soccer players during the 2011-2013 seasons, using a retrospective method for calculating athletic exposures. **Methods**: A web-based survey was created and sent to every high school soccer coach in Missouri using the Missouri State High School Activities Association (MSHSAA) database. The survey investigated the number of athletic exposures over the course of the season and number of ACL injuries for each team in both the 2011-2012 and 2012-2013 seasons. The primary outcome measure was ACL injuries. Secondary endpoints included specific characteristics of each ACL injury including contact or non-contact, position, practice or game, school grade, and playing surface. **Results**: During the study period 330,062 athletic exposures (163,511 male and 166,551 female) were reported. 36 ACL tears (28 female and 8 male) occurred. ACL injury rates were calculated per 1000 estimated athletic exposures: Female: total, 0.17; match, 0.47; practice, 0.02. Male: total, 0.05; match, 0.18; practice, 0. Female high school soccer athletes had a 3.4 times greater risk of ACL tear than male high school soccer athletes. Female athletes were 27x more likely to tear their ACL in a match compared to practice. **Conclusions**: Female high school soccer athletes had an increased susceptibility to ACL tear compared to male athletes. For both female and male athletes, a large majority of ACL tears occurred during matches.

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### Prevalence Of Musculoskeletal Injuries And Dysfunction Amongst Physical Education Teachers In Singapore

Swarup Mukherjee, Muhammad Ridhuan Johari, Ying Hwa Kee. *Nanyang Technological University, Singapore, Singapore.*

*(No relevant relationships reported)*

Occupational demands in PE teachers (PETs) require them to cope with heavy workloads, subject their bodies to impact-loading activities like running and jumping, carrying loads, asymmetrical and stressful postural techniques. This subjects the PETs to a high risk of musculoskeletal (MSK) injuries and dysfunction-related problems that can affect PE teaching and quality-of-life in the long-term.**PURPOSE**: To determine the prevalence of injuries and MSK dysfunction in PETs in Singapore.
**METHODS**: A retrospective injury registration questionnaire and Short Musculoskeletal Function Assessment (SMFA) was used. 152 full-time PETs (116 male; 36 female) participated in the study.
**RESULTS**: 66 PETs reported 73 injuries over a 6-month recall period. In both males and females, knee was the most commonly injured body part, followed by the lower back and shoulder in males and foot and the patella in females. 21 (28.7%) new injuries, 22 (30%) recurrences of an old injury and 27 (36.9%) aggravations of pre-existing injuries were documented. Incomplete ligament sprain followed by muscle tendon strain were the most common injuries. 48 (65.7%) injuries did not lead to any absence from work, 11 injuries (15%) led to 1-2 days of absence while 14 cases (19.1%) led to 3-15 days of absence. 51 injuries did not affect teaching PE, while 15 injuries lead to some PE teaching time loss (range, 1-10 days). In five cases, the injuries were severe enough to require surgery and these PETs were unable to teach PE for the entire term. 31 PETs reported to be continuing to teach PE with some pain and discomfort due to effect of injuries.
On the SMFA, 132 PETs reported sub-optimal functional index while 112 reported sub-optimal bothersome index. 95 PETs had sub-optimal standardized mobility score, 132 had sub-optimal standardized functional score and 112 PETs had sub-optimal standardized bothersome score. Scores on all three scales were comparable between males and females. However, MSK dysfunction was more prevalent in primary PETs compared to secondary school PETs.
**CONCLUSIONS**: There is a high prevalence of injuries and MSK dysfunction amongst PETs in Singapore. Knee, shoulder and foot are at the highest risk of injury. This can adversely affect their PE teaching capacities as well as quality of life in both short and long-term.

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### Evaluating the Concussed Athlete: Co-Occurring Psychiatric Conditions Predict Psychological Function and Recovery

Jeremy P. McConnell[1], Cali A. VanValkenburg[1], Vincent C. Nittoli[2], Adam W. Shunk[2], Courtney D. Jensen[1]. *[1]University of the Pacific, Stockton, CA. [2]St. Vincent Sports Performance, Indianapolis, IN.*

*(No relevant relationships reported)*

More than 35 million American children ages 5 to 18 and approximately 400,000 collegiate athletes engage in organized sports. Sport participation bears a risk of traumatic brain injury (TBI). The annual incidence of sport-related TBI exceeds 1.5 million and is increasing among youth athletes. Many sufferers of TBI present with co-occurring psychiatric conditions, such as anxiety, depression, and learning disabilities. The effect of these conditions on diagnosis and prognosis remains largely unexplored.
**PURPOSE:** To assess the effect of co-occurring conditions on TBI symptoms in youth athletes. **METHODS:** We analyzed 80 student-athletes (primary education through college) who underwent comprehensive evaluation following a TBI. Medical histories were collected, neuropsychological tests were conducted, and co-occurring

psychiatric conditions were diagnosed. Co-occurring conditions were 1) attention deficit and hyperactivity disorders, 2) anxiety disorders, 3) depression and mood disorders, 4) adjustment disorders, and 5) learning disabilities. Tests of behavior and cognitive function were 1) the ImPACT test, and 2) the Behavior Assessment System for Children 2nd Edition (BASC). Linear regressions tested the effect of co-occurring conditions on psychological and behavioral outcomes. **RESULTS:** Subjects were 16.0 ± 2.6 years of age, 56.3% were male, and 72.5% were diagnosed with ≥1 co-occurring condition. Linear regressions revealed the number of diagnoses to predict poorer visual motor speed (p=0.031), poorer reaction time (p=0.010), and, summarizing speed and accuracy indices, poorer performance on the cognitive efficiency index (p=0.043). The number of co-occurring conditions was also a significant predictor ($p<0.05$) of 13 individual BASC categories and all BASC composite assessments, indicating poorer behaviors and attitudes. **CONCLUSION:** TBI associates with acute neural deficits and psychological changes. We found that co-occurring psychiatric diagnoses may compound these complications in youth athletes. When appraising the severity of a TBI in this population, a comprehensive psychiatric evaluation may be warranted to understand and accurately characterize the scope and prognosis of the condition.

2338 Board #174 June 1 9:30 AM - 11:00 AM

### Seasonal Distribution Of Cold Weather Injuries In The U.s. Army

David W. DeGroot, FACSM[1], Catherine Rappole[2], Robyn Martin[3]. *[1]Tripler Army Medical Center, Honolulu, HI. [2]Army Public Health Center, Aberdeen Proving Ground, MD. [3]Naval Health Research Center, San Diego, CA.*

*(No relevant relationships reported)*

The incidence of and risk factors for cold weather injury (CWI) in the US Army have been well characterized. Unlike the 'heat season,' when the risk of heat illness is highest and application of risk mitigation procedures is mandatory, there is no definition of the 'cold season' and the proportion of CWI that occur outside of a defined cold season is unknown. **PURPOSE**: To identify the cold season and to determine the within-year seasonal distribution of CWI at select Army installations. **METHODS**: The 10 US Army installations with the highest frequency of CWI from 1 July 2008-30 June 2013 were identified and used for analysis. In- and out-patient CWI data (ICD-9-CM codes 991.0-991.9, first, second or third diagnoses only) were obtained from the Defense Medical Surveillance System. Piecewise regression analysis was utilized to determine the critical cut points at which trends in CWI significantly increased or decreased, indicating the start and end, respectively, of the cold season. The proportional distribution of EHI within the cold season, overall and by installation, was determined.
**RESULTS**: During the study period there were 1,012 CWI and the overall rate was 0.79 per 10,000 person-months. The highest rate occurred during the month of February (2.16 per 10,000 person-months) and the installation with the highest rate was Ft Drum, NY (5.40 per 10,000 person-months). There was at least one CWI during every week of the year during the 5 year study period. Piecewise regression analyses indicated that on average the cold season started during week 14 (Sept 30) and ended during week 39 (March 24). Using this definition, 83.2% (842/2012) of CWI occurred during the cold season. The longest cold season occurred at Ft Wainwright, AK (34 weeks) and the shortest at Ft Carson, CO (17 weeks), illustrating the considerable variability between locations.
**CONCLUSIONS**: Our data suggest that the risk of CWI exists year round at select Army installations, though further research sub-grouped by type of CWI is warranted. Based on the piecewise regression analysis, we recommend that the 'cold season' starts 1 October and continues through March, as ~83% of CWI occurred during this period.

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### Incidence and Severity of Game-Related College Football Thoracoabdominal Injuries on Artificial versus Natural Grass

Theresa M. Gustaveson, Michael C. Meyers, FACSM, Shad K. Robinson. *Idaho State University, Pocatello, ID.*

**Reported Relationships: T.M. Gustaveson:** *Contracted Research - Including Principle Investigator; Partial support by FieldTurf USA.*

In the past, serious injuries have been attributed to playing on artificial turf. Newer generations of artificial turf, however, have been developed to duplicate the playing characteristics of natural grass. No long-term studies have compared articular and muscle trauma of the thoracoabdominal region between the two surfaces. **PURPOSE:** To quantify incidence and severity of game-related thoracoabdominal collegiate football injuries on artificial turf vs natural grass. **METHODS:** A total of 24 universities were evaluated over 8 competitive seasons for injury incidence rates (IIRs) across injury severity, injury category, injury mechanism and situation, primary type of injury, anatomical location, type of tissue injured, elective imaging and surgical procedures, and turf age. **RESULTS:** Of the 1,237 collegiate games documented, 628 (50.8%) were played on artificial turf vs 609 (49.2%) played on natural grass. A total of 379 thoracoabdominal injuries were reported with 147 (38.8%) occurring on artificial turf, and 232 (61.2%) on natural grass. MANOVAs per 10 games indicated a significant playing surface effect by injury severity ($F_{2,379} = 7.505$; $P = .001$), primary type of injury ($F_{12,379} = 4.412$; $P = .000$), tissue type ($F_{3,379} = 9.412$; $P = .000$), elective imaging and surgical procedures ($F_{3,379} = 3.517$; $P = .007$), and turf age ($F_{2,379} = 91.093$; $P = .000$), but not by injury category ($F_{3,379} = 2.175$; $P = .089$), injury mechanism ($F_{3,379} = 1.439$; $P = .133$), or injury situation ($F_{8,379} = 1.329$; $P = .181$). Univariate analyses indicated significantly lower ($P = .05$ - $.0001$) IIRs across severity, both in 1st degree, 2.1 (95% CI, 1.8-2.5) vs 2.9 (2.5-3.2), and 2nd degree IIRs, 0.1 (95% CI, 0.1-0.2) vs 0.7 (0.5-0.9); defensive positions, 0.8 (95% CI, 0.6-1.1) vs 1.4 (1.2-1.7); contusions, 1.3 (95% CI, 1.1-1.6) vs 2.0 (1.7-2.3); muscle, 2.0 (95% CI, 1.7-2.3) vs 3.0 (2.6-3.4); MRI, 0.1 (95% CI, 0.0-0.2) vs 0.2 (0.1-0.4); and turf lasting 4-7 years, 0.8 (95% CI, 0.6-1.1) vs 0.9 (0.7-1.2), and 8+ years 0.1 (95% CI, 0.1-0.2) vs 0.5 (0.4-0.8) when comparing artificial turf vs natural grass, respectively. **CONCLUSION:** Since minimal differences existed between artificial turf and natural grass over an 8-year period of competitive play, artificial turf is a practical alternative when comparing thoracoabdominal injuries in collegiate football.

2340 Board #176 June 1 9:30 AM - 11:00 AM

### Racquet Sport-Related Injuries Treated in United States Emergency Departments, 2007-2016

Andrew McBride, Morteza Khodaee, 80045, FACSM. *University of Colorado - Denver, Aurora, CO.* (Sponsor: Morteza Khodaee, FACSM)

*(No relevant relationships reported)*

Title: Racquet Sport-Related Injuries Treated in United States Emergency Departments, 2007-2016
Authors: Andrew J. McBride, Morteza Khodaee, FACSM
Institutions: University of Colorado-Denver
Purpose: Racquet sports, especially tennis, have grown in popularity in the United States. There are limited studies analyzing injuries in badminton, squash, and other lesser-known racquet sports. We aimed to analyze the injury pattern in all racquet sports that resulted in the United States emergency department (USED) visits.
Methods: This was a retrospective analysis of National Electronic Injury Surveillance System data on racquet-sport related injuries that presented to the USEDs for the past 10 years.
Results: From 2007-2016, there were 8,024 cases of racquet-sports related injuries that presented to USEDs. The majority of these injuries were in men (61%). Caucasians had the highest percentage of injuries (47%) followed by African Americans (7%) and Asian Americans (3%). Sprain/strain were the most common types of injuries (34%) followed by fracture (13%) and contusion/abrasion (12%) The body part most frequently injured was the ankle at 13% followed by facial injuries at 10%. Over 93% of injuries were treated and released from the USED while 5% of patients were admitted for hospitalization. Approximately two third of injuries occurred at a place of recreation or sport. Tennis was the most common sport of injury at 68% followed by one of squash, racquetball and paddleball at 17%. The summer months were the most common months of injury and adolescence was the most common age group injured. Women tennis players (75% compared to 63% in men) and men squash/racquetball/paddleball players (22% compared to 9% in women) were more likely to present to the USED with injuries.
Conclusion: Racquet sport-related injuries are varied in their presentation and body part involvement. Gender differences were seen in injury rates for tennis and squash/racquetball/paddleball. Tennis-related injuries make up two-thirds of racquet sport-related injuries making knowledge of other racquet sport injuries important.

2341 Board #177 June 1 9:30 AM - 11:00 AM

### Incident and Severity of Lower Leg NCAA Women's Soccer Trauma on Artificial versus Natural Grass

Sarah Friend, Michael C. Meyers, FACSM. *Idaho State University, Pocatello, ID.* (Sponsor: Michael Meyers, FACSM)

**Reported Relationships: S. Friend:** *Contracted Research - Including Principle Investigator; Partial support by FieldTurf USA.*

Recently, artificial turf has been developed to duplicate the playing characteristics of natural grass. No long-term studies have compared game-related, NCAA women's soccer musculoskeletal trauma of the lower leg between surfaces. **PURPOSE:** To quantify incidence, mechanisms, and severity of game-related lower leg NCAA women's soccer injuries on artificial turf vs natural grass. **METHODS:** 13 universities were evaluated over a 5-year period for injury incidence rates (IIR) across injury category, severity of injury, primary type of injury, elective imaging/ surgery, type of tissue injured, field conditions, position played at time of injury, turf age, anatomical location, injury mechanism, and injury situation. **RESULTS:** In sum, 797 collegiate games were evaluated for women's soccer injuries sustained on artificial turf or natural grass, with 355 games (45%) played on artificial turf and 442 games (55%) played on natural grass. A total of 245 injuries were documented, with 91 occurring on artificial turf and, 154 occurring on natural grass. MANOVAs per 10 games indicated a significant playing surface effect by severity of injury ($F_{2,242} = 7.865$; $P < .001$), field

conditions ($F_{3,241}$ = 6.862; $P$ <.0001), skill position at time of injury ($F_{9,235}$ = 2.821; $P$ = .002), turf age ($F_{3,241}$ = 13.612; $P$ < .0001), injury situation ($F_{8,236}$ = 2.411; $P$ = .006), but not by primary type of injury ($F_{87,238}$ = 0.997; $P$ = .445), elective imaging/ surgical ($F_{34,239}$ = 4.183; $P$ = .382), type of tissue injured ($F_{4,240}$ = 1.102; $P$=.333), lower extremity-joint/ muscle ($F_{10,234}$ = 0.810; $P$ = .620)/ ($F_{3,231}$ = 0.331; $P$ = .857). Post hoc analyses indicated significant IIRs ($P$ =.05 =.001) across first degree, second degree, 0.0 (95% CI, 0.0-0.0) vs 0.1 (95% CI, 0.1-0.1); no precipitation/ dry field, 0.2 (95% CI, 0.2-0.3) vs 0.3 (95% CI, 0.2-0.3); center back/ sweeper/ libero, 0.0 (95% CI, 0.0-0.1) vs 0.1 (95% CI, 0.0-0.1); dual/ deep-lying striker, 0.0 (95% CI, 0.0-0.0) vs 0.0 (95% CI, 0.0-0.1); turf age of 1-3 yrs, 0.1 (95% CI, 0.1-0.1) vs 0.1 (95% CI, 0.1-0.1); and turf age of 8+ yrs 0.0, (95% CI 0.0-0.0) vs 0.1 (95% CI, 0.0-0.1). **CONCLUSION:** Although similarities existed between artificial turf and natural grass during competitive play, artificial turf is a practical alternative for natural grass when comparing this specific artificial surface and level of play.

2342 Board #178 June 1 9:30 AM - 11:00 AM

### Head Impacts In Female Professional Mixed Martial Arts

Mark Jesunathadas, Elizabeth D. Edwards, Trenton E. Gould, Scott G. Piland. *University of Southern Mississippi, Hattiesburg, MS.*

*(No relevant relationships reported)*

Mixed martial arts (MMA) is a full-contact combat sport, which in recent years has experienced an increase in participation of female athletes. Previous research has indicated knockouts (KO) and technical knockouts (TKO), which are typically associated with head trauma, are frequent occurrences (46.2% of match outcomes are determined by KO and TKO) in male MMA competitions. However, the occurrences and context of KOs and TKOs have not been investigated in female MMA competitions. **PURPOSE**: To characterize the occurrences and context of KOs and TKOs in female professional MMA competition. **METHODS**: Publicly available score card and video data of female Ultimate Fighting Championship (UFC) competitions that occurred between November 2014 (UFC 180) and July 2016 (UFC 200) were analyzed. Score card information from www.ufc.com and www.sherdog.com was used to determine the occurrences of KOs and TKOs of female UFC fights. The MMA Knockout Tool was used to analyze video of the female UFC fights that ended in KO or TKO. The MMA Knockout Tool allows for coding of the context of a KO and TKO as well as coding the number of head and body strikes sustained by the loser in the 30 s prior to the KO or TKO. **RESULTS**: Two out of a total 29 matches ended in KO while 4 ended in TKO due to repetitive strikes. One other TKO was due to a musculoskeletal injury and was not included in the analysis. The combined incidence of KOs and TKOs from head trauma was 103.4 per 1000 athlete exposures (AEs). Video analysis of the KOs and TKOs revealed that in 5 of the 6 KO/TKOs the loser was standing and not clinched with the winner, and in 1 fight the loser was on the ground. In the 30 s prior to TKO the loser sustained a mean of 15.5 ± 7.6 impacts to the head with a mean 8.0 ± 3.6 strikes to the head occurring in the final 10 s. The head regions that sustained the greatest number of strikes within the 30 s prior to KO or TKO were the mandibular and temporal regions, which received 34.7 and 30.7 % of all head strikes, respectively. **CONCLUSIONS**: KO and TKO events may represent a conservative estimate of concussive events in MMA competition. The incidence of 103.4 TKO/KOs per 1000 AEs is less than that observed for professional female boxing and male MMA competitions. Furthermore, our data suggest that engaging in a standup versus ground fight is associated with greater incidences of KO/TKOs.

2343 Board #179 June 1 9:30 AM - 11:00 AM

### Injuries Resulting From Checking In United States High School Boy's Lacrosse, 2008/09-2015/16 School Years

E. Paige Harrell[1], Zachary Y. Kerr[1], Andrew E. Lincoln[2], Lauren A. Pierpoint[3], Margot Putukian, FACSM[4], Shane V. Caswell[5]. *[1]University of North Carolina at Chapel Hill, Chapel Hill, NC. [2]MedStar Sports Medicine Research Center, Baltimore, MD. [3]University of Colorado Anschutz, Aurora, CO. [4]Princeton University, Princeton, NJ. [5]George Mason University, Manassas, VA.* (Sponsor: Margot Putukian, FACSM)

*(No relevant relationships reported)*

High school boys' lacrosse allows for intentional contact through body and stick checking. Recently, rules further limiting body checking were implemented to reduce injury risk. Yet, there is limited research focused on the epidemiology of injuries resulting from being checked.**PURPOSE:** Describe the epidemiology of injuries resulting from being body and stick checked in high school boys' lacrosse during the 2008/09-2015/16 school years. **METHODS:** Athletic Trainers (ATs) collected injury and athlete-exposure (AE) data via the High School Reporting Information Online system. Injury was defined as: (1) occurring from participation in a school-sanctioned completion or practice; (2) requiring medical attention by an AT or physician; and (3) resulting in time loss of at least 24 hours (although all concussions, dental injuries, fractures were included). Analyses were restricted to injuries occurring from being body and stick checked. Injury counts, rates per 10,000AE, and injury rate ratios (IRR) with 95% confidence intervals (CI) were reported. Linear regression estimated annual average changes in injury rates. **RESULTS**: ATs reported 160 "body checked" and 137 "stick checked" injuries. These injuries occurred during 933,165AE, leading to injury rates of 1.71 and 1.47/10,000AE, respectively. A decrease in injury rate was found for "body checked" injuries (annual average change of -0.18/10,000AE; 95%CI: -0.23, -0.13; P<0.001) but not for "stick checked" injuries (annual average change of 0.02/10,000AE; 95%CI: -0.07, 0.11; P=0.68). The injury rate was higher in competitions than practices for both "body checked" (4.35 vs. 0.56/10,000AE; IRR=7.82; 95%CI: 5.40, 11.34) and "stick checked" injuries (3.40 vs. 0.62/10,000AE; IRR=5.51; 95%CI: 3.81, 7.96). Most "body checked" injuries were to the head/face (47.5%) and shoulder (16.9%), and diagnosed as concussions (43.8%). In contrast, most "stick checked" injuries were to the hand/wrist (29.2%) and head/face (21.2%), and diagnosed as fractures (32.8%) and contusions (27.7%). **CONCLUSION:** "Body checked" and "stick checked" injuries occurred at higher rates in competitions than practices, but varied in body part and diagnosis distributions. Reductions in the "body checked" injury rate across time may be associated with rule changes limiting body checking.

2344 Board #180 June 1 9:30 AM - 11:00 AM

### The Epidemiology Of Dii Baseball, Basketball, And Soccer Injuries And Potential Preventive Strategies

Christopher P. Holdren, Andrea Fradkin, FACSM. *Bloomsburg University of Pennsylvania, Bloomsburg, PA.*

*(No relevant relationships reported)*

Baseball (B), basketball (K), and soccer (S) are among the top-five sports causing injury in males. To date, no published studies have prospectively investigated the epidemiology of sporting injuries. **PURPOSE:** To design and implement a prospective injury surveillance system to describe B, K, and S injuries, and devise potential preventive measures to help reduce injury risk. **METHODS:** Participants were recruited from Bloomsburg University's B, K, and S teams. Sport-specific injury reporting forms were developed, and injury details were recorded by athletic trainers. Information was collected on the injury and circumstances surrounding the injury, with injury defined as "damage to the body that occurs as a result of competing, practicing and/or participating in an athletic activity". **RESULTS:** The B, K, and S teams consisted of 32, 11, and 25 players respectively. There were 73 injuries sustained (B = 34, K = 12, S = 27), with significant differences ($p \leq 0.001$) in all injury parameters between sports. Excluding those who were unsure, in all sports, soft tissue injuries were most common (66.6%), with B having more non-contact injuries, and K and S having more contact injuries ($p \leq 0.001$). There were similar numbers of head and torso injuries among sports, however B had more upper extremity injuries ($p \leq 0.05$), while K and S had more lower extremity injuries ($p \leq 0.001$). B and K had more competition injuries ($p \leq 0.05$), while S had more training injuries ($p \leq 0.001$). **CONCLUSION:** Due to the high injury prevalence, this study reinforces the need for injury prevention strategies, and further highlights that all sports require unique injury prevention strategies, as well as tailoring these strategies to players' positions. For all sports, undertaking a suitable warm-up, evaluating and correcting improper mechanics, and enforcing competition rules may reduce injury risk. Proper conditioning to provide strength and flexibility to the lower extremities in K and S, and upper extremities in B also seems warranted. In S specifically, modifying training intensities and investigating footwear worn and surfaces where games and trainings are conducted might be useful. Whereas in K, plyometric training could be used to improve landing techniques. Lastly, in B, proper preseason conditioning, particularly in pitchers should be investigated.

2345 Board #181 June 1 9:30 AM - 11:00 AM

### Descriptive Epidemiology of Injuries AmongRecreational Mountain Bikers

Lauren Samuels[1], Julia Kammel[1], Jonathan Finnoff, FACSM[2], Masaru Teramoto[1], Stuart Willick, FACSM[1]. *[1]University of Utah, Salt Lake City, UT. [2]Mayo Clinic, Rochester, MN.*

*(No relevant relationships reported)*

**Introduction:**
Although mountain biking is an inherently dangerous activity, participation in the sport is steadily rising. To date, there are very few publications on mountain biking injuries. Further investigation of mountain biking injuries can improve medical care and lead to the development of safety initiatives.
**Purpose:**
The aim of this study was to describe injury patterns among recreational mountain bikers in the United States.
**Methods:**
Mountain biking injury data between the years 1996-2016 were gathered from the National Electronic Injury Surveillance System (NEISS). Any injury sustained while mountain biking that resulted in an emergency department visit to one of the 96 NEISS

participating facilities was included in this study. The NEISS database is designed to represent a probability sampling of emergency departments nationwide. Data analysis was performed using descriptive statistics, a $\chi^2$ test, and a logistic regression model.

**Results:**

A total of 2,621 mountain biking injury cases were identified in the NEISS database in the past 11 years. Fracture was the leading diagnosis (26.86%), followed by contusion/abrasion (19.11%), strain/sprain (14.88%), laceration (14.42%), internal injury (6.87%), dislocation (3.97%), and concussion (3.93%). The most commonly injured body part was the shoulder (17.44%), followed by head (11.10%), upper trunk (10.07%), and knee (6.64%). Males had a significantly higher proportion of shoulder injuries than did females (20.3% of males vs. 8.7% of females, Rao-Scott $\chi^2 = 30.66$, $p < 0.001$). On the other hand, a significantly higher proportion of females than males sustained elbow injuries (4.7% of males vs. 11.0% of females, Rao-Scott $\chi^2 = 25.46$, $p < 0.001$) and wrist injuries (4.8% of males vs. 8.5% of females, Rao-Scott $\chi^2 = 9.55$, $p < 0.011$). The logistic regression model showed that these results held true even after adjusting for age.

**Conclusion:**

The results of this study suggest mountain biking injuries are commonly seen in emergency departments, and injuries are often severe. The shoulder is the most commonly injured anatomic location, with different injury patterns seen among males and females. Further research is needed to determine specific mechanisms of injury that might inform injury prevention strategies.

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2346 Board #182 June 1 9:30 AM - 11:00 AM

### Incidence and Severity of College Football Hand and Wrist Injuries on Artificial versus Natural Grass

Marissa R. Chase, Michael C. Meyers, FACSM, Shad K. Robinson. *Idaho State University, Pocatello, ID.*

**Reported Relationships: M.R. Chase:** *Contracted Research - Including Principle Investigator; Partial support by FieldTurf USA.*

Over the past two decades, newer generations of artificial turf have been developed to duplicate the playing characteristics of natural grass. Few turf-related studies have been published comparing hand and wrist trauma. **PURPOSE:** To quantify incidence and severity of game-related collegiate football hand and wrist injuries on artificial turf vs natural grass. **METHODS:** 24 universities were evaluated over 8 competitive seasons for injury incidence rates (IIRs) across injury severity, injury category, injury mechanism and situation, primary type of injury, anatomical location, type of tissue injured, elective imaging/surgery, field conditions, and turf age. **RESULTS:** Of the 1,237 collegiate games documented, 628 (50.8%) were played on artificial turf vs 609 (49.2%) played on natural grass. A total of 536 hand and wrist injuries were reported with 212 (39.6%) occurring on artificial turf, and 324 (60.4%) on natural grass. MANOVAs (Wilks' $\lambda$) indicated a significant playing surface effect by injury severity ($F_{2,533} = 8.053$; $P < .0001$), primary type of injury ($F_{11,524} = 5.254$; $P < .0001$), body part injured ($F_{4,531} = 3.294$; $P = .006$), tissue type ($F_{3,532} = 12.421$; $P < .0001$), elective imaging/surgery ($F_{4,531} = 2.798$; $P = .039$), field conditions ($F_{3,532} = 13.991$; $P < .0001$) and turf age ($F_{3,532} = 90.901$; $P < .0001$), but not by injury category, position played, injury mechanism, or situation. Post hoc analyses indicated significantly lower IIRs ($P < .05$ to $.0001$) observed across 2nd degree trauma, 0.2 (95% CI, 0.1-0.3) vs 0.6 (0.4-0.8); ligament sprains, 1.4 (95% CI, 1.2-1.7) vs 2.0 (1.7-2.3), and subluxations, 0.4 (95% CI, 0.3-0.6) vs 0.3 (0.3-0.5); joint, 2.1 (95% CI, 1.8-2.4) vs 2.5 (2.2-2.9), and muscle trauma, 0.6 (95% CI, 0.5-0.9) vs 2.0 (1.7-2.3); MRIs, 0.0 (95% CI, 0.0-0.1) vs 0.2 (0.1-0.3), and x-rays ordered, 1.7 (95% CI, 1.4-2.0) vs 2.2 (1.8-2.5); during adverse weather conditions, 0.3 (95% CI, 0.2-0.6) vs 1.2 (0.8-1.6); and turf lasting 4-7 yrs, 0.9 (95% CI, 0.7-1.2) vs 1.3 (1.1-1.6), and 8+ yrs, 0.1 (95% CI, 0.1-0.2) vs 0.8 (0.7-1.1) when comparing artificial turf to natural grass, respectively. **CONCLUSION:** Although similarities existed between both surfaces over an 8-year period of competitive play, artificial turf is in many cases safer than natural grass when comparing hand and wrist trauma in college football.

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2347 Board #183 June 1 9:30 AM - 11:00 AM

### Medical Attention Injury Rates in U.S. Women Rugby-7s Players by Positions

Christian Victoria[1], Victor Lopez Jr[2], Richard Ma[3], Meryle G. Weinstein[4], James L. Chen[5], Arun T. Gupta[6], Samuel Y. Haleem[7], Answorth A. Allen[8]. *[1]New York University, New York, NY. [2]Rugby Research and Injury Prevention Group, Inc, Hospital for Special Surgery, New York, NY. [3]University of Missouri, Missouri Orthopaedic Institute & Thompson Laboratory for Regenerative Orthopaedics, Columbia, MO. [4]New York University, Steinhardt School of Culture, Education and Human Development, New York, NY. [5]University of California, San Francisco, San Francisco, CA. [6]University of Calgary, Calgary, AB, Canada. [7]City College of New York of the City University of New York, New York, NY. [8]Hospital for Special Surgery, New York, NY.* (Sponsor: Robert Cantu, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: There is a lack of injury data on women's rugby, and less on the Olympic format of Rugby-7s. Reporting medical-attention injuries may provide a more complete picture of the true burden of injury and illness in sport. The aim was to determine medical attention (no time-loss) injury incidence in U.S. women's Rugby-7s. **METHODS**: A prospective epidemiology study of U.S. women Rugby-7s (6,768 players; 564 teams), in multi-level *USA Rugby* and *USA Sevens LLC* tournaments (2010-2014). Incidence (per 1000 player-hour (ph)) and biomechanism of medical attention injuries were captured via the Rugby Injury Survey & Evaluation (RISE) Report methodology.

**RESULTS**: Medical attention injury rate was found at 84.4/1000 ph (n=356). Amongst positions, injuries were found at similar rates (backs: 60%, 59.3/1000ph, n=143; forwards: 40%, 53.6/1000ph, n=97; RR=1.11; P=0.447). Most injuries were acute (95%) occurring during the tackle (67%). Most match injuries were from a shoulder tackle (70%) (backs 72%; forwards 62%; RR=1.32; P=0.113). Recurrent injuries occurred at 25%. Lower extremity ligament sprains (53%) were most common, among injury types, muscle/tendon injuries were most common overall at 41% (backs 41/1000ph; forwards 42/1000ph; P=0.998). Knee injuries occurred more frequently in forwards (23%) than backs (16%; P<0.213). Head/neck injury rates, were 22% of all injuries. The sub-acute head contusion rate, where players were physician-cleared to return to sport was 6% (3.5/1000ph). **CONCLUSIONS**: Documentation of medical-attention incidents is recommended in the literature, as this is likely to capture a far greater number of ailments, than time loss injuries alone and will therefore, provide a more inclusive picture of the true burden of injury and illness in a population. A panoptic view of rugby-7s injury rates, provides fundamental gender injury data, to guide injury prevention protocols by stakeholders to guide player welfare. Head/neck and upper extremity injury rates (both at 21%) support an emphasis on tackling techniques for injury reduction. A program, including contact-based-awareness, for women newly introduced to this collision-sport, would nurture injury prevention. Furthermore, adherence on return to play protocols would decrease recurrent injury rates seen in this gender-specific cohort.

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2348 Board #184 June 1 9:30 AM - 11:00 AM

### The Epidemiology of Female Golfing Injuries

Andrea Fradkin, FACSM. *Bloomsburg University, Bloomsburg, PA.*

*(No relevant relationships reported)*

Golf is a popular sport worldwide, however, the tendency of players to be older and in poor physical condition contributes to its injury risk. Although golf has a moderate injury incidence, few studies have illustrated the extent of golfing injuries, and only one study has focused on female golf injuries. **PURPOSE:** To examine the injury profile of female golfers and investigate differences in injury epidemiology by age, handicap, experience, and participation. **METHODS:** Female golfers over 18 years with a registered handicap documented their 12-month injury status and associated golfing demographics. **RESULTS:** 1803 female golfers (median age: 51.3 years; handicap: 12.4; experience: 13.7 years) reported 671 injuries (37.2%) over a 12-month period, with the majority of injuries sustained during play (72.9%). The most common injury sites were the shoulder (23.2%), lower back (22.9%), and elbow (18.1%). Strains were the most frequent type of injury (43.0%), with overuse injuries most prevalent (32.2%), followed by a technical error (24.8%). Over half of all injuries required treatment from a healthcare professional (57.8%), and 1358 (75.3%) of the injured golfers reported an impact on their performance or participation. Over two-thirds of the injured golfers missed participation time due to their injury, and 187 of the injured golfers (10.4%) needed time off school or work. Chi-square analysis showed golfers' handicap ($\chi^2_4 = 23.747$, $p \leq 0.001$), hours of play ($\chi^2_8 = 35.735$, $p \leq 0.001$), hours of practice ($\chi^2_8 = 30.137$, $p \leq 0.001$), and experience ($\chi^2_9 = 28.003$, $p \leq 0.001$) were significantly associated with their injury status. Handicap, hours of play, and experience level were also significant independent predictors of injury. The Hosmer and Lemeshow test indicated acceptable goodness of fit ($p = 0.905$).

**CONCLUSION:** This study confirms the common occurrence of, and impact injuries have on golfers. Lower handicap golfers were more likely sustain an injury than higher handicap golfers, potentially due to increased exposure time required to obtain lower handicaps. This is further supported as exposure time and experience level were found to be significant predictors of injury. Before suggesting limits to golf participation, other prevention avenues focusing on specific female golfer characteristics must be investigated.

2349 Board #185

**Abstract Withdrawn**

2350 Board #186 June 1 9:30 AM - 11:00 AM

**A Cross-sectional Look At Injuries Among Individuals Engaged In Crossfit Training: A Four-year Study.**

Yuri Feito, FACSM[1], Evanette K. Burrows[2], Loni P. Tabb[2]. *[1]Kennesaw State University, Kennesaw, GA. [2]Drexel University, Philadelphia, PA.*

*(No relevant relationships reported)*

Little epidemiological data exist to describe the incidence of injury among individuals engaged in CrossFit training. **PURPOSE**: To examine the prevalence and incidence of injury among individuals engaged in CrossFit training over a four-year period. **METHODS**: Between 2013-2017, individuals (Females = F; Males = M) engaged in CrossFit training were asked to complete a survey designed to examine variables related to their participation in CrossFit training and their injury history over the previous 12 months (survey was distributed at the end of each year). **RESULTS**: A total of 3,079 individuals responded to the online survey. Data was only analyzed for the cases that had complete data (N = 3,049; F = 48.6%, M = 51.4%). Overall, 30.5% (n = 931) of individuals reported experiencing an injury, with no difference between F and M [14% (n = 436); 16.2% (n = 495), respectively; $\chi 2$= 1.65, $p$ = 0.1989]. Of those who experienced an injury, 62.4% (n = 581) reported an injury to a single body part, while 37.6% (n = 350) reported injuries to multiple body parts; in addition, there were significant differences between males and females ($\chi 2=8.43$, $p=0.0037$) in the number of body parts injured. The shoulders (39%), back (36%), knees (15%), elbows (12%), and wrists (11%) recorded the highest prevalence of injury. Based on the assumed maximum number of workout hours per week, the injury rate was 0.27 per 1,000 hours (F = 0.28, M = 0.26); whereas, the assumed minimum number of workout hours per week resulted in an injury rate of 0.74 per 1,000 hours (F = 0.78, M = 0.70). **CONCLUSIONS**: To our knowledge, this is the first study to examine the prevalence and incidence of injury in a multi-year large sample of individuals participating in CrossFit training. Our findings support the notion that CrossFit training has similar rates of injury than other forms of exercise training.

