

F-10 Thematic Poster - Cardiovascular II

Friday, June 3, 2016, 1:00 PM - 3:00 PM
Room: 104

2860 **Chair: Rob Shave. Cardiff Metropolitan University, Cardiff, United Kingdom.**

(No relationships reported)

2861 Board #1 June 3, 1:00 PM - 3:00 PM
Manipulating The Exercise Intensity-duration Matrix Has A Profound Impact On Exercise-induced Functional And Biochemical Perturbations In The Human Heart.

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(No relationships reported)

PURPOSE: Strenuous endurance exercise stimulates transient cardiac perturbations with ambiguous health outcomes. Therefore, this study aimed to alter the magnitude and time-course of exercise-induced functional and biochemical cardiac perturbations by manipulating the exercise intensity-duration matrix.

METHODS: Echocardiograph-derived left (LV) and right (RV) ventricular global longitudinal strain (GLS), and serum high-sensitivity cardiac troponin (hs-cTnI) concentration, were examined in 10 males (Age: 27 ± 4 yr; VO₂peak: 4.0 ± 0.8L·min⁻¹) before, throughout (50-, 75- & 100-%), and during recovery (1-, 3-, 6- & 24-h) from two exercise trials. The two exercise trials consisted of cycling for either 90-min above, or 120-min within, the moderate-intensity exercise domain to complete an equivalent total mechanical work.

RESULTS: LVGLS decreased (p<lt0.01) during the 90-min trial only, with reductions peaking at 1-h post (pre: -19.9 ± 0.6; 1-h post: -18.5 ± 0.7%) and persisting for >24-h into recovery. RVGLS decreased (p<lt0.05) during both exercise trials with reductions in the 90-min trial peaking at 1-h post (pre: -27.5 ± 0.7%; 1-h post: -25.1 ± 0.8%) and persisting for >24-h into recovery. Serum hs-cTnI increased (p<lt0.01) during both exercise trials with concentrations peaking at 3-h post, but only exceeding cardio-healthy reference limits (14ng/L) in the 90-min trial (pre: 4.2 ± 2.4ng/L; 3-h post: 25.1 ± 7.9ng/L).

CONCLUSIONS: Exercise-induced reductions in ventricular strain and increases in cardiac injury markers persist for 24 hours following exercise that is typical of day-to-day endurance exercise training; however, the magnitude and time-course of this response can be altered by manipulating the intensity-duration matrix.

2862 Board #2 June 3, 1:00 PM - 3:00 PM
Moderate Versus Heavy Intensity Interval Training For Vascular Health In Post-menopausal Women: A Paradox!

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(No relationships reported)

PURPOSE: Whilst the menopause has been associated with a decline in vascular function, sedentary postmenopausal women report a dislike of heavy intensity exercise. This study aimed to compare the impact of moderate (MOD) versus heavy (HVY) intensity interval exercise training upon vascular function and endothelial integrity. **METHODS:** 27 sedentary post-menopausal women completed either MOD (90% lactate threshold (LT) 10:10 s duty cycle) or HVY (120% LT 30:30 s duty cycle) interval exercise training twice per week for 12 weeks. Endothelial function (FMD), peak oxygen uptake (VO₂peak), LT, circulating angiogenic cell number (FACS) and adhesive capacity to cultured saphenous vein vascular smooth muscle cells (VSMCs) were recorded prior to and following training. Group and time differences were assessed via two-way mixed mode ANOVA.

RESULTS: VO₂peak and LT increased in HVY only (VO₂peak: MOD: 29.97 ± 5.5 to 29.65 ± 5.4; HVY: 30.18 ± 5.3 to 32.25 ± 6.5 ml/kg/min; interaction P=0.02; LT: MOD: 1.13 ± 0.19 to 1.11 ± 0.18; HVY: 1.09 ± 0.15 to 1.22 ± 0.17 L/min; interaction P=0.005). FMD (group mean: 4.7 ± 2.4 %), brachial diameter (group mean: 3.7 ± 0.3 mm) and blood pressure were unaffected by training (P>0.05), whilst peripheral arterial stiffness decreased post training in both groups (-0.58 a.u.). [CD34+CD45dim] increased after MOD but not after HVY intensity interval training (MOD: 5.3 ± 3.8 to 8.9 ± 6.3; HVY:

6.34 ± 3.1 to 5.7 ± 2.6 CAC/105 leucocytes: interaction P=0.02). The adhesive capacity of CACs to VSMCs was seen to increase by 70% following MOD but only 12 % following HVY (P>0.05), this capacity persisted over 60 min in the MOD group (time x group interaction: P=0.05).

CONCLUSION: In post-menopausal women HVY intensity interval training provided greater benefits for cardiorespiratory fitness. However, MOD intensity intervals produced equivalent reductions in arterial stiffness and greater modulation of CAC function perceived as beneficial to endothelial integrity. Neither intensity was sufficient to produce significant changes in FMD. Varying the intensities used in interval exercise prescription may provide the most effective cardiovascular benefits in post-menopausal women.