2351 Board #187 June 1 9:30 AM - 11:00 AM

**Incidence And Severity Of Collegiate Men's Soccer Lower Leg Injuries On Artificial Versus Natural Grass**

Shianne M. Blessing, Michael C. Meyers, FACSM, Shad K. Robinson. *Idaho State University, Pocatello, ID.*

**Reported Relationships: S.M. Blessing:** *Contracted Research - Including Principle Investigator; Partial support by FieldTurf USA.*

Recently, artificial turf has been developed to duplicate the playing characteristics of natural grass. No long-term studies have compared match-related, collegiate men's soccer lower leg trauma between the two surfaces. **PURPOSE:** To quantify incidence, mechanisms, and severity of match-related lower leg collegiate men's soccer injuries on artificial turf versus natural grass. **METHODS:** 11 universities were evaluated over 6 seasons for injury incidence rate (IIR) across injury severity, lower leg joint/muscle, elective imaging/surgery, type of tissue injured, injury mechanism/situation, player position, injury category, field conditions, cleat design, and turf age. **RESULTS:** Overall, 380 games (49.7%) were played on artificial turf versus 385 games (50.3%) played on natural grass. A total of 256 injuries were documented, with 109 occurring on artificial turf and 147 on natural grass. MANOVAs per 10 games indicated a significant playing surface effect by lower leg trauma-joint/muscle ($F_{11,256}$ = 5.668; $P$ < .0001/$F_{4,256}$ = 17.931; $P$ < .001), elective imaging/surgery ($F_{3,256}$ = 18.129; $P$ < .0001), type of tissue injured ($F_{5,256}$ = 12.413; $P$ < .0001), injury mechanism/situation ($F_{16,256}$ = 2.305; $P$ < .001/$F_{8,256}$ = 5.592; $P$ < .0001), injury category ($F_{6,256}$ = 40.251; $P$ < .0001), and cleat design ($F_{3,256}$ = 2.258; $P$ < .047), but none observed by severity injury, player position, and field conditions. Significantly lower IIRs (P = .05-.0001) across distal tibiofibular joint, 0.3 (95% CI, 0.2-0.5) vs 0.5 (95% CI, 0.3-0.8); lower leg muscles combined, 1.4 (95% CI, 1.1-1.8) vs 2.2 (95% CI, 1.8-2.6); total medical procedures combined, 0.8 (95% CI, 0.6-1.1) vs 1.2 (95% CI, 0.9-1.6); ligament sprains, 1.4 (95% CI, 1.1-1.8) vs 1.5 (95% CI, 1.2-1.9); muscle-tendon strain/spasm/tears, 0.6 (95% CI, 0.4-0.9) vs 0.3 (95% CI, 0.2-0.5); tackled from the side/behind, 0.7 (95% CI, 0.5-1.0) vs 1.2 (95% CI, 0.9-1.5); player-turf impacts, 0.2 (95% CI, 0.1-0.3) vs 0.4 (95% CI, 0.2-0.6); adverse weather conditions combined, 0.5 (95% CI, 0.3-0.8) vs 1.3 (95% CI, 1.0-1.7) between artificial turf and natural grass, respectively. **CONCLUSION:** Although similarities exist between both surfaces during competitive play, artificial turf is in many cases safer than natural grass when comparing this specific artificial surface and level of play.

2352 Board #188 June 1 9:30 AM - 11:00 AM

**Epidemiology Of Sports-related Facial Injuries Treated In The United States Emergency Departments Between 1997-2016.**

Natalie Ronshaugen, Morteza Khodaee, FACSM. *University of Colorado, Aurora, CO.*

*(No relevant relationships reported)*

**Purpose:** Worldwide, facial injuries in sports make up a large number of emergency room visits each year. The purpose of this study was to describe the epidemiology of sports related facial injuries that presented to the United States emergency departments (EDs). **Methods:** This was a retrospective analysis of the data of facial injuries in the ED related to sports from the National Electronic Injury Surveillance System (NEISS) from 1997-2016. **Results:** A total of 183,985 people presented to US EDs for sports related facial injuries from 1997-2016. The average age was 19 years. About three quarters of patients were male. The most common injury was facial laceration (50%), followed by contusion/abrasion (27%), fracture (12%), followed by eyeball injuries (10%). The majority did not require admission and were discharged from the ED (97%). The most common sports associated with facial injuries were biking (19%), basketball (16%), baseball (11%), football (6%), softball (4%), and soccer (4%). The most common sport associated with male facial injuries was biking (19%), followed by basketball (18%), baseball (12%), football (8%), and soccer (4%). The most common sport associated with female facial injuries was biking (21%), followed by softball (10%), basketball (8%), baseball (7%), and soccer (5%). **Conclusion:** This study identifies common facial injuries in sports and which sports are more likely to cause them. Biking and basketball have the highest incidence of facial injuries overall though softball is the second most common sport associated with female injuries. Most injuries occurred in males. Most injuries were minor in nature and did not require hospitalization. <!--EndFragment-->

2353 Board #189 June 1 9:30 AM - 11:00 AM

**Profile Of Non-time-loss Conditions/injuries In U.s. Men'S Rugby-7s Players**

Richard Ma[1], Victor Lopez Jr[2], Meryle G. Weinstein[3], Christian Victoria[4], James L. Chen[5], Arun T. Gupta[6], Martena T. Mettry[7], Answorth A. Allen[8]. *[1]University of Missouri, Missouri Orthopaedic Institute & Thompson Laboratory for Regenerative Orthopaedics, Columbia, MO. [2]Rugby Research and Injury Prevention Group, Inc., Hospital for Special Surgery, New York, NY. [3]New York University, Steinhardt School of Culture, Education and Human Development, New York, NY. [4]New York University, New York, NY. [5]University of California, San Francisco, San Francisco, CA. [6]University of Calgary, Calgary, AB, Canada. [7]City College of New York of the City University of New York, New York, NY. [8]Hospital for Special Surgery, New York, NY.* (Sponsor: Robert C. Cantu, FACSM)

**Reported Relationships: R. Ma:** *Contracted Research - Including Principle Investigator; USA Rugby New England and Empire GU Rugby Football Unions and the National Operating Committee on Standards for Athletic Equipment grant (ID 44-16), Chapel Hill, NC, USA.*

**PURPOSE**: Rugby-7s, on the Olympic program, over the next decade, has a dearth of injury data, limiting injury prevention. Most injury reporting focuses on time-loss injuries with little or no data on medical attention injuries. The aim was to determine the match non-time-loss injury incidence in U.S. men's Rugby-7s. **METHODS**: A prospective epidemiology study of 17,770 U.S. men Rugby-7s players (1,474 teams), in multi-level *USA Rugby* and *USA Sevens LLC* tournaments (2010-2014). Incidence (per 1000 player-hour (ph)) and biomechanism of non-time-loss injuries were captured via the Rugby Injury Survey & Evaluation (RISE) Report methodology. **RESULTS**: Non-time-loss injuries were found at 66.1/1000 ph (n=686). Positionally, backs encountered more injuries (63%; 67.4/1000ph; n=400) than forwards (36%; 52.4/1000ph; n=233; RR=1.3; P=0.002). Most injuries were acute (93%), occurring in the tackle (67%). Shoulder tackles resulted in most non-time-loss injuries (63%) (backs 65%; forwards 58%; RR=1.7; P<0.001). Recurrent injuries (23%) occurred frequently. Main injuries were lower extremity ligament sprains (14.2%). Overall head/neck injury rates were 23%, and found higher with incorporation of tackles (26%). The sub-acute head trauma/contusion rate, where players were physician-cleared to return to sport (non-time loss) was 4.9% (3.2/1000ph). **CONCLUSIONS**: Recording non-time-loss (medical attention) injuries will provide a true burden of injury and illness among the growing U.S. Rugby-7s population. Most injuries occur to the lower extremity (41%), reflective of the greater amount running, acceleration and deceleration in the Rugby-7s format. Head/neck non-time-loss injury rates were found lower than the "all medical attention injuries (30%)" in community international male Rugby-15s. Most injuries

were related to tackling amongst the upper extremity (35%), and head/neck (26%), making these areas a focus to reduce risk in the U.S. and support tackle-technique evaluations especially with head positional focusing and its target area (lateral hip). Proper medical assessments, need to scrutinize return to play post-tournaments to reduce recurrent injury risk in the U.S. men's cohort. Investigations such as this will aid in understanding the current needs and allocation of medical resources for Rugby-7s.

2354 Board #190 June 1 9:30 AM - 11:00 AM

### Perfectionist Concerns Predict Injury Risk In Collegiate Distance Runners - Preliminary Findings From A Prospective Study

Lace E. Luedke[1], Brian J. Wallace[1], Maya L. Puleo[1], Mitchell J. Rauh, FACSM[2]. [1]*University of Wisconsin - Oshkosh, Oshkosh, WI.* [2]*San Diego State University, San Diego, CA.* (Sponsor: Mitchell J Rauh, FACSM)

*(No relevant relationships reported)*

Distance runners have a high incidence of running-related injury (RRI). While anatomical, biomechanical, and training load have been associated with RRIs, psychological factors like perfectionism may also contribute to injury risk. Perfectionist strivings (high personal standards [PS]) can be adaptive, but perfectionist concerns (concerns over mistakes [COM]) and doubts about actions [DAA]) are considered maladaptive. The combination of high PS with high COM and DAA is considered unhealthy perfectionism and may increase a runner's risk of RRI. **PURPOSE:** To determine whether perfectionist concerns were associated with RRI occurrence in distance runners. We hypothesized that runners with higher PS and COM and/or DAA would have a higher incidence of RRI during the season. **METHODS:** Thirty-four NCAA Division III collegiate cross country runners (18 males, 16 females; mean age of 19.6±1.2 years; BMI of 20.6±1.8) completed the Sport Multidimensional Perfectionism Scale-2 (Sport-MPS-2) on the first day of their competitive season. Runners were followed prospectively during the first 8 weeks of their season for any RRIs resulting in limited or missed practices or competitions. Fifteen runners (44.1%) experienced a time loss RRI. Independent t-tests were used to compare mean differences of PS, COM and DAA scores between runners who experienced a RRI and runners without RRI. Odds ratios (OR) and 95% confidence intervals (CI) assessed the risk of RRI between runners with and without perfectionist concerns. **RESULTS:** Injured runners rated their COM higher (23.5±4.9 points) than uninjured runners (19.9±5.3 points) (p=0.05). Injured runners also rated their DAA higher (14.5±4.2 points) higher than uninjured runners (11.4±3.6 points) (p=0.03). Runners with perfectionist concerns (high PS and high COM and/or DAA) were 17 times more likely to experience a RRI during the season (OR=17.0, 95% CI 2.8-104.5, p=0.001). **CONCLUSIONS:** Runners reporting Sport-MPS-2 scores classifying them as having unhealthy perfectionism were more likely to incur a RRI than runners with lower Sport-MPS-2 scores. Further study is needed to determine whether interventions can modify perfectionist concerns and whether training load modifications for those with unhealthy perfectionism affect injury rates.

2355 Board #191 June 1 9:30 AM - 11:00 AM

### Video Corroboration Of Player Incurred Impacts Using Trunk Worn Sensors Among National Ice-hockey Team Members

Aaron Pilotti-Riley, Davor Stoyanov, Muhammad Sohaib Arif, Stephen J. McGregor. *Eastern Michigan University, Ypsilanti, MI.* (Sponsor: Mark Peterson, FACSM)

*(No relevant relationships reported)*

Wearable sensors (WS) have been increasingly used to quantify training loads in team sports but can also be used to identify impacts. Helmet worn sensors have been used to identify head impacts, but there is currently no data with regard to whole-body impacts incurred by players in ice hockey using trunk-worn sensors.
PURPOSE: To use video to corroborate impacts identified by trunk-worn WS and determine validity of player incurred impacts (PII) among elite national ice hockey team members.
METHODS: 23 players on the U.S. National Team Development Program (NTDP) U18 team consented to procedures approved by EMU Human Subjects Committee. Players wore a BH-3 (Zephyr, MD) WS to measure occurrences of PII during games. Of the 23 players, 8 with the top activity levels each game determined by WS, were observed using video. Game video was collected by NTDP staff and synchronized with accelerometer data. Previous pilot work determined only impacts of > 6 g were relevant, so, impacts identified by WS of 6 - 7.9 g (Z3), 8 - 9.9 g (Z4) and 10+ g (Z5) were used to corroborate PII. Magnitude and duration of each identified impact were compared by category using MANOVA with Tukey *post hoc* ($\alpha$= 0.05; SPSS 22.0, IBM, NY).
RESULTS: WS logged 419 on-ice impacts, 358 were confirmed true PII (85.5%), 60 were confirmed as other non-PII (14.3%) and 1 false positive (0.2%). For 358 PII, 17 (4.1%) were categorized as 1) Board contact/no check, 74 (17.7%) as 2) Board contact/check, 202 (48.2%) as 3) Open ice check, 65 (15.5%) as 4) Player fall. For the 60 Non-PII, 19 (4.5%) as 5) other form of player to player event, 16 (3.8%) as 6) Hard Stop, 19 (4.5%) as 7) Slapshots and 6 (1.4%) as 8) other identifiable player events. 140 of the 200 Z3 events were confirmed PII (80%), 103 of 110 Z4 events (93.6%) and 95 of 109 Z5 events were PII (92.2%). The magnitude of impacts was not different by category, but the duration of category 6 (Hard stop; .058 s) was lower than categories 2, 4 and 7 (.112, .112, .133 s, respectively, p<.05).
CONCLUSION: These data show that using some limited criteria (e.g. impact magnitude and duration), PII can be identified with relatively high accuracy in ice hockey using trunk-worn wearable sensors. Use of these devices should allow a more complete understanding of the whole-body impacts incurred by players participating in ice hockey.
Supported by USA Hockey Foundation

2356 Board #192 June 1 9:30 AM - 11:00 AM

### Pain and Overuse in High School Baseball Pitchers During a Season

Michael P. McNally[1], James A. Onate[1], Jingzhen G. Yang[2], Kevin E. Klingele[2], Ajit MW Chaudhari, FACSM[1]. [1]*Ohio State University College of Medicine, Columbus, OH.* [2]*Nationwide Children's Hospital, Columbus, OH.* (Sponsor: Ajit Chaudhari, FACSM)

*(No relevant relationships reported)*

Over half of adolescent baseball pitchers retrospectively recall throwing arm pain during a baseball season, leading to the institution of pitch count regulations across high school baseball; however, how pain varies throughout the season is unknown. PURPOSE: The purpose of this study was to determine the prevalence of pain and overuse symptoms occurring in high school baseball pitchers throughout a high school baseball season. METHODS: 97 pitchers were enrolled in the research study from eight central and southern Ohio high schools. Weekly surveys were sent via text message to assess overuse and pain using a validated questionnaire throughout the season (11 weeks). 44 of the 60 participants who met all inclusion criteria responded a minimum of 80% of the time and were included in the analysis. Descriptive statistics and prevalence of overuse and pain were calculated weekly throughout the season. RESULTS: The final participant pool maintained an average weekly completion rate of 91.8±0.2%. 34.8±7.9% of participants reported symptoms of overuse each week, with peak prevalence occurring in the 4th week of practice (45.5%), and trending downwards with 26.2% reporting overuse in the final week of the season. Prevalence of severe overuse, determined by a report of moderate or greater effect on training or performance, was low throughout the season (4.0±1.8%). Of those who did experience any symptom of overuse, the mean weekly overuse score was 22.0±3.1 out of 100 (mild overuse). Pain prevalence showed similar trends, with 28.5±7.6% of participants reporting pain during the season, with the peak occurring in week 4 of practice (40.9%), and trending down with 19.0% experiencing pain in the final week. The majority who experienced pain reported mild pain (81.3±7.1%), with few experiencing moderate pain (18.0±7.1%), and only one report of severe pain occurring in week 3. CONCLUSION: Prevalence of pain and overuse symptoms varies over the course of a high school baseball season, peaking within the first five weeks of the season, though most pain is mild. Further research is needed to determine whether increases in pain at this time are preceded by an initial period of chronic overuse or more acute changes in workload.

2357 Board #193 June 1 9:30 AM - 11:00 AM

### Evaluating Methods For Utilizing Time-loss Data In Sports Settings Using A Sample Of US Collegiate Soccer-related Injury Observations

Avinash S. Chandran, Angelo Elmi, Heather Young, Loretta DiPietro, FACSM. *The George Washington University, Washington DC, DC.* (Sponsor: Dr. Loretta DiPietro, FACSM)

*(No relevant relationships reported)*

Time-loss has featured heavily in assessments of sports-related injury severity, and has been helpful in identifying sport-specific injury severity patterns.
**PURPOSE:** To compare inferences from distinct approaches for conditional, multifactorial modeling of time-loss due to injury in sports settings.
**METHODS:** Data from the NCAA-ISS for the 2004/05-2013/14 years, were used for this analysis. For unadjusted analyses, time-loss was considered a count outcome, following a Poisson distribution with some underlying intensity $\lambda_j$. Time-loss was examined across categories of potential time-loss determinants, by assuming a distribution-free random effect that accounted for the heterogeneity introduced by latent 'injury severity.' Then, the random effect was incorporated into multifactorial Poisson models. A second approach was considered for building multifactorial models of time-loss, where time-loss was considered a continuous outcome and Accelerated Failure Time (AFT) models were built with frailties to capture latent 'injury severity.' Both approaches for regression modeling were used to derive conditional parameter estimates. **RESULTS:** In both modeling approaches, injury site, injury mechanism

and injury history had the strongest overall associations with time lost due to injury. The direction and magnitudes of conditional estimates obtained from both regression approaches were also comparable. For example, in the Poisson approach, time-loss due to a contact injury was significantly lower than time-loss due to a 'similarly severe' non-contact injury (Adj. TLR= 0.835, 95% CI= [0.787, 0.885]). Similarly, in the AFT approach, a non-contact injury seemed more (~17%) deleterious (in terms of time spent injured) than a 'similarly severe' contact injury ($\beta$= -0.1906, p<0.0001). Importantly, post-hoc residual analyses (for the Poisson approach), and examinations of AICs (for the AFT approach) revealed that the random-effects based models fit these time-loss data better than models with only fixed-effects. **CONCLUSIONS:** Although using time-loss as an indicator to define 'injury severity' may be justifiable, comparing time lost due to 'similarly severe' injuries to 2 different sites, or resultant of 2 different mechanisms using the approaches described here, may be more scientifically salient.

2358 Board #194 June 1 9:30 AM - 11:00 AM

### Perception about Running and Knee Joint Health among the Public and Healthcare Practitioners

Jean-Francois Esculier, Natasha M. Krowchuk, Linda L. Li, Jack E. Taunton, FACSM, Michael A. Hunt. *University of British Columbia, Vancouver, BC, Canada.* (Sponsor: Jack Taunton, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: There is conflicting evidence surrounding the effect of running on knee joint health, particularly as it relates to knee osteoarthritis (KOA). The perception about running and knee joint health could affect choices of activities, but remains undocumented in the population. Given the uncertainty in the literature, the objective of this study was to evaluate the perception of the public and healthcare practitioners (HCP) with respect to running and KOA.
**METHODS**: A total of 397 public respondents (mean age=53.1 years, 163 females; 79 non-runners [NRUN]; 318 runners [RUN]) and 176 HCP (mean age=39.2 years, 68 females) completed an online cross-sectional survey. The survey included multiple-choice questions about perceptions of running as it relates to knee joint health, and about the appropriateness of maintaining running by individuals with KOA. The HCP subgroup was also asked about clinical recommendations to runners with KOA. Proportions (agree, uncertain, disagree) were compared between subgroups using chi-squared tests.
**RESULTS**: In general, 11% of respondents perceived running as detrimental for knee joint health (NRUN=43.0%, RUN=5.0%, HCP=6.3%; $p$<0.001) while 21.1% were uncertain. Frequent running was perceived as a risk factor for KOA by 6.3% of respondents (NRUN=24.1%, RUN=2.2%, HCP=5.7%; $p$<0.001) and 26.5% were uncertain. Running long distances (marathons, ultra-marathons) was perceived by 15.5% as a risk factor (NRUN=32.9%, RUN=9.1%, HCP=19.3%; $p$<0.001), but 38.7% were uncertain. As for continuation of running in the presence of KOA, 14.7% of respondents agreed that it would lead to greater cartilage damage (NRUN=40.5%, RUN=10.2%, HCP=11.1%; $p$<0.001). However, 31.3% were uncertain about the appropriateness of running in the absence of symptoms (NRUN=34.2%, RUN=38.7%, HCP=16.4%; $p$<0.001). The subgroup of HCP reported having recommended to 76.1% and 30.7% of runners with KOA to modify training parameters and to quit running, respectively.
**CONCLUSION**: These results suggest that many non-runners perceive running as detrimental to knee joint health. High rates of uncertainty warrant further studies to guide the population and HCP about the appropriateness of running for individuals with KOA, as it may influence choices of physical activity and clinical recommendations.

2359 Board #195 June 1 9:30 AM - 11:00 AM

### Concussion and Mental Health among United States Service Academy Cadets

Jonathan C. Jackson[1], C. Dain Allred[1], Bonnie M. Anderson[1], Kevin J. Baldovich[1], Darren E. Campbell[1], Christopher J. D'Lauro[1], Megan N. Houston[2], Brian R. Johnson[1], Tim Kelly[2], Gerald T. McGinty[1], Kathryn L. O'Connor[3], Patrick G. O'Donnell[4], Karen Y. Peck[2], Joel B. Robb[1], Steven J. Svoboda[2], Michael F. Zupan[1], Paul Pasquina[5], Thomas McAllister[6], Michael McCrea[7], Steven P. Broglio, FACSM[3]. *[1]United States Air Force Academy, Colorado Springs, CO. [2]United States Military Academy, West Point, NY. [3]University of Michigan, Ann Arbor, MI. [4]United States Coast Guard Academy, New London, CT. [5]Uniformed Services University of the Health Sciences, Bethesda, MD. [6]Indiana University, Indianapolis, IN. [7]Medical College of Wisconsin, Milwaukee, WI.* (Sponsor: Steven P Broglio, FACSM)

*(No relevant relationships reported)*

**Purpose**: Few studies have evaluated the association between pre-participation psychological symptoms and concussion. The purpose of the current analysis was to evaluate the relationship between previous concussions, incident concussions, and Brief Symptom Inventory-18 (BSI-18) among U.S. military service academy cadets.
**Methods**: Data were analyzed from the Concussion Assessment, Research and Education (CARE) Consortium at three U.S. Service Academy sites. Between August 2014 and June 2017, 10,603 participants were enrolled and completed the BSI-18 assessing three psychological domains: somatization, depression, and anxiety. The total number of previous concussions (diagnosed or undiagnosed) was extracted from participant self-reports at baseline screening. Incident concussions were captured prospectively via the CARE protocol. Pearson correlations assessed associations between total number of prior concussions and BSI-18 scores. Analyses controlling for sex, age, service academy, previous concussions, and freshman status evaluated the association between baseline BSI-18 total score and odds of incident concussion.
**Results**: Total concussions and "diagnosed" prior concussions did not have a significant correlation with baseline BSI-18 scores. Statistical but not clinically significant correlations were observed between the total prior undiagnosed concussions and somatization ($r = 0.05$, $p < 0.01$), depression ($r = 0.05$, $p < 0.01$), anxiety ($r = 0.04$, $p < 0.01$), and total BSI-18 score($r = 0.06$, $p < 0.01$). While significant, each of the correlations are small. Multivariable analyses estimating the odds of incident concussion based on BSI-18 total score were significant ($X^2(7) = 271.68$; $p < 0.01$). BSI-18 total score was a significant estimator of incident concussion odds ($p = 0.02$) even after controlling for all covariates (all p's < 0.01). For each point increase in BSI-18 score, the odds for incident concussion increased 2% (OR = 1.02; 95% CI: 1.01-1.03).
**Conclusions**: Univariate analyses demonstrate a limited association between previous self-reported undiagnosed concussions and BSI-18 scores. Pre-participation BSI-18 scores may be predictive of subsequent concussion likelihood. These results highlight the interaction between the functional concussive and psychological health.

## E-36 Free Communication/Poster - Walking for Better Health

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2360 Board #196 June 1 9:30 AM - 11:00 AM

### Classification Accuracy Of A Moderate Intensity Cadence (steps/min) Threshold During Overground Walking

Zachary R. Gould[1], Elroy J. Aguiar[1], Scott W. Ducharme[1], Christopher C. Moore[1], John M. Schuna[2], Tiago V. Barreira[3], Stuart R. Chipkin[1], Catrine Tudor-Locke, FACSM[1]. *[1]University of Massachusetts Amherst, Amherst, MA. [2]Oregon State University, Corvalis, OR. [3]Syracuse University, Syracuse, NY.* (Sponsor: Dr. Catrine Tudor-Locke, FACSM)

*(No relevant relationships reported)*

A walking cadence of 100 steps/min has been established as a heuristic (evidence-based, rounded) threshold for absolutely defined moderate intensity (3 Metabolic Equivalents, METs). This threshold was calibrated during treadmill (TM) walking, however few studies have assessed its classification accuracy during overground (OG) walking. **PURPOSE:** To evaluate the classification accuracy of the 100 steps/min cadence threshold originally established during TM walking to OG walking.
**METHODS:** Participants (n=75, 50.7 % men, 21-40 years of age, mean±SD age:

30.3±5.8 years, BMI: 24.8±3.4 kg/m²) performed a 13 m overground corridor walk back and forth at a self-selected pace for 5-min. Cadence was hand-tallied and METs were obtained using indirect calorimetry. Receiver Operating Characteristic curves were used to determine the optimal OG cadence threshold associated with moderate intensity (Youden's index). Classification accuracies (counts and percentages for true positives and negatives, false positives and negatives) for the optimal OG and original TM heuristic (100 steps/min) thresholds were compared. **RESULTS:** Table 1 reports the classification accuracies of optimal OG and original TM heuristic cadence thresholds for identifying moderate intensity. The optimal OG threshold displayed an overall accuracy (i.e., correctly classified bouts; true positives and negatives) of 74.6%, compared to 73.3% for the TM heuristic threshold. The positive predictive value (i.e., probability of achieving ≥3 METs at ≥100 steps/min) was 80.3%. **CONCLUSION:** Optimal OG and original TM heuristic thresholds produced similar classification accuracies. The probability of achieving a moderate intensity when walking at a cadence ≥100 steps/min was >80%. The original TM heuristic (100 steps/min) threshold remains a valid heuristic threshold for achieving moderate intensity during overground walking.

Table 1: Classification accuracy of optimal OG and original TM heuristic cadence thresholds for corr

| | Cadence (steps/min) | True Negative | False Negative | True Positive | False Positive |
|---|---|---|---|---|---|
| Optimal OG | 103 | 10 (13.3%) | 11 (14.7%) | 46 (61.3%) | 8 (10.7%) |
| Heuristic (TM-based) | 100 | 6 (8.0%) | 8 (10.7%) | 49 (65.3%) | 12 (16.0%) |

2361 Board #197 June 1 9:30 AM - 11:00 AM

### Aerobic Physical Activity Does Not Mediate the Association of Neighborhood Walkability with Overweight/Obesity in Latino Adults

Rosenda Murillo, Layton M. Reesor, Daphne C. Hernandez, Ezemenari M. Obasi. *University of Houston, Houston, TX.*

*(No relevant relationships reported)*

**PURPOSE:** To examine whether aerobic physical activity mediates the association between neighborhood walkability and overweight/obesity among Latino adults. **METHODS:** We used cross-sectional 2015 National Health Interview Survey data on Latino participants 18 years of age and older (n=4,765). Neighborhood walkability was assessed based on self-reported measures of built environment (e.g., presence of sidewalks, presence of paths/trails) and neighborhood safety (e.g., presence of traffic, crime). A neighborhood walkability score was created by combining the built environment and neighborhood safety items, with a higher score indicating higher walkability. Self-reported height and weight were used calculate body mass index categories (overweight/obesity versus normal weight). Aerobic physical activity was measured continuously based on self-reported total minutes of moderate-to-vigorous aerobic activity per week. Multivariate logistic regression models, accounting for the complex survey design, were used to estimate the association between neighborhood walkability and overweight/obesity, with covariates adjusting for age, sex, education, and acculturation. Indirect effects were assessed using bootstrap methods outlined by Preacher and Hayes, to quantify the extent to which aerobic physical activity mediates the association of neighborhood walkability with overweight/obesity (BMI≥25 kg/m²). **RESULTS:** On average the sample was 44 years old, 56% were female, 36% had less than a high school education, and 58% were foreign-born. After adjusting for covariates, a one-unit higher neighborhood walkability score was associated with significantly lower odds of overweight/obesity (OR: 0.98; 95% CI: 0.93, 0.99), relative to normal weight. Results indicated that aerobic physical activity accounted for 0.7% of the total effect of neighborhood walkability on overweight/obesity among Latino adults, but was not significant ($p$=0.46). **CONCLUSION:** These findings suggest neighborhood walkability contributes to overweight/obesity among Latino adults. However, mediation results indicate aerobic physical activity does not account for the impact of neighborhood walkability on overweight/obesity, suggesting other factors may play a role.

2362 Board #198 June 1 9:30 AM - 11:00 AM

### Physical Activity Levels of Students Walking Shelter Dogs in anActivity Course: A Pilot Study

Melanie Sartore-Baldwin, Bhibha M. Das, Lacey Schwab, Katrina DuBose, FACSM. *East Carolina University, Greenville, NC.* (Sponsor: Katrina DuBose, FACSM)

*(No relevant relationships reported)*

While it is becoming less and less common for four-year colleges and universities to require physical activity courses as part of student curricula, many schools continue to offer elective physical activity courses. These elective courses are important given the benefits associated with physical activity and the low levels of physical activity found within the college student population. College and universities also stress the importance of community engagement within their courses, suggesting that addressing the physical activity needs of others, such as shelter dogs, within activity-based courses may benefit multiple entities.
**PURPOSE**: The purpose of this study was to assess the physical activity levels of students enrolled in a service-learning fitness walking course in which students walk local shelter dogs. **METHODS**: Ten college students (age = 20.8 years (SD = 1.23); 80% female; 90% White), enrolled in a fitness walking course that met at the county animal shelter, were asked to wear NL-1000 pedometers twice a week for 50 minutes for a duration of 10 weeks. Students will complete a survey about their experience at the end of the semester. **RESULTS**: Preliminary results indicate that, on average, students acquired approximately 4726.5 steps (SD = 299.14; range 2167-6212 steps) per walking session and walk an average of 2.26 miles (SD = .14; range 1.06-3.23 miles). Of the time spent on these walks, approximately 28.5 minutes (SD = 2.4; range 11.32-43.44 minutes) was moderate physical activity. **CONCLUSIONS**: Students enrolled in this course are currently reaching approximately 40% of their recommended daily physical activity requirements during class time. To date, student perceptions of the course have been overwhelmingly positive suggesting that incorporating shelter dogs into a physical activity elective course at a college or university can promote physical activity amongst college students. The local shelter dogs also benefitted from being physically active demonstrating the utility of community engagement when seeking new and fun ways to promote physical activity among college students.

2363 Board #199 June 1 9:30 AM - 11:00 AM

### The Effect ofa Web-based Physical Activity Promotion Program on Sedentary Behavior: The Walk 2.0 Trial

Gregory S. Kolt, FACSM[1], Tanya Wood[1], Mitch J. Duncan[2], Cristina M. Caperchione[3], Anthony J. Maeder[4], Richard R. Rosenkranz, FACSM[5], Trevor N. Savage[6], Anetta Van Italie[7], W Kerry Mummery[8], Corneel Vandelanotte[7], Emma S. George[1]. *[1]Western Sydney University, Sydney, Australia. [2]University of Newcastle, Newcastle, Australia. [3]University of British Columbia, Kelowna, BC, Canada. [4]Flinders University, Adelaide, Australia. [5]Kansas State University, Manhattan, KS. [6]Griffith University, Gold Coast, Australia. [7]Central Queensland University, Rockhampton, Australia. [8]University of Alberta, Edmonton, AB, Canada.*

*(No relevant relationships reported)*

Time spent engaging in sedentary behavior represents a growing public health concern, with many national physical activity guidelines now also including recommendations on reducing sedentary time. Sedentary behavior contributes to a range of poor health outcomes. Web-based interventions are increasingly used in health promotion given their broad reach and ability to engage participants through Web 2.0 technologies. The WALK 2.0 intervention (a Web 2.0-based physical activity intervention) has demonstrated effectiveness in increasing physical activity, yet its impact on sedentary behaviour is unknown. **PURPOSE**: To investigate the effectiveness of the WALK 2.0 intervention on sedentary behaviour. **METHODS**: Participants were 504 (328 female and 176 male, mean age 50.8±13.1 years) adults randomised to one of two web-based interventions or a paper-based Logbook group. Those in the Web 1.0 group participated in the existing 10,000 Steps program and those in the Web 2.0 group participated in a Web 2.0-enabled physical activity intervention that included social networking capabilities. Sedentary behaviour was assessed using ActiGraph GT3X activity monitors and was recorded in terms of total minutes of sedentary time per day and number of bouts (> 10 minutes) of sedentary time per day. **RESULTS**: For total daily minutes of sedentary behaviour, repeated measures analysis showed no significant group x time interactions in either the unadjusted model (p=0.46) or the model adjusted for gender, age at baseline, BMI, education, and accelerometer wear time (p=0.58). No significant group x time interactions were shown for daily bouts of sedentary time in either the unadjusted (p=0.21) or adjusted (p=0.21) models. There were no significant changes in total minutes or number of bouts of sedentary behaviour within groups or across time. **CONCLUSIONS**: The WALK 2.0 intervention is not effective in reducing sedentary behavior. Specific behavior strategies targeting both sedentary behaviour and physical activity are necessary and their implementation requires careful consideration in the design phase.

2364 Board #200 June 1 9:30 AM - 11:00 AM

### Effects of One Session of Treadmill Desk Walking on Free-Living Physical Activity

Rebecca R. Rogers, Erica Disbrow, Kendra Skenderi, John K. Petrella, FACSM, Mallory R. Marshall, Christopher G. Ballmann. *Samford University, Birmingham, AL.*

*(No relevant relationships reported)*

**PURPOSE**: Treadmill desks are being implemented in office and classroom settings to counteract long durations of sedentary behavior. The purpose of this study was to examine the effects of one treadmill desk walking session on daily physical activity patterns outside of work or school in healthy individuals.
**METHODS**: Male and female participants (age = 38 yrs ± 8.0, weight = 166.2 lbs ± 47.5, height = 62.0 in ± 71.5) were recruited for this study. To assess baseline free-living physical activity patterns, all participants wore an Actigraph GT9X link accelerometer for one week during waking hours. Participants completed one session of treadmill desk walking at a speed of 2.0 mph for a total of 3 hours. During the 3 hours, participants performed typical office or school related tasks. Physical activity patterns were then recorded via accelerometer for 2 additional days following the treadmill workstation bout.
**RESULTS**: Participants classified as "low active" (mean steps/day = 7368.0 steps ± 540.4) did not show a significant difference in average steps/day (p=0.190) or activity counts (p=0.204) between the 2 days prior and after the treadmill desk session. No significant differences in average steps/day (p=0.233) or activity counts (p=0.119) were observed pre and post treadmill desk session in participants classified as "somewhat active" to "active" (mean steps/day = 9538.5 steps ± 578.7) indicating there was no change in daily physical activity levels.
**CONCLUSIONS**: This study suggests that treadmill desk walking does not influence free-living physical activity regardless of activity classification.

2365 Board #201 June 1 9:30 AM - 11:00 AM

### Obesity and Walking Efficiency in Survivors of Acute Lymphoblastic Leukemia: Report from St. Jude Life

Matthew D. Wogksch, Carrie R. Howell, Robyn E. Partin, Heather Chambliss, FACSM, Hiroto Inaba, Ching-Hon Pui, Melissa M. Hudson, Leslie L. Robison, Kirsten K. Ness. *St. Jude Children's Research Hospital, Memphis, TN.*

*(No relevant relationships reported)*

Treatment for childhood acute lymphoblastic leukemia (ALL) is associated with an increased risk of being overweight/obese, having neuromusculoskeletal impairment and mobility limitations. Obesity may contribute to mobility limitations by increasing the physiologic cost/effort associated with movement.
**PURPOSE:** To evaluate associations between obesity and walking efficiency in adult survivors of childhood ALL. **METHODS**: ALL survivors (N=351, mean±SD age: 28.5±6.0 years, 51.6% male) and 342 age-, sex- and race-matched controls (N=342, 29.0±7.5 years, 51.2% male) were assessed for body mass index (BMI: kg/m$^2$), body fat percentage (%BF) using dual x-ray absorptiometry, and completed the six minute walk test. Walking efficiency was characterized with the physiological cost index (PCI). PCI is calculated using the formula: (Maximal heart rate (HR) during walking – HR at rest)/distance walked; expressed as beats per meter (normal range 0.13-0.49 in adults). **RESULTS:** ALL survivors with BMI ≥40 kg/m$^2$ had higher PCI values compared with normal weight survivors (0.63±.040 vs. 0.50±0.019, p<.01), adjusting for age, sex, physical activity, and cranial radiation exposure. ALL survivors with excess %BF (defined as > 25% for men and > 33% for women) also had higher PCI values compared to survivors with normal %BF (0.54±.013 vs. 0.47±0.017, p<.01). No associations between obesity and PCI were evident among controls.
**CONCLUSIONS:** Obesity is associated with reduced walking efficiency in ALL survivors but not in healthy controls, suggesting that ALL survivors do not have the same capacity to compensate for excess body weight as their peers with no cancer history. Weight loss interventions may have a significant impact on daily activity in this population.

2366 Board #202 June 1 9:30 AM - 11:00 AM

### Evaluation of Step Rate of Walking Corresponding to Moderate Intensity

Woo Ram Bae[1], So Mi Yun[1], Yun Bin Lee[1], Min Gi Jung[1], Da Hye Lim[1], Ah Reum Jung[1], Woong Hee Lee[1], Eun Jin Hwang[1], Ik Jin Kwon[2], Dae Taek Lee[1]. *[1]Kookmin University, Seoul, Korea, Republic of. [2]Chung-Ang University, Seoul, Korea, Republic of.*

*(No relevant relationships reported)*

**PURPOSE**: Walking at 100 steps per min is assumed to be the moderate exercise intensity in most cases. But it may not be universally accepted. This study evaluated how the overground walking at different step rates would elicit exercise intensities, and aimed to provide a cut-point of step rate which corresponds to a moderate walking intensity.
**METHODS**: Twenty-three young men (25±2 yrs, 175±6 cm, 76±14 kg) completed four overground walking trials. At the first trial, participants were asked to walk freely for 6-min at an intensity they felt moderate. Subsequently, they walked another 3 occasions for 6-min of each at 100, 120, and 140 beat/min while matching to a metronome beat. During the walking, oxygen consumption ($VO_2$), walking speed (WS), step rate (SR), and ratings of perceived exertion (RPE) were measured. On a separate occasion, their resting $VO_2$ and maximal aerobic capacity ($VO_2$max 41±6 ml·$O_2$/kg/min) on a treadmill using Bruce Protocol were measured.
**RESULTS**: The actual SR at free walking and 100, 120, and 140 beat/min was 117±9, 101±2, 120±1, and 138±4 step/min, respectively (p<0.01). SR they felt moderate during free walking was higher than 100 step/min (p<0.01). Based on the intensity parameters such as WS (4.9±0.5, 3.9±0.3, 5.2±0.4, and 6.4±0.5 km/h), %$VO_2$ reserve (31±8, 24±6, 33±9, and 45±9 %), and RPE (7.6±1.5, 7.4±1.5, 9.4±2.0, and 12.3±1.9 at free walking and, 100, 120, and 140 beat/min, respectively), the criteria of a moderate intensity of walking (100 step/min) was not satisfied. Regression analysis revealed that a cut-point of SR representing a moderate intensity (about 40%$VO_2$ reserve) was 128 step/min based on %$VO_2$ reserve, while it was 88.2 step/min based on metabolic equivalents. When grouped by aerobic fitness level, the less fit participant ($VO_2$max 32±3 ml·$O_2$/kg/min) met the moderate intensity at SR of 120 step/min while the more fit ($VO_2$max 50±2 ml·$O_2$/kg/min) did at 140 step/min.
**CONCLUSIONS**: Based on the relative intensity index (%$VO_2$ reserve), the cut-point corresponding to a moderate intensity was 128.9 step/min. But this estimation also has to be widened by the aerobic fitness level of the walkers. In general, approximately 120-140 step/min of overground walking can be considered as a moderate walking intensity for those of healthy population.

2367 Board #203 June 1 9:30 AM - 11:00 AM

### Process Evaluation of a Multi-Component "Sit Less, Walk More" Workplace Intervention for Office Workers

Yun-Ping Lin[1], Shu-Hua Lu[1], Wei-Fen Ma[1], Kwo-Chen Lee[1], Chiu-Chu Lin[2], Meei-Maan Chen[3]. *[1]China Medical University, Taichung, Taiwan. [2]Kaohsiung Medical University, Kaohsiung, Taiwan. [3]National Taipei University of Nursing and Health Sciences, Taipei, Taiwan.*

*(No relevant relationships reported)*

Sit Less, Walk More (SLWM) workplace intervention was designed for office workers with demonstrated efficacy in improving walking and some cardiometabolic biomarkers. However, little is known about the participants' perceptions of the program and each program component's contribution to observed program effects.
**PURPOSE:** To evaluate participants' perceptions of and engagement with the program components in the SLWM to understand program effects. **METHOD:** Process evaluation data were collected during and immediately after the 12-week intervention period. The SLWM included multi-components: three monthly newsletters, six biweekly motivational tools, a team-based 10,000 steps challenge, environmental prompts, and walking routes and resources. A survey contained both closed and open-ended questions assessing frequency of use and perceptions of program components; factors that hindered the use of program components; and recommendations for improving program components. Qualitative data were analyzed using content analysis. **RESULTS:** Fifty-one (100%) intervention participants completed the post-intervention survey. Their ages ranged from 30 to 62 (mean = 52.1, *SD* = 6.57). The majority of participants were married (92.2%) and highly educated (60.8% had a college or graduate degree). Most participants were satisfied with the SLWM program (84.3%) and thought the program to be beneficial (78.4%) and effective (74.5%) to them in increasing physical activity and decreasing sitting behavior. Participants reported the 10,000 steps challenge to be the most helpful component because of the motivation and encouragement elicited by the pedometer and Step Log (79.6%), goal setting (45.5%), and the use of the support group approach as well as rewards and recognition for group competition (29.6%). The walking route was not received well by the participants. The reasons for this included time constraints due to work or family obligations (54.1%), physical environment issues primarily due to weather (21.6%), and using their own preferred methods of exercise or walking routes (13.5%). **CONCLUSIONS:** The findings provide a better understanding of the use and preference for different program components and how future SLWM workplace intervention for office workers could be provided.
Supported by MOST Grant.

2368 Board #204 June 1 9:30 AM - 11:00 AM

### Application Of The ActiGraph GT9X IMU For The Assessment Of Turning During Walking And Running

Robert T. Marcotte[1], David R. Bassett, Jr, FACSM[2], Joshua T. Weinhandl[2], Scott E. Crouter, FACSM[2]. *[1]University of Massachusetts Amherst, Amherst, MA. [2]University of Tennessee Knoxville, Knoxville, TN.*

*(No relevant relationships reported)*

Rotational movements, such as turning, can significantly increase energy expenditure (EE) during ambulatory activity. Gyroscope and magnetometer sensors can quantify rotational motion, which provides additional information on movement beyond linear acceleration that is provided by only using an accelerometer. **PURPOSE**: The purpose of this study was to examine the use of the ActiGraph GT9X gyroscope and magnetometer for detecting turns and quantifying turn degree during walking and running. **METHODS:** Participants (N=17) completed pivot trials, treadmill walking and running (TM; 3 to 6 mph) and four turn conditions (i.e. 45°, 90°, 135°, and 180°) during over-ground walking and running (OG). Pivot and TM trials were completed for 1-min and 6-min, respectively. Turn frequency was constant (10 turns/min) for all OG trials. A GT9X was placed on the left hip and a Cosmed K4b$^2$ was used to measure EE. Raw GT9X gyroscope and magnetometer data were processed through various low-pass filter frequencies (0.25 Hz to 2.0 Hz). TM and pivot trials were used to develop thresholds for turn detection using the gyroscope and magnetometer data and the OG trials were used for cross-validation. K4b$^2$ data ($VO_2$) were averaged over 30-s periods and converted to relative $VO_2$ (ml/kg·min). Linear mixed models were used to compare actual and predicted number of turns, measured and predicted turn degree, and differences in $VO_2$ across OG conditions. **RESULTS:** There were no main effects for speed or turn condition on turn detection when filtering the gyroscope at 0.25 Hz ($p>0.05$). A speed main effect was present when filtering the magnetometer at 0.75 Hz ($p<0.001$). 0.25 Hz (gyroscope) and 0.75 Hz (magnetometer) filters resulted in 100.5%±4.4% and 96.9%±45.4% of turns detected, respectively. Using the gyroscope, turn degree was estimated to within approximately 2.2° for all turn conditions ($p<0.001$). In general, the $VO_2$ of walking and running was significantly greater during 135° and 180° turn conditions compared to 0-90° turn conditions ($p<0.05$). **CONCLUSION:** The GT9X gyroscope, when low-pass filtered at 0.25 Hz, can be used to detect the number of turns and estimate turn degree. The magnetometer was only useful for detecting the number of turns. Future work should explore the gyroscope use for turn detection during activities other than walking and running.

2369 Board #205 June 1 9:30 AM - 11:00 AM

### Peak Torque, Rate Of Velocity Development And Walking Performance: The Baltimore Longitudinal Study Of Aging

Yusuke Osawa, Stephanie A. Studenski, Luigi Ferrucci. *National Institute on Aging/ NIH, Baltimore, MD.*

*(No relevant relationships reported)*

**PURPOSE**: Efficiency of movements depends on both muscle strength and movement velocity. Men have higher muscle strength than women but whether strength and velocity contribute differently to walking performance in men and women remains unclear. Using data from the Baltimore Longitudinal Study of Aging, we investigated whether knee extension rate of velocity development (RVD) and peak torque differently contribute to walking performance measures in men and women. **METHODS**: We assessed the effect of sex on associations of RVD and peak torque with physical performance independent of demographics, body composition and subjective knee pain in 868 BLSA participants (48.2% women; aged 26 to 96 years; women, 64.1 ± 13.6 years; men, 68.6 ±14.4 years). We measured peak torque and RVD by isokinetic, concentric knee extension at 180 deg/sec. RVD was determined from the slope of the velocity-time relationship from the onset of movement to the time point that angular velocity first reached target velocity. Walking performance tests included gait speed during a 6m walk at usual and fast pace (6m-usual and fast) and during a 400m walk at fast pace (400m), and the distance covered in a 2.5-minute walk at normal pace (2.5min). Sex-specific generalized linear regression models were adjusted for age, race, body height, appendicular lean mass, whole body fat mass, and knee pain. A term testing whether the interaction between RVD and peak torque significantly improves the model fit was also included. **RESULTS**: In men, RVD was associated with 6m-usual ($p<0.0001$), while higher peak torque was significantly associated with better performances in 2.5min walk, 6m-fast, and 6m-fast ($p<0.05$). A significant interaction between RVD and peak torque was observed in 6m-usual ($p<0.0001$). In women, higher RVD was significantly associated with better performances in all measures independent of peak torque, and a significant interaction between RVD and peak torque was observed in all measures ($p<0.05$). **CONCLUSIONS**: RVD predicts walking performance in women but less in men. These results suggest that sex-specific strategies to accomplish motor tasks exist. Future studies are needed to identify the mechanisms underlying this sex difference.

2370 Board #206 June 1 9:30 AM - 11:00 AM

### Comparison of Physical Activity Levels of College Students after a Five Week Walking Class

Julio Morales. *Lamar University, Beaumont, TX.*

*(No relevant relationships reported)*

Physical Activity (PA) of college students has been the focus of much study because of its decline when students enter college. Efforts are consistently made to provide strategies to foment college students' engagement in PA**.** **PURPOSE**: To compare the level of PA of college students before and after participation in a walking class containing information on PA and exercise. **METHODS**: Participants in the study were sixty nine (25 males, 44 females; ages 19 to 26) college students enrolled in three different five week summer walking classes held during the same period over three different summers. Participants were administered the International Physical Activity Questionnaire-Short Form during the first and last class meeting to assess their leisure time physical activity. An experienced investigator read the questions and answered any questions during the administration of the questionnaire. He also made clear during the second administration that students should only report the PA done outside class. Walking (WMET), Moderate (MMET), Vigorous (VMET) and Total (TMET) METS levels were calculated following the IPAQ scoring guidelines. Paired samples t tests were conducted by gender for the pre and post administration for all MET levels. Independent samples t tests were conducted between genders to examine differences pre and post class. **RESULTS**:Females showed a significant increase in TMET form pre ($M = 5665.01$, $SD = 5580.14$) to post ($M = 8229.76$, $SD = 7121.46$), $t(31) = -2.21$, $p<.034$ (two tailed). In the gender post comparison, females had significantly higher MMET values ($M = 2584.38$, $SD = 3542.06$) than males ($M = 724.44$, $SD = 843.81$), $t(37 = 2.83$, $p <007$ (two tailed). **CONCLUSIONS**: Findings may suggest that there are possibilities for the use of content driven college activity courses could offer another avenue to foment participation in physical activity.

2371 Board #207 June 1 9:30 AM - 11:00 AM

### Association Between the National Walkability Index and Sidewalk Features

Kathleen B. Watson, Susan A. Carlson, Kristine Day, Janet E. Fulton, FACSM. *Centers for Disease Control and Prevention, Atlanta, GA.* (Sponsor: Janet E. Fulton, FACSM)

*(No relevant relationships reported)*

*Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities* calls on Americans to work together to increase walking and improve walkability. Well-connected, safe, and attractive sidewalks is one common feature of walkability. The Environmental Protection Agency National Walkability Index (NWI) provides a composite index of walkability at the block group level but does not include a direct measure of sidewalks. Knowing the associations between the NWI and sidewalk presence and quality may help assess the utility of the NWI to facilitate the planning of walkable communities. **PURPOSE** To determine the association between a nationwide geographic measure of walkability and features of sidewalks. **METHODS** We surveyed adults from 20 Community Transformation Grant sites. Respondents (n=20,918) reported on the presence of individual sidewalk features in their neighborhood (present; well maintained; separated from traffic by parked cars; separated from streets by grass/dirt strips). Sidewalk data were merged with the NWI - a nationwide geographic measure of walkability that encompasses density, land use mix, and proximity to transit. Associations of the NWI score with sidewalk presence and features were assessed by correlations and by comparing NWI mean scores by individual sidewalk features, tested with pairwise comparisons. **RESULTS** The correlation between the NWI and sidewalk presence was moderate (r=0.52) while correlations between NWI and individual sidewalk features were weak (r=0.04-0.19). Among adults who reported sidewalks present (73%), the mean (± standard deviation) NWI scores were higher ($p<0.05$) for those reporting (versus not reporting) sidewalks on most streets (11.6±0.1 vs. 9.6±0.1), well-maintained sidewalks (11.5±0.1 vs. 11.1±0.1), and sidewalks separated from traffic by parked cars (11.9±0.1 vs. 10.3±0.1). The NWI was lower ($p<0.05$) for sidewalks separated from street by grass/dirt (11.2±0.1 vs. 11.8±0.1). **CONCLUSIONS** The NWI was moderately associated with sidewalk presence; however, associations with individual sidewalk features were weak. The NWI may be not be useful to identify individual features of sidewalk quality or locations where sidewalks are lacking. Future studies may want to assess its utility to facilitate planning in other locations.

## E-37 Free Communication/Poster - Ergogenic Aids I - Proteins, Amino Acids, Peptides

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2372 Board #208 June 1 11:00 AM - 12:30 PM

### Creatine Hcl In Elite Gymnastic Athletes

Caroline Ayme Yoshioka[1], Renata Furlan Viebig[2], Paulo Carrara[3], Jeferson Oliveira Santana[1], Diana Madureira[1], Elias de França[1], Iris Callado Sanches[1], Erico Caperuto[1]. *[1]São Judas Tadeu University, São Paulo, Brazil. [2]Mackenzie Presbiterian University, São Paulo, Brazil. [3]São Paulo University, São Paulo, Brazil.*

*(No relevant relationships reported)*

**PURPOSE**: The objective of this study was to compare the effects of creatine HCl and monohydrate supplementation on performance and body composition markers in weight-dependent elite athletes.**METHODS**: Elite athletes from the Artistic Gymnastics Brazilian top team (11 males, 15 to 25 years old), were randomly divided into the randomized cross-over model into two conditions: Placebo (PG), Creatine Monohydrate Supplement (CMG) and Creatine HCl Supplement (HClG). In a 30-day period (Pre and Post), including experimental protocols and gymnastics training, variables related to body composition were measured (IN BODY Bioimpedance), maximum strength (1RM test), and RPE (Physical Self-Efficacy Scale (RPE)). **RESULTS**: The results showed that lean mass increased in both moments when intragroup values were compared (CMG Pre 53.81 ± 6.67 and Post 54.98 ± 6.28 p=0.000025; HClG Pre 54.81 ± 5.96 and Post 55.29 ± 6.07; p=0.002). Regarding fat percentage, creatine hydrochloride supplementation showed significant decrease (HClG Pre 5.28 ± 1.44 and Post 4.37 ± 1.32; p=0.0001). There were similar strength gains between the two supplements in the post-period (CMG Pre 93.09 ± 16.86 and Post 96.64 ± 16.20 p=0.00014; HClG Pre 96.91 ± 15.35 and Post 102.00 ± 14.94; p=0.0018). Finally, the psychophysiological analysis (RPE) showed changes in the athletes' perception regarding the training only at the end of the creatine hydrochloride period (HClG Pre 3.27 ± 0.90 and Post 2.18 ± 0.75; p=0.003). **CONCLUSIONS**: We concluded that both creatines were effective in relation to muscle mass gains (p<0.05), but only HCl creatine was able to promote body composition and self efficacy perception changes.

2373 Board #209 June 1 11:00 AM - 12:30 PM

### Preliminary Analysis - Moderating the Stress Perception of Collegiate Distance Runners Using Branched-Chain Amino Acids

Tara K. Whiton, Kimitake Sato, Asher Flynn, Joseph Walters, Caleb Bazyler, Michael H. Stone, Brad DeWeese. *East Tennessee State University, Johnson City, TN.*

*(No relevant relationships reported)*

Exercise-induced fatigue may be caused by increases in cerebral serotonin resulting in symptoms of central fatigue (i.e. decreased mood, and increased stress and sleepiness). Branched-chain amino acid (BCAA) supplementation is one intervention that can reduce symptoms of central fatigue by competing for the tryptophan transporter reducing serotonin synthesis. Psychological monitoring tools such as The Daily Analysis of Life Demands for Athletes (DALDA) Questionnaire can be used to study symptoms of central fatigue by identifying sources of general and sport-specific stress as well as an athlete's reaction to stressors. **PURPOSE:** To examine the response of BCAA on stress perception of trained collegiate distance runners using DALDA. **METHODS:** 8 collegiate distance runners (men n=4, women n=4) took BCAA supplement (SUP) (0.08g/kg) or placebo (PLA) daily for 6 weeks, alternating conditions week to week. Each morning athletes filled out the 34-item DALDA prior to training by selecting one of 3 answers corresponding to stress symptoms: A = "feel worse than normal", B= "feel normal", C= "feel better than normal". Response ratios were generated for each of the 3 answers for each condition (SUP or PLA) by taking total number of responses for each answer over number of answers overall. Response ratios were calculated as weekly mean ± SD and MANOVA was used for analysis. The alpha criterion was set to p<0.05. **RESULTS:** Statistical significance was found (p<0.01), and further analyses were done to examine changes from week to week. On average, athletes reported fewer 'A' responses in SUP weeks than PLA weeks (SUP: 9.27% ± 2.21%; PLA: 13.46% ± 7.29%), while response percentage for 'C' was the same between both conditions (SUP: 11.78 ± 2.12%; PLA: 11.24% ± 2.32%). Changes from SUP weeks to PLA weeks produced noticeable changes in 'A' responses (e.g.: 14.36% SUP week to PLA week; -9.95% from PLA week to SUP week). **CONCLUSIONS:** Results from DALDA revealed a noticeable change in the stress response of the athletes from condition to condition. The athletes reported higher instances of feeling "worse than normal" during PLA weeks and fewer instances of feeling "worse than normal" during SUP weeks. These results indicate that BCAA supplementation seems to be an effective means of reducing the stress perception in these collegiate distance runners.

2374 Board #210 June 1 11:00 AM - 12:30 PM

### Effect Of B-Hydroxy B-Methylbutyrate Supplementation On Sprint Kinetics Across A Collegiate Rugby Season

Jennifer M. Julian, Katy L. Hayes, Trisha A. VanDusseldorp, Garrett M. Hester, Yuri Feito, FACSM, Gerald T. Mangine. *Kennesaw State University, Kennesaw, GA.* (Sponsor: Dr. Yuri Feito, FACSM)

*(No relevant relationships reported)*

During a collegiate rugby season, players practice and compete for 1-2 hours on multiple days per week for 3-4 months per year. Practices and matches consist of multiple activities (e.g. sprinting, hitting, etc.) that could result in accumulated damage and affect performance. β-Hydroxy β-Methylbutyrate (HMB) is thought to speed protein synthesis which in turn could maintain performance. **PURPOSE:** To determine the effect of HMB supplementation on sprint kinetics throughout a rugby season. **METHODS**: In this cross-over design investigation, 13 collegiate male rugby players were assigned to consume one of two supplementation regimens: 5 g HMB + 5 g creatine per day (HMB) or 5 g creatine + 5 g placebo per day (PLB) for six weeks. During the fall season, players were matched for lean body mass and randomly assigned to HMB (n = 7; 21.1 ± 1.1 y; 88.2 ± 16.5 kg; 176.3 ± 7.9 cm) or PLB (n = 6; 21.5 ± 2.4 y; 88.8 ± 15.4 kg; 179.3 ± 5.2 cm). The supplementation regimen was switched for athletes who returned and completed the spring season (n = 7; 22.5 ± 1.3 y; 96.4 ± 14.7 kg; 179.6 ± 4.5 cm). Prior to and following each supplementation period (i.e., fall or spring), 40-m sprinting kinetics were assessed in all athletes while tethered to a robotic sprinting device. Peak ($_{PK}$) and mean sprinting power (P), force (F), and velocity were assessed against minimal (1 kg) and heavy (15 kg) resistance. Since only 7 of the original 13 athletes returned and completed the spring season, separate 2 × 2 repeated measures analyses of variance (RMANOVA) with Bonferroni adjustments were used to assess group differences in each variable during the fall, while a 2 × 4 RMANOVA was used to assess the cross-over sub-sample throughout the fall and spring. **RESULTS**: While no group differences were observed in sprint kinetics during the fall, a significant group × time interaction was observed for $P_{PK}$ at 1kg ($F = 4.85$, $p = 0.020$, $\eta^2_p = 0.55$) across the fall and spring seasons, where during the spring, $P_{PK}$ at 1kg decreased for $PLB_{SPRING}$ (-6.9 ± 1.2%, p = 0.020) but not for $HMB_{SPRING}$ (+7.5 ± 10.7%). No other differences were observed. **CONCLUSION**: Our data suggest a potential benefit from HMB supplementation for maintaining sprinting power in rugby players.

2375 Board #211 June 1 11:00 AM - 12:30 PM

### Effect Of β-hydroxy-β-methylbutyrate And Creatine Supplementation On Muscle Recovery In Elite Rowers As Measured By Anabolic And Catabolic Hormones.

Calleja-González Julio[1], Ana Martha Espinosa-Uribe[2], Juan Mielgo-Ayuso[2], Jeffrey Mjaanes, FACSM[3]. *[1]Faculty of Sports Sciences.University of the Basque Country, Vitoria, Spain. [2]Kaiarriba Donostiarra, San Sebastian, Spain. [3]Northwestern University, Chicago, IL.* (Sponsor: Dr. Jeffrey Mjaanes,MD, FACSM)

*(No relevant relationships reported)*

PURPOSE: The aim of the present study was to experimentally investigate the effect of supplementation with creatine (Cr) and / or β-hydroxymethyl-β-hydroxy (HMB) on muscle recovery in elite rowers using anabolic and catabolic hormones. The hypothesis was that supplementation with both HMB + Cr for 10 weeks would improve muscle recovery, as measured by testosterone and T/C ratio, to a greater degree than would each individual supplements alone.
METHODS:
Twenty-four elite rowers (27.0 ± 5.6 years) who participated in the 10-week non-placebo-controlled trial were randomized to one of the following 4 groups: GC: Control group; GCR: Group supplemented with Cr (0.04 g / kg / day); GHMB: Group supplemented with HMB (3 g / day); and, GCR + HMB (supplemented with the same doses as individual).
RESULTS:
There were significant differences in testosterone behavior, as well as in the Testosterone / Cortisol ratio (T/C) between groups. Higher testosterone levels were observed in GCR + HMB than in the others (p <0.05). A smaller decrease in the T / C ratio in the GCR + HMB than in the others was also observed (p <0.05).
CONCLUSIONS:
This study indicates that combined supplementation with Cr (0.04 mg / kg) together with β-hydroxymethyl-βutyrate (HMB) (3 g / kg) in elite rowers favors endogenous recovery through an increase in total testosterone and maintenance of the T / C ratio.

2376 Board #212 June 1 11:00 AM - 12:30 PM

### Effect of Preand Post-Exercise Creatine Supplementation on Bone Mineral in Aging Adults

Darren Glenn Candow, Sarah Johannsmeyer. *University of Regina, Regina, SK, Canada.*

*(No relevant relationships reported)*

**PURPOSE**: Creatine supplementation before and after resistance training may be an important strategy for increasing aging muscle health; however, it is unknown whether the timing of creatine ingestion influences aging bone health.
**METHODS**: Using a double-blind, repeated measures design, aging adults were randomized to one of two groups: Creatine-Before (CR-B: n=15; 53.2 ± 2.5 yrs, 170.1 ± 9.9 cm, 77.1 ± 15.6 kg; creatine [0.1g·kg$^{-1}$] immediately before resistance training and placebo [0.1g·kg$^{-1}$ corn-starch maltodextrin] immediately after resistance training) or Creatine-After (CR-A: n=12; 55.2 ± 3.5 yrs, 173.4 ± 8.2 cm, 86.8 ± 20.1 kg; placebo immediately before resistance training and creatine immediately after resistance training). Resistance training (11 exercises) was performed 3 days/week for 8 months. Prior to and following training and supplementation, bone mineral content (BMC) and density (BMD) of the whole-body, femoral neck, lumbar spine, and hip was measured by dual energy x-ray absorptiometry.
**RESULTS**: There was a time main effect (p=0.04) for femoral neck BMD (CR-B: pre 0.80 ± 0.11g, post 0.79 ± 0.11g; CR-A: pre 0.87 ± 0.15g, post 0.86 ± 0.13g) and a group x time interaction for hip BMD (p=0.02). Hip BMD was preserved in the CR-A group over time (pre 1.01 ± 0.15g/cm$^2$, post 1.01 ± 0.15g/cm$^2$) whereas the CR-B experienced a slight reduction (pre 0.98 ± 0.12g/cm$^2$, post 0.96 ± 0.12g/cm$^2$). There were no other differences (p>0.05).
**CONCLUSIONS**: Creatine supplementation immediately following resistance training helps preserve hip BMD. Creatine supplementation only on training days has no effect on bone mineral in aging adults.

2377 Board #213 June 1 11:00 AM - 12:30 PM

### No Impact of HMB Supplementation on Muscle or Strength Gains During an Undulating Periodized Resistance Training Program in Trained, Young Men

Josie S. Jakubowski[1], Edwin P. Wong[1], Everson A. Nunes[2], Josh Vandeweerd[1], Kenneth S. Noguchi[1], Kevin T. Murphy[1], Robert W. Morton[1], Steven K. Baker[1], Stuart M. Phillips, FACSM[1]. [1]*McMaster Univeristy, Hamilton, ON, Canada.* [2]*Federal University of Santa Catarina, Florianoplóis, SC, Brazil.* (Sponsor: Stuart Phillips, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: We examined the effect of whey protein enriched with leucine compared to whey protein plus calcium-β-hydroxy, β-methylbutyrate (HMB) on skeletal muscle strength, mass, and recovery during 12 weeks of an undulating periodized resistance training (RT) program in young men. **METHODS:** Twenty-six recreationally trained men (≥2x/wk RT, aged 23±2y, lean mass 63.0±7.2kg) performed 12 weeks of a 3-phase RT program. Participants underwent 8 weeks of undulating periodized RT (Phase 1), followed by a 2-week overreaching period (Phase 2), and a 2-week taper (Phase 3). During the 12-week RT program, participants were randomized to ingest: whey protein (25g) with added HMB (1.5g) (Whey+HMB;n=13) or whey protein (25g) with added leucine (1.5g) (Whey+LEU;n=13), twice daily. One-repetition maximum (1-RM) strength tests were conducted throughout Phase 1, Phase 2 and upon completion of Phase 3. Fat and bone-free mass (FBFM) was measured with dual-energy X-ray absorptiometry (DXA) scans at weeks 0,4,8,10,12. B-mode ultrasound was preformed to assess muscle thickness (MT) and cross sectional area (CSA) at weeks 0,8,12. Systemic hormone concentrations were measured at weeks 0,4,8,9,10,12. **RESULTS:** In response to RT, participants increased their 1-RM for squat, bench-press and deadlift (p≤ 0.01), with no significant differences between groups. FBFM increased similarly in Whey+HMB and Whey+LEU (2.3±1.2kg and 2.6±1.9kg, respectively; p=0.59). Following RT, *Vastus lateralis* MT increased by 5±6% and 5±6%, with no difference (p>0.05) between groups. Both groups exhibited comparable changes in CSA, Whey+HMB; 2.2±1.4cm2 (6±4% increase) and Whey+LEU; 2.3±1.4cm2 (7±4% increase). Following overreaching, both groups experienced similar changes (p>0.05) in 1-RM strength for squat (HMB 2±4%, LEU -1±5%) bench-press (HMB -1±4%, LEU -1±3%) and deadlift (HMB -2±5%, LEU -3±7%). Circulating creatine kinase and cortisol concentrations increased significantly (p≤0.05) from week 0 at phase 2, in both groups. There were no between-group differences in these blood markers during any phase of the study. **CONCLUSION:** These data demonstrate that there are no additional effects of Whey+HMB supplementation on muscle strength or size following 12 weeks of RT in young healthy men when compared to a leucine-fortified supplement Whey+LEU.

2378 Board #214 June 1 11:00 AM - 12:30 PM

### Body Composition And Muscular Performance Following 8-weeks Of Resistance-training And Protein Supplementation: Pilot Study

Matthew S. Stone, Michelle Gray, Austin Toups, Jordan Rezac, Dominique Blake, Jake Blalock. *University of Arkansas, Fayetteville, AR.*

*(No relevant relationships reported)*

Increased protein intake in the diet decreases fat mass (FM) and increases lean mass (LM). Resistance training increases LM, as well as increases muscular strength. Together, protein supplementation and resistance exercise work synergistically when taken prior to or following exercise. **PURPOSE**: The purpose of this pilot study was to investigate the effects 8 weeks of protein supplementation and Autoregulatory Progressive Resistance Exercise (APRE) training had on measures of body composition and muscular performance. **METHODS**: Untrained males ($n$ = 22; 42.1 ± 7.1 years) participated in this pilot study. LM and FM were measured via Dual Energy X-ray Absorptiometry (DEXA), while strength was measured utilizing one repetition maximum (1RM), and endurance measured using maximum repetitions completed (REPS) at 75% 1RM for the bench and leg press. Subjects were randomly placed into one of four groups: control (CON), protein (PO), APRE, or protein plus APRE (PAPRE). Subjects repeated testing for the DEXA, 1RM, and REPS every four weeks for 8 weeks. Both PO and PAPRE groups ingested 25g of supplemental protein twice daily. Subjects in the exercise groups completed a resistance training program, 3 days per week, for 8 weeks, or 24 training sessions. **RESULTS:** Repeated measures ANOVA indicated a significant group by time interaction for LM, bench press 1RM, and leg press 1RM ($p$ < .05). LM increased by 4% (+2.3 ± 0.2kg) in the PAPRE group, while increases in bench and leg press 1RM were 23% (+14.7 ± 0.7kg) and 50% (+132.1 ± 13.9 kg), respectively. There were no other group by time interactions for any of the variables assessed ($p$ > .05). LM ($p$ < .05), bench press 1RM ($p$ < .001), and leg press 1RM ($p$ < .001) indicated a significant time effect (+0.93 ± 0.02kg, +6.3 ± 0.9kg, and +68.2 ± 2.5kg, respectively). Body fat percentage showed a trend for decreasing over time ($p$ = .05), while FM was significantly reduced over the 8-week training period ($p$ < .05). Bench press increased 20% (+13.0 ± 2.0kg) from baseline for the APRE group, while leg press increased 13% (+32.9 ± 7.3kg), 18% (+43.1 ± 8.5kg), and 20% (+64.6 ± 28.8kg) for CON, PO, and APRE groups, respectively.
**CONCLUSION**: The synergistic effects of protein plus exercise can be seen with the PAPRE group out-performing all other groups given the significant increases in LM and muscular strength over 8 weeks.

2379 Board #215 June 1 11:00 AM - 12:30 PM

### Branched-chain Amino Acid Supplementation May Produce Marginal Reductions in Muscular Soreness in CollegiateDistance Runners

Asher Flynn, Tara Whiton, Kimitake Sato. *East Tennessee State University, Johnson City, TN.*

*(No relevant relationships reported)*

**Branched-chain Amino Acid Supplementation May Produce Marginal Reductions Muscular Soreness in Collegiate Distance Runners**
Asher Flynn, Tara Whiton, Kimitake Sato
East Tennessee State University
**INTRODUCTION:** A normal response to a rigorous training program is delayed onset muscle soreness (DOMS) often characterized by painful, tender, and swollen muscles with reduced range of motion and strength loss. These symptoms can take 24-48 hours to appear and dissipate within 5 to 7 days. Ingesting branched-chain amino acids (BCAA) has been shown to mitigate symptoms of DOMS by reducing muscle damage factors, sparing protein, and increasing muscle protein synthesis. **PURPOSE:** The purpose of this study was to investigate the influence of BCAA on perception of muscular soreness in collegiate distance runners. **METHODS:** 8 collegiate distance runners (men n=4, women n=4) took BCAA supplement (SUP) (0.08g/kg) or placebo (PLA) daily for 6 weeks, alternating conditions each week. Each morning prior to training, athletes filled out a 10-point scale Soreness Chart in which they rated soreness levels for each major muscle group on both anterior (ANT) and posterior (POST) body segments (1= no pain at all and 10= excruciating pain). Responses were totaled for each condition (SUP or PLA) and body segment (ANT or POST). After preliminary analyses for data, upper extremity data were excluded. Data were analyzed using paired-samples T-test to compare soreness levels between PLA and SUP weeks. **RESULTS:** Statistical significance ranged from p=0.09 – 0.89 depending on lower extremity segments. Based on descriptive analyses, athletes reported higher ratings of soreness in the ANT segment of the lower body. Overall soreness ratings were lower in SUP weeks vs PLA in both ANT and POST (SUP: ANT= 98.01% ± 34.86%; POST= 97.18% ± 39.72% and PLA: ANT= 108.52% ± 38.41%; POST = 110.32% ± 38.60%) but did not reach statistical significance. **CONCLUSION:** Although significance was not met, some note-worthy changes were captured. For instance, leg muscles, the primary movers involved in running, had a greater tendency to be less sore while

on the supplement. Since gains in athletic performance can often be marginal, it is possible that marginal reductions of DOMS can eventually lead to an improvement training experiences.

2380 Board #216 June 1 11:00 AM - 12:30 PM

### The Effects of Creatine Loading on Dynamic Balance, Mobility and Strength in Older Adults

Joseph Reale, John Petrizzo, John Wygand, FACSM, Melhaney Reichelt, Glen Reid, Robert M. Otto, FACSM. *Adelphi University, Garden City, NY.* (Sponsor: Robert M. Otto, FACSM)
*(No relevant relationships reported)*

Aging often attenuates balance and strength regardless of activity profile, thus resulting in an increased risk of falling. Older populations taking part in a resistance training program tend to minimize the loss of lean body mass, but still may suffer decrements. Creatine (Cr) supplementation has been studied extensively for almost 20 years and is a popular supplement of choice by athletes. Cr purportedly provides an enhancement of the phosphocreatine energy system allowing users to maintain a greater work intensity for an extended time. **Purpose:** To determine if acute Cr supplementation (20g of Cr/day for 5 days) improves balance, mobility, and strength in older adult populations. **Methods:** Ten subjects (age 64.4 ± 5.2 yr, ht. 168 ± 5.6 cm, body mass 76.3 ± 8.1 kg, 96) participated in familiarization trials conducted on the Biodex Balance SD [four conditions: normal stance w/ eyes open (NEO), N w/ eyes closed (NEC): and closed stance w/ eyes open (CEO), and C w/ eyes closed (CEC)], isokinetic knee extension (KE) and knee flexion (KF) peak torque (ft/lbs) and the Timed Up and Go Test (TUG) expressed in seconds. The battery of tests were conducted in the same sequence for each of the four assessments (pre control [PC], post control [PoC], pre Cr [PCr], and post Cr [PoCr]). Subjects were randomly assigned to 5 days of either 20 g of Cr or a matched placebo in a double blind protocol with a washout period of 14 days between treatments. Cr and placebo were indistinguishable in volume, taste, flavor, texture and color. **Results:** Statistical analysis by ANOVA revealed NSD (p>.05) between treatments.

| | KE | KF | TUG | NEO | NEC | CEO | CEC |
|---|---|---|---|---|---|---|---|
| PC | 30.3±20 | 47.1±22 | 8.8±1.5 | 15.9±24 | 40.0±83 | 27.7±30 | 83.7±114 |
| PoC | 30.2±17 | 61.6±43 | 8.2±1.1 | 11.5±15 | 21.9±33 | 23.1±30 | 68.6±99 |
| PCr | 30.5±14 | 64.7±34 | 8.2±1.2 | 23.9±26 | 46.3±79 | 46.4±38 | 102.6±90 |
| PoCr | 27.9±12 | 55.0±21 | 8.1±1.1 | 21.8±21 | 38.5±36 | 43.0±40 | 101.1±100 |

**Conclusion:** The acute use of Cr loading for individuals aged ≥60 was ineffective in altering muscular strength, balance or mobility for moderately active adults. It may require a longer period of loading or larger doses for creatine to be effective in older populations.

2381 Board #217 June 1 11:00 AM - 12:30 PM

### The Effect of Pre-sleep Protein Supplementation After Resistance Exercise on Next Day Performance and Recovery

Margaret Morrissey[1], Jaymie Donaldson[2], Andrew McKune[3], Michael Ormsbee, FACSM[1]. *[1]Florida State University, Tallahassee, FL. [2]University of KwaZulu-Natal, Durban 4000, South Africa. [3]University of Canberra, Bruce, Canberra ACT 2601, Australia.* (Sponsor: Michael Ormsbee, FACSM)
*(No relevant relationships reported)*

**PURPOSE:** To evaluate the effect of pre-sleep protein supplementation after an acute bout of resistance training on performance and post-exercise recovery the following day. **METHODS:** Eighteen athletic men performed a single bout of eight sets of eight repetitions of weighted barbell squats and weighted barbell chest press immediately followed by an exercise recovery drink (60g carbohydrate, 20g whey protein). The participants received either a pre-sleep protein supplement (PRO) containing 40g of casein protein (n=10; mean ± SD; age = 24.00 ± 3.86yrs; height = 1.81 ± 0.08m; weight = 84.91 ± 9.45kg) or a non-caloric, flavor matched placebo (PLA; n=8; age = 28.38 ± 9.97yrs; height = 1.81 ± 0.07m; weight = 86.68 ± 10.93kg) 30 min before sleep (1 hour after recovery drink). Blood samples were obtained at baseline (BL), pre- and post-exercise, prior to pre-sleep supplementation, and the following day to assess creatine kinase and C-reactive protein. Visual analog scales were utilized to assess perceived pain, hunger, and recovery. One-RM tests for bench and squat were performed at BL and the day following resistance exercise. Jump performance was assessed at BL, immediately post-exercise, and the day following resistance exercise. Statistical analyses were performed using SPSS (V.23) and $p \leq 0.05$ was considered statistically significant; values reported as mean ± SD. **RESULTS:** PRO reported significantly less hunger the following day compared to PLA, which represented a moderate and probably beneficial effect (PRO:4.21 ± 2.85, PLA: 6.94 ± 2.22; 95% C.I. = 0.1, 2.0; p=0.04; *d* = 1.1; 95% C.I. = 0.1, 2.0). Although perceived recovery was not significantly different (p=0.14), the effect of PRO was interpreted as moderate and possibly beneficial (PRO:7.36 ± 1.71, PLA: 5.76 ± 2.13; *d* = 0.8; 95% C.I.= -0.1, 1.8). There were no significant differences between groups in post-exercise recovery biomarkers or muscular performance assessments. Jump squat power was significantly higher in PLA immediately post exercise compared to PRO (29.7 ± 16.4 $W.kg^{-1}$, 22.9 ± 18.4 $W.kg^{-1}$, respectively; p=0.02). **CONCLUSIONS:** Pre-sleep protein supplementation after resistance exercise may improve perceived rate of recovery and hunger the following day with no effect on next day performance. This study was supported by Dymatize Nutrition.

2382 Board #218 June 1 11:00 AM - 12:30 PM

### The Effects Of Leucine-enriched Branched-chain Amino Acid Supplementation On Exercise-induced Muscle Damage

Gabriela Juache, Adam Osmond, Dean Directo, Michael Wong, Edward Jo. *Cal Poly Pomona, Pomona, CA.*
*(No relevant relationships reported)*

A significant degree of efficacy of branched-chain amino acid (BCAA) supplements in attenuating the symptoms of exercise-induced muscle damage (EIMD) and accelerating recovery from intense exercise have been demonstrated. Of the BCAA, leucine is evidently most contributory to the anabolic and anti-catabolic properties of BCAA in skeletal muscle. The speculation that supplementary leucine alone would likewise attenuate the symptoms of EIMD is within scientific reason. However, whether a leucine-enriched BCAA supplement (LBCAA) or a free-form leucine supplement (LEU) further attenuates EIMD when compared to a conventional BCAA supplement remains of significant debate. PURPOSE: To examine the effects of LBCAA and LEU supplementation on select markers of EIMD elicited by a bout of damaging exercise. MEHODS: Participants completed a bout of damaging eccentric-based resistance exercise (ECRE) following a 7-day supplementation period with either a conventional BCAA supplement (BCAA), LBCAA, or LEU. Muscle soreness, mean average power (MAP), mean peak power (MPP), lower body flexibility, and pressure-pain threshold were measured immediately before ECRE (0 hours) and at 24, 48, and 72 hours following ECRE. RESULTS: MAP (45 ± 56%, p=0.01) and MPP (41 ± 20%, p<0.05) decreased at 48 hours post-ECRE in LEU only. Additionally, at 48 hours post-ECRE, MPP in LEU was significantly lower than BCAA (41 ± 20% vs. 98 ± 15%, p=0.05). During resting conditions, LBCAA reported increased soreness from 0 to 48 hours post-ECRE (p<0.05), while LEU reported increased soreness from 0 to 24 hours post-ECRE (p<0.05), and BCAA exhibited no changes from 0 hours. During a contracted state, both LBCAA and LEU demonstrated increased soreness from 0 to 24 and 48 hours post-ECRE (p<0.05) while BCAA only exhibited an increase from 0 to 48 hours post-ECRE (p<0.05). All groups returned to baseline soreness levels at 72 hours post-ECRE. There were no other differences in lower body flexibility and pressure-pain threshold among supplementation groups. CONCLUSION: LBCAA and LEU failed to afford any discernible advantages to recovery from a bout of damaging exercise over BCAA.

2383 Board #219 June 1 11:00 AM - 12:30 PM

### BCAA Supplementation Improves Mental Performance Following a Soccer-Specific Conditioning Session

Beau K. Greer, Matthew S. Manzo. *Sacred Heart University, Fairfield, CT.*
*(No relevant relationships reported)*

The efficacy of branched-chain amino acid (BCAA) supplementation on exercise performance has been researched extensively, but influence on post-exercise mental performance remains understudied. **PURPOSE**: The present study sought to determine the efficacy of BCAA supplementation on cognitive and psychomotor performance after a high-intensity conditioning session, as well as on post-exercise rating of perceived exertion (RPE). **METHODS**: In a double-blind manner, 14 male Division I collegiate soccer players performed a smartphone-based Stroop test (EncephalApp) immediately before and after a conditioning-heavy, 80-minute soccer practice. Before and during practice, subjects ingested a water-based solution containing either BCAAs (SUPP; n=7) or an isocaloric amount of maltodextrin (PLAC; n=7) at fixed time intervals. The SUPP treatment beverage contained a total of 18 grams of BCAA, with a 3:1:1 ratio of leucine, isoleucine, and valine, respectively. Paired t-tests were used to assess within-group differences. Session RPE was assessed 30 minutes post-exercise, and between-group comparisons were made via a Mann-Whitney U test. **RESULTS**: Subjects in the SUPP group had significantly ($p < 0.05$) improved performance on the EncephalApp following exercise (11.1 ± 1.5 s) as compared to before exercise (13.4 ± 3.6 s). There was not a significant difference ($p > 0.05$) between pre-exercise (12.5 ± 2.2 s) and post-exercise (11.0 ± 1.4 s) performance in the PLAC group. No between-group difference was found for session RPE ($p > 0.05$). **CONCLUSIONS**: This evidence suggests that BCAA supplementation before and during exercise may improve certain aspects of post-exercise cognitive and psychomotor performance, but without influencing session RPE.

2384 Board #220 June 1 11:00 AM - 12:30 PM

### Effects of Creatine Monohydrate Timing Supplementation on Isometric Strength In Male College Soccer Players

Clara Yunnuen Rodriguez-Ramirez, Alejandro Gaytan-Gonzalez, Eduardo Pinedo-Ruan, Andrea Patricia Rohan-Lopez, Roberto Gabriel Gonzalez-Mendoza, Sayra Nataly Muñoz-Rodriguez, Ana Gabriela Gutierrez-Muñiz, Marisol Villegas-Balcazar, Juan R. Lopez-Taylor. *Universidad de Guadalajara, Guadalajara, Mexico.*

*(No relevant relationships reported)*

**PURPOSE**: To compare the effects of timing supplementation with creatine monohydrate in isometric strength in male college soccer players.
**METHODS**: Fifteen male college soccer players were supplemented with creatine monohydrate for 26 days with a load phase (5 days 20 g creatine/d) and a maintenance phase (21 days 5 g creatine/d). In the maintenance phase subjects were assigned, in a randomized and double blind form, to either consume 5 g of creatine before training and 5 g of maltodextrin after training (CRB) or 5 g of maltodextrin before training and 5 g of creatine after training (CRA) diluted in flavored water. At the same time a physical conditioning program was carried out (resistance training + soccer training 2 d/week; soccer training only 3 d/week). Before and after intervention, isometric strength in biceps, back, legs and forearms. were evaluated through dynamometry. Similarly, nutritional intake was evaluated (before and after) through 24-h dietary recalls. The strength and nutritional variables were compared by group (CRB vs CRA) and by time (PRE vs POST).
**RESULTS**: There were no significant differences in strength variables between groups at the beginning nor at the end of the study. However, CRB group had a significant increase in leg strength at the end of the study. The CRA group also had significant changes at the end of the study; an increase in back strength and leg strength were observed (Table 1). No other strength variable had significant changes. In the nutritional variables, there were no significant differences between groups at the beginning nor at the end of the study. Nonetheless, CRA group showed a significant decrease in energy and total protein intake (Table 1).
**CONCLUSIONS**: Both CRA and CRB showed similar strength gains in legs but CRA helped to increase strength in back, considering that energy and protein intake for players in CRA group decreased and they still had a significant increase in strength.

Table 1. Strength and nutritional variables compared by group (CRB vs CRA) and by time (PRE vs POST)

| | | PRE | | | POST | | | p CRB by time | p CRA by time |
|---|---|---|---|---|---|---|---|---|---|
| | | CRB | CRA | p group | CRB | CRA | p group | | |
| Strength | Biceps | 37 ±4 | 35 ±4 | 0.49 | 38 ±3 | 36 ±4 | 0.50 | 0.42 | 0.68 |
| | Back | 99 ±19 | 93 ±14 | 0.55 | 97 ±18 | 102 ±13 | 0.58 | 0.75 | 0.05 |
| | Legs | 85 ±16 | 85 ±12 | 0.88 | 104 ±17 | 100 ±7 | 0.60 | 0.04 | 0.02 |
| | Right forearm | 43 ±8 | 44 ±6 | 0.86 | 43 ±6 | 42 ±6 | 0.80 | 0.62 | 0.28 |
| | Left forearm | 42 ±7 | 40 ±7 | 0.73 | 41 ±6 | 39 ±6 | 0.31 | 0.68 | 0.72 |
| Nutrition | Kcal | 3312 ±1137 | 3541 ±783 | 0.65 | 2558 ±428 | 2793 ±813 | 0.51 | 0.10 | 0.02 |
| | CHO (g/day) | 479 ±181 | 443 ±86 | 0.64 | 359 ±85 | 345 ±79 | 0.73 | 0.09 | 0.07 |
| | Protein (g/day) | 94 ±41 | 123 ±60 | 0.65 | 64 ±19 | 95 ±64 | 0.86 | 0.55 | 0.05 |
| | Fat (g/day) | 155 ±57 | 167 ±46 | 0.26 | 135 ±41 | 132 ±32 | 0.23 | 0.07 | 0.10 |
| | CH (g/kg/day) | 7.1 ±3 | 6.6 ±2 | 0.69 | 5.4 ±2 | 5.0 ±1 | 0.68 | 0.10 | 0.10 |
| | Protein (g/kg/day) | 1.4 ±1 | 1.9 ±1 | 0.79 | 0.9 ±0.3 | 1.4 ±1 | 0.94 | 0.49 | 0.07 |
| | Fat (g/kg/day) | 2.3 ±1 | 2.5 ±1 | 0.33 | 2.0 ±0.5 | 1.9 ±1 | 0.56 | 0.07 | 0.10 |

2385 Board #221 June 1 11:00 AM - 12:30 PM

### Chronic (24 weeks) Beta-alanine Supplementation Does Not Affect Muscle Taurine Or Blood Clinical Chemistry

Bryan Saunders[1], Mariana Franchi[1], Luana F. Oliveira[1], Vitor S. Painelli[1], Vinicius E. Silva[1], Rafael P. Silva[1], Luiz A.R. Costa[1], Craig Sale, FACSM[2], Roger C. Harris[3], Hamilton Roschel[1], Guilherme G. Artioli[1], Bruno Gualano[1]. *[1]University of Sao Paulo, Sao Paulo, Brazil. [2]Nottingham Trent University, Nottingham, United Kingdom. [3]Junipa Ltd, Newmarket, United Kingdom.*

**Reported Relationships: B. Saunders:** *Salary; Natural Alternative Inc..*

**PURPOSE:** To investigate the effects of chronic beta-alanine (BA) supplementation on muscle taurine content, blood clinical markers and sensory side-effects.
**METHODS:** Twenty-five healthy male participants (age 27 ± 4 y, height 1.75 ± 0.09 m, body mass 78.9 ± 11.7 kg) were supplemented with 6.4 g·day$^{-1}$ of sustained release BA (N = 16; CarnoSyn™, NAI, USA) or placebo (PL; N = 9; maltodextrin) for 24 weeks. Muscle biopsies of the *m. vastus lateralis* were taken at 0, 12 and 24 weeks and analysed for taurine content using high-performance liquid chromatography. Resting venous blood samples were taken in the supine position every 4 weeks and analysed for markers of renal, hepatic and muscle function (aspartate transaminase; alanine aminotransferase; alkaline phosphatase; lactate dehydrogenase; albumin; globulin; creatinine; estimated glomerular filtration rate and creatine kinase). Data were analysed using mixed model ANOVA. **RESULTS:** There were no significant differences in taurine content at Week 0 (BA: 33.67 ± 8.18 mmol·kg$^{-1}$dm, PL: 27.75 ± 4.86 mmol·kg$^{-1}$dm; $p$ = 0.21). There was a significant main effect of group ($p$ = 0.04) on muscle taurine, with overall lower values in PL, although there was no main effect of time or interaction effect (both $p$ > 0.05; BA, Week 12: 35.93 ± 8.79 mmol·kg$^{-1}$dm and Week 24: 35.42 ± 6.16 mmol·kg$^{-1}$dm; PL, Week 12: 27.67 ± 4.75 mmol·kg$^{-1}$dm and Week 24: 31.99 ± 5.60 mmol·kg$^{-1}$dm). There was no effect of treatment, time or any interaction effects on any blood marker (all $p$ > 0.05) and no self-reported side effects in these participants throughout the study. **CONCLUSION:** The current study showed that twenty-four weeks of BA supplementation at 6.4 g·day$^{-1}$ did not affect muscle taurine content, clinical markers of renal, hepatic and muscle function, nor did it result in chronic sensory side-effects, in these healthy individuals. Since athletes are likely to engage in chronic supplementation, these data provide important evidence to suggest that supplementation with BA at these doses for up to 24 weeks do not adversely affect these markers in healthy individuals.

## E-38 Free Communication/Poster - Ergogenic Aids II - Beetroot and Nitrates

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2386 Board #222 June 1 11:00 AM - 12:30 PM

### Sucrose But Not Nitrate Ingestion Reduces High-intensity Exercise-induced Gut Injury

Kristin L. Jonvik[1], Kaatje Lenaerts[1], Joey SJ Smeets[1], Jeroen Kolkman[2], Luc JC van Loon[1], Lex B. Verdijk[1]. *[1]Maastricht University, Maastricht, Netherlands. [2]Medisch Spectrum Twente and University Medical Center, Groningen, Netherlands.*
(Sponsor: Professor Janice L Thompson, PhD, FACSM)

*(No relevant relationships reported)*

**Purpose:** During high-intensity exercise many athletes suffer from gastrointestinal (GI)complaints, which are likely related to splanchnic hypoperfusion, resulting in intestinal injury. Intestinal perfusion may be improved by increasing circulating nitric oxide (NO) levels or inducing postprandial hyperemia, potentially attenuating intestinal injury during exercise. Therefore we investigated the effects of both dietary nitrate and sucrose ingestion on splanchnic perfusion and intestinal injury induced by high-intensity exercise.
**Methods:** In a randomized cross-over manner, 16 well-trained male athletes (age: 28±7 y; $W_{max}$: 5.0±0.3 W·kg$^{-1}$) cycled 60 min at 70% $W_{max}$ following acute ingestion of: sodium nitrate (NIT; 800 mg $NO_3$), sucrose (SUC; 40 g) or water placebo (PLA). Splanchnic perfusion was assessed using gastric air tonometry. Plasma intestinal fatty-acid binding protein (I-FABP) concentrations, reflecting enterocyte damage, were assessed every 20 min during and up to 60 min post-exercise.
**Results:** The exercise protocol resulted in hypoperfusion, as $gap_{g-a}pCO_2$ levels increased during exercise ($P$<0.001), with no differences between treatments ($P$=0.47 for time x treatment interaction). Although plasma I-FABP concentrations increased during and post-exercise for all treatments ($P$<0.001), the increase was attenuated following SUC ($P$=0.007 for time x treatment interaction). In accordance, total I-FABP

area under curve (AUC) tended to be different between treatments ($P$=0.061), and I-FABP AUC was significantly different in the post-exercise period ($P$=0.006). Post hoc testing showed significantly lower I-FABP AUC in SUC vs PLA (1096±2182% vs 3900±3731%, $P$=0.022). No differences were observed between NIT and PLA ($P$=1.0). **Conclusions:** Sucrose but not nitrate ingestion lowers gut injury evoked during high-intensity exercise. These results suggest that sucrose, but not nitrate, may prevent hypoperfusion-induced GI damage during exercise and, as such, may prevent or lower exercise-related GI complaints.
*Supported by a grant from the Dutch Technology Foundation STW*

2387 Board #223 June 1 11:00 AM - 12:30 PM

**The Effect Of Nitrate Supplementation Through Powdered Beetroot Juice In Endurance Athletes Over The Time Required To Complete A 10-km Bicycle Time-trial.**

Alexia Wiegandt Rohde. *Universidad Iberoamericana Mexico City, Mexico City, Mexico.*
*(No relevant relationships reported)*

It has been found that nitrate supplementation in the diet of athletes may have ergogenic effects, such as a decrease in the cost of oxygen when exercising at low or moderate intensity. Significant improvement has also been observed in the results of several time trials or incremental exercise tests after nitrate supplementation. Nitrate supplementation is achieved through beetroot consumption, since it is one of the nitrate-richest foods, containing over 250 mg. of nitrate per 100 g gross weight. **PURPOSE**: Analyze if a group of amateur endurance athletes reduce their time to complete a 10Km time-trial on a stationary bicycle after a 5-day supplementation period with powdered beetroot juice.
**METHODS**: Amateur runners, cyclists and triathletes who participate regularly in sports events in any of the disciplines mentioned before participated in this study. Two tests were performed, the subjects arrived at the laboratory having taken the last dose of either placebo or supplement 2 hours earlier. This supplement should have been taken daily during the previous four days. After remaining seated for 10 minutes blood pressure and cardiac rhythm was be measured. A 10 kilometer time-trial on the stationary bicycle was performed, during which oxygen volume, cardiac rhythm and pedaling power was measured. Subjects were asked periodically at what level in the Scale of Perceived Exertion they felt to be. At the end the time taken for their cardiac frequency to be restored to its initial value was measured. **RESULTS**: Participants were able to increase their power significantly after supplementation with beetroot juice powder 159.2 (27,3-287.3) Watts, as compared to the placebo 130.85 (26.7-260.3) Watts (p=0.041). A significant reduction of approximately 56 (15:12-22:34) seconds was also achieved in the time the participants required to cover 10 Km on the stationary bicycle (p=0.41).
**CONCLUSIONS**: Beetroot juice in powder or liquid form may improve athlete's performance, since it increases considerably the power that may be exerted during a sub maximal exercise test, such as that of 10 Km by bicycle. It still remains to be determined whether these effects are consistent with those in professional athletes, since there are no studies to prove it, and whether these effects are just as efficient in longer distances.

2388 Board #224 June 1 11:00 AM - 12:30 PM

**The Effects of Beetroot Juice Supplementation on Cycling Time-Trial Performance in Normoxia and Moderate Hypoxia**

Samantha Fessler. *East Stroudsburg University, East Stroudsburg, PA.* (Sponsor: Shala Davis, FACSM)
*(No relevant relationships reported)*

Recent research has shown that Beetroot Juice (BR) ingestion assists in Nitric Oxide (NO) production and may increase exercise efficiency, decrease muscular fatigue, increase mitochondrial respiration, increase calcium handling, elevate glucose uptake, and aid vasodilatation. Also, given evidence for the detrimental effects of environmental hypoxia on exercise due to decreases in partial pressure of arterial oxygen ($P_aO_2$), as well as hypoxia-induced reductions in NO, increases in NO production via dietary nitrate supplementation may serve to enhance performance in hypoxia. **PURPOSE:** To investigate the effects of 3 day supplementation of beetroot juice on oxygen consumption ($VO_2$), arterial oxygen saturation ($SpO_2$), and average workload (W) during 15 minute time trial (TT) in both normoxic and simulated hypoxic ($F_IO_2$ = 15.3%) conditions in active males, aged 18-24. **METHODS:** Ten recreationally active healthy males participated in the study. Subjects were assigned in a double-blind randomized, crossover design consuming 140 mL of beetroot juice (2 shots) containing ~8.4mmol of nitrate ($NO_3$-) and nitrate depleted placebo (PL) for 2 days prior to testing and 2.5 hours prior to testing in both normoxic and hypoxic conditions. A 72 hour washout was utilized during the crossover. Prior to testing all subjects completed a maximal effort protocol to determine Maximal Power Output ($W_{max}$).During testing, subjects completed a 5 minute warmup, a 15 minute steady state normoxic preload at 50% $W_{max}$, and finished with a 15 minute cycling time trial (TT) at 70% $W_{max}$, in either normoxia or simulated hypoxia ($F_IO_2$=15.3% $O_2$). **RESULTS:** No significant difference was found for BR vs PL group by condition in mean workload (164.5±20.7 vs. 166.5±18.7 watts in normoxia and 162.6±13.9 vs. 161.0±22.1 watts in hypoxia, p=.769). **CONCLUSION:** The present research found no significant differences in average workloads during a 15 minute cycling TT performed in either normoxia or moderate simulated hypoxia after chronic supplementation of beetroot juice (140 mL X 3 days) vs. placebo. A 3-day chronic dosing protocol of 8.4 mmol $NO_3$- per day in the form of BR may not be beneficial to athletes competing in cycling time trials of ~15 minutes in duration at either sea level, or following acute altitude exposure at ~2500m.

2389 Board #225 June 1 11:00 AM - 12:30 PM

**Effect Of Inorganic Nitrate Supplementation On $O_2$ Uptake And Quadriceps Deoxygenation During The Onset And Offset Of Exercise.**

Brynmor Breese[1], David Poole, FACSM[2], Dai Okushima[3], Stephen Bailey[4], Andrew Jones, FACSM[5], Narihiko Kondo[6], Tatsuro Amano[7], Shunsaku Koga[3]. *[1]Plymouth University, Plymouth, United Kingdom. [2]Kansas State University, Manhattan, KS. [3]Kobe Design University, Kobe, Japan. [4]Loughborough University, Loughborough, United Kingdom. [5]Exeter University, Exeter, United Kingdom. [6]Kobe University, Kobe, Japan. [7]Niigata University, Niigata, Japan.*
*(No relevant relationships reported)*

**PURPOSE**: To investigate the effect of inorganic nitrate ($NO_3$-) supplementation on $O_2$ uptake ($VO_2$) and deoxyhemoglobin/myoglobin (i.e. deoxy-[Hb + Mb]) kinetics at contrasting muscle depths during the onset and offset of submaximal cycle exercise.
**METHODS**: In a randomized, cross-over study, eight males completed step cycle tests at a work rate equivalent to 50% of the difference (Δ) between the gas exchange threshold and peak $VO_2$ over 4-day supplementation periods with $NO_3$-rich beetroot juice (BR; providing 8.4 mmol $NO_3$-·day$^{-1}$) and $NO_3$-depleted (placebo; PLA) beetroot juice. Pulmonary $VO_2$ was measured and absolute deoxy-[Hb + Mb] was determined in the superficial and deep vastus lateralis (i.e. VL-s and VL-d, respectively).
**RESULTS**: Whereas primary $VO_2$ kinetics (i.e. on versus off) were symmetrical, the primary deoxy-[Hb + Mb] mean response time ($MRT_p$) slowed within the VL-s during the off- compared to on- transient ($P < 0.05$). There were no significant differences ($P > 0.05$) between the PLA and BR trials in the deoxy-[Hb + Mb] $MRT_p$ within the VL-s at exercise onset (PLA: 21 ± 5 vs. BR: 22 ± 5 s) or offset (PLA: 32 ± 4 vs. BR: 32 ± 9 s). Likewise, whilst the primary deoxy-[Hb + Mb] amplitude was asymmetrical within the VL-d (i.e. off > on, $P < 0.05$), there were no significant differences ($P > 0.05$) between supplement conditions at exercise onset (PLA: 27 ± 34 vs. BR: 16 ± 20 μM) or offset (PLA: 37 ± 44 vs. BR: 24 ± 26 μM).
**CONCLUSIONS**: Dietary $NO_3$- supplementation does not affect the dynamic asymmetry of muscle deoxy-[Hb + Mb] kinetics (and by extension the matching between $O_2$ delivery to $O_2$ utilization) within deep and superficial sites during intense submaximal exercise.

2390 Board #226 June 1 11:00 AM - 12:30 PM

**Beetroot Juice Supplementation Lowers Oxygen Cost of Vigorous Intensity Aerobic Exercise in Trained Endurance Athletes**

Ryan E. Fiddler[1], Erik Lind[1], Nathaniel S. Ashton[1], Joanna L. Fiddler[2]. *[1]SUNY-Cortland, Cortland, NY. [2]Cornell University, Ithaca, NY.*
*(No relevant relationships reported)*

Nitric oxide (NO) plays a critical role in regulating blood flow to skeletal muscle. NO production in humans is 1) oxygen-dependent via NO-synthases that convert L-arginine to NO and 2) oxygen-independent via the nitrate-nitrite-NO pathway. The latter can be augmented via beetroot juice supplementation (BR). **Purpose**: The purpose of this study was to investigate the effect of BR during vigorous intensity aerobic exercise. **Methods**: Using a double-blind, repeated measures crossover design, 11 Division III collegiate distance runners (mean ± SD: age = 20.3 ± 1.1 yr; $VO_2$peak = 55.5 ± 8.1 ml·kg$^{-1}$·min$^{-1}$) consumed either 120 mL·day$^{-1}$ of BR or placebo (PL) for 4 days. On day 5 of each 4-day supplementation period, subjects completed an exercise trial on a motorized treadmill consisting of five minutes of running at 65%, 85%, and 100% of volume of oxygen uptake reserve ($VO_2R$) separated by 2 minutes each. BR and PL supplementation protocols were separated by a 7-day washout period. Two-way repeated measures ANOVAs were used to determine the effect of treatment (BR or PL) and exercise intensity (65%, 85%, and 100% $VO_2R$) on $VO_2$, heart rate (HR), respiratory exchange ratio (RER), and rating of perceived exertion (RPE).
**Results**: There were no statistically significant interactions between treatment and exercise intensity for $VO_2$, HR, RER, or RPE. The main effect of treatment was not statistically significant for HR, $F(1, 10) = 0.514$, $p = 0.490$; RER, $F(1, 9) = 0.590$, $p = 0.462$; or RPE $F(1, 10) = 0.562$, $p = 0.471$. However, the main effect of treatment was statistically significant for $VO_2$, where BR (2.43±0.18 L·min$^{-1}$) was lower compared

to PL (2.49±0.17 L·min$^{-1}$), $p$ = 0.029. **Conclusions**: These results suggest that a 4-day protocol of 120 mL·day$^{-1}$ of BR reduces $VO_2$ during vigorous intensity aerobic exercise in trained endurance athletes.

2391 Board #227 June 1 11:00 AM - 12:30 PM

### Acute Dietary Nitrate Supplementation has no Significant Effect on Wasted Left Ventricular Energy in Young Healthy Individuals

Jozelyn Rascon[1], Francisco J. Morales[1], Brycen J. Ratcliffe[2], Caleb D. Harrison[2], Evan J. Bockover[2], Sierra Crowe[2], Colin R. Carriker[3], Alvaro N. Gurovich, FACSM[1]. *[1]The University of Texas at El Paso, El Paso, TX. [2]Indiana State University, Terre Haute, IN. [3]High Point University, High Point, NC.*

*(No relevant relationships reported)*

Cardiovascular disease is the leading cause of death worldwide and is associated with low levels of Nitric Oxide (NO) bioavailability. NO is a vascular protective agent, which bioavailability could increase through dietary nitrate supplementation. Wasted left ventricular energy (LVEw) represents the added workload the ventricle must produce during the duration of the reflecting pressure wave within a cardiac cycle. This energy is wasted because there is no blood flow gain produced by the extra work being exerted by the ventricle. LVEw is associated with arterial stiffness, left ventricular hypertrophy, and refractory angina syndrome. Higher levels of NO are associated with lower cardiovascular disease risks. Therefore, an increase in NO through dietary nitrates might reduce LVEw.
**Purpose:** To determine the response of an acute dietary nitrate supplement in LVEw via noninvasive pulse wave analysis (PWA).
**Methods:** A double-blind, cross-over study design was performed in 17 young, healthy subjects (18 to 24 years old). Four lab visits were schedule within 10 days; the first 2 visits in back to back days and the last 2 visits one week after. Subjects were asked to follow a low-nitrate diet for 3 days (NHLBI: 7 East Low-Nitrate Diet), starting two days prior to the first and third lab visits. Two hours before visits 2 and 4, subjects were asked to drink 800 mg of nitrate or placebo (solutions randomly assigned). LVEw was calculated using LVEw =((π/4) x (Ps-Pi) x (ED - ΔTp) x 1.333) where ED is ejection duration, Ps and Pi represent central systolic pressure and the central incident pressure from reflecting pressure wave, respectively, and ΔTp is the round trip travel time of the reflecting pressure wave. PWA was measured non-invasively with a cuff-based PWA device (SphygmoCor Xcel®). A two-way repeated measurements ANOVA (time x sex) was performed and significance was set at alpha=0.05.
**Results:** LVEw ranged from 736 ± 644 dyne•s•cm$^{-2}$ at baseline in males to 997 ± 917 dyne•s•cm$^{-2}$ after placebo, also in males and there was no significant interaction (time x sex).
**Conclusions:** These results show that an acute dose of dietary nitrate supplement has no effect on LVEw in young healthy individuals. Further studies including the elderly or patients with hypertension should be performed to assess more clinical effects of dietary nitrates.

2392 Board #228 June 1 11:00 AM - 12:30 PM

### Changes in Oxidative Stress and Resting Metabolic Rate after Acute Dietary Nitrate Supplementation

Brycen J. Ratcliffe[1], Caleb D. Harrison[1], Evan J. Bockover[1], Sierra Crowe[1], Alberto Friedmann[1], Francisco J. Morales[2], Colin R. Carriker[3], Alvaro N. Gurovich, FACSM[2]. *[1]Indiana State University, Terre Haute, IN. [2]The University of Texas at El Paso, El Paso, TX. [3]High Point University, High Point, NC.*

*(No relevant relationships reported)*

**BACKGROUND:** Cardiovascular disease is the leading cause of preventable death in the United States and the Western world. A major component of cardiovascular disease is the deterioration of the cardiovascular system by increased oxidative stress. Dietary nitrate supplementation could increase nitric oxide bioavailability, decreasing oxidative stress.
**PURPOSE:** The purpose of the present study is twofold: 1) to determine the impact of an acute dietary nitrate supplementation on oxidative stress and 2) to assess the oxygen dependent nature of a dietary nitrate supplementation.
**METHODS:** Eighteen (7 females and 11 males) apparently healthy subjects, aged 18-30 years of age, participated in a randomized, double blind, placebo-controlled crossover study. Following a 12-hour fast and adherence to an NIH-approved low-nitrate diet for 48 hours, subjects visited the lab on 4 occasions (identical procedures) within 2 weeks. A resting blood draw preceded 15 minutes of supine rest followed by a 20-minute period of metabolic gas analysis for determination of resting metabolic rate; RMR (True One, ParvoMedics, Sandy, Utah, USA). Visits 2 and 4 served as baseline controls for the placebo or dietary nitrate treatments (negligible and 800mg nitrate, respectively) which were consumed 2.5 hours prior to visits 3 and 5. The resting concentration of the oxidative stress marker 8-isoprostane (8-ISO) was determined by ELISA testing using a commercial available kit (Cayman Chemical, USA). A 2-way repeated measures ANOVA was used to determine differences between protocols and over time, with an alpha of 0.05.
**RESULTS:** There was no significant difference between placebo and dietary nitrate supplementation in oxidative stress (Placebo: 158±59 vs. 181±62 pg/ml; Active: 176±74 vs. 171±59 pg/ml, p=0.84) or in RMR (Placebo: 1839±308 vs. 1790±307 kcal/day; Active: 1828±318 vs. 1859±324 kcal/day, p=0.20).
**CONCLUSION:** These data showed that acute dietary nitrate supplementation does not decrease resting oxidative stress. The conversion of nitrate to nitrite to nitric oxide has been previously described to be oxygen-independent. Our data supported this statement, as RMR did not change following the dietary nitrate supplementation.

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### Effect of Increased Nitric Oxide Bioavailability on Endothelial Function and Pulse Wave Velocity

Evan J. Bockover[1], Sierra Crowe[1], Brycen J. Ratcliffe[1], Caleb D. Harrison[1], Alberto Friedmann[1], Francisco J. Morales[2], Colin R. Carriker[3], Alvaro N. Gurovich, FACSM[2]. *[1]Indiana State University, Terre Haute, IN. [2]The University of Texas at El Paso, El Paso, TX. [3]High Point University, High Point, NC.*

*(No relevant relationships reported)*

**BACKGROUND:** Dietary nitrate supplementation is believed to increase the long-term bioavailability of nitric oxide (NO) within the body. This increase in NO bioavailability should lead to a decrease in arterial stiffness and an increase in endothelial function due to the vasodilator characteristics of NO.
**PURPOSE:** The purpose of this experiment was to evaluate whether an increased NO bioavailability, achieved through dietary nitrate supplementation, improves pulse wave velocity (PWV) and flow-mediated dilation (FMD).
**METHODS:** In a randomized double blind, placebo-controlled crossover design, eighteen (7 females, 11 males) apparently healthy subjects aged 18-30 years old visited the lab 4 times within 2 weeks. All subjects were required to fast for 10 to 12 hours prior to testing and each visit consisted of a resting blood draw followed by peripheral blood pressure acquisition, PWV and assessment of brachial FMD. Visits 2 and 4 (separated by a 1-week washout) were baseline controls and, 24 hours after, on visits 3 and 5 participants consumed a concentrate nitrate beverage or placebo (800mg and negligible nitrate, respectively) 2.5 hours prior to testing. Plasma nitrate/nitrite (NOx) concentration was determine by ELISA testing using a commercially available kit (Cayman, USA). A 2-way repeated measures ANOVA was used to determine differences between conditions and over time, with an alpha of 0.05.
**RESULTS:** There was an acute increase in NOx concentration after dietary nitrate supplementation compared to the baseline control (1.2±1.3 vs. 27.1±10.8 µmol/l, p<0.01) while no difference was seen following consumption of the placebo: 1.7±1.5 vs. 1.7±1.1 µmol/l, p=0.311). No changes were observed for PWV (Placebo: 6.2±0.6 vs. 6.2±0.7 m/s; Active: 6.1±0.6 vs. 6.1±0.8 m/s, p=0.81), or FMD (Placebo: 9.7±6.6 vs. 9.0±10.2 %; Active: 10.4±5.0 vs. 9.9±7.3 %, p=0.96) between nitrate and placebo conditions.
**CONCLUSION:** The data from this experiment illustrates that the dietary nitrate supplementation did provide an acute increase of NO bioavailability. However, this acute increase in NO bioavailability did not result in acute benefits to arterial stiffness or endothelial function measured via PWV and FMD, respectively.

2394 Board #230 June 1 11:00 AM - 12:30 PM

### Effects of Beet Juice on Anaerobic Exercise Performance

Clare Zamzow[1], Matthew E. Darnell[2], Philip Ford[1], Scott A. Conger[1]. *[1]Boise State University, Boise, ID. [2]University of Pittsburgh, Pittsburgh, PA.* (Sponsor: Dawn P. Coe, FACSM)

*(No relevant relationships reported)*

Research suggests dietary nitrate contained in beet juice is beneficial during aerobic exercise. Its impact during anaerobic (i.e. short duration, high power) exercise has received much less attention. **PURPOSE:** To determine the effects of acute beet juice supplementation on anaerobic performance during 30-s and 60-s maximal effort cycling sprints. **METHODS:** Fourteen male hockey players participated in this study. The exercise protocol included maximal effort 30-s and 60-s tests (Wingate), on a stationary bike with a fixed amount of resistance applied relative to body weight. In addition to two familiarization trials, each participant completed in random order 30-s placebo and beet juice trials and 60-s placebo and beet juice trials. The beet juice supplement contained ~8mmol/496 mg of dietary nitrate. Apple-cherry-cranberry juice served as the placebo, containing a negligible amount of dietary nitrate. Paired t-tests were run to compare performance in both the 30-s and 60-s trials, analyzing peak and mean power (W), peak and mean RPM, relative power (W/kg), total work (J), and fatigue index (FI, %). A one-way ANOVA was utilized to compare the change between the beet juice and placebo trials of the 30-s test, to the change between beet juice and placebo trials of the 60-s test. **RESULTS:** Beet juice supplementation yielded no statistical differences in any of the measured variables during the 30-s or 60-s tests

($p > 0.05$). A trend occurred during the 30-s test ($p = 0.059$), showing a decreased FI (53.44 vs. 56.01%), suggesting less fatigue occurred after beet supplementation, while there was no statistical difference in FI during the 60-s trials. The percent change for FI was significantly different between the 30 and 60-s tests (30-s: -5.24 9.70, 60-s: 0.50 5.94, $p = 0.032$). No other significant differences emerged between the 30-s and 60-s tests. **CONCLUSIONS:** A dose of ~8 mmol of beet juice did not improve anaerobic exercise performance during a 30-s or 60-s maximal effort cycling sprint. The performance differences were similar when comparing the 30-s and 60-s bouts after beet juice supplementation. Beet juice supplementation during high power, anaerobic exercise does not produce similar improvements in performance that have been reported during aerobic exercise.

2395 Board #231 June 1 11:00 AM - 12:30 PM

### Effect of Beet Root Juice on Delayed Onset Muscle Soreness Following Eccentric Loading.

Charles R. Jedlicka, Hailey M. Richter, Abigail E. Geislinger, Gianna E. Scala, Adrienne T. Tryan, Katelyn D. Olson, Shannon M. Bodily, Kaitlyn A. Anderson, Kent C. Hansen. *winona state university, Winona, MN.*

*(No relevant relationships reported)*

The increase in prevalence of super foods, such as beet root, in popular culture has necessitated research into their effectiveness. Betalains, a prominent phytonutrient in beet root, have proven to have both antioxidant and anti-inflammatory properties. Due to these qualities, betalains have the potential to augment the natural process of healing delayed onset muscle soreness (DOMS) from eccentric loading. **Purpose**: To determine if beet root juice provides benefit in DOMS recovery. **Methods:** 13 healthy college aged males were recruited into a double-blind crossover design study using a beet root concentrate. Participants were randomly assigned to a beet root juice (BRJ) or a placebo (PLA) group. Prior to eccentric loading, participants were dosed twice daily (2x70mL) for six days. They were then subjected to an eccentric only load protocol (5 sets of 10 repetitions) on the biceps brachii using a Biodex Dyanamometer. Several variables reflective of DOMS were measured including: maximal isometric voluntary contraction (MIVC), flexed arm angle (FAA), relaxed arm angle (RAA), subjective pain, point tenderness, and maximal contractile force. The indicators were measured at baseline and three time points following eccentric loading (24, 48, and 72 hrs). Dosing continued through the 72hr time point. **Results:** A significant treatment effect (p=0.03) was seen in reducing the angle at the elbow while being flexed (FAA) at all post exercise timepoints (24, 48, and 72 hrs) while being dosed with beet root juice concentrate. A trend toward a significant treatment effect (p=0.09) was observed in increasing isometric biceps brachii strength (MIVC). A significant time effect was observed (p<.001) for all measured variables. **Conclusion**: This evidence suggests that BRJ has the potential to provide improvement in recovering from exercise induced muscle damage.

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### Nitrate Supplementation Influences Contraction-Relaxation Rates During Ischemic Exercise in Post-Menopausal Women

Swapan Mookerjee[1], Jin-Kwang Kim[2], Kristina Neely[2], Jacqueline Tucker[2], Yasina Somani[2], Michael P. Flanagan[2], Daniel B. Kim-Shapiro[3], Swati Basu[3], David N. Proctor, FACSM[2]. *[1]Bloomsburg University, Bloomsburg, PA. [2]Penn State University, University Park, PA. [3]Wake Forest University, Winston-Salem, NC.* (Sponsor: David Nathan Proctor, FACSM)

*(No relevant relationships reported)*

**Purpose:**
Recent studies suggest that dietary nitrate supplementation can increase contractile force development and relaxation rates in electrically-stimulated human and rodent muscles, particularly at low stimulation frequencies (i.e., conditions associated with enhanced SR $Ca^{++}$ release). In the present study we retrospectively examined handgrip force recordings from a prior study in which we observed a nitrate-associated enhancement of ischemic exercise tolerance in older women. We hypothesized that rates of handgrip force development and relaxation would be increased during their nitrate supplement visit relative to their placebo visit.
**Methods:**
Nine healthy, normotensive, post-menopausal women (57-64 years) performed intermittent handgrip exercise (10% of MVC, 30 per min) during progressive upper arm cuff inflation (+20 mmHg per min) on 3 study visits, with 7 to 10 days between visits. Approximately one week following visit 1, participants randomly consumed 140 ml of nitrate-concentrated (0.6 g of nitrate; $BrJ_{nitrate}$) or nitrate-depleted ($BrJ_{placebo}$) beetroot juice (James White Beet-It Organic; IND#119978), with handgrip exercise beginning two hours post-consumption. Grip force recordings (1,000 Hz sampling rate) were subsequently analyzed and time to 90% peak force (t90%) as well as half relaxation time (hrt) were determined.
**Results:**
Compared to responses observed during the $BrJ_{placebo}$ visit, $BrJ_{nitrate}$ consumption increased time to volitional fatigue (526±46 vs. 567±50 sec) ($p<0.05$). Significant Δ (BRJplacebo - BRJnitrate) effects were noted for Δ t90% (mean 27.7 ± 31.8 msec, $p <0.03$) as well as Δ hrt (27.8 ± 31.6 msec, $p<0.03$), indicating a faster rate of force development as well as a faster relaxation rate with $BrJ_{nitrate}$ consumption.
Visit order (i.e., practice) did not influence exercise tolerance. **Conclusion:** Acute dietary nitrate supplementation increases rates of muscle force development and relaxation during ischemic, voluntary exercise in older women, possibly implicating improved calcium handling as a mechanism underlying their enhanced fatigue resistance under these conditions.
**Funding:** Penn State Hershey Family and Community Medicine (JAFFE endowment)

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### The Integrative Benefits Of Oral Nitrate Supplementation On Supra-Maximal Cycling Work Demands

Craig E. Broeder, FACSM[1], Victoria Flores[1], Bill Julian[1], Frank Wojan[2], Rachel Tauber[2], Laurie Schubert[1], Amanda Salacinski[3]. *[1]Exercising Nutritionally, LLC, Naperville, IL. [2]Northern Illinois University, DeKalb, IL. [3]University of Masschusetts, Lowell, MA.*

**Reported Relationships: C.E. Broeder:** *Contracted Research - Including Principle Investigator; Corporate grant.*

**PURPOSE:** This study investigated the effects beet nitrate supplementation had on cycling performance (power, force, cadence (Cad) speed (Spd), distance, time to fatigue, kJ expended) during repeated high intensity intervals (HIIT). **METHODS:** Eight cyclists participated (Age: 41.4 ± 9.1; WT: 83.3 ± 9.6 kg; BF%: 21.7 ± 0.1; VO2 max: 4.20 ± 0.58 L/min, functional threshold power (FTP): 245.4 ± 43.6 watts). This study was a randomized, double-blind, crossover, matched pair design. Prior to the HIIT sessions, subjects consumed for 7-days placebo (PL) or an oral beet nitrate (BN) supplement. On the day of testing, after completing baseline measurements & 45-mins prior to the HIIT session, 10g of the treatment week's supplement was consumed by each rider. The HIIT workload was set at a wattage 1.5 times greater than a cyclist's baseline FTP, e.g., FTP = 200 watts; HIIT work interval = 300 watts. Each HIIT segment was 75-secs and followed by a 2-min recovery at 50% of FTP. Cyclists were instructed to do as many intervals as possible. A matched paired t-test was used to compare each treatment for the summary data (i.e., total secs completed under the placebo versus beet supplementation conditions), HIIT trial total work data, and HIIT trial total recovery data. When a significant difference was observed, Cohen's d effect size (ES) procedures were used to determine the magnitude. **RESULTS:** BN supplementation improved time to exhaustion (PL: 1,251 ± 562 secs, BN: 1,475 ± 504 secs; p = 0.02; ES = 0.423) and total energy expended (PL: 251.3 ± 48.6 secs, BN: 306.6 ± 55.2 kJ; p = 0.01; ES = 1.079) compared to PL. Subjects during the BN trials completed more intervals (BN = 8.14 ± 2.4, PL = 7.00 ± 2.5, p = 0.03, ES = 0.42) and cycled 23.9% further (BN = 13.5 ± 3.9 km, PL = 10.9 ± 4.0 km, p = 0.01, ES = 0.65). During the work segments, BN enhanced cadence and speed by 2.0% at the same force compared to PL (Cad: p = 0.02; ES = 0.20; Spd; p = 0.02; ES = 0.20). During recovery, comparing BN to PL, force was lower (PL: 68.2 ± 15.6 N, BN: 65.5 ± 13.7 N, p = 0.01, ES = 0.23), Cad was higher (PL: 91.8 ± 10.9 rpm, BN: 93.9 ± 7.4 rpm, p = 0.01, ES = 0.23), Spd was greater (PL: 30.7 ± 3.3 kph, BN: 31.4 ± 1.9 kph, p = 0.02, ES = 0.27). **CONCLUSIONS:** BN enhanced HIIT work and recovery performance allowing a more efficient maintenance of Cad, force, & Spd.

2398 Board #234 June 1 11:00 AM - 12:30 PM

### Nitrate and Nitrite Content of Beet Juice Products Marketed to Athletes

Edgar J. Gallardo, Andrew R. Coggan, FACSM. *Indiana University Purdue University Indianapolis, Indianapolis, IN.*

*(No relevant relationships reported)*

The consumption of beet juice has become particularly popular among athletes, due to the fact that dietary nitrate has been shown to enhance exercise capacity. This has resulted in many companies creating and marketing beet-based products to meet consumer demand. Depending on growing conditions, however, the nitrate content of beets can vary significantly. This makes it difficult for athletes to know how much nitrate they are actually ingesting. **PURPOSE**: To determine the quantity of nitrate (and nitrite) present in beet juice products marketed towards, or easily available to, athletes. **METHODS**: Samples from 26 different lots of 11 different beet juice products produced by 10 different companies were purchased locally or via the internet. After reconstituting (if necessary) and diluting each sample 1000x in water, nitrate and nitrite concentrations were measured using a dedicated high performance liquid chromatography system**.** The amount of nitrate and nitrite per serving was then calculated based on the measured concentrations and either 1) the manufacturer's recommended serving size (for prepackaged/single dose products) or 2) a volume of 500 mL (for beet juice sold in bulk containers). **RESULTS**: There was moderate-to-large variability in nitrate content between samples of the same product, with a mean coefficient of variation of 14.9±21.2% (range 2.3 to 60.6%). However, there was even

greater variability between products, with nearly a 20-fold range in nitrate content between the lowest (1.0±0.6 mmol/serving) and highest (17.9±0.8 mmol/serving). The amount of nitrite in all products was very low (i.e., <0.5% compared to nitrate), except for one that contained 10.2±1.1%. Over half of the products contained less nitrate (or nitrite) per serving than appears necessary to enhance exercise capacity in most individuals. Interestingly, among bulk juices there was no difference between certified organic and non-organic products in terms of nitrate content (i.e., 9.2±6.0 vs. 8.4±3.4 mmol/serving). **CONCLUSIONS**: The present results may be useful to athletes or coaches contemplating which (if any) beet juice product to utilize. These data may also offer some insight into variability in the literature with the respect to the effects of beet juice on exercise performance.

2399 Board #235 June 1 11:00 AM - 12:30 PM

### Effects Of Tetrahydrobiopterin On Limb Blood Flow And Muscle Metabolism In Patients With COPD

Stephen Decker[1], Oh Sung Kwon[1], Taylor S. Thurston[1], Yann Le Fur[2], Eun-Kee Jeong[1], Gwenael Layec[1]. *[1]University of Utah, Salt Lake City, UT. [2]Centre de Resonance Magnetique Biologique et Medicale, Marseille, France.*

*(No relevant relationships reported)*

Exercise intolerance is a frequent complaint and an important predictor of mortality in patients with Chronic Obstructive Pulmonary Disease (COPD). Though several factors have been implicated in the development of muscle dysfunction with COPD, chronic oxidative stress and reduced nitric oxide (NO) bioavailability have been previously suggested to be key factors involved in impaired muscular function. Thus, restoration of the redox balance and NO bioavailability using tetrahydrobiopterin ($BH_4$), an essential cofactor involved in the production of NO and free-radicals, appears to represent a novel therapeutic target for improving muscle oxygenation and metabolism in patients with COPD. **PURPOSE:** The aim of this study was to determine the effects of an acute $BH_4$ supplementation (10 mg·kg$^{-1}$) on peripheral $O_2$ delivery and muscle metabolism in the plantar flexor muscles of patients with COPD. **METHODS:** 5 patients with clinically diagnosed COPD performed dynamic plantar flexion exercise at 40% of maximal work rate with phosphorus magnetic resonance spectroscopy ($^{31}$P-MRS), near-infrared spectroscopy (NIRS), and vascular Doppler ultrasound assessments following oral supplementation of $BH_4$ or placebo (PL). **RESULTS:** Following $BH_4$ supplementation, exercise-induced changes in Phosphocreatine (PL: 35.4% ± 11.7%; $BH_4$: 26.8% ± 10.7%, P<0.01), inorganic phosphate (PL: 8.4% ± 2.2%; $BH_4$: 6.1% ± 1.4%, P<0.05), and pH (PL: 6.89 ± 0.12; $BH_4$: 6.97 ± 0.04, P=0.10) showed attenuated responses. In contrast, end-exercise limb blood flow was not significantly different between $BH_4$ and PL. **CONCLUSION:** Acute oral $BH_4$ supplementation in patients with COPD appears a promising therapy to, at least partially, restore skeletal muscle metabolism, thus potentially contributing to improved exercise tolerance and quality of life.

## E-39 Free Communication/Poster - Ergogenic Aids III - Bicarbonate and Caffeine

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2400 Board #236 June 1 11:00 AM - 12:30 PM

### The Acute Effect of Energy Shots on 5K Run Performance

Aashaun Khedaru, Matthew Marra, John Petrizzo, Lauren Yanni, Jessica Machaby, John Wygand, FACSM, Robert M. Otto, FACSM. *Adelphi University, Garden City, NY.* (Sponsor: Robert M. Otto, FACSM)

*(No relevant relationships reported)*

Caffeine (CF) is the most widely used psychotropic drug in the world and has wide spread use in sport performance. The benefit in short, powerful activities may be questionable, but the benefit to endurance performance is well studied. Generally this central nervous system stimulant is believed to delay the perception of fatigue and may improve performance. CF can be ingested in isolation or in combination with other substances. Energy shots (60-90 mL volume) with less sugar, carbohydrates, and carbonated water than traditional energy drinks are gaining popularity for CF delivery with less gastrointestinal distress. **Purpose:** The purpose of this study was to determine the effect of an acute ingestion of two types of energy shots on 5K treadmill time-trial run performance. **Methods:** In a double-blind crossover study, 17 recreational or intercollegiate runners (body mass 64.3 ± 16 kg, height 172.9 ± 4 cm, age 23.9 ± 3.6 yr, run 40 ± 8 km/wk, 10♂) performed three randomly assigned 5K trials preceded by abstaining from CF for 48 hrs and ingesting a matched fluid from an opaque container, 30 minutes pre-trial. Trials A and B both contained 5 mg CF/kg, but A contained a popular energy shot, while Trial B contained naturally occurring CF derived from plants with additional minerals, vitamins, and anti-oxidants. Trial C (placebo) contained only the same lemon-lime taste in water absent of CF. Subjects performed their own consistent warm-up, controlled their pace throughout each trial, and were informed of splits at each mile. Statistical analysis by ANOVA ($p<.05$) was applied to these data. **Results:** Time trial performance for Trials A, B, and C were 1393 ± 274 sec, 1368 ± 287 sec, and 1403 ± 295 sec, respectively with NSD among all trials. The analysis of mile split times revealed NSD among each mile of the 5K distance, as well. **Conclusion:** The use of CF at 5 mg/kg was insufficient to improve run performance in moderate duration endurance activity during self-modulated treadmill running for recreational through intercollegiate runners. CF tolerance, initiated by the chronic ingestion of CF, is acquired gradually and dissipates over a similar time course. It may be possible that the 48 hour abstinence from CF was insufficient for some of the runners to reduce their CF tolerance, and thus the acute effect of CF was attenuated.

2401 Board #237 June 1 11:00 AM - 12:30 PM

### Optimising Sodium Bicarbonate Supplementation: Are Gastro-resistant Capsules The Answer?

Luana F. Oliveira, Bryan Saunders, Guilherme Yamaguchi, Bruno Gualano, Hamilton Roschel, Guilherme G. Artioli. *University of São Paulo, Sao Paulo, Brazil.*

*(No relevant relationships reported)*

**PURPOSE**: To investigate the effects of sodium bicarbonate (SB) delivery method (gastro-resistance or gelatin capsules) and dosage on bicarbonate increase and side-effects incidence. **METHODS**: Fourteen healthy men (age 27 ± 5 y; body mass [BM] 76.1 ± 11.4 kg; height 1.75 ± 0.06 m) participated in a double-blind and crossover study, composed of five laboratory visits. During each visit they received a different treatment: 0.3 g•kg$^{-1}$ BM of SB in gastro-resistent (RES3) and gelatine capsules (GEL3); 0.1 g•kg$^{-1}$ BM of SB in gastro-resistent (RES1) and gelatine capsules (GEL1); and 0.3 g•kg$^{-1}$ BM of corn flour (PLA). Following an overnight fast, participants consumed a standardised breakfast one hour before ingesting the supplements. Blood samples were taken before and every 10-min following supplement ingestion for 3 h and then every 20 min for a further 1h and were analysed for bicarbonate concentration (RAPIDLab 348, Siemens). Area under the curve (AUC), and peak bicarbonate were recorded. Side-effects were assessed using a modified questionnaire. Data were analysed using mixed-model ANOVA for blood variables and Friedman test for side-effects. **RESULTS**: There was a significant main effect of treatment on AUC and peak bicarbonate (both $p < 0.001$), with greater values in RES3 (AUC: 1594.5; peak: 36.4 mmol•L$^{-1}$) and GEL3 (AUC: 1641.6; peak: 35.1 mmol•L$^{-1}$) compared to RES1 (AUC: 1069.6; peak: 31.8 mmol•L$^{-1}$), GEL1 (AUC: 888.7; peak: 31.5 mmol•L$^{-1}$) and PLA (AUC: 849.3; peak: 29.7 mmol•L$^{-1}$); there were no differences between types of capsules. Side-effects were significantly different between treatments ($X^2$=13.545; p=0.009), with higher incidence in RES3 and GEL3 than RES1, GEL1 and PLA, with no differences between capsule types. **CONCLUSIONS**: The current study showed thatblood variables were not different when SB was delivered in gastro-resistant and gelatine capsules, nor were any associated side-effects. The only differences shown were due to dose and not the type of capsule. SB supplementation in gastro-resistent capsules did not lead to greater increases in circulating bicarbonate or less side-side effects compared to gelatine capsules.

2402 Board #238 June 1 11:00 AM - 12:30 PM

### Double-blind, Placebo Controlled, Randomized Crossover Pilot Study Evaluating The Impacts Of Sodium Bicarbonate in a Transdermal Delivery System on Physiological Parameters and Exercise Performance

Mark Kern[1], Lisa M. Misell[2], Andrew Ordille[1], Madeline Alm[1], Brookell Salewske[1]. *[1]San Diego State University, San Diego, CA. [2]Ampersand Biopharmaceuticals, LLC, Thousand Oaks, CA.* (Sponsor: Michael Buono, FACSM)

**Reported Relationships: M. Kern:** *Contracted Research - Including Principle Investigator; Ampersand.*

Oral sodium bicarbonate has been used for decades as an ergogenic aid by buffering muscle acid production during exercise and subsequently delaying the onset of fatigue in athletes. However, gastrointestinal side effects limit the use of sodium bicarbonate. **PURPOSE**: This study evaluated the efficacy of a commercially available topical transdermal sodium bicarbonate (TSB) lotion (Topical Edge™) which is claimed to be delivered through the skin using a novel patent-pending transdermal delivery system for impacting exercise metabolism and performance.
**METHODS**: 20 trained cyclists (Category 1-3) and a professional triathlete participated in this randomized, cross-over, double-blinded, placebo-controlled study. After application of TSB or placebo lotions, subjects completed a variety of exercise and performance tests. On one day subjects completed a high-intensity series of exercise tests which included a ramped protocol until reaching a rating of perceived exertion (RPE) of 17 out of 20, a 30-second sprint performance test, and a 5-minute

time trial performance test, with 5 minutes of recovery between tests. On a separate day subjects completed a 1-hour time trial. Heart rate, RPE, blood lactate and pH were assessed before, during, and after performance testing.
**RESULTS**: Heart rate and RPE were significantly ($p<0.05$) lower for TSB compared to placebo at the 15-min mark of the 1-hour time trial, but not at other time points. When TSB was applied, lactate was higher ($p<0.05$) after the high-intensity ramp, sprint and 5-min time trial series (10.8±3.2 mmol/L versus 9.7±3.1 mmol/L for TSB and placebo, respectively). Similar effects were not observed after the 1-hour time trial. Significance was not reached when examining performance differences ($p>0.05$).
**CONCLUSIONS**: Overall, the findings from this study provide evidence that TSB can significantly impact blood lactate, heart rate and RPE during performance tests of varying intensity/length. These significant findings support the ability of this lotion to trandermally deliver sodium bicarbonate, which could allows athletes to avoid the side-effects of oral bicarbonate use. Further research is warranted to substantiate these findings and determine the most effective use for this commercially available transdermal sodium bicarbonate lotion.

2403 Board #239 June 1 11:00 AM - 12:30 PM

### Double-blind, Placebo Controlled, Randomized Crossover Pilot Study Evaluating the Impacts of Sodium Bicarbonate in a Transdermal Delivery System on Delayed Muscle Onset Soreness

Lisa Misell[1], Mark Kern[2], Andrew Ordille[2], Madeline Alm[2], Brookell Salewske[2]. *[1]Ampersand Biopharmaceuticals, LLC, Thousand Oaks, CA. [2]San Diego State University, San Diego, CA.* (Sponsor: Michael Buono, FACSM)

**Reported Relationships: M. Kern:** *Contracted Research - Including Principle Investigator; Ampersand.*

Sodium bicarbonate/alkalinization may reduce muscle mitochondrial damage caused by reactive oxygen species during intense exercise. Such damage can induce post-exercise inflammation and pain, which may be linked to delayed onset muscle soreness, or DOMS. However gastrointestinal side effects limit the use of oral sodium bicarbonate. **PURPOSE**: This study evaluated the efficacy of a commercially available, topical transdermal sodium bicarbonate (TSB) lotion (Topical Edge™), which is claimed to be delivered through the skin using a novel patent-pending transdermal delivery system for impacting DOMS.
**METHODS**: 20 trained cyclists (Category 1-3) and professional triathletes participated in this randomized, cross-over, double-blinded, placebo-controlled study. After application of TSB or a placebo, subjects completed a variety of exercise and performance tests varying in duration. On one day subjects completed a series of high-intensity exercises which included a ramped protocol to a rating of perceived exertion (RPE) of 17 out of 20, a 30-sec sprint performance test, and a 5-min time trial with 5 minutes of recovery between tests. On a separate day subjects completed a 1-hr time trial. Subjects completed DOMS questionnaires 24- and 48-hours after exercise sessions. Muscle soreness was rated on a scale of 0-100 where 0 = "no soreness", 25 = "mild pain", 50 = "moderate pain", 75 = "severe pain" and 100 = "the worst pain you can imagine".
**RESULTS**: DOMS was reduced following the high-intensity series with TSB compared to placebo. Similar effects were not observed following the 1-hr exercise bout. From the first to second day following the high-intensity exercise series, subjects using TSB experienced a 54% reduction in DOMS versus an increase in DOMS of 34% with placebo ($p=0.007$). **CONCLUSIONS**: Findings from this study suggest that TSB can significantly shorten recovery from DOMS following high-intensity exercise. Findings also support the effectiveness of the transdermal system in delivering sodium bicarbonate topically and may allow athletes to achieve these results while avoiding the side-effects of oral bicarbonate. Furthermore, we believe this study is the first to provide a direct link between sodium bicarbonate use and DOMS in athletes. Additional research is underway to further substantiate these findings.

2404 Board #240 June 1 11:00 AM - 12:30 PM

### Effects of a Thermogenic Pre-Workout Supplement on Fat Oxidation Rates During Moderate-Intensity Running in Females

Jamie Erickson[1], Andrew Jagim[2], Glenn Wright[1], Carl Foster, FACSM[1], Clayton Camic[3]. *[1]University of Wisconsin-La Crosse, La Crosse, WI. [2]Lindenwood University, St. Charles, MO. [3]Northern Illinois University, DeKalb, IL.* (Sponsor: Carl Foster, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: The purpose of the present study was to examine the effects of acute doses of a thermogenic, pre-workout supplement on fat oxidation rates during moderate-intensity treadmill running in females.
**METHODS**: Twelve aerobically-trained females (mean ± SD: age = 25.3 ± 9.4 years; body mass = 61.2 ± 6.8 kg) volunteered to visit the laboratory on four occasions. For the first visit, each subject completed an incremental treadmill test to exhaustion to determine their ventilatory threshold (VT) using a metabolic cart. On the second visit, each subject consumed a standardized meal following overnight fasting (8 hours) 30 minutes prior to ingestion of one (S1) or two servings (S2) of the supplement or placebo (P). One serving of the supplement contained caffeine anhydrous (150 mg), beta alanine (1600 mg), arginine AKG (1000 mg), as well as tyrosine, L-carnitine, green coffee bean extract, and velvet bean extract at unspecified quantities. The placebo was a non-caloric mix that was matched for flavor and consistency. Thirty minutes post-ingestion, the subjects performed a 30-minute constant-velocity treadmill run at 90% of their VT with ventilatory parameters expressed as 5-min averages. The subjects then returned to the laboratory for their third and fourth visits to ingest the remaining conditions (S1, S2, or P) and underwent the same testing procedures (including time of day) as the second visit. A two-way ANOVA with repeated-measures was used to compare the rates of fat oxidation among the conditions (S1, S2, P) at the common time points (5, 10, 15, 20, 25, 30 min) of the 30-minute run.
**RESULTS**: For the rates of fat oxidation, there was no significant ($P > 0.05$) condition x time interaction or main effect for condition, but there was a main effect for time. Specifically, the marginal means (collapsed across conditions) for fat oxidation rates were significantly ($P < 0.05$) greater at 5-min ($0.35 \pm 0.20$ g·min$^{-1}$) and 30-min ($0.35 \pm 0.16$ g·min$^{-1}$) than 10-min ($0.28 \pm 0.13$ g·min$^{-1}$), 15-min ($0.29 \pm 0.13$ g·min$^{-1}$), 20-min ($0.28 \pm 0.14$ g·min$^{-1}$), and 25-min ($0.31 \pm 0.15$ g·min$^{-1}$).
**CONCLUSIONS**: The present findings indicated that one or two servings of the pre-workout supplement had no significant effect on rates of fat oxidation during 30 minutes of moderate-intensity treadmill running in aerobically-trained females when compared to placebo.

2405 Board #241 June 1 11:00 AM - 12:30 PM

### The Effects Of Caffeine On Time-trial Performance And Associated Physiological Responses: a Meta-analysis

Mark Glaister, FACSM. *St Mary's University, Twickenham, United Kingdom.*

*(No relevant relationships reported)*

PURPOSE: The aim of this study was to carry out a systematic review and meta-analysis of the effects of caffeine supplementation on moderate to high-intensity closed-loop time-trial performance and associated physiological responses.
METHODS: 32 studies met the inclusion criteria of adopting double-blind, randomized, crossover designs that included a closed-loop time-trial of moderate to high-intensity aerobic exercise performed under a standard caffeine dose of 3-6 mg·kg$^{-1}$ administered 30 – 90 minutes prior to performance. Meta-analyses were completed using a random-effects model, with effects on time-trial performance presented as standardized mean difference (δ) and with physiological responses presented as raw mean difference (*D*). 95% confidence limits ($CL_{95}$) were calculated for all estimates.
RESULTS: Relative to placebo, caffeine had a significant positive effect on time-trial performance ($\delta = 0.43$; $CL_{95}$ [0.26,0.60]; $p < 0.00001$; $n = 329$). Moreover, the effects of caffeine on time-trial performance corresponded with significant increases in heart rate ($D = +3.1$ b·min$^{-1}$; $CL_{95}$ [+1.6, +4.6]; $p < 0.0001$; $n = 164$), blood lactate ($D = +1.53$ mmol·L$^{-1}$; $CL_{95}$ [+1.21, +1.84]; $p < 0.00001$; $n = 209$), and blood glucose ($D = +1.12$ mmol·L$^{-1}$; $CL_{95}$ [+0.80, +1.43]; $p < 0.00001$; $n = 95$). In contrast, caffeine had no effect on time-trial measures of oxygen uptake ($D = +0.07$ L·min$^{-1}$; $CL_{95}$ [-0.02, +0.15]; $p = 0.13$; $n = 96$), respiratory exchange ratio ($D = +0.01$; $CL_{95}$ [-0.01, +0.03]; $p = 0.37$; $n = 78$), or ratings of perceived exertion ($D = +0.06$; $CL_{95}$ [-0.14, +0.26]; $p = 0.54$; $n = 196$). CONCLUSION: The results of this analysis reveal a clear effect of caffeine on moderate to high-intensity time-trial performance; an effect which is accompanied by significant increases in heart rate, blood lactate, and blood glucose. When considered in conjunction with research using fixed-intensity exercise, the caffeine-induced increase in time-trial intensity likely explains all of the associated increase in heart rate, and part of the increase in blood lactate and blood glucose.

2406 Board #242 June 1 11:00 AM - 12:30 PM

### Caffeine Mouth Rinsing in the Fed State Does Not Enhance 3-km Cycling Performance

Michael J. Saunders, FACSM, Kayla A. Sweeney, Nicholas D. Luden, Christopher J. Womack, FACSM. *James Madison University, Harrisonburg, VA.*

*(No relevant relationships reported)*

**PURPOSE**: A prior investigation from our laboratory reported that a caffeine mouth-rinse (CMR) enhanced 3-km cycling performance during trials conducted in the early morning (before 10:00), but not in the late-morning. However, interpretation of these findings was complicated by the fact that early-morning trials were predominantly completed after an overnight fast, whereas late-morning trials were all post-prandial. Thus, the purpose of the present study was to assess the effects of a CMR on cycling performance in the fed-state, at different times of day. **METHODS**: 12 recreational cyclists ($VO_{2peak}$ = 51 ± 8 ml/kg/min) completed a simulated 3-km time trial on four occasions; twice in the morning (before 10:00) and twice in the afternoon (after 16:00). 25 ml of a mouth-rinse solution, containing either 300 mg of caffeine (CMR), or a placebo (PL) was swirled in the mouth for 5 s on three occasions during a 10 min

period prior to each time-trial. All trials were completed two hours after ingestion of a standardized meal (~ 500 kcal, consisting of cereal with milk, yogurt, and juice). A randomly counterbalanced, double blind design was implemented to examine the efficacy of the CMR (versus PL) in the morning and the afternoon. Magnitude-based inferences were used to evaluate treatment effects on performance time. **RESULTS**: CMR did not improve cycling performance in the morning [PL = 343 ± 33 s; CMR = 348 ± 32 s; 'possibly' impaired performance (62% likelihood)] or in the afternoon [PL = 346 ± 42 s; CMR = 349 ± 41 s; 'possibly' impaired performance (43% likelihood)]. Treatment effects were similar between the morning and afternoon trials, with no clear effect of time of day. **CONCLUSIONS**: CMR provided in the fed state did not improve 3-km cycling performance, and responses were similar during trials conducted in the morning and the afternoon. When considered in the context of our prior study, these findings suggest that the efficacy of CMR on cycling performance may be influenced by feeding state, but not time of day.

2407 Board #243 June 1 11:00 AM - 12:30 PM

### Acute Caffeine Ingestion Enhances Upper and Lower Body Torque During Isometric and Isokinetic Muscle Actions

Daniel T. Flahie, Donovan S. Conley, FACSM, Tammy K. Evetovich, FACSM. *Wayne State College, Wayne, NE.* (Sponsor: Donovan Conley, FACSM)

*(No relevant relationships reported)*

A comprehensive meta-analysis reported caffeine ingestion (CI) produces greater maximal voluntary contraction (MVC) force in lower body (LB) versus upper body (UB) musculature (Warren et al., Med. Sci. Sports Exerc. 42:1375-1387, 2010). However, research is lacking on direct comparisons between UB versus LB force production, particularly comparing these muscular strength measures across the same subjects. **PURPOSE:** To compare the effects of caffeine supplementation in subjects who self-report low (LOWCS) vs. moderate/high (MHCS) sensitivity to caffeine during isokinetic and isometric muscle actions for the forearm flexor (FORE) and knee extensor (KNEE) muscle groups. **METHODS:** Sixteen recreationally trained males volunteered to participate in the study (M±SD, age=20.6±1.73 y, height=180.1±6.87 cm, mass=83.5±11.48 kg, body fat=10.6±3.04 %). Subjects were randomly assigned to either CAF (5 mg·kg$^{-1}$) or placebo (NOCAF) treatments using a double-blind design with at least 48 h between testing sessions. Testing was conducted using a HUMAC NORM for both KNEE and FORE at 60°·sec$^{-1}$ and two-6 sec isometric muscle actions. Testing began immediately after 45 min of either CAF or NOCAF treatments. **RESULTS:** Statistical analysis indicated for isokinetic strength, there was a greater response for KNEE (CAF=213.84 ± 25.38 Nm; NOCAF 201.47 ± 28.56 Nm) versus FORE (CAF= 62.29 ± 6.41 Nm; NOCAF= 58.46 ± 8.27 Nm). For isometric peak torque, the results revealed significantly ($p<0.05$) greater torque for CAF (M±SD=150.44 ± 22.9Nm) compared to NOCAF (140.39 ± 29.7 Nm) collapsed across upper/lower body and group. **CONCLUSION:** Our data indicates caffeine (5 mg·kg$^{-1}$), consumed approximately 45 min before performance improves isokinetic and isometric peak torque in both lower and upper body muscle groups and, has a significantly greater effect on dynamic LB vs UB force production in recreationally resistance trained men, regardless of self-reported habitual caffeine consumption. This suggests that ingestion of moderate doses of caffeine 45 min prior to sports and physical activity performance may enhance muscular strength independent of habitual caffeine use.

2408 Board #244 June 1 11:00 AM - 12:30 PM

### The Effects of Caffeine Gum Administered in a Divided Dose on Cycling Performance

Edward J. Ryan[1], Mohammed Alshedokhi[1], Shaima Alhabib[1], Samaher Shikh[1], Emily J. Ryan[2], Jason R. Edsall[1], Andres E. Carrillo[1]. *[1]Chatham University, Pittsburgh, PA. [2]West Virginia University, Morgantown, WV.*

*(No relevant relationships reported)*

**PURPOSE**: Previous work in our lab has demonstrated that a single bolus of caffeine gum (300mg) enhanced cycling performance.The purpose of the present study was to determine the effects of caffeine gum administered in a divided dose on cycling performance. **METHODS**: Seven apparently healthy, younger (27 ± 10 years) adults of modest fitness (42 ± 10 ml·kg$^{-1}$·min$^{-1}$) participated in three separate laboratory sessions. During the first visit, subjects underwent a graded exercise test on a Lode cycle ergometer to determine maximal oxygen consumption ($VO_{2max}$). For the next two visits (experimental testing) subjects arrived at the Exercise Science Laboratory in the fasted state between 0600 and 1200 hours. Subjects consumed a light breakfast consisting of a plain bagel and a sports drink then rested for 10 min. Thereafter two pieces of Military Energy Gum [caffeine (CAFF) or placebo (PLA)] were administered in a double blind manner. Subjects were instructed to chew the gum for 5 min then expectorate. Following a standard warm-up, subjects cycled at 70% $VO_{2max}$ (constant Wattage) for 15 min. Subjects rested for 20 min and were then instructed to chew two additional pieces of Military Energy Gum for 5 min. Following the second administration, the ergometer was set to linear mode and subjects were instructed to complete as much work as possible in a 15-min performance ride. Total work (kJ) completed was used as the primary outcome variable. Each piece of caffeinated Military Energy Gum has 100mg of CAFF and the order in which the subjects completed the experimental trials was counterbalanced.
**RESULTS**: Performance data were analyzed using a two-way paired samples t-test. Total work completed did not differ between trials (CAFF = 157.8 ± 45 kJ, PLA = 157.6 ± 40 kJ) and no main effect of treatment was evident ($t = 0.035$, $p = 0.97$).
**CONCLUSIONS**: These data demonstrated that caffeine gum administered in a divided dose does not improve total work completed during a 15-min performance ride in physically active adults.

2409 Board #245 June 1 11:00 AM - 12:30 PM

### Neither Coffee Nor A Stimulant Containing "Pre-workout" Drink Alter Cardiovascular Drift During Walking In Young Men

Stephanie M. Paulsen, Gregory A. Brown, FACSM. *the University of Nebraska at Kearney, Kearney, NE.* (Sponsor: Gregory A. Brown, FACSM)

*(No relevant relationships reported)*

Caffeine is a widely used stimulant that is often consumed in coffee. Caffeine is also the main ingredient in many "pre-workout" drinks, which are purported to enhance exercise performance. Due to the stimulatory effects of caffeine on the heart and the potential diuretic effects of caffeine, drinking coffee or a pre-workout drink before exercise may exacerbate cardiovascular drift**. PURPOSE**: The purpose of this study was to compare the effects of coffee and a commercially available pre-workout drink on cardiovascular drift during prolonged moderate intensity walking. **METHODS**: Eight healthy, recreationally active males consumed coffee (containing 120 mg caffeine), decaffeinated coffee, a pre-workout drink (containing 120 mg caffeine), or a placebo in a randomly assigned cross over design one hour before walking for 40 minutes on a treadmill at a workload that corresponded to 50% of their $VO_2$ max. **RESULTS**: Heart rate gradually increased ($P<0.05$) from 123.2 ± 5.5 beats/min at 10 minutes to 132.8 ± 8.6 beats/min for all treatments, but there was no main effect of treatment or interaction effect of treatment X time on heart rate. Respiratory exchange ratio (RER) gradually decreased ($P<0.05$) from 0.76 ± 0.02 at 10 minutes to 0.73 ± 0.04 for all treatments, but there was no main effect of treatment or interaction effect of treatment X time on RER. Similarly, there was no main effect of treatment or interaction effect of treatment X time on oxygen consumption. **CONCLUSIONS**: The gradual increase in heart rate in the present study demonstrates cardiovascular drift during 40 minutes of walking at 50% $VO_{2max}$ , with no changes due to consuming coffee or a pre-workout drink 1 hour prior to exercise. Furthermore, the ingestion of coffee or a pre-workout drink 1 hour prior to exercise did not alter the RER indicating no effects on fat or carbohydrate use. The lack of difference in oxygen consumption indicates that ingesting coffee or a pre-workout drink 1 hour prior to exercise does not alter energy expenditure. Overall, the lack of effects of coffee or a pre-workout drink in the present investigation suggest that while the caffeine dose does not present additional challenges to cardiovascular function, the caffeine dose does not influence exercise performance during 40 minutes of walking at 50% $VO_2$max.

2410 Board #246 June 1 11:00 AM - 12:30 PM

### Effects of Varying Caffeine Dosage on Free Throw Accuracy Before and After Exhaustive Intermittent Exercise

Bulent Sokmen, Molly Kommer, Carly Gill, Katrina Buhagiar. *Sonoma State University, Rohnert Park, CA.*

*(No relevant relationships reported)*

**PURPOSE**: This study evaluated the effects of varying caffeine dosage on free throw accuracy before and after exhaustive intermittent exercise.
**METHODS**: Fourteen NCAA Div 2 collegiate female basketball players participated (mean ± SD; age = 19.9 ± 1.04 yrs; body mass = 67.25 ± 8.17 kg; height = 171.45 ± 8.41 m; BMI = 22.85 ± 1.72; percent body fat = 22.45 ± 4.16%). Participants each completed baseline tests with a familiarizing session and three randomized double-blind experimental trial sessions in the course of this study. The experimental trials included ingestion of placebo (0 mg•kg•BW$^{-1}$), of caffeine at 1.5 mg•kg•BW$^{-1}$, and of caffeine at 3 mg•kg•BW$^{-1}$. Each trial was administered following 12h overnight fasting, separated by at least one week, and with no moderate to heavy exercise 48h prior to the trial. At the lab, subjects consumed a standard breakfast and 500ml of fluid, with a varying caffeine dose or placebo. Subjects performed 20 free throws, rested 1 min, then ran ten 20m sprints at full speed, with 20 sec recovery. They rested 1 min, and performed 20 free throws again. All free throws were performed with a soundtrack playing music and recorded crowd noise at high volume in the background.
**RESULTS**: Our results found that only the 3 mg•kg•BW$^{-1}$ caffeine dosage showed significant improvement ($\Delta$=7.17%) in free throw performance following exhaustive intermittent exercise ($P<0.05$). No change was observed in free throw performance with 1.5 mg•kg•BW$^{-1}$ caffeine dosage and placebo ($P>0.05$).

**CONCLUSIONS**: This study demonstrated that a moderate dose of caffeine can improve free throw ability following exhaustive intermittent exercise compared to low dose and placebo conditions in NCAA Division 2 female basketball players.

2411 Board #247 June 1 11:00 AM - 12:30 PM

### Caffeine and Citrate Aurantium Supplementation Alter Resting Cardiac Autonomic Function but Not During Recovery

Emily Bechke, Cassie Williamson, Paul Bailey, Wade Hoffstetter, Cherilyn McLester, Brian Kliszczewicz. *Kennesaw State University, Kennesaw, GA.* (Sponsor: Mark Tillman, FACSM)

*(No relevant relationships reported)*

**Purpose:** To examine the combined effects of the pre exercise complex Citrate Aurantium and Caffeine (CA+C) on cardiac autonomic activity following ingestion and immediately after high-intensity anaerobic exercise in habitual caffeine users. **Methods:** Ten physically active males (25.1± 3.9 years; mass 78.7± 9.5kg) who habitually consume caffeine (≥ 1 serving a day [95mg] 4 days a week) participated. This was a double-blind crossover design, where either a CA+C or a placebo capsule was consumed followed by a 45-min ingestion period, a repeated Wingate protocol, and a 45-min recovery period. Cardiac autonomic activity was assessed through Heart Rate (HR), plasma epinephrine (E) and norepinephrine (NE), and markers of Heart Rate Variability (HRV): root mean squared of successive R-R differences (RMSSD); Standard Deviation of R-R intervals (SDNN); High-Frequency (HF); Low-Frequency (LF); and its ratio (LF:HF). Markers were taken at four time points: pre-Ingestion (PRE-ig), 40-45-min post (Post-ig); Wingate recovery (PRE-rcv), 40-45-min post recovery (Post-rcv). **Results:** Markers that violated normality were naturally log transformed prior to further analysis (ln). Pre-planned comparisons were performed to assess differences between pre and post time points as well as the corresponding time point of the other trial within their respected phase. During the CA+C trial, an increase in HR, lnSDNN, lnLF, EPI, and NE were observed at Post-ig when compared to Pre-ig ($p \leq 0.05$). Significant differences were observed in all markers, except LF:HF, during the CA+C and PLA trials from the Pre-rcv to Post-rcv ($p \leq 0.05$). **Conclusion:** The consumption of CA+C stimulates sympathetic activity during rest (e.g. ingestion phase) without influencing parasympathetic activity. CA+C provides no influence over cardiac autonomic recovery.

2412 Board #248 June 1 11:00 AM - 12:30 PM

### Effects of Energy Drinks on Resting Cardiovascular Measures

Will Peveler[1], Andy Bosak[1], Gabe Sanders[2]. *[1]Liberty University, Lynchburg, VA. [2]Northern Kentucky University, Highland Heights, KY.* (Sponsor: James Schoffstall, FACSM)

*(No relevant relationships reported)*

The use of energy drinks among athletes has risen greatly. Reviews of energy drink related health complications have highlighted adverse cardiovascular events. **PURPOSE:** To examine the effects of three commercially available energy drinks on resting cardiovascular measures prior to exercise. **METHODS:** Twenty-five healthy subjects participated in this study. Subjects reported to the laboratory on four separate occasions where they ingested a placebo or one of three commercially available energy drinks (energy drink 1, energy drink 2 and energy drink 3). Trials were conducted subject blinded and counterbalanced. During each trial blood pressure and heart rate were measured at three key points: prior to beverage ingestion, at 30 minutes post ingestion and at 60 minutes post ingestion. Subjects remained seated and in a relaxed state for the duration of the 60 minute trials. Means for dependent measures were analyzed using repeated measures ANOVA with an alpha of 0.05 to determine significance. **RESULTS:** Heart rate was found to be significantly increased from pre-ingestion measures to 60 minute measures for both energy drink 2 (Pre = 65.12 ± 9.81 bpm and 60 min = 73.08 ± 10.82 bpm at p=0.010) and energy drink 3 (Pre = 65.76 ± 8.44 bpm and 60 min = 73.52 ± 11.25 bpm at p=0.005). Systolic blood pressure was found to be significantly increased from pre-ingestion to 60 minutes for energy drink 1 (Pre = 114.84 ± 9.33 mmHg and 60 min = 120.80 ± 9.43 mmHg at p=0.003), energy drink 2 (Pre = 113.56 ± 8.55 mmHg and 60 min = 121.44 ± 8.86 mmHg at p=0.004), and energy drink 3 (Pre = 113.24 ± 7.09 mmHg and 60 min = 119.40 ± 10.58 mmHg at p=0.037). **CONCLUSION:** These findings demonstrate that energy drinks impact cardiovascular measures by increasing both heart rate and blood pressure during a resting state. While the demonstrated increases may not be dangerously high, users should be aware of the impact of these drinks on cardiovascular measures.

2413 Board #249 June 1 11:00 AM - 12:30 PM

### Menstrual Phase Influence and Oral Contraceptive Use on the Ergogenic Effects of Caffeine during Cycling

David L. Wenos, Annette M. Lemanski, Nicholas D. Luden, Christopher J. Womack, FACSM, Michael J. Saunders, FACSM. *James Madison University, Harrisonburg, VA.* (Sponsor: Michael J. Saunders, FACSM)

*(No relevant relationships reported)*

It is suggested that inter-individual differences in the ergogenic effects of caffeine may be attributed to individual variability in caffeine absorption and metabolism. It is known that menstrual status and oral contraceptive (OCS) use affects caffeine metabolism, but it is not clear whether these factors mediate the ergogenic effects of caffeine consumption. **Purpose:** To determine whether menstrual phase or OCS use influence the effects of caffeine ingestion on 3-km cycling performance. **Methods:** Sixteen recreational cyclists completed two 3-km time trials (TT) during both the follicular (early) and luteal (late) phases. Riders ingested either a placebo or 6mg/kg caffeine capsule one hour prior to each trial. Subjects were divided into a non-OCS users group (n = 8; age, 20.9 ± 2.1 yr; VO2max = 50.9 ± 7.8 ml/kg/min) and an OCS users group (n=8; age = 21.4 ±1.4 yr; VO2max = 48.0 ± 4.0 ml/kg/min). Magnitude-based inferences were used to evaluate the effects of treatment (placebo versus caffeine), menstrual phase (follicular versus luteal) and group (OCS users versus non-users) on power output during the cycling TT. **Results:** Overall, caffeine improved power output during the TT, regardless of menstrual phases or OCS use. Among non-OCS users, caffeine 'likely' improved power output in the follicular phase (6.7 ± 6.1%), and 'very likely' improved power output in the luteal phase (6.7 ± 4.8%). In the OCS users, caffeine 'likely' increased power output in the follicular phase (4.7 ± 5.6%), and 'very likely' improved power output during the luteal phase (7.2 ± 3.7%). Differences in the ergogenic effects of caffeine between the two groups (OCS users versus non-users) and between menstrual phases were 'unclear'. **Conclusion:** Caffeine ingestion improved power output during a 3-km cycling TT. However, the magnitude of the ergogenic effects of caffeine were not affected by OCS use, or menstrual phase.

2414 Board #250 June 1 11:00 AM - 12:30 PM

### The Influence Of Caffeine And A CYP1A2 Polymorphism On The Ventilatory Threshold - A Pilot Study

Paul R. Nagelkirk[1], Liam F. Fitzgerald[1], James Sackett[1], Ahmed El-Sohemy[2], Christopher J. Womack, FACSM[3]. *[1]Ball State University, Muncie, IN. [2]University of Toronto, Toronto, ON, Canada. [3]James Madison University, Harrisonburg, VA.* (Sponsor: Christopher J. Womack, FACSM)

*(No relevant relationships reported)*

Previous research suggests acute caffeine supplementation may alter substrate utilization and/or ventilatory responses that influence the ventilatory threshold (VT). Caffeine metabolism is influenced by a single nucleotide polymorphism at intron 1 of the cytochrome P450 (CYP1A2) gene, which may influence the ergogenic effects associated with caffeine use. **PURPOSE:** The purpose of this study was to examine the influence of caffeine on exercise responses at the VT, and determine the effect of the CYP1A2 polymorphism on those responses. **METHODS:** 17 healthy men (age 24.8 ± 2.7 yrs; weight 79.5 ± 9.2 kg) participated in this study. Subjects performed graded maximal exercise tests on a cycle ergometer after consuming either 6 mg/kg of caffeine or placebo. Subjects were categorized as possessing the C allele (C allele carriers) (n = 8) or being homozygous for the A allele (AA homozygotes) (n = 9). VT was determined using the V-slope method. The effects of caffeine (CAF) vs placebo (PL), genotype, and treatment x genotype were assessed using a two-factor ANOVA. **RESULTS:** At the VT, caffeine significantly augmented workload (CAF= 220 ± 43 Watts, PL= 211 ± 46 Watts), $VO_2$ (CAF= 33.5 ± 8.2, PL= 32.2 ± 7.7 ml/kg/min), $VO_2$ as a % of $VO_2$max (CAF= 69.0 ± 8.2%, PL= 64.8 ± 9.6%), RER (CAF= 0.98 ± 0.06, PL= 0.95 ± 0.07), and HR (CAF= 155 ± 16, PL= 151 ± 16 bpm), compared to placebo (all $p<0.05$). A significant treatment x genotype interaction was observed for RER (AA group: CAF= 0.99 ± 0.07, PL= 0.91 ± 0.08; C allele: CAF= 0.97 ± 0.07, PL= 0.97 ± 0.09). A non-significant between group trend was observed for $VO_2$ as a % of $VO_2$max (AA group 62.5 ± 6.6%, C allele = 67.2 ± 9.6% p=0.10, $eta^2$=0.17) and workload (AA group 196.4 ± 37.7, C allele = 214.1 ± 40.0 Watts, p=0.10, $eta^2$=0.17). **CONCLUSION:** Caffeine enhances exercise performance at the VT. The CYP1A2 polymorphism likely modulates substrate utilization and exercise intensity at the VT. Additional research is needed to verify these preliminary findings.

2415 Board #251 June 1 11:00 AM - 12:30 PM

**Caffeine Does Not Increase Heat Stress during Endurance Exercise in a Hot, Humid Environment**

Christopher W. Bach, Jack W. Ransone, FACSM. *University of Nebraska - Lincoln, Lincoln, NE.*

*(No relevant relationships reported)*

The diuretic effects of caffeine and its subsequent role on fluid balance have been highly debated for years. Given the lack of mechanistic understanding behind many of its effects, it is important to determine if caffeine presents a risk to normal thermoregulatory patterns during exercise in hot, humid conditions. **PURPOSE**: To determine if caffeine (CAFF) ingestion increases core body temperature in physically active subjects exercising in a hot, humid environment during repeated endurance exercise tests (EET). **METHODS**: This study used a placebo-controlled, double-blind, cross-over experimental design to investigate the effects of caffeine ingestion on heart rate (HR) and core body temperature in physically active males when exercising in a hot and humid environment. Twenty-one healthy male subjects (age 27.70±2.90yrs; height 1.76±0.10m; weight 74.19±7.10kg) performed a maximal graded exercise test (GXT) and two endurance exercise tests (EET) separated by at least 48hrs. Subjects were randomly assigned to consume either 6mg/kg of body weight of a placebo (PLAC) or CAFF supplement for one EET and the opposite substance (PLAC or CAFF) for the second test. In addition, the subjects consumed a CorTemp® core body temperature sensor to measure core body temperature throughout each test. Each EET consisted of cycling on a cycle ergometer at 65% of their $VO_{2max}$ for 40min in a controlled hot, humid environment (36.37±0.58°C; 59.46±5.14%RH). **RESULTS**: Results indicated no significant difference between groups for core body temperature or heart rate at any time point, with the exception of an elevated HR 5min post-exercise in the CAFF group when compared to PLAC (136.82±7.51 vs. 127.65±3.17, respectively; $p$=0.011). A significant increase in HR from pre-exercise to 40min was observed in both groups (CAFF: 84.27±4.19 to 164.50±5.13, PLAC: 79.23±3.47 to 162.71±3.26; $p$<0.01), but CAFF consumption elicited no synergistic effects on HR or core body temperature before, during, or after exercise. Interestingly, CAFF consumption did elicit a diminished HR recovery within the first 5min of recovery, potentially indicating a greater degree of heat stress in the CAFF group. C**ONCLUSION**: Based upon this evidence, caffeine consumption does not impair normal thermoregulatory patterns during exercise in a hot, humid environment.

2416 Board #252 June 1 11:00 AM - 12:30 PM

**Caffeine Intake Maintains 3-km Cycling Time Trial Performance the Morning Following Sleep Restriction**

Jeremy Via, Erin Horil, Michael Saunders, FACSM, Trent Hargens, FACSM, Christopher Womack, FACSM, Nicholas Luden. *James Madison University, Harrisonburg, VA.* (Sponsor: Michael Saunders, FACSM)

*(No relevant relationships reported)*

Athletes are at an increased risk for acute sleep loss due to the physiological and psychological tolls of heavy training and competition. We recently reported that a single night of sleep restriction (SR) following heavy exercise impaired 3-km cycling performance the next morning. Because caffeine can mitigate fatigue and enhance physical and cognitive function, caffeine is a logical candidate to offset the negative impact of sleep restriction on next-day performance. **PURPOSE:** The primary aim of this project was to determine the effects benefit of caffeine supplementation for exercise performance following one night of SR in trained cyclists. **METHODS:** Ten (8 male; 2 female) cyclists (age, 21 ± 3 yrs; VO2max, 61 ± 8 ml/kg/min) completed four experimental phases. Each phase consisted of an evening of heavy exercise (EX1; 3-km cycling time trial followed by 60 min of high intensity cycling intervals) followed by a morning session (EX2) to evaluate perceived fatigue and 3-km TT performance. EX1 and EX2 were separated by an assigned sleep condition [FULL, ~6.4 hrs vs. Sleep Restriction (SR), ~3 hrs]. Each sleep condition was implemented twice with cyclists receiving 6 mg/kg of caffeine (CAF) and placebo (PLA) 60 min prior to EX2 after FULL and SR. Magnitude-based inferences were used to compare perceived fatigue and subsequent 3-km TT performance (mean power output) between each of the following conditions: FULL/PLA, FULL/CAF, SR/PLA, and SR/CAF. **RESULTS:** Surprisingly, 3-km TT power output was 'possibly' [44% Likelihood (LH)] greater following SR/PLA vs. FULL/PLA (+0.9%). Power output was 'likely' higher (94% LH) following SR/CAF vs. SR/PLA (+6%), with no systematic differences between SR/CAF and FULL/CAF. Perceived fatigue was rank ordered as SR/PLA>SR/CAF>FULL/PLA>FULL/CAF. **CONCLUSION:** The current data suggests that caffeine has the ability to offset performance impairments that may result from a single night of SR compared to a full night of sleep. However, in contrast to our previous report, this interpretation is weakened by the fact that EX2 performances were similar between SR and FULL. Regardless, athletes may want to consider caffeine supplementation as a viable strategy to offset the negative impact of occasional sleep restriction.

2417 Board #253 June 1 11:00 AM - 12:30 PM

**Acute Effect of Different Doses of Caffeine on Strength and Calcium Release**

Luis H. Boiko Ferreira[1], Andre C. Smolarek[1], Luis P. G. Mascarenhas[2], Cleyton S. Oliveira[1], Bruna A. Zandoná[1], Brad J. Schoenfeld[3], Alan C. Utter, FACSM[4], Steven R. McAnulty[5], Tácito P. Souza-Junior[1]. *[1]Universidade Federal do Paraná, Curitiba, Brazil. [2]Universidade Estadual do Centro-Oeste, Irati, Brazil. [3]CUNY Lehman College, Bronx, NY. [4]Texas Woman's University, Dentron, TX. [5]Appalachian State University, Boone, NC.* (Sponsor: Alan C. Utter, FACSM)

*(No relevant relationships reported)*

Although the benefits of caffeine on aerobic performance have been well-established, knowledge about the effect of different doses of caffeine on strength and mechanisms related to calcium release, such as inhibition of specific phosphodiesterases and antagonistic actions at the level of adenosine receptors are lacking. We aimed to analyze these effects on resistance exercises. PURPOSE: Analyze the acute effect of different doses of caffeine on strength and calcium release in recreationally trained men. METHODS: The effect of different doses of caffeine on strength, calcium release, RPE, and TG were assessed in 13 recreationally active young adults (age 19 ± 2 yrs), who performed three tasks on three different occasions with a washout of 14 days between sessions. Day one involved collecting baseline data and acclimating participants to the protocol to determine the weight loads at each subject's 10 RM. Participants were instructed to avoid food or beverages that may contain caffeine two days before the tests. The effect of different doses of caffeine on strength was evaluated in three different resistance exercises: bench press (BP); deadlift (DL); and squats (SQ). Blood samples were collected immediately upon arrival to the laboratory, followed by consumption of a standardized isocaloric shake along with capsules containing different doses of caffeine: 6mg • kg $^{-1}$ (CF1); 8mg • kg $^{-1}$ (CF2); or placebo (CG). A additional blood samples were collected 45 minutes after caffeine/placebo consumption and immediately after the execution of each exercise. The supplementation followed a double-blind, randomized model. RESULTS: The strength on BP, DL and SQ statistically improved between CG and CF2 (BP 94.3 ± 5.2 to 101.4 ± 3.4; DL 120.7 ± 7.7 to 136.3 ± 7.09; SQ 119.4 ± 7.4 to 132.1 ± 5.2 p<0.05). Although a strength increase was found at CF2 compared to CF1, no other statistical differences were found (BP 98.1 ± 3.8 to 101.4 ± 3.4; DL 130.2 ± 8.3 to 136.3 ± 7.09; SQ 129.5 ± 8.01 to 132.1 ± 5.2 p=0.001). Calcium release statistically improved in CF2 in comparison to CF1 and CG (10.9 ± 0.2 to 8.9 ± 0.4 and 10.9 to 8.3 ± 0.2 p=0.001). CONCLUSION: An 8 mg • kg $^{-1}$ dose of caffeine seems to be more effective than 6 mg • kg $^{-1}$ for improving strength levels in the BP, DL and SQ; these enhancements were directly related to improvements in calcium release during CF2.

## E-40 Free Communication/Poster - **Endocrinology**

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2418 Board #254 June 1 9:30 AM - 11:00 AM

**The Associations Between metabolic Syndrome and Thyroid Function In U.S. Adolescents: Nhanes Iii**

Jonathan Austin, Kelly Laurson. *Illinois State University, Normal, IL.*

*(No relevant relationships reported)*

The global prevalence of metabolic syndrome (MetS) and its associated components (high fasting glucose, waist circumference, blood pressure, triglycerides, and low HDL) have increased over the past few decades. In addition, abnormal thyroid hormone levels have been found to manifest in a cascade of metabolic dysfunction, which may be linked to MetS in youth. **PURPOSE:** The purpose of the study is to investigate the association between MetS, its components, and markers of thyroid function in a nationally-representative sample of adolescents. **METHODS:** The National Health and Nutrition Examination Survey III (1988-1994) collected data on the components of metabolic syndrome and thyroid function in 1,322 adolescents aged 12-18.9 years (613 males and 709 females). Participants were grouped based on MetS status, number of MetS components, and markers of thyroid function using age- and sex-specific reference values (including thyroid stimulating hormone [TSH], thyroxine [T4], antimicrosomal antibody [AMA], and anti-thyroglobulin antibody [TgAb]. Logistic models were used to predict the status of the thyroid markers (as high/low) from MetS status, controlling for age, sex, and race/ethnicity. **RESULTS:** The prevalence of metabolic syndrome was 5.4% in the full sample. The logistic models indicated the MetS positive group had a significantly lower odds of having a low TSH (OR = 0.06, 95%CI [0.01, 0.5], p = 0.005) compared to the MetS negative group. However, follow-up analyses revealed adolescents with ≥ 2 MetS components were more likely to have high TSH (OR = 5.0, 95%CI [1.4, 18.2], p = 0.013) and be

positive for AMA (OR = 2.6, 95%CI [1.1, 6.7], p = 0.042), while being less likely to have low TSH (OR = 0.07, 95%CI [0.01, 0.31], p < 0.001) compared to those with 1 or 0 components. No associations were found between high/low T4 or TgAb and MetS or MetS components (all p > 0.05). **CONCLUSION:** In this nationally-representative sample of adolescents, those with multiple MetS components were more likely to have elevated TSH and be positive for AMA, while being less likely to have low TSH. T4 and TgAb values were similar, regardless of MetS status. Even in adolescence metabolic dysfunction appears to be associated with some markers of thyroid function.

2419 Board #255 June 1 9:30 AM - 11:00 AM

### Evidence of Hypothalamic Regulation by AVP and CRH on Running-Induced Stress Response

Kanako Takahashi, Takeru Shima, Jangsoo Yook, Mariko Soya, Hikaru Koizumi, Masahiro Okamoto, Subrina Jesmin, Hideaki Soya. *University of Tsukuba, Tsukuba, Japan.*

*(No relevant relationships reported)*

Moderate exercise with an intensity near the lactate threshold (LT) is beneficial to human health and one of the possible underlying mechanisms of this may be exercise-induced activation of the hypothalamus with enhanced stress and metabolic responsiveness. In general, adrenocorticotropic hormone (ACTH) secretion, a potential systemic stress marker, is regulated by the hypothalamic corticotropin-releasing hormone (CRH) through the CRH type 1 receptor (CRH1R), which is enhanced by hypothalamic arginine vasopressin (AVP) via the AVP $V_{1b}$ receptor ($V_{1b}R$). Conversely, it has been suggested that ACTH secretion during exercise above the LT is mainly regulated by AVP, not CRH. However, to date there is no clear evidence for how exercise-induced ACTH secretion is enhanced *via* these factors. **PURPOSE**: To elucidate whether AVP and/or CRH regulates exercise-induced ACTH secretion using specific receptor antagonists.
**METHODS**: Rats acclimatized to treadmill running were randomly divided into four groups: Vehicle, SSR ($V_{1b}R$ antagonist), CP (CRH1R antagonist), and SSR+CP injection groups, based on i.p. injection of these drugs before running on a treadmill at just above LT (21.5 m/min) for 30 min. Blood was collected from a catheter inserted into the right external jugular vein before the injection and pre- and post-running to measure blood lactate and plasma ACTH levels.
**RESULTS**: Baseline lactate and ACTH levels in all groups were unaffected irrespective of drug treatment. Post-running blood lactate levels were significantly higher than pre-running ($p<0.0001$, all groups) with no inter-group difference. Plasma ACTH levels did not increase after running in the SSR+CP group ($p>0.05$ for SSR+CP group, cp. $p<0.0001$ for Vehicle, SSR and CP groups). Post-running ACTH levels were lower in all antagonist groups compared to the Vehicle group ($p<0.0001$ for SSR, CP, and SSR+CP vs. Vehicle group). ACTH levels for the SSR+CP group decreased compared to those for the SSR and CP groups ($p<0.05$ for SSR+CP vs. SSR and CP, respectively).
**CONCLUSIONS**: We revealed for the first time that exercise-induced ACTH secretion is regulated by both AVP and CRH with concomitant blood lactate increase. Further, our results suggest that AVP and CRH cooperatively enhance exercise-induced ACTH response independent of metabolic response.

2420 Board #256 June 1 9:30 AM - 11:00 AM

### Changes in Muscle Strength Following Cross-sex Hormone Treatment in Transgender Individuals

Anna Wiik, Tommy R. Lundberg, Mats Lilja, Daniel P. Andersson, Stefan Arver, Thomas Gustafsson. *Karolinska Institutet, Stockholm, Sweden.*

*(No relevant relationships reported)*

Many biological differences seen in men and women are driven by relative differences in estrogen and testosterone levels. In transgender individuals, gender-affirming treatment includes inhibition of endogenous sex hormones and subsequent replacement with the cross-sex hormones. Yet, the effect of this treatment on functional muscle strength remains poorly described. **PURPOSE**: The aim of the current study was to assess the effects of an altered sex hormone pattern on muscle strength.
**METHODS**: Twelve transgender individuals, 6 male to female (tranwomen) and 6 female to male (transmen) who had been accepted to start gender-affirming medical intervention, were recruited. Knee extensor and flexor muscle strength was assessed using isokinetic dynamometry at three different angular velocities (0, 60 and 90 °/s). The assessments were made at four time points: (T1) before treatment initiation, (T2) four weeks after initiated gonadal hormonal down regulation but before hormone replacement, (T3) three months after hormone replacement therapy and (T4) eleven months after hormone replacement therapy.
**RESULTS**: There were significant ($P<0.05$) group x time interactions at each angular velocity. Thus, while the transmen increased their strength over the four time points, strength levels were generally maintained in the transwomen. When averaging the three strength tests, knee extension (16%) and knee flexion (34%) strength increased from T1 to T4 in transmen. The corresponding changes in the transwomen group were -6% and 0%, respectively.
**CONCLUSIONS**: These results show that ~1 year of cross-sex hormone treatment results in increased muscle strength in transmen. However, transwomen maintain their strength levels throughout the treatment period. We conclude that the altered sex hormone pattern induced by gender-affirming treatment differentially affect muscle strength in transmen vs. transwomen.

2421 Board #257 June 1 9:30 AM - 11:00 AM

### Soy Protein Supplementation Is Not Adipogenic Or Estrogenic In Young Men When Combined With Resistance Training

Cody Haun, C. Brooks Mobley, Christopher Vann, Matthew Romero, Paul Roberson, Petey Mumford, Wesley Kephart, James Healy, Romil Patel, Shelby Osburn, Darren Beck, Michael Roberts. *Auburn University, Auburn, AL.*

*(No relevant relationships reported)*

**PURPOSE**: : Sex hormone physiology (e.g., estradiol, testosterone) may be affected by soy and/or whey protein consumption. Alterations in sex hormones due to resistance training (RT) and/or protein supplementation may explain meaningful variation in adipocyte and skeletal myocyte size alterations. Consequential molecular signaling in these cell types remain unclear. Therefore, we examined effects of RT and soy (SPC), whey (WPC), or placebo (PLA) supplementation in young men.
**METHODS**: 47 healthy, young men were partitioned into PLA, SPC, or WPC groups and completed 12 weeks of RT. Body composition, serum hormones, androgen signaling markers in myocytes, and estrogen signaling markers in adipocytes were examined using DXA, ELISA, western blotting, PCR, and immunohistochemistry.
**RESULTS**: Testosterone increased over time, but more so in subjects consuming WPC ($p<0.05$). Adipocyte mRNA expression of the estrogen receptor alpha increased ($p<0.05$), as did hormone sensitive lipase over time ($p<0.05$). Skeletal muscle androgen receptor mRNA expression increased while ornithine decarboxylase mRNA decreased over time ($p<0.05$). Alterations in body composition, adipocyte, and myocyte morphology were not significantly different between groups ($p>0.05$). Changes in 17β-estradiol and testosterone explained <3% of alterations in adipocyte and myocyte size.
**CONCLUSIONS**: These data suggest primarily RT-mediated effects with little influence of protein type and hormonal changes.

2422 Board #258 June 1 9:30 AM - 11:00 AM

### Relationship Between Wnt Signaling Inhibitors And Muscle Function In Young And Middle-aged Premenopausal Women

Pragya Sharma Ghimire[1], Samuel Buchanan[2], Michael G. Bemben, FACSM[2], Debra A. Bemben, FACSM[2]. *[1]Lander University, Greenwood, SC. [2]The University of Oklahoma, Norman, OK.* (Sponsor: Dr. Debra A Bemben, FACSM)

*(No relevant relationships reported)*

The Wnt signaling pathway, an important regulator of skeletal development, is inhibited by several glycoproteins including sclerostin and Dickkopf -1 (DKK-1). Animal studies have reported Wnt 7a plays an important role in skeletal muscle growth and improving strength. However, to date, no studies have examined relationships between circulating levels of sclerostin and DKK-1 and muscle function in humans.
**PURPOSE:** This study investigated the relationship between sclerostin and DKK-1 with jump and strength variables in young (20-30 yrs, n=25) and middle-aged (35-45 yrs, n=25) women. Further, the effects of age group and physical activity level on muscle function variables were evaluated. Physical activity levels were based on the International Physical Activity Questionnaire. **METHODS:** Serum sclerostin and DKK-1 levels were measured in fasting morning blood samples by ELISA. Lower body strength and power were assessed by a two-leg press maximal strength test (1RM) and a vertical jump test (Just Jump Mat, Tendo Sports Machine), respectively.
**RESULTS**: Two-way ANOVA showed a significant age group effect for JH, relative jump power (RJP), and 1RM ($p<0.05$), which were higher in young women (Table 1). There were no significant differences in muscle performance variables based on physical activity levels. Jump height (JH) was negatively correlated ($r= -0.27$, $p< 0.05$) with sclerostin levels. **CONCLUSION:** Lower muscle strength and jump height in middle-age women supports an age-related decrease in muscle function. Generally, sclerostin and DKK-1 were not related to muscle performance variables.
Table 1. Muscle Function Variables based on Age Group and Physical Activity Levels (Mean ± SD)

| Variables | Young (n=25) | | Middle-aged (n=25) | |
|---|---|---|---|---|
| | Low-Moderate (n=13) | HEPA-Active (n=12) | Low-Moderate (n=12) | HEPA-Active (n=13) |
| JH (inches) ** | 13.43 ± 3.10 | 14.13 ± 2.69 | 11.12 ± 2.52 | 11.20 ± 3.33 |
| Velocity (m/s) | 0.99 ± 0.13 | 1.04 ± 0.09 | 0.94 ± 0.13 | 0.94 ± 0.09 |
| Jump Power (watts) | 647.40 ± 107.99 | 698.13 ± 141.61 | 622.91 ±142.39 | 593.20 ± 127.62 |
| RJP (watts/kg)* | 9.85 ± 1.30 | 11.44 ± 3.69 | 9.22 ± 1.49 | 9.17 ± 1.02 |
| 1RM (kg)* | 125.17 ± 25.07 | 144.29 ± 36.90 | 113.24 ± 20.18 | 121.67 ± 29.23 |

** p<0.01, * p<0.05 Significant age group effect; HEPA-Health enhancing physical activity

2423 Board #259 June 1 9:30 AM - 11:00 AM

### Acute Resistance Exercise on Bioactive and Immunoreactive Growth Hormone in Women.

Emily M. Post[1], Matthew K. Beeler[1], William H. Dupont[1], Lydia K. Caldwell[1], John P. Anders[1], Vincent H. Hardesty[1], Emily C. Barnhart[1], Emily C. Borden[1], Jeff S. Volek[1], Wesley C. Hymer[2], William J. Kraemer, FACSM[1]. *[1]The Ohio State University, columbus, OH. [2]The Pennsylvania State University, University Park, PA.* (Sponsor: Dr. Wiliiam J. Kraemer, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: The purpose was to determine the differences between trained and untrained women for concentrations of BGH and IGH in response to acute resistance exercise.
**METHODS**: Untrained recreationally active women (UT) (N= 12), mean ± SD: 24 ± 2.4 yr, 167 ± 6.3 cm, 68.8 ± 7.3 kg, 27.3 ± 4.0% body fat, and trained women (TW) (N= 12), 25 ± 3.4 yr, 168 ± 7.3 cm, 69.8 ± 6.3 kg, 19.3 ± 2.7% body fat gave informed consent. Trained status was determined by participation in aerobic/resistance training programs for at least 1 year. The women were tested for 1 repetition maximum strength (1 RM) in the squat and were familiarized with the squat test protocol that consisted of 6 sets of 10 repetitions at 75% of their 1 RM with 2 minutes rest between sets. Testing was performed during the early follicular phase between 0630 and 1100 after an 8- to 12-h fast. Pre-exercise blood samples were obtained via standard venipuncture 15 min before the test and post-exercise samples were obtained immediately after the resistance training test protocol. Plasma was collected and assayed for IGH using polyclonal and monoclonal assays. Total BGH was assayed using the rat tibial line *in vivo* bioassay. A two-way analysis of variance (2 X 2) for group and time were used to analyze the data, with $p \leq 0.05$ defined as significance.
**RESULTS**: The TW were significantly stronger than the UT in the squat. Both groups significantly increased their IGH concentrations post-exercise, with the monoclonal assay showing significantly higher values than polyclonal assays and TW showing greater post-exercise values than UT [Monoclonal: (TW: 5 ± 2 to 19 ± 3 µg/L-1, UT: 4.9 ± 2 to 10.2 ± 3.0 µg/L-1)]. BGH did not increase pre to post exercise in either group, yet TW had significantly higher pre-exercise and post-exercise BGH (3900 ± 233 to 4100 ± 323 µg/L-1) than UT women (2500 ± 333 to 2100 ± 223 µg/L-1). BGH was significantly higher than IGH assays at all time points.
**CONCLUSIONS**: Resistance training impacts both the BGH and IGH secretion patterns from the anterior pituitary gland. IGH is acutely increased in response to resistance training in women, with an even higher response in trained women. BGH is chronically higher in trained women than untrained, but shows no response with acute resistance training. These findings may be more responsible for GH's role in chronic resistance training adaptations.

## E-41 Free Communication/Poster - Injury Risk Assessment and Readiness to Return to Sport

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2424 Board #260 June 1 9:30 AM - 11:00 AM

### The Reliability And Criterion Validity Of A Novel Dorsiflexion Range Of Motion Screen

Kyle B. Kiesel[1], Kate Schwartzkopf-Phifer[1], Bethany Huebner[1], Garrett S. Bullock[2], Mary Beth Garner[1], Joshua Hayden[1], Kyle Matsel[1], Risa Ricard[1], Phillip J. Plisky[1]. *[1]University of Evansville, Evansville, IN. [2]Mountain River PT, Chatham, VA.*

*(No relevant relationships reported)*

**Purpose:** Limited ankle dorsiflexion (DF) is associated with abnormal biomechanics as well as lower extremity injuries. Identifying and correcting restricted ankle DF may be a viable preventative strategy to normalize motor control and reduce injury. A reliable ankle screen may help clinicians to identify decreased ankle range of motion (ROM). The purpose of this study was to determine the reliability and criterion validity of a novel standing ankle dorsiflexion screen (SADS). It is proposed that the SADS will demonstrate strong inter-rater reliability and criterion validity. **Methods:** 37 healthy subjects (74 ankles) participated in the study. Ankle DF ROM was measured using an electronic inclinometer by 2 raters. Four raters measured ankle DF using the criteria of the SADS. The SADS is performed in a heel-to-toe position. Subjects performed DF by dropping their back knee forward as far as possible without lifting their back heel. The back-ankle DF is scored by identifying the position of the anterior knee in relation to the medial malleolus of the front limb. It scored as either beyond the front of the malleolus (pass), or behind the front of the malleolus (fail). Measurements were obtained by four raters, two times per ankle, with 5 minutes of rest between measurements to prevent a treatment effect. Reliability was calculated using an ICC between the 2 raters using the electronic inclinometer and using a Kappa coefficient between the 4 pairs of raters for the SADS. **Results:** The ICC values from the electronic inclinometer were reported as mean values for the 3 trials at 0.95 (0.92-0.97). The Kappa values were calculated for a single trial for SADS and ranged from 0.61-0.81 with percent agreement ranging from 86%-94%. There was a statistically significant difference ($p<0.001$) in ankle DF ROM between the behind category (mean DF = 41.3° SD 4.7°) and the beyond category (mean value was 51.8° SD 6.1°). **Conclusions:** This novel ankle screen can be considered reliable for screening ankle DF ROM. Criterion validity, as compared to a standard goniometric measure, can also be considered meaningful. The screen may provide clinicians an effective tool to screen for ankle DF ROM deficits.

2425 Board #261 June 1 9:30 AM - 11:00 AM

### Validation of a Modified Functional Movement Screen Test for Division III Female Soccer Players

Tiffany R. Widseth, Ana B. Freire Ribeiro. *Augsburg University, Minneapolis, MN.* (Sponsor: Dr. Mark Blegen, FACSM)

*(No relevant relationships reported)*

**Abstract**
**Background:** The Functional Movement Screen (FMS) is comprised of seven tests to identify compensatory movement patterns that may increase injury risk and reduce performance. A modified FMS (MFMS) was created by Augsburg Athletic Trainers to improve screening efficiency and includes three original FMS tests: shoulder mobility, active straight leg raise, trunk stability pushup, and a newly added test; the vertical drop jump (VDJ), all scored on a simplified 0-2 scale.
Objective: This study aimed to validate the MFMS for DIII female soccer players.
**Methods:** Sixteen NCAA DIII soccer players and twenty non-athlete controls were recruited and completed two trials of FMS and MFMS. Reliability was calculated as Pearson Product Moment. Concurrent validity was calculated between FMS and MFMS scores, using R Statistical Software.
**Results:** Mean age of soccer group was 21 (SD=1.37) and control 21.05 (SD=1.61). Mean FMS score for soccer group was 14.38 (SD=1.54) and control 13.35 (SD=2.39). Mean MFMS score for soccer was 5.62 (SD=0.96) and control 4.95 (SD=0.69). Soccer scores for the first MFMS trial were significantly larger than controls' ($p$=0.02). FMS reliability coefficient was 0.99 and MFMS' was 0.88.
**Discussion:** There were moderate positive correlations between FMS and MFMS for the
soccer group (r=0.51) and for controls (r=0.46), but they were not large enough to validate the MFMS. When the MFMS was rescored on the original 0-3 scale (excluding VDJ) it was valid for both groups (soccer r = 0.79, controls r= 0.83).
**Conclusion:** The MFMS is not valid, suggesting potential issues with the new scoring system.

**Keywords:** Functional Movement Screen (FMS), validity, reliability, DIII Female soccer players

2426 Board #262 June 1 9:30 AM - 11:00 AM

### Effect of Instability in Legpress Testing on Strength & Muscle Activity in Functional Ankle Instability

Mina Khajooei, Chiao-I Lin, Müller Steffan, Frank Mayer. *Potsdam University, Potsdam, Germany.*

*(No relevant relationships reported)*

Compensating instable situations is an important functional capability to maintain joint stability, to compensate perturbations and to prevent (re-)injury. Therefore, a reduced maximum strength and altered neuromuscular activity is expected by inducing instability to high loading test situations. Possible effects are not clear for induced instability during maximum legpress tests in healthy and furthermore in subjects with functional ankle instability (FAI).
**PURPOSE:** First, to compare maximum strength and lower leg muscle activity between stable (S) and unstable (UN) maximum legpress tests. Second, to evaluate the association between FAI and effect of instability during testing. **Methods:** 18 male subjects (12 healthy/6 subjective FAI, age: 28±4yrs, height: 180±8cm, weight: 80±9kg, physical activity: 6±5h/wk) were included and their ankle function was quantified by the Foot and Ankle measure (FAAM) questionnaire. Five maximum strength test with leg press isokinetic device in concentric (CON) and eccentric (ECC) mode were measured. Muscle activity were recorded by EMG of m. tibialis anterior (TA), m. peroneus longus (PL) and m. soleus (SOL). Peak force ($F_{Peak}$, Nm) for maximum strength and root mean square (RMS, Hz) for EMG amplitude of TA, PL and SOL were calculated. Comparisons of conditions (S vs UN) were analyzed descriptively and with paired T-tests. For association, Pearson correlation was applied using FAAM score and RMS differences (condition UN – S). **Results:** UN lead to a significant peak force reduction of 10.1% (CON) and 13.7% (ECC) significantly ($p<0.001$). RMS of PL in CON and TA in CON and ECC mode were 26.2%, 59.7% and 35.8% respectively significant higher in UN footplate in comparison with S ($p<0.01$). In addition, no correlations between FAI and loss of strength or changes in muscle activity have been found. **Conclusion:** Reduction in peak force and increased muscle activity confirmed the expected increased effort to compensate instability. The missing association between FAI and amount of altered strength or muscle activity might be attributed to a low level of FAI in the included subjects.

2427 Board #263 June 1 9:30 AM - 11:00 AM

### Comparing The Possible Ankle Dorsiflexion Effects Of The Mulligan Ankle Dorsiflexion Mwm In Weight-bearing To The Mulligan Fibula Mwm For Dorsiflexion In Non-weight-bearing

Smokey Fermin[1], Lucas Bianco[2], Robert Oates[3]. *[1]University of Idaho, Moscow, ID. [2]Georgia Southwestern State University, Americus, GA. [3]Wilmington College, Wilmington, OH.*

*(No relevant relationships reported)*

Decreased ankle dorsiflexion can be a factor that limits participation in activities and predisposes individuals to chronic issues. Traditionally, stretching protocols, strengthening of muscles, balance training, and traditional joint mobilizations have been used to increase ankle dorsiflexion. Although current methods have been successful at mitigating ankle dorsiflexion restrictions, alternative treatments should be researched. **Purpose:** Determine the possible effect of two Mulligan Mobilization with Movement (MWM) Techniques on ankle dorsiflexion **Methods:** Individuals were recruited at three college athletic training clinics around the United States. Participants were randomly allocated into two groups, the Mulligan Ankle Dorsiflexion MWM in weight bearing and the Mulligan Fibula MWM for Dorsiflexion in non-weight-bearing. Once allocated, clinicians applied a single treatment of three sets of ten. Distance from wall and Tibial angle for the weight-bearing dorsiflexion lunge test was collected pretreatment, post treatment, at a 48-hour follow up, and at a one week follow up. **Results:** Significant effect was found for WBLT Distance ($F(2,11) = 54.8$, $p < .001$), WBLT Angle ($F(2,11) = 77.5$, $p < .001$) Y-Balance Composite ($F 2,11) = 6.1$, $p < .004$), and WBLT PSFS ($F(2,11) = 12.9$, $p < .004$). **Conclusions:** The results support the use of both the Mulligan Concept techniques to increase ankle dorsiflexion ROM. The immediate increases in ankle dorsiflexion ROM were maintained at one week follow-up.

2428 Board #264 June 1 9:30 AM - 11:00 AM

### Early Sport Specialization and Bilateral Tissue Differences in Overhead Athletes

Aaron Struminger[1], Alfred Atanda, Jr.[2], James Richards[3], Thomas Buckley[3], Charles B. Swanik[3]. *[1]Eastern Michigan University, Ypsilanti, MI. [2]Nemours/Alred I. DuPont Hospital for Children, Wilmington, DE. [3]University of Delaware, Newark, DE.*

*(No relevant relationships reported)*

Early sport specialization is a growing concern because it may lead to repetitive stress and excessive joint loading. Current data indicate that early specialization leads to injury, but its role in producing underlying tissue changes has not been examined.
**PURPOSE**: To determine effects of sport specialization on upper extremity tissue characteristics.
**METHODS**: Seventy-five collegiate baseball, softball, and tennis players (36 male, 39 female; age = 19.8 ± 1.4 years, height = 175.3 ± 10.4 cm; weight = 76.0 ± 13.9 kg) participated. Subjects completed surveys and were grouped based on age when they chose a primary sport and started competing for more than 8 months/year. Shoulder range of motion was measured with an inclinometer. Posterior capsule thickness, humeral retrotorsion, and ulnar collateral ligament (UCL) thickness were collected via ultrasound. For each measurement, non-dominant arm values were subtracted from dominant arm. Data were analyzed with hierarchical multiple regression, which determined group differences while controlling for sport played.
**RESULTS**: Sport specialization criteria were met by 21 athletes before age 11 (Early), 28 athletes between the ages of 11-14 (Middle), and 25 athletes age 15 or older (Late). Shoulder internal (Early = -9.7 ± 5.6°; Middle = -8.8 ± 7.0°; Late = -8.2 ± 6.2°) and external (Early = 9.6 ± 11.1; Middle = 10.4 ± 11.8; Late = 9.9 ± 8.1) rotation produced clinically significant variations bilaterally but no statistically significant group differences (Internal: $R^2 = .08$, $p = .23$; External: $R^2 = .07$, $p = .26$). No group differences were noted for posterior capsule thickness ($R^2 = .07$, $p = .28$), humeral retrotorsion ($R^2 = .16$, $p = .07$), or UCL thickness ($R^2 = .11$, $p = .09$). Mean humeral retrotorsion (10.2 ± 6.1°) and UCL thickness (0.42 ± 0.61 mm) were greater on the dominant arm.
**CONCLUSIONS**: Early sport specialization does not appear to exacerbate the bilateral tissue differences naturally present in collegiate overhead athletes. Therefore, sport specialization may be less concerning at the tissue level than the stress of overhead sport for the average athlete. Since the magnitude of tissue maladaptation associated with injury remains unknown, more data should be collected to determine connections among specialization, tissue characteristics, and injury rates in this population.

2429 Board #265 June 1 9:30 AM - 11:00 AM

### Preseason Physicals, Are Important Factors Missing?

Garth Babcock. *Eastern Washington University, Cheney, WA.* (Sponsor: Wendy Repovich, FACSM)

*(No relevant relationships reported)*

Research shows NFL football players are at increased risk for Metabolic Syndrome (MetS) but it is unclear when MetS develops or whether additional tests in a sports pre-particpation (PPE) exam might identify risk factors (RF). **PURPOSE:** To identify MetS RF and their associations using the National Cholesterol Education Program Adult Treatment Panel (NCEP ATP) III standards and measures of abdominal fat in college players. **METHODS:** Forty-seven freshmen from a Division 1 FCS (n = 15), and a Division 3 (n = 32) football team volunteered to be tested during their PPE. Tests included fasting Triglycerides (TG), High Density Lipoprotein (HDL), blood glucose (BG), blood pressure (BP), suprailiac (SIWC) and umbilical (UWC) waist circumference, percent body fat (%BF), and subcutaneous (SCAT) and visceral (VAT) fat depth. All NCEP ATP guidelines were followed and %BF, SCAT, and VAT were measured using a BodyMetrix™ Ultrasound. Statistical analysis using SPSS (v24) included descriptive statistics, a Pearson Correlation, and a Stepwise Multiple Regression to determine RF present, and the relationship between all clinical measures. **RESULTS:** Ten players (21%) met the criteria for MetS (n = 2 with 3, n = 6 with 4, and n = 2 with 5 RF). Division 1 had a higher percent of players (n = 5, 33%, 3 were offensive linemen) meeting the criteria compared to Division 3 (n = 5, 16%, 1 was an offensive lineman). All NCEP ATP III risk factors except BG were correlated (all positive except HDL) with meeting the criteria for MetS, with the SWC being the highest ($r = .77$, $p = .001$). Using non NCEP ATP III RF, significant positive correlations were found between %BF ($r = .65$, $p = .0001$, SCAT ($r = .35$, $p = .013$),and VAT ($r = .49$, $p = .001$). Lineman meeting the criteria for MetS had a %BF >21. Five variables (SIWC, TG, HDL, BG & VAT) were statistically significant in predicting MetS ($p = .001$, $R^2 = .83$). The stepwise multiple regression reported that SIWC accounted for the greatest variance on the MetS prediction ($p < .000$, $ß = .65$, $R^2 = .65$), and when combined with TG accounted for 73% of variance. **CONCLUSIONS:** The data suggests that freshmen football players have a high incidence of MetS RF. Waist circumference, specifically at the suprailiac location, TG, and %BF should be included in PPE evaluation with follow up for early intervention as necessary.

2430 Board #266 June 1 9:30 AM - 11:00 AM

### Ultrasound Imaging to Evaluate Acute Adaptations of the Medial Elbow Joint Complex

Kevin P. Lynch, Arie J. van Duijn, Shawn D. Felton, Mitchell L. Cordova, FACSM. *Florida Gulf Coast University, Fort Myers, FL.* (Sponsor: Mitchell L. Cordova, FACSM)

*(No relevant relationships reported)*

Musculoskeletal ultrasound imaging (MSKUI) has become an increasing studied assessment tool in orthopedic sports medicine. Several studies have investigated ulnar collateral ligament (UCL) integrity and morphology in the throwing arm of baseball players with MSKUI. Research data has indicated that UCL thickening and medial joint space (MJS) widening occurs in athletes during sustained competition.
**PURPOSE**: To examine acute UCL thickness and MJS adaptations in the throwing arm of Division I collegiate baseball pitchers with MSKUI following one in-game performance.
**METHODS**: Ten NCAA Division I collegiate baseball pitchers (mean age 20.4 ± 1.4 yrs) with no history of significant upper extremity injuries participated. Musculoskeletal ultrasound images were obtained with a GE LOGIQ e ultrasound unit before and immediately after (< 15 minutes) pitching performance during each subject's first game of the season. A 3 kg valgus force was applied with a handheld dynamometer (Hoggan Scientific microFET 2) 20 cm distal to the medial epicondyle of the throwing arm during imaging. Post-imaging ligament thickness measurements were performed at the mid-substance of UCL and at the apex of the trochlea. Moreover, post-imaging measurements were performed from the apex of the trochlea to the apex of the ulna to evaluate MJS. Changes to UCL thickness (mid-substance and apex of the trochlea) and MJS were analyzed using paired samples t-tests.
**RESULTS**: There was no significant difference in mid-substance UCL thickness width before (5.72 ± 0.7mm) and after performance (5.70 ± 0.7mm; t (9)= .36, p = .73). With respect to apex of trochlea UCL width, no significant differences were found before (2.67 ± 0.7mm) and after (2.61 ± 0.6mm; t (9)= 1.30, p = .23) performance. When assessing MJS, a significant change of ~4% was observed before (6.30 ± 1.5 mm) and after (6.60 ± 1.5; p= .005). Controlling for the innings pitched [F (1,7) = .11, p = .75] and pitch count [F (1,7) = .21, p = .66] did not affect the change in MJS.
**CONCLUSIONS**: A significant MJS widening did occur after one pitching outing at the start of the season; whereas, no changes were observed in UCL thickness measured at two different locations. Further research is needed to understand the etiology of increased medial elbow joint widening in pitchers at the start of the collegiate baseball season.

2431 Board #267 June 1 9:30 AM - 11:00 AM

### Does Shoulder Joint ROM Predict Medial Elbow Joint Space and UCL Thickness?

Shawn D. Felton, Arie J. van Duijn, Mitchell L. Cordova, FACSM. *Florida Gulf Coast University, Fort Myers, FL.* (Sponsor: Mitchell L. Cordova, FACSM)

*(No relevant relationships reported)*

Baseball athletes, especially pitchers, are prone to ulnar collateral ligament (UCL) injuries of the elbow. It is well documented that baseball athletes typically exhibit an increase in shoulder external rotation range of motion (ERRM) and a decrease in internal rotation range of motion (IRRM) while maintaining total rotational range of motion (TROM) in the throwing extremity. Furthermore, loss of TROM and ERRM may be associated with increased risk for UCL injury. Ultrasound imaging allows clinicians to evaluate UCL thickness and medial joint space (MJS) opening non-invasively.
**PURPOSE**:
To examine if shoulder joint motion (ERRM, IRRM, TROM), predicts medial elbow joint space (MJS) opening and UCL thickness in asymptomatic collegiate baseball pitchers at the start of the pre-season.
**METHODS**:
Nineteen asymptomatic NCAA Division I collegiate baseball pitchers (age 20.4 ± 1.45 yrs) participated in this study. Ultrasound images were obtained of the medial joint space and UCL on the participant's throwing arm using a GE LOGIQ e ultrasound unit. Participants were placed supine with a wedge placed underneath their pitching hand to maintain elbow position at 30 degrees. A 3 kg valgus force, as measured by a hand held dynamometer, was applied 20 cm distal to the medial epicondyle. Ligament thickness measurements were performed at the mid-substance of UCL and at the apex of the trochlea. Imaging measurements to evaluate MJS opening were performed from the apex of the trochlea to the apex of the ulna. Standard goniometric procedures were performed with the athlete supine to obtain ERRM, IRRM, and TROM values. Three stepwise linear multiple regression analyses were performed to determine if shoulder joint motion could predict UCL thickness and MJS.
**RESULTS**:
Shoulder joint range of motion did not significantly predict MJS [$R^2$ = .05, F (2,16) = 0.44, p=0.65,], UCL thickness at the mid-substance [$R^2$ = .01, F (2,16) = 0.12, p=0.89], or UCL thickness at the apex of the trochlea [$R^2$ = .04, F (2, 16) = 0.36, p=0.70].
**CONCLUSIONS**:
Measures of shoulder joint ROM do not predict MJS or UCL thickness in asymptomatic baseball pitchers at the start of the season. Further research is recommended to perform multiple imagining sessions throughout the competitive season to further evaluate relationships between shoulder ROM and medial elbow structures.

2432 Board #268 June 1 9:30 AM - 11:00 AM

### Do Biomarkers Play A Role On Tendinopathy?

Leonardo P. Oliveira, Anoop Mayampurath, Nzuekoh Nchinda, Jennifer M. Wolf. *University of Chicago, Chicago, IL.* (Sponsor: Holly Benjamin, MD, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: It is estimated that lower extremity tendinopathy (LE) affects 1.4% of the population and that prevalence increases with the type of sport, level of performance, and body part involved. Achilles and patellar tendon are two sites commonly associated with tendinopathy in the LE. In the upper extremity (UE), the shoulder and elbow are the most frequent locations. The pathophysiology of tendinopathy is thought to be secondary to repetitive use leading to injury. However, medical risk factors such as diabetes have been associated with higher prevalence of the disease. Our goal in this study was to understand the impact of biomarkers and medical risk factors on the prevalence of tendinopathy. **METHODS**: Retrospective chart review of the medical charts of patients evaluated in the ambulatory clinics at the University of Chicago Medical Center from 2006 to 2016 were reviewed for the ICD9/10 codes for tendinitis. Biomarkers (HbA1c, TSH, 25-Hydroxy-VitaminD[VITD], Hemoglobin[Hbg], ANA, ESR, CRP, and Creatinine) were considered valid if obtained within 3 months prior to the diagnosis. Chi-Square Analysis and Independent T-Tests were completed using R, with p<0.05 indicating significance.**RESULTS**: Among 19,682 patients that were found to have biomarkers fulfilling the study criteria, 1648 had the diagnosis of tendinopathy. VITD as a continuous variable (shown on table) as well as categorical (<30 or ≥ 30 ng/dl) was not significantly different between groups. However, quartile-based analysis revealed a higher prevalence of tendinopathy in patients with VITD 18-26 ng/dl (p=0.025). Lower ESR, CRP, and HbA1c were also associated with higher prevalence of tendinopathy.**CONCLUSIONS**: VITD between 18-26 ng/ml was associated with higher prevalence of tendonitis. Tendinopathy was more prevalent in individuals with lower inflammatory markers and fewer comorbidities. VITD deficiency appears to play a role in tendon disease.

| Association of Biomarkers and Tendinopathy | | | |
|---|---|---|---|
| Biomarkers | With The Diagnosis of Tendinopathy | WithoutThe Diagnosis of Tendinopathy | P-Value |
| 25-hydroxy-Vitamin D(ng/ml), mean±SD | 26.2 ±9.2 ng/ml | 26.5±12.4 ng/ml | 0.7966 |
| Hemoglobin A1c, mean±SD | 6.5±1.21 % | 7.5±1.75 % | <0.01 |
| ESR ≥30 mm/hr (n/%) | 63(40%) | 684 (53%) | 0.0021 |
| CRP ≥ 6 mg/L (n/%) | 61 (36%) | 747 (47%) | 0.006 |
| Hbg(Abnormal) men: <13.5 mg/dl or > 17.5 mg/dl / women:<11.5mg/dl or > 15.5 mg/dl (n/%) | 138 (32%) | 3854 (48%) | <0.01 |

2433 Board #269 June 1 9:30 AM - 11:00 AM

### Acceptability of Personal Sensing to Develop a Digital Biomarker of Stress-Related Injury Risk in Athletes

Giampietro L. Vairo, David E. Conroy, Vasant G. Honavar. *The Pennsylvania State University, University Park, PA.* (Sponsor: W. Larry Kenney, FACSM)

*(No relevant relationships reported)*

Stress is a dynamic internal risk factor for musculoskeletal injury but existing monitoring tools are not well-suited for triggering just-in-time adaptive interventions to reduce risk during times of vulnerability. People carry smartphones with a rich array of sensors as they go about their daily lives. Data collected from these sensors offer unprecedented opportunities for developing digital biomarkers to improve health and wellbeing. Realizing the full potential of such data for reducing musculoskeletal injury risk is contingent upon the willingness of individuals to permit the collection and analyses of such data. This may depend on a variety of factors, e.g., those having to do with the target population, intended use of the data, specific types of information being collected, the individuals with whom the information is to be shared and the conditions under which it will be shared, etc. **PURPOSE:** This study examined the willingness of athletes to permit the collection and analyses of their smartphone sensor data to develop digital biomarkers that reliably predict the risk of stress-related musculoskeletal injuries. **METHODS:** College student-athletes (n=75)

completed a 46-item online questionnaire about their interest in a digital biomarker for monitoring stress-related injury risk, and their willingness to share data from specific smartphone sensors to develop that digital biomarker. **RESULTS:** Most athletes (82%) expressed an interest in a digital biomarker for monitoring their stress-related injury risk; however interest was significantly lower if medical staff (73%), coaches (64%), or administrators (60%) would have access to the biomarker (all $p < .01$). Most were willing to share data from sensors capturing motion (88%), environment (93%), location (73%), connections (77%), and usage (65%). Keyboard input was the least accepted source of data with almost 40% reporting they would never share that data to create a digital biomarker. **CONCLUSION:** Athletes generally find it acceptable to share their smartphone sensor data if the data will be used to identify digital biomarkers of stress-related injury risk and to recommend just-in-time stress management interventions for injury prevention.

2434 Board #270 June 1 9:30 AM - 11:00 AM

### The Development of a Single Leg Hurdle Test to Assess Return to Sport Readiness

Hayley Reed, Chelsey Roe, Samantha Price, Gaelen Athanaze, Jessica Schilling, Brian Noehren, FACSM. *University of Kentucky, Lexington, KY.* (Sponsor: Brian Noehren, FACSM)
*(No relevant relationships reported)*

Few tests of dynamic quadriceps muscle asymmetry exist for return to sport testing. Such a test would be beneficial, as quadriceps asymmetries are associated with higher injury levels once athletes return to play. Current hop tests emphasize horizontal progression, which previous studies have shown recruits the gluteal muscles much more than the quadriceps. Implementing an assessment, such as jumping over a hurdle, into a hop test may require increased demands of the quadriceps. As a first step, we sought to determine the reliability of a new type of hop test using a series of hurdles.
**PURPOSE**: The objective of this study was to assess the between and within session reliability of a new single leg hurdle test.
**METHODS**: 20 healthy subjects (11 M, ages 22.4 ± 3.1, BMI 22.9 ± 3.0) with no prior lower extremity injuries completed a single leg hop over a series of four consecutive 30.5 cm high hurdles. The distance between the hurdles was equal to the subject's leg length with 2 trials preformed on each leg. Performance was measured as the time it took to complete the hurdle series and how many attempts it took them to complete successfully. An error occurred if the subject knocked over a hurdle, hopped to the side of the hurdle or did not stick the landing on the final hop. Reliability between raters as well as within and between days was assessed using an Intraclass Correlation Coefficient (ICC).
**RESULTS:** The average time to complete the hurdle test was (3.63 ±1.59 seconds), and the average difference between days was (0.66 ±0.95 seconds). Between rater reliability (ICC>0.99), between day reliability (ICC=0.90), and within rater same day reliability (ICC=0.98) were all excellent.
**CONCLUSION:** The single leg hurdle test shows excellent within and between day reliability to complete the task. These results indicate that the test is a reliable assessment and establishes its face validity. The greater vertical component associated with this test may bias the hop towards greater quadriceps activation and help screen individuals for asymmetries. Having established the tests reliability, subsequent studies should assess its use for determining return to sport for patients following an injury.

2435 Board #271 June 1 9:30 AM - 11:00 AM

### Development of a Lateral Hop Endurance Test

Jessica Schilling, Chelsey Roe, Samantha Price, Gaelen Athanaze, Hayley Reed, Brian Noehren, FACSM. *University of Kentucky, Lexington, KY.* (Sponsor: Brian Noehren, FACSM)
*(No relevant relationships reported)*

Functional tests for patients attempting to return to sports, typically focus on sagittal plane movement such as a hop test. Additionally, most functional tests do not have an endurance component to them. Many injuries involve aberrant frontal plane control and occur later in a game situation. The development of a lateral endurance hop may prove useful to identify at risk athletes. As a first step, we sought to determine the reliability of a newly developed lateral hop test.
**PURPOSE:** The purpose of this study was to evaluate the reliability of a new lateral hop endurance test.
**METHOD:** 19 healthy subjects (11 M, ages 22.4 ± 3.1, BMI 22.9 ± 3.0) with no prior lower extremity injuries completed 30 second intervals of single legged lateral hopping with the targets separated by 15.24 centimeters. Performance was measured by counting the number of times the subject was able to hop completely over and back. An error was classified as putting a foot down or landing on the target and not counted. Reliability between raters as well as within and between days was assessed using an Intraclass Correlation Coefficient (ICC) and Pearson Product Moment Correlation.
**RESULTS:** The average number of successful hops was (29.20 ±6.35 hops). Between rater reliability (ICC>0.99), between day reliability (ICC=0.94), and correlation between days (r=0.89, p=<0.001) were all excellent.
**CONCLUSION:** The 30 second lateral hop endurance test had excellent reliability between raters and between days as well as a strong correlation between days. Having established the reliability of this test between days and rater, subsequent studies will evaluate differences within injured athletes.

2436 Board #272 June 1 9:30 AM - 11:00 AM

### Jump Training Improves Psychological Impairments and Facilitates Greater Sports Participation in Athletes with ACL Reconstruction

Ryan L. Mizner, Audrey R. Elias. *University of Montana, Missoula, MT.*
*(No relevant relationships reported)*

**PURPOSE**: About 35% of athletes with anterior cruciate ligament (ACL) reconstruction fail to return to their preinjury level of sports participation. Psychological factors, such as fear of reinjury, often prevent athletes who wish to return to their sport from achieving their goal. Limited evidence is available to direct patient care to target these psychological impairments. Most ACL injuries are non-contact in nature and typically occur during a deceleration task such as jump landing. We propose that training focused on improving jump landing performance will improve psychological factors and facilitate increased sports participation.
**METHODS**: Forty-eight athletes completed screening tests an average of 2 years after unilateral ACLR (Wk0). Testing included the ACL-Return to Sport after Injury (ACL-RSI) scale as measure of psychological readiness for sports participation. Athletes (n = 25, 9 men, age = 23 ± 5 yr) who scored below normative ACL-RSI recovery standards (<65%) completed 8 weeks of twice-weekly jump landing training. Retesting occurred at midtraining (Wk4), posttraining (Wk8), and 2 months after training (Wk16). Athletes answered a survey measuring perceived changes in sports participation at the end of training. Changes observed during training were determined via repeated measures ANOVA.
**RESULTS**: ACL-RSI scores improved substantially throughout treatment (mean ± SD; Wk0: 53 ± 18%, Wk4: 67 ± 15%, Wk8: 76 ± 16%; p<0.001). Treatment benefits were maintained over the retention period (Wk16: 81 ± 15%; p=0.052). Four out of 5 athletes trained report that they were more likely to participate in their sports activities after training and two thirds of the cohort described at least a moderate increase in their sports participation.
**CONCLUSIONS**: Progressively dosed jump training that focuses on correcting aberrant landing movements is effective at addressing psychological factors in athletes who self-identified as having limited readiness for sport. The training was also effective at facilitating increased sports participation. Clinicians should consider implementing similar jump training interventions to help athletes who are struggling to return to their desired sports participation because of limited confidence or high fear of reinjury. Funded in part by the Foundation for Physical Therapy.

2437 Board #273 June 1 9:30 AM - 11:00 AM

### An Evaluation of Star Excursion Balance Test In Identifying Athletes At Risk For Injury

Mackenzie Pierson[1], Karlee Burns[2], Mimi Nakajima[2]. [1]*The University of North Carolina at Greensboro, Greensboro, NC.* [2]*California State University Long Beach, Long Beach, CA.*
*(No relevant relationships reported)*

**PURPOSE**: The use of the Star Excursion Balance Test (SEBT) is to screen deficits in dynamic postural control due to musculoskeletal injuries and to identify athletes at greater risk for lower extremity injury. However, the use of the SEBT has not proved reliably in female soccer populations in identifying potential lower extremity injury when assessed during pre-participation physical examinations. **METHODS**: 23 healthy NCAA Division I female soccer athletes; 20.3 (1.2) years, 165.1 (7.62) cm, 59.8 (8.6) kg, participated in this study. Prior to the start of the season, the anterior, posteromedial, and posterolateral SEBT reach distances were measured bilaterally. Each reach distances were normalized for lower limb length. Throughout the season, injury record was maintained by the certified athletic trainer. The athletes were grouped into injured (INJ) and non-injured (N-INJ) athletes. Composite scores for all three reach distances were also calculated.
**RESULTS**: Independent t-test was conducted to compare reach distances for the SEBT between INJ and N-INJ athletes. There were no significant differences between the INJ and N-INJ group for normalized reach distances, nor composite scores of the SEBT. However, there was a significant difference in anterior reach asymmetries for those that sustained an injury (M= 6.06, SD=4.5); t(21)=2.78, p= 0.011) and those that did not sustain a lower extremity injury (M=2.5, SD=1.3). **CONCLUSIONS**: In this study, the SEBT showed differences for lower extremity injury in the female soccer population when assessing the anterior asymmetries. Our results suggest that portions of the SEBT can be incorporated into pre-participation physical examinations to identify soccer athletes who may have a significant difference between limbs and potentially be at an increased risk for lower extremity injury.

2438 Board #274 June 1 9:30 AM - 11:00 AM

### Limb Asymmetries in Post-ACL Reconstruction Patients

Mark Vorensky[1], Nicole Veltri[2], Jamie Kronenberg[2], Joshua M. Tome[2], Rumit Singh Kakar[2]. *[1]NYU Langone Health Orthopedic Center, New York, NY. [2]Ithaca College, Ithaca, NY.*

*(No relevant relationships reported)*

The reinjury rate of young athletes post anterior cruciate ligament reconstruction (ACLR) is 23%. Return to sport (RTS) testing, assessing limb asymmetries between the affected limb (AL) and unaffected limb (UAL), is utilized with hopes of preventing injury. **PURPOSE** To compare performances of the AL and UAL ≥ 12 months post ACLR to the dominant limb (DL) and non dominant limb (NDL) of healthy controls during common RTS tests. **METHODS** 11 ACLR (9 females, 2 males, 22.4±3.7 years old, 5.4±4.2 years post op) and 11 healthy BMI matched controls (9 females, 2 males, 21.7 ±2.1 years old) were recruited. Tests included: Y excursion (anterior, posteriolateral, posteriomedial), hop tests (single hop, triple hop, and triple cross over hop, timed 6m hop), weight bearing lunge and isokinetic concentric peak flexion and extension torque at 60, 120 and 300deg/sec (Biodex System 4 Dynamometer MVP). 3 Acceptable trials for each test and limb were recorded. The limb symmetry index (LSI) equaled 100(AL/UAL) and 100(DL/NDL) for ACLR and control groups respectively and was compared between groups using MANOVA ($p<.05$). LSI ≤ 85% and LSI ≥ 115% were deemed clinically important differences. Pearson correlation coefficients were calculated between peak isokinetic torques and functional tests. **RESULTS** No statistically significant differences between ACLR and control LSIs were observed ($F=1.691$, $p=0.293$, $\eta^2=0.844$, Power=0.289). A clinically significant difference was observed in peak flexion torque at 120deg/s (118.7±55.3%) for controls. There were no clinically significant differences for the ACLR group (93.4±8.8% - 113.4±35.9%). Primarily small correlations were shown between isokinetic and RTS tests. One strong correlation presented between NDL triple hop and 60deg/s peak extension torque for controls ($r=0.74$). **CONCLUSION** For athletes ≥ 12months post ACLR, no statistically or clinically important asymmetries were found for RTS tests compared to controls. These findings question the sensitivity and validity of the current RTS assessment. 3D motion analysis has shown kinematic asymmetries that affect function 2 years post ACLR. Future studies should investigate the role of 3D biomechanical analyses in RTS testing, with hopes to improve injury prevention.

2439 Board #275 June 1 9:30 AM - 11:00 AM

### The Relationship Between The Half Kneeling Ankle Dorsiflexion And A Novel Weight Bearing Lunge Tests

Garrett S. Bullock[1], Phillip J. Plisky[2], Kyle Matsel[2], Allison Weaver[3], Jenna Gourlay[3], Kyle Kiesel[2]. *[1]Mountain River PT, Chatham, VA. [2]University of Evansville, Evansville, IN. [3]ProRehab-PC, Evansville, IN.*

*(No relevant relationships reported)*

**Purpose:** Decreased ankle dorsiflexion has a relationship to lower extremity injury. Utilizing screens to effectively identify decreased dorsiflexion can help improve clinicians' efficiency. The purpose of this study was to compare ankle dorsiflexion range of motion (ROM) using an ordinal scored modified weight bearing lunge test (MWLT) and the established half kneeling dorsiflexion test (HDT). It is proposed that there will be a relationship between MWLT dorsiflexion ordinal scoring and the HDT ROM measurements. **Methods:** 30 healthy subjects (60 ankles) participated in this study. Ankle dorsiflexion ROM was measured using the MWLT and HDT. The MWLT was completed in a standing heel to toe position. The dorsiflexion of the back ankle was scored in relation to how anterior the back knee aligns relative to the medial malleolus of the front ankle. The MWLT is scored on an ordinal scale: behind, within, or beyond the malleolus. The HDT was performed with the patient in a half kneeling position, placing a digital inclinometer just inferior to the tibial tuberosity on the forward leg. Subjects were instructed in both the HDT and MWLT to bring their knee as forward far as possible without lifting their heel off of the ground. All measurements were obtained two times per side, with 5 minutes of rest between measurements to prevent a treatment effect. Statistical analysis was completed using a series of ANOVAs. Tukey post-hoc were used to identify specific group-to-group differences ($p<0.05$). **Results:** Significance was found between HDT and MWLT ($p<0.001$). The mean HDT measurement for the MWLT score of behind was 33.5±2.0 degrees, within was 38.6±1.2 degrees, and beyond was 43.0±0.78 degrees. Tukey post hoc analysis showed that there was a significant difference comparing MWLT score of beyond and behind ($p<0.001$) and beyond and within ($p=0.0097$). No differences were found comparing MWLT score of within and behind to HDT ($p=0.0760$). **Conclusions:** There was a distinct difference in ankle dorsiflexion ROM between the MWLT scores of beyond and behind and beyond and within, when comparing to HDT. There was no difference in the MWLT scores of behind and within when compared to HDT. Future studies should compare goniometric measure of the MWLT to the ordinal scale and further elucidate the differences and underlying causes in the MWLT ordinal scores.

2440 Board #276 June 1 9:30 AM - 11:00 AM

### Assessing Psychological Readiness After ACL Reconstruction: Is It Possible With One Questionnaire?

Adam Meierbachtol, Michael Obermeier, Terese Chmielewski. *TRIA Orthopedic Center, Bloomington, MN.*

*(No relevant relationships reported)*

**Purpose:** The return to sport following anterior cruciate ligament reconstruction (ACLR) may be impeded by psychological factors such as high fear of re-injury (kinesiophobia) or low confidence (self-efficacy). Screening psychological readiness for sport can identify individuals in need of additional intervention. The Anterior Cruciate Ligament Return to Sport after Injury (ACL-RSI) is a 12-item questionnaire to assess psychological readiness for sport in domains of Emotions, Confidence, and Risk Appraisal. The ACL-RSI contains 2 fear of re-injury items (Emotions domain) and 5 confidence items (Confidence domain). Fear of re-injury has lower representation in the ACL-RSI total score and may not be identified to the same extent as confidence level. The purpose of this study was to examine during return to sport after ACLR 1) the relative ranking of ACL-RSI fear of re-injury item scores compared to other item scores and association with ACL-RSI total score, and 2) the association of ACL-RSI domain and total scores with kinesiophobia and self-efficacy questionnaire scores. **Methods:** Participants were 21 patients with ACLR (mean 17.4 years, 11 males) enrolled in a 5 week (10 visit) group-based return to sport training program. ACL-RSI, Tampa Scale for Kinesiophobia-11 (TSK-11) and Knee Activity Self Efficacy (KASE) questionnaires were administered before and after training. **Results:** All questionnaire scores improved from pre- to post-training (ACL-RSI: 63.2 to 73.8, TSK-11: 21.4 to 17.3, KASE: 78.5 to 92.5; $p < .01$). Both ACL-RSI fear of re-injury items ranked in the lowest 3 item scores at pre- and post-training, but had moderate to high correlation with ACL-RSI total score (range: $r=.56$ to .83, $p<.01$). ACL-RSI Confidence domain score and total score were positively correlated with KASE score at pre-training, post-training, and in the pre- to post-training change (range: $r=.50$ to .73, $p <.05$). ACL-RSI Emotions domain score and total score were not significantly correlated with TSK-11 score at any time point ($p>.05$). **Conclusions:** Athletes with high fear of re-injury should be appropriately identified by their ACL-RSI score. It appears necessary to administer the TSK-11 separately to identify high kinesiophobia, whereas a separate questionnaire for knee self-efficacy does not appear warranted.

2441 Board #277 June 1 9:30 AM - 11:00 AM

### Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST) in DIII Collegiate Baseball and Softball Players

Aaron Mallace, David Schilling, Ashraf Elazzazi. *Utica College, Utica, NY.*

*(No relevant relationships reported)*

**PURPOSE:**
The Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST) has been used as an alternative to the push up test to examine upper extremity stability and function. However, no studies have investigated its use in division III collegiate baseball (BB) and softball (SB) players. The purpose of this study was to describe the normative values, power and normalized scores for the CKCUEST for this population.
**METHODS:**
Seventy four division III collegiate athletes (SB n=24; BB n=50) between 18-21 years old signed an approved informed consent. Participants assumed a push-up (male) or a modified push-up (female) position and were instructed to alternately touch two pieces of tape placed on the ground 36 inches apart as many times as possible for 15 seconds. After one submaximal warm-up, the average number of lines touched (CKCUEST value) from three trials was calculated. Power and a normalized score were calculated based on the CKCUEST value and the participant's weight or height, respectively. Additionally, shoulder strength was measured bilaterally for internal and external rotation using a handheld dynamometer in the standard testing position.
**RESULTS:**
There was a significant difference ($p<.001$) between the power of BB (71.35±14.4) and SB (55.37±11.6) players. However, there was no significant difference between the two groups in in the CKCUEST value or the normalized score. There were small and nonsignificant correlations between the CKCUEST and shoulder internal (IR) or external rotation (ER) strength.
**CONCLUSIONS:**
This study reported the normative values for the CKCUEST for division III SB and BB players with representation from all positions. The significant differences in power between BB and SB players may be linked to sex, training regimens and/or the physical requirements of each sport. The small correlation of shoulder IR and ER strength and the CKCUEST value may be related to the rotator cuffs primary stabilization function; which may not influence the CKCUEST value as much as the strength of the prime movers of the shoulder during the motion prescribed by the test. Strength of the pectoralis major and deltoid may better correlate with the values of the CKCUEST for this population and should be considered in future research.

2442 Board #278 June 1 9:30 AM - 11:00 AM

### Asymmetry Of Knee Extension Strength And Single-leg Landing Impact In ACL reconstructed Athletes

Junya Aizawa, Kenji Hirohata, Shunsuke Ohji, Takehiro Ohmi, Kazuyoshi Yagishita. *Tokyo Medical and Dental University, Tokyo, Japan.*

*(No relevant relationships reported)*

**PURPOSE:** Excessive magnitude, speed, and asymmetry of single-leg landing impacts contribute to re-injury risk in athletes after ACL reconstruction (ACLR). The limb symmetry index (LSI) of knee strength tends to decrease after ACLR even after return to sport. We analyzed relationships between the asymmetry of vertical ground reaction force (VGRF) parameters during single-leg jump landings and the knee isokinetic extension strength in athletes after ACLR. **METHODS:** Twenty-six participants were recruited based on the inclusion criteria: age 16-40 years at time of measurement; primary or one-sided ACL injury; >150 and <240 days since anatomical double-bundle ACLR using a hamstring tendon autograft; completed athletic rehabilitation within the same protocol; and agreement to participate in single-leg hop exercise and basic noncontact practice of jump-landings and cutting sports. The isokinetic strength of the quadriceps was tested at an angle of 60°/sec. Participants were subdivided into groups according to LSI for quadriceps strength (low quadriceps [LQ], <85% LSI, N10; high quadriceps [HQ], >90% LSI, N12). A 20-cm step was placed 60 cm from the center of a force plate. The participants stood on one leg on the step with their arms crossed, then jumped forward without any intended upward action and landed as naturally as possible on the same leg in the center of the force plate. The VGRF was collected at a sampling rate of 1000 Hz, filtered using a low-pass Butterworth filter with a cut-off frequency of 50 Hz, and normalized by body weight. Loading rate was calculated as peak VGRF (pVGRF) divided by the time from initial contact to pVGRF. The LSI of pVGRF and loading rate were compared between groups using non-paired t-tests. **RESULTS:** The quadriceps strength LSI of the LQ and HQ groups were 76±6.7% and 96.5±7.2%, respectively. The pVGRF LSI were 104.0±1.3% and 98.0±8.7%, respectively. Loading rate LSI were 115.9±23.6% and 98.8±21.7%, respectively. Loading rate LSI of LQ was significant larger than HQ ($p$=0.041). The pVGRF LSI of LQ tended to be larger than HQ ($p$=0.074). **CONCLUSIONS:** Smaller asymmetry in knee extension isokinetic strength is important for symmetrical landing impact during single-leg anterior jump-landings performed by athletes after ACLR. Supported by JSPS KAKENHI Grant number 26350606.

2443 Board #279 June 1 9:30 AM - 11:00 AM

### Relations Between Return to Play Unilateral Knee Extension Strength and Triple-Hop Tests

Lauren E. McIntosh[1], Alexander J. Hron[2], Benjamin C. Noonan[2], Colin W. Bond[2]. *[1]North Dakota State University, Fargo, ND. [2]Sanford Health, Fargo, ND.*

*(No relevant relationships reported)*

Unilateral assessments are used to monitor the restoration of strength and strength symmetry following unilateral injury, such as an anterior cruciate ligament (ACL) tear. **PURPOSE:** To assess the relation between unilateral isokinetic knee extension (KE) strength and triple hop distance in post-operative ACL reconstruction patients at the time of return to sport (RTS). **METHODS:** Thirty patients (15 male; 18 ± 6 y; 1.75 ± 0.13 m; 76 ± 19 kg) were assessed for unilateral isokinetic KE strength at 180° $s^{-1}$ and triple hop distance. Peak KE strength on the involved leg (IL) and uninvolved leg (UIL) were averaged to obtain an overall strength value and strength asymmetry was calculated between legs as a percentage. Participants were stratified into four groups based on the cohort's overall median strength and strength asymmetry values (low strength low asymmetry, low strength high asymmetry, high strength low asymmetry, and high strength high asymmetry). Pearson correlations were used to determine the relation between KE strength and triple hop distance. One-way analysis of variance was used to assess the effect of group on triple hop distance on IL and UIL. T-tests were used to determine the source of identified effects and to compare IL to UIL in each group. **RESULTS:** For all patients, the mean IL and UIL KE strength was 1.52 ± 0.59 Nm $kg^{-1}$ and 1.68 ± 0.61 Nm $kg^{-1}$, respectively, and the median KE strength asymmetry was 13.2%. The mean IL and UIL triple hop distance was 4.27 ± 1.09 m and 4.26 ± 1.27 m, respectively. No significant correlations were identified between UIL KE strength and triple hop distance ($r = 0.34$; $p > 0.05$), but were identified for IL KE strength and triple hop distance ($r = 0.40$; $p = 0.03$). No significant effect of group for IL was identified ($p > 0.05$) but was identified for UIL ($p = 0.03$), though individual comparisons were not significant ($p > 0.05$). Among all groups, triple hop distance was not significantly different between IL and UIL ($p > 0.05$). **CONCLUSION:** The low explained variance between KE strength and triple hop distance suggests these test shouldn't be used in isolation during RTS testing. Groups may have demonstrated similar triple hop distance because demand may be shifted to proximal or distal joints during unilateral hopping, which masks unilateral KE strength deficits and results in symmetrical unilateral function.

2444 Board #280 June 1 9:30 AM - 11:00 AM

### Knee Extensor Strength In The Uninjured Leg Following Anterior Cruciate Ligament Reconstruction: A Meta-analysis

Christopher M. Jeanfreau, Katherine A. Hamblin, Gordon L. Warren, FACSM, Sharon L. Leslie, Liang-Ching Tsai. *Georgia State University, Atlanta, GA.* (Sponsor: Gordon L. Warren, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: After anterior cruciate ligament reconstruction (ACLR), the uninjured leg is often used for comparison to determine knee extensor (KE) strength deficit in the ACLR leg. This meta-analysis examined the KE strength of the uninjured leg when compared to healthy controls.
**METHODS**: 1702 studies conducted between 2010 and 2016 were collected from 10 databases and screened for the following inclusion criteria: 1) unilateral ACLR and 2) KE strength reported for ACLR patients' uninjured legs and healthy controls. Studies were excluded if they were non-English or if the strength was measured only at ≥10 years post-ACLR. A total of 20 studies with 636 ACLR subjects and 504 healthy controls met the selection criteria and resulted in 73 Cohen's d effect sizes (ESs) for analysis. A positive ES equates to the KE of the patients' uninjured legs being stronger than those of healthy controls.
**RESULTS**: While the overall ES revealed no difference between the uninjured legs and healthy controls (ES = 0.089, $P = 0.305$), high between-study variance was observed ($P < 0.001$). Meta regressions indicated a significant association of the time post-ACLR with the study ES ($P = 0.037$). Based on the regressions, the uninjured legs would be predicted to be stronger than healthy controls (i.e. ES > 0) after 9 months post-ACLR. For the first 44 months post ACLR, the ES in studies using patella tendon autografts was greater than that in studies using hamstring tendon autografts ($P < 0.001$). The ES from studies involving patients with concomitant injuries (e.g., meniscus tears) was smaller than that from those without concomitant injuries ($P = 0.012$). Regressions also indicated a greater study ES as the isokinetic testing speed increased ($P = 0.040$).
**CONCLUSIONS**: Time post-ACLR, graft type, concomitant injuries, and isokinetic testing speed may explain some of the between-study variability in the KE strength of ACLR patients' uninjured legs when compared to healthy controls. Future studies are needed to examine the causal effects of these identified variables on the uninjured leg's KE strength post-ACLR. Current practice using the uninjured leg as the reference for recovery post-ACLR may need to be implemented with caution, particularly in patients in the early stages of rehabilitation, with hamstring tendon autografts, and/or with concomitant injuries.

2445 Board #281 June 1 9:30 AM - 11:00 AM

### Comparison of Handheld and Human Norm Dynamometry for Lower Extremity Muscle Strength Measurements

Karlee Burns[1], Mackenzie Pierson[2], Will Wu[1], Mimi Nakajima[1]. *[1]California State University, Long Beach, Long Beach, CA. [2]UNC, Greensboro, Greensboro, NC.*

*(No relevant relationships reported)*

**Purpose:** The use of hand held dynamometry is commonplace in research and clinical practice when an isokinetic unit is not available for muscle strength testing. However, the use of a hand-held dynamometer alone or in conjunction with a patient stabilization strap has not been thoroughly examined and compared to the isokinetic machine. **Methods:** Nine healthy convenience sample volunteers (2 males, 7 females; age: 24.40(5.78) years; height: 67.0(4.0) inches; mass: 72.30(17.25) kg) participated in the study. The participants randomly completed isometric strength tests of knee flexion and extension with the handheld dynamometer (HD), handheld dynamometer with patient stabilization strap (SHD), and HUMAC NORM Dynamometer (HN; CSMi, Stoughton, MA). The average of three trials was normalized by body weight and the ratio between knee flexion and extension strength was recorded for analysis. **Results:** A repeated measures ANOVA was performed to determine significant differences (P < .05 a priori) between variables; $F(2) = 19.352$ $p < .01$. Post hoc comparison showed SHD (mean = 2.7070.245) was significantly greater than HD (1.3960.065) and HDS was significantly greater than HN (mean=1.649 0.164). HD and HN produced similar results. **Conclusion:** Results indicated that using a hand-held dynamometer without the use of a patient stabilization strap produced similar measurements to the HUMAC NORM dynamometer. Using the patient stabilization strap overestimated the patients' strength. Using a handheld dynamometer for these measurements may be used to produce similar results without the time obligation and expense of using a Humac Norm dynamometer unit.

2446 Board #282 June 1 9:30 AM - 11:00 AM

### Quantification of Three Clinical Tests for the Assessment of the Femoroacetabular Impingement : Preliminary Results

Marc-Olivier St-Pierre, Stephane Sobczak, Naomi Fontaine, Nour Saade, Karine Boivin. *University of Quebec in Trois-Rivières, Trois-Rivières, QC, Canada.*

*(No relevant relationships reported)*

Femoroacetabular impingement (FAI) is a growing orthopedic condition among athletes and general population. It has been reported as being a precursor of hip pain and osteo-arthritis development. Many orthopedic manual (OM) tests are currently used to assess FAI. The cause of their low reliability is related to the variability between practitioners in their approach. **Purpose:** To quantify three tests commonly used to diagnose FAI (FABER, FADIR and the impingement sign). **Methods:** A sample of twenty healthy participants (10 men, 10 women) without hip, knee, or back pain will be recruited. Presently, measurements were performed on the thirteen first participants during two sessions (one day apart) by three raters. We quantified the FABER height (Distance of the tibial tuberosity to the table) and ROM (in millimeter and degree), FADIR ROM and impingement sign ROM (magnitude in internal rotation in degree) using four conditions for each test: (C1) classic, (C2) using an algometer to document pressure variability between tests and raters, (C3) under a hip positioning personalized according to a specific functional task and (C4) including the two last one. Reliabilities of measurements were determined using mean intraclass correlation coefficient (min-max) and the confidence intervals. **Results:**
Regarding intra-rater reliability (Table 1), impingement sign and FADIR tests had higher ICC values thru all the conditions when compared to FABER. Concerning the use of an algometer, intra-rater reliability increased for the three tests in comparison to C1 and C2 (mean values). Concerning inter-rater reliability, the analysis showed best mean value for C1. The use of an algometer did not increase ICC between C1 and C2. **Conclusion:** Impingement sign, with a simpler hip positioning, had the highest intra and inter reliability values. Using an algometer while performing OM tests seems to be helpful to improve reliability of test measurements. However, FABER test still needs improvement.

**TABLE 1. Mean Intra-class Correlation Coefficients (ICC 2.1)**

| | Intra-rater ICC ; mean (min-max) | | | | |
|---|---|---|---|---|---|
| | FABER | | Impingement | FADIR | |
| | *HEIGHT* | *ROM* | *ROM* | *ROM* | *MEAN (CI 95%)* |
| **C1** | 0,53 (0,41-0,66) | 0,52 (0,36-0,75) | 0,79 (0,73-0,85) | 0,77 (0,73-0,81) | 0,65 (±0,08) |
| **C2** | 0,56 (0,41-0,68) | 0,67 (0,55-0,75) | 0,81 (0,69-0,90) | 0,79 (0,70-0,91) | 0,71 (±0,06) |
| **C3** | 0,42 (-0,34-0,81) | 0,55 (0,47-0,68) | 0,68 (0,52-0,90) | 0,72 (0,61-0,82) | 0,59 (±0,07) |
| **C4** | 0,57 (0,30-0,70) | 0,57 (0,42-0,70) | 0,70 (0,58-0,89) | 0,63 (0,51-0,79) | 0,62 (±0,03) |
| | Inter-rater ICC | | | | |
| | FABER | | Impingement | FADIR | |
| | *HEIGHT* | *ROM* | *ROM* | *ROM* | *MEAN (CI 95%)* |
| **C1** | 0,50 | 0,57 | 0,85 | 0,45 | 0,59 (±0,10) |
| **C2** | 0,42 | 0,59 | 0,68 | 0,61 | 0,57 (±0,06) |
| **C3** | 0,48 | 0,58 | 0,63 | 0,47 | 0,54 (±0,04) |
| **C4** | 0,46 | 0,73 | 0,70 | 0,41 | 0,57 (±0,09) |

## E-42 Free Communication/Poster - **Obesity and Exercise**

Friday, June 1, 2018, 7:30 AM - 12:30 PM
Room: CC-Hall B

2447 Board #283 June 1 9:30 AM - 11:00 AM

### Interindividual Variability For Change In Waist Circumference And Body Weight In Response To Standardized Exercise

Matthew W. Nelms[1], Brittany P. Hammond[1], Andrea M. Brennan[1], Andrew Day[1], Paula J. Stotz[1], Benoit Lamarche[2], Robert Ross, FACSM[1]. *[1]Queen's University, Kingston, ON, Canada. [2]Laval University, Quebec City, QC, Canada.*

*(No relevant relationships reported)*

Substantial interindividual variability in response to a standard dose of exercise exists independent of the trait under investigation. Whether interindividual variability attributed to exercise exists after accounting for random variability is unknown. **PURPOSE**: To determine the magnitude of the interindividual variability in response to exercise for waist circumference (WC) and body weight (BW) after accounting for random variability and, the extent to which the variability is explained by lifestyle behaviors. **METHODS**: Participants were 181 (61% female) sedentary, abdominally obese adults (mean, (SD); 53, (7.5) years) who completed a 24-week intervention. Participants were randomly assigned to: control (n=44) or 5 weekly sessions of low amount, low intensity (LALI) (180 and 300kcal/session for women and men respectively at 50% V02peak, n=46); high amount, low intensity (HALI) (360 and 600kcal/session for women and men respectively at 50% V02peak, n=53); or high amount, high intensity (HAHI) (360 and 600kcal/session for women and men respectively at 75% V02peak, n=38). Adherence was ≥ 80% in all exercise groups. Physical activity (PA) performed outside of the prescribed exercise was measured by accelerometer. Daily self-report diet records were used to derive energy intake (kcal) and diet quality (Canadian-Healthy Eating Index-2010, Mediterranean Score). The variability in response to exercise (SDR) was determined by separating the random variability from the intervention variability using the standard deviations (SD) from both the control and intervention groups. **RESULTS**: WC and BW were substantially reduced at 24 weeks in all exercise groups compared to control ($P<0.01$). The variability due to exercise (SDR) for change in WC was 3.1, -0.3 and 3.1 cm for LALI, HALI and HAHI groups respectively. Corresponding values for BW were 3.8, 2.0 and 3.5 kg for LALI, HALI and HAHI respectively. No dietary or PA variable was identified as a determinant of the individual variability in response to exercise for WC or BW ($p>0.05$). **CONCLUSIONS**: A substantial individual variability in response to exercise was observed for change in WC and BW after accounting for the random variability. The determinants of the heterogeneity in response to exercise remain to be determined. Supported by CIHR Grant OHN-63277.

2448 Board #284 June 1 9:30 AM - 11:00 AM

### Effects Of Exercise Training On Strength And Functionality In Obese Subjects Undergoing Bariatric Surgery: Preliminary Findings

Hamilton Roschel, Saulo Gil, Wagner S. Dantas, Igor H. Murai, Carlos Merege, Filho, Marco A. Santo, Roberto Cleva, Bruno Gualano. *University of Sao Paulo, Sao Paulo, Brazil.*

*(No relevant relationships reported)*

**PURPOSE**: To examine the effects of exercise training on strength, functionality and physical activity level in women undergoing bariatric surgery.
**METHODS**: Twenty-nine obese women were randomly allocated into one of two groups: bariatric surgery (BAR: BMI = 46.5±6.2 kg/m²) and bariatric surgery plus exercise training (BAR+EX: BMI = 48.3±5.2 kg/m²). Patients were assessed at baseline, three (3mo), and nine months (9mo) after surgery. The 6-month exercise intervention started 3 months after surgery for BAR+EX while BAR follow standard care. Lower- and upper-limb 1RM, functionality [timed-up-and-go (TUG) and timed-stands (TST) test], and physical activity level [light activity (LA) and moderate to vigorous activity (MVPA)] were assessed. A mixed-model for repeated measures with Tukey adjustment was used. Significance level was set at $p<0.05$.
**RESULTS**: Both groups presented with reduced lower- (BAR = 31% and BAR+EX = 25%, $p<0.01$) and upper-limb 1RM (BAR = 27% and BAR+EX = 31%, $p<0.01$) at 3mo. Importantly, BAR+EX increased lower- and upper-limb 1RM at 9mo in comparison to 3mo (45 and 13%, respectively; both $p<0.01$). In contrast, no significant differences were observed in BAR group at the same points (3 and 5% for lower- and upper-limb 1RM, respectively; both $p>0.05$). Additionally, lower-limb 1RM was significantly greater in BAR+EX when compared with BAR at 9mo ($p<0.01$). No significant changes on TUG and TST were observed in any of the groups at 3mo (all $p>0.05$). BAR+EX showed improved TUG and TST scores in comparison to 3mo (8 and 22%, respectively; $p<0.01$) while no significant differences were observed in BAR (3 and 7%, respectively, both $p>0.05$). Finally, TUG and TST scores were significantly greater in BAR+EX when compared with BAR at 9mo (all $p<0.01$). No significant changes in physical activity level were noted at any time point (all $p>0.05$).
**CONCLUSIONS**: Our data suggest that a 6-month exercise training program is effective in counteracting strength and functionality impairments observed after bariatric surgery without any changes in physical activity-related behaviors.

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### Modifications Taken in a Yoga Practice in Overweight versus Normal Weight Individuals

Sally A. Sherman, Renee J. Rogers, Kelliann K. Davis, John M. Jakicic, FACSM. *University of Pittsburgh, Pittsburgh, PA.* (Sponsor: John M. Jakicic, PhD., FACSM)

*(No relevant relationships reported)*

Vinyasa yoga has demonstrated to elicit energy expenditure that is comparable to brisk walking. Whether overweight adults need to modify their yoga practice compare to normal weight adults, and whether this elicits a difference in energy expenditure is unclear. **PURPOSE:** To compared the number of modifications taken by participants, and the energy expenditure, during a yoga session between overweight and normal weight individuals. **METHODS:** Forty adults (men=20; women=20) participated in this study, with 21 classified as normal weight (BMI=22.0±1.6 kg/m²; age=30.8±8.8 years) and 19 classified as overweight (BMI=27.2±2.3 kg/m²; age=30.8±8.8 years). Participants engaged in a 60-minute Vinyasa yoga session that included a yoga sequence on a video that contained the instructor's cues along with a

person demonstrating the sequence. Participants were instructed to follow the verbal cues, but were permitted to take modifications of the poses to match their skill level. A trained instructor of Vinyasa yoga monitored whether each pose was performed in a manner consistent with the video or whether the individual modified the pose. Heart rate was assessed with a chest-worn monitor and energy expenditure was assessed with a portable metabolic indirect calorimetry device. **RESULTS:** The number of modifications to the asanas did not differ between overweight (4.5±3.7) vs. normal weight (4.6±3.3) across the yoga session (p=0.93). Total energy expenditure during the yoga session was greater in overweight (315.3±68.1) vs. normal weight (190.1+51.3) (p=0.80). However, energy expenditure relative to body weight (kcal per kg) did not differ between overweight (3.8±0.5) vs. normal weight (3.7+0.7) (p=0.80), and mean METs per minute did not differ between overweight (3.6±0.6) vs. normal weight (3.6±0.5) (p=0.85). **CONCLUSIONS:** In a 60-minute yoga session, the number of modifications to the asanas and the relative energy expenditure did not differ between overweight and normal weight participants. These findings may suggest that yoga is a viable form of exercise for both normal weight and overweight adults, which may have implications for enhancing energy expenditure and for body weight regulation.

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## Cardiac Autonomic Modulation Following Acute Aerobic Exercise in Young Obese Adults

Kanokwan Bunsawat[1], Georgios Grigoriadis[2], Sang Ouk Wee[3], Garett Griffith[2], Bo Fernhall, FACSM[2], Tracy Baynard, FACSM[2]. *[1]University of Utah, Salt Lake City, UT. [2]University of Illinois at Chicago, Chicago, IL. [3]California State University San Bernardino, San Bernardino, CA.* (Sponsor: Tracy Baynard, Ph.D., FACSM)

*(No relevant relationships reported)*

**INTRODUCTION:** Obesity is associated with cardiac autonomic dysfunction at rest and may also influence the ability to recover from acute aerobic exercise (AE), but this still remains unclear. This is important, because acute AE induces a shift in autonomic balance towards sympathetic dominance, especially at moderate to vigorous intensities, which places greater stress on the cardiovascular system. The inability to return this balance to homeostatic levels quickly and efficiently after AE is an important indicator of risk. **PURPOSE:** To evaluate cardiac autonomic function at rest and during exercise recovery using heart rate variability (HRV) analyses in young, otherwise healthy obese vs. lean adults. **METHODS:** Seventeen lean (female=6; 26±5 yrs; 22.7±1.7 kg/m$^2$) and 17 obese adults (female=7; 27±4 yrs; 32.3±2.2 kg/m$^2$) performed moderate-intensity cycling exercise for 60 min. HRV was assessed at baseline, and at 30, 60, and 90-min post-exercise in both the frequency (total power (TP), low frequency (LF), high frequency (HF), and LF/HF ratio) and time domains (Root mean square of successive differences (RMSSD)). Frequency data were log-transformed (Ln) to create normally distributed data. **RESULTS:** No baseline differences were observed for any variable ($p$>0.05). During recovery, heart rate and LnLF/LnHF ratio increased from baseline, whereas all other HRV parameters decreased from baseline similarly in both groups ($p$<0.05). In both groups, LnHF, LnLF, and RMSSD returned to baseline at 90-min post-exercise, whereas heart rate and LnLF/LnHF remained above and LnTP remained below baseline at 90-min post-exercise ($p$<0.05). **CONCLUSION:** Our findings suggest that compared with lean counterparts, young otherwise healthy obese adults did not exhibit altered cardiac autonomic modulation following acute AE. Furthermore, our findings highlight that it may take longer than 90 min for both groups to recover from the autonomic shift induced by acute moderate-intensity AE.

| | Group | Baseline | 30-min | 60-min | 90-min |
|---|---|---|---|---|---|
| Heart Rate (bpm) * | Lean | 63±2 | 78±3 | 75±3 | 76±3 |
| | Obese | 60±2 | 76±3 | 74±3 | 73±3 |
| LnTP (ms$^2$) * | Lean | 7.98±0.21 | 7.16±0.28 | 7.60±0.25 | 7.67±0.27 |
| | Obese | 8.35±0.21 | 7.77±0.28 | 7.77±0.25 | 8.02±0.27 |
| LnHF (ms$^2$) * | Lean | 6.61±0.27 | 5.24±0.39 | 5.83±0.34 | 6.61±0.27 |
| | Obese | 6.82±0.27 | 5.94±0.39 | 5.84±0.34 | 6.82±0.27 |
| LnLF (ms$^2$) * | Lean | 6.84±0.25 | 6.11±0.27 | 6.41±0.25 | 6.84±0.25 |
| | Obese | 7.15±0.25 | 6.67±0.27 | 6.63±0.25 | 7.15±0.25 |
| LnLF/LnHF * | Lean | 1.05±0.03 | 1.22±0.08 | 1.12±0.06 | 1.13±0.07 |
| | Obese | 1.06±0.03 | 1.22±0.08 | 1.20±0.06 | 1.20±0.07 |
| RMSSD (ms) * | Lean | 65±8 | 35±7 | 42±8 | 65±8 |
| | Obese | 74±8 | 50±7 | 51±8 | 74±8 |
| Data are mean±SE. *$p$<0.05, time effect. | | | | | |

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## The Effects of HIIT on Maximal Oxygen Uptake and Peak Power in Sedentary, Obese Women

Amy S. Clark, Annie B. De La Rosa, Jamie L. DeRevere, Todd A. Astorino. *California State University San Marcos, San Marcos, CA.*

*(No relevant relationships reported)*

Globally, 1.9 billion adults are overweight, with 600 million classified as obese which creates a serious public health problem (World Health Organization 2015). In 2008, only 20 % of adults in the United States met the CDC physical activity guidelines. Low levels of physical activity contribute to obesity, and a sedentary lifestyle along with obesity is related to higher risk of cardiovascular disease, type 2 diabetes, hypertension, and dyslipidemia (Abate 2000). High intensity interval training (HIIT) induces rapid increases in maximal oxygen uptake ($VO_2$max) in the initial weeks of exercise training, which is essential in obese populations, and is a more time efficient and enjoyable form of exercise than endurance training (Bartlett et al. 2011). Yet, few studies have investigated the effects of different HIIT regimes on change in $VO_2$max in obese, sedentary individuals.
**PURPOSE**: To investigate effects of two HIIT regimes on $VO_2$max and peak power output (PPO) in obese, sedentary women.
**METHODS**: 17 obese sedentary women (age and BMI=37.5±10.5 yr and 39.0±4.7 kg/m$^2$) participated in a six-week exercise intervention with three training sessions per week. Participants were randomized to low volume HIIT (LOW) (n=9, $VO_2$max=21.5±3.2 mL/kg/min) or periodized HIIT (PER) (n=8, $VO_2$max=17.3±2.4mL/kg/min). $VO_2$max was measured on a cycle ergometer at baseline and at 3 and 6 weeks using a ramp exercise test. Women in LOW completed repeated 60 s bouts of HIIT at 70-85% PPO; whereas, women in PER performed a different number of bouts and intensities each week.
**RESULTS**: There was a significant difference in relative (p=0.001; LOW: 21.5±3.2 vs. 22.5±3.2 mL/kg/min; PER: 17.3±2.41 vs. 18.0±2.2 mL/kg/min) and absolute (p=0.002; LOW: 2.1±0.3 vs. 2.2±0.3 L/min; PER: 1.9±0.4 vs. 2.0±0.3 L/min) $VO_2$max across time, but no interaction (p>0.05). PPO also increased in response to training (p=0.01; LOW: 178.4±21.1 vs. 193.7±30.7 W; PER: 169.0±21.2 vs. 174.8±24.1 W) but there was no interaction (p>0.05).
**CONCLUSION**: Although there were no significant differences between regimes, HIIT elicits significant changes in PPO and $VO_2$max in sedentary obese women, which are beneficial to
health. The magnitude of change in $VO_2$max is lower than previously-reported values which raises the question if morbid obesity diminishes $VO_2$max response to training.

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## Apelin Secretion In Overweight/obese Adults Following A Single Bout Of Exhaustive Exercise

Jun Seok Son[1], Song Ah Chae[2], Min Du[1], Wook Song[3]. *[1]Washington State University, Pullman, WA. [2]University of Idaho, Moscow, ID. [3]Seoul National University, Seoul, Korea, Republic of.*

*(No relevant relationships reported)*

Obesity and associated metabolic dysfunction has reaching epidemic levels. Physical activity is beneficial for preventing metabolic symptoms, of which myocytes secreted during exercise play a major role. In this study, the circulatory level of apelin, one of the myokines, was assessed in patients with obesity and metabolic diseases.
**PURPOSE:** To examine the effects of body composition, metabolic parameters, and physical fitness on apelin secretion following a single bout of exhaustive exercise.
**METHODS:** A total 60 subjects [34 women (21 lean and 13 overweight/obese) and 26 men (8 lean and 18 overweight/obese)], age 30-59 years, with body max index (BMI) of 18-30 kg/m$^2$ were recruited based on the guidelines for overweight (BMI of 23-24.9 kg/m$^2$) and obesity (BMI of over 25 kg/m$^2$) in Korean. Body composition, clinical parameters, and physical fitness test were conducted. During an acute treadmill exercise following Bruce protocol, the blood before and 0, 15, 30 min after exercise were collected for analyses of apelin, lactate, lactate dehydrogenase (LDH), and creatine kinase (CK). Relationships among exercise-induced apelin, metabolic factors, and physical capacity were then analyzed. All measurements were conducted using independent, paired *t*-test between groups/time points, and *Pearson* correlations.
**RESULTS:** There are significant positive correlations in post-exercise apelin level and skeletal muscle mass (r = 0.350, $P$ = 0.006), homeostatic model assessment of insulin resistance (HOMA-IR; r = 0.366, $P$ = 0.004), HOMA insulin secretion (HOMA-%B; r = 0.360, $P$ = 0.005), and isokinetic flexion and extension tests in 60° and 240°/sec (all variables, $P$ < 0.05), but these parameters were not correlated with pre-exercise apelin levels. In men, the area under the curve of plasma apelin level was significantly higher in obese than lean individuals ($P$ < 0.05), but this difference was not observed in women.
**CONCLUSIONS:** A single bout of exhaustive exercise induced apelin secretion, which not only correlated with muscle mass, and insulin resistance and secretion,

but also associated with upper and lower limbs' physical capacity. Our data suggest that apelin may be a therapeutic target to overcome metabolic dysfunction in obese patients.
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### High Intensity Interval Training is Feasible Outside of a Laboratory Setting in Sedentary, Obese Women

Annie B. De La Rosa, Amy S. Clark, Jamie L. DeRevere, Todd A. Astorino. *California State University, San Marcos, San Marcos, CA.*

*(No relevant relationships reported)*

High intensity interval training (HIIT) is a suitable alternative to endurance exercise (Burgomaster et al. 2008) as it elicits similar adaptations yet is more time efficient and enjoyable (Kong et al., 2016). Results from Sawyer et al. (2016) and Higgins et al. (2016) reported that HIIT is effective in persons with obesity. However, the majority of existing data supporting efficacy of HIIT were acquired in a laboratory in which trained personnel supervise all sessions. This setting may not translate to HIIT performed in a "real world" environment. **PURPOSE:** The purpose of this study was to determine the feasibility of HIIT outside of a laboratory setting in sedentary, obese women. **METHODS:** 17 sedentary, obese women (age=37.51 ± 10.53 yr.; BMI=39.11+4.34 kg/m$^2$) participated in a 6-week exercise intervention with 3 training sessions per week, 2 in the laboratory (LAB) and 1 at home (HOME). Sessions were held at the same time of day within subjects and were performed a minimum of 24 hr apart. Heart rate (HR) was recorded via telemetry during LAB sessions, which were performed on a cycle ergometer. However, subjects were allowed to select the exercise modality for the HOME sessions, including running, cycling, or elliptical. The instructions for the HOME exercise mimicked the structure of the LAB sessions. Subjects were given downloadable HR monitors (Polar Inc., Lake Success, NY) to record HR during each HOME session. Subjects were asked to complete a HOME session 1 day/week at Rating of Perceived Exertion equal those attained during LAB on the Borg CR-10 scale. There were no consequences if the sessions were not completed. **RESULTS:** The average compliance rate for HOME in all 17 subjects was 73.53 ± 30.65%. Peak HR was higher during HOME for Week 1 (174.09 ± 18.63 vs 163.50 ± 14.98 b/min; p=0.01), Week 2 (175.56 ± 16.76 vs 157.50 ± 18.54 b/min; p=0.007), Week 3 (167.92 ± 20.45 vs 158.83 ± 13.89 b/min; p=0.014), and Week 4 (167.22 ± 21.38 vs 155.11 ± 15.77 b/min; p=0.026) versus LAB. There were no differences in peak HR between HOME and LAB peak HR for Week 5 (158.67 ± 26.08 vs 157.00 ± 16.30 b/min; p =0.99) or Week 6 (154.00 ± 28.82 vs 129.67 ± 31.66 b/min; p=0.31). **CONCLUSION:** In obese women, compliance to home-based HIIT is relatively high, and selected intensities are higher than those attained during lab sessions.

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### Comparison of Measured and Predicted Resting Energy Expenditure Equations in Obese Pre-bariatric Surgery Patients

Chelsea L. Wenrich[1], Scott T. Jamieson[2], G. Craig Wood[2], Adam M. Cook[2], Christopher D. Still[2], Luke Haile[1], Curt B. Dixon, FACSM[3], Joseph L. Andreacci, FACSM[1]. *[1]Bloomsburg University, Bloomsburg, PA. [2]Geisinger, Danville, PA. [3]Lock Haven University, Lock Haven, PA.* (Sponsor: Joseph Andreacci, FACSM)

*(No relevant relationships reported)*

**PURPOSE**: To compare measured resting energy expenditure (MREE) to predicted resting energy expenditure (PREE) determined by three pre-programmed multi-frequency bioelectrical impedance analysis prediction equations in obese pre-bariatric surgery patients.
**METHODS**: Ninety women and twenty-six men (age: 42.6 ± 11.0 years, BMI: 48.1 ± 9.1 kg/m$^2$) were included in this sample. After 3 hours of seated rest, MREE was measured prior to bioelectrical impedance analysis (SECA-mBCA 514) body composition assessment. MREE was obtained over a 10-minute period using a hand-held indirect calorimetry device (Korr REE-VUE). Three preprogrammed equations in the bioelectrical impedance analyzer (i.e. Mueller 2004, Liu 1995, and FAO/WHO/UHU) were used to calculate PREE.
**RESULTS**: The mean MREE determined by indirect calorimetry was 2164.1 ± 460.2 kcal. The PREE values (mean ± SD) for the Mueller, FAO/WHO/UHU, and Liu equations were 2182.5 ± 427.8 kcal, 2129.2 ± 521.2 kcal, and 2352.2 ± 473.4 kcal, respectively. Following statistical comparison, no significant differences were observed between MREE and PREE determined by the Mueller (14.6 ± 313.6 kcal, p = 0.896) and FAO/WHO/UHU (-38.8 ± 371.8 kcal, p = 0.102) equations. However, a significant difference was observed between MREE and PREE by Liu (184.2 ± 333.3 kcal, p = 0.003).
**CONCLUSIONS**: Our findings indicate that the Mueller and FAO/WHO/UHU programmed bioelectrical impedance analysis equations produce similar resting energy expenditure values as indirect calorimetry. These findings are important to weight management clinics without access to indirect calorimetry that currently use or are considering the use of this bioelectrical impedance analysis technology for their patients. Resting energy expenditure can be predicted in obese patients prior to individualized diet and exercise programming.

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### Obesity in the Trauma Patient Delays Hospital Discharge and Increases Treatment Cost

Bushra Irshad[1], Lariel J. Mateo[1], Michelle M. Amaral[1], Lewis E. Jacobson[2], Jonathan M. Saxe[2], Courtney D. Jensen[1]. *[1]University of the Pacific, Stockton, CA. [2]St. Vincent Hospital, Indianapolis, IN.*

*(No relevant relationships reported)*

In the United States, more than one third of all adults are obese, classified by a BMI ≥ 30 kg/m$^2$. Direct medical costs for these individuals account for approximately 6% of national health expenditure. Several mechanisms have been proposed, but most consistently, obesity has been shown to complicate treatment and inflate resource utilization. Another possible explanation is obesity's role in prolonging recovery. Currently, information regarding the relationship between obesity and the duration of care is limited.
**PURPOSE**: To examine the effect of obesity on hospital discharge and consequent treatment cost.
**METHODS**: Our study involved 1,201 patients admitted to a Midwestern hospital who had complete demographic, anthropometric, and treatment data. Independent variables were age, sex, anthropometric indices, and five measurements of injury severity. Dependent variables were hospital length of stay (number of days) and total patient billing (dollars). Independent-samples t tests assessed differences between obese and non-obese patients, a negative binomial regression evaluated hospital length of stay, and a multiple linear regression tested logged cost data.
**RESULTS**: Across the sample, average age was 55.1 ± 20.3 and 67.5% of patients were male. Average BMI was 28.4 ± 6.6 and 14.4% of patients were obese. Mean injury severity score was 16.3 ± 10.6 and average length of stay was 7.7 ± 9.0 days. Independent-samples t tests found obese patients to have 19.4% longer hospital stays (1.5 days; p=0.061) and 31.4% greater hospital bills (p=0.015) than non-obese patients. With confounding variables held constant, the negative binomial regression found obesity to predict a 17.1% longer hospital stay (1.3 days; p=0.007). While the multiple linear regression showed a non-significant increase for the effect of BMI on logged patient charges (p=0.111), classification of obesity on logged patient charges supported a trend for increase in patient cost (p=0.078).
**CONCLUSIONS**: Obesity in the hospitalized patient associated with a significantly longer duration of care and a trend for increased total expenditure. Exercise may function as a preventive strategy to avert the temporal and financial ramifications of obesity.

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### Reducing Attrition and Improving Program Adherence in a Physician-Referred Weight Loss Program for Adults.

Jennifer J. Zwetsloot[1], Rebecca A. Battista, FACSM[1], Kristopher Hartley[2], Chris Demczar[2], Alanna Young[2], Erica Larson[1]. *[1]Appalachian State University, Boone, NC. [2]Appalachian Regional Healthcare Systems, Paul H. Broyhill Wellness Center, Boone, NC.* (Sponsor: Rebecca A. Battista, FACSM)

*(No relevant relationships reported)*

It has been shown that physician-referred hospital-based team-approach programs can be effective interventions for weight loss for adults. Programs that include strategies in behavior change may assist in successfully completing a weight loss program.
**PURPOSE:** The purpose of this project was to evaluate the effectiveness of behavioral contracting to improve program adherence and reduce attrition in a physician-referred weight loss program for adults. **METHODS:** Participants included obese (BMI≥30) adults (Age 53.4±1.3yrs) enrolled in a physician-referred program. Participants were enrolled without signing an accountability contract (CONTROL, N=48) or enrolled after signing an accountability contract (CONTRACT, N=48). Starting and final weights were recorded before and after a 16-24 week intervention period that included supervised exercise sessions (EX), and scheduled consultations with a registered dietitian (RD, N=4) and a behavioral health specialist (BHS, N=4). The CONTRACT group signed an accountability statement that listed program goals, standards/expectations, and an acknowledgment of commitment statement. Attendance for EX, RD, and BHS sessions was recorded. Program completion was determined if a final weight was recorded for a participant at the end of the program. Independent sample t-tests ($p<0.05$) were used to determine differences in participant characteristics.
**RESULTS:** There were no significant differences in participant characteristics for

CONTRACT as compared to CONTROL (Age 53.0±13.6 vs. 53.8±12.0; Sex 81.3% vs. 81.3% female; Starting Weight (lbs) 238.1±44.7 vs. 228.1±38.9; % Weight Loss -6.7±3.3% vs. -4.8±4.5%). Program completion was higher for CONTRACT as compared to CONTROL (87.5% vs. 58.3%). The proportion of participants who attended 75-100% of required consultation visits was higher for CONTRACT as compared to CONTROL (RD 85% vs. 29%; BHS 77% vs. 25%). However, EX attendance was slightly lower for CONTRACT as compared to CONTROL (44% vs. 52%). **CONCLUSION:** Behavioral contracting may be an effective tool for increasing specialized consultation adherence and reducing attrition in a physician-referred weight loss program. Additional research is required to determine how to increase exercise session adherence.