2863 Board #3 June 3, 1:00 PM - 3:00 PM
Exercise Training Effects on Elevated NOX-Dependent ROS and Microvascular Endothelial Dysfunction in Obese Humans

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(No relationships reported)

Excessive production of reactive oxygen species (ROS) has been causally linked to endothelial dysfunction and cardiovascular disease. The measurement of ROS in vivo in humans has been elusive due to the reactive and transient nature of ROS; therefore, the changes in ROS production due to exercise training in humans are not well described. **PURPOSE:** To determine the effect of interval exercise training on ROS production, nutritive blood flow and endothelial function in obese individuals. **METHODS:** Young, sedentary men and women age 20-40 years were divided into lean (BMI 18-25 kg/m²; n = 14), intermediate (BMI 28-32.5 kg/m²; n = 13), and obese (BMI 33-40 kg/m²; n = 15) groups. A novel microdialysis technique was utilized to monitor ROS and nutritive blood flow in the vastus lateralis before and after 8 weeks of an interval training intervention. Subjects performed a 10-minute warm-up at ~60% heart rate maximum (HRmax), followed by four 4-minute intervals at 88-92% HRmax interspersed by 3-minute active recovery periods at ~70% HRmax, with a subsequent 4-minute cool down at ~60% HRmax. Total exercise time was 42 minutes per session performed 3 days/week. **RESULTS:** There were 2.5-fold and 3-fold elevations in muscle interstitial hydrogen peroxide (H₂O₂) and superoxide (markers of ROS), respectively (P<0.001), and a 65% reduction in acetylcholine-stimulated blood flow (P<0.05) in obese compared to both lean and intermediate subjects before training. Perfusion of the NADPH oxidase inhibitor apocynin normalized H₂O₂ and superoxide levels and reversed microvascular endothelial dysfunction in the obese. Following exercise training, H₂O₂ was 50% lower than pre-training, and microvascular endothelial function (acetylcholine-stimulated flow) was increased 2.7-fold compared to pre-training in the obese subjects (P<0.05). No alterations with training were observed in the lean and intermediate groups. **CONCLUSIONS:** NADPH oxidase is a likely source of excessive ROS production that is linked to microvascular endothelial dysfunction in skeletal muscle of obese individuals. However, aerobic exercise training is an effective strategy for counteracting excessive ROS and associated endothelial dysfunction.

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2864 Board #4 June 3, 1:00 PM - 3:00 PM
Nitrite Enhances Microvascular Oxygen Pressure Dynamics in Healthy Rat Skeletal Muscle

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(No relationships reported)

Exercise intolerance characteristic of diseases such as chronic heart failure and diabetes is associated with the reduced nitric oxide (NO) bioavailability from nitric oxide synthase (NOS); resulting in an impaired O₂ driving pressure (PO_{2,mv}: O₂ delivery - O₂ utilization) and impaired metabolic control. Nitrite (NO₂⁻) augments NO bioavailability independent of the NOS pathway. The potent NO donor sodium nitroprusside augments NO bioavailability, yet decreases arterial pressure (MAP) reducing its efficacy especially for patient populations. **PURPOSE:** To determine the microvascular effects of local NO₂⁻ administration (further reduced to NO) at rest and during muscle contractions. It was hypothesized that local NO₂⁻ administration would elevate resting PO_{2,mv} and slow PO_{2,mv} kinetics (increased τ: time constant, MRT: mean response time) at the onset of muscle contractions. Both effects would act to enhance blood-myocyte O₂ flux and raise intramyocyte PO₂. **METHODS:** In 12 anesthetized Sprague-Dawley rats, PO_{2,mv} of the circulation-intact spinotrapezius muscle was measured during 180 s of electrically induced twitch contractions (1 Hz) before and after superfusion of NaNO₂ (15 mg kg⁻¹). **RESULTS:** NO₂⁻ superfusion

elevated resting $PO_{2,mv}$ (CON: 28.4 ± 1.1 vs NO_2 : 31.6 ± 1.2 mmHg, $P \leq 0.05$), τ (CON: 12.3 ± 1.2 vs NO_2 : 19.7 ± 2.2 s, $P \leq 0.05$) and MRT (CON: 19.3 ± 1.9 vs NO_2 : 25.6 ± 3.3 s, $P \leq 0.05$). Importantly, these effects occurred in the absence of any reduction in MAP ($P \leq 0.05$). **CONCLUSION:** These results indicate that at rest and following the onset of muscle contraction, NO_2 enhances the driving pressure of oxygen from the vasculature into the myocyte without compromising MAP. Therefore, NO_2 administration has the potential to decrease reliance upon non-oxidative energy supply and delay metabolically-induced development of exercise intolerance in health and disease.

2865 Board #5 June 3, 1:00 PM - 3:00 PM
Passive Leg Movement (PLM) in Patients with COPD: Evidence of Vascular Dysfunction in Locomotor Muscle

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Chronic obstructive pulmonary disease (COPD) is characterized by limited pulmonary function, inflammation, greater free-radical levels, vascular dysfunction and subsequently a greater incidence of CVD. However, in terms of vascular function, as previous investigations have focused on the brachial artery flow mediated dilation technique, whether vascular dysfunction exists in the locomotor muscles in patients with COPD, remains unknown. **PURPOSE:** To determine the hemodynamic response to PLM in patients with COPD and healthy age-matched controls. **METHODS:** Second-by-second finger photoplethysmography measurements of heart rate (HR), stroke volume (SV), cardiac output (CO), mean arterial pressure (MAP), and femoral artery blood flow (FBF) (Doppler ultrasound) were recorded prior to and during 2 min of continuous upright PLM in patients with COPD ($n=12$, 64 ± 3 yrs) and healthy age matched controls ($n=12$, 66 ± 4 yrs). **RESULTS:** Baseline values for MAP (Controls: 85 ± 4 ; COPD: 99 ± 4 mmHg) and HR (Controls: 59 ± 3 COPD: 74 ± 3 bpm) were significantly different between groups ($p < 0.05$), while FBF, femoral vascular conductance (FVC), SV, and CO were not different ($p > 0.05$). In response to PLM, the HR (3.7 ± 1.8 vs 5.9 ± 1.9 Δ bpm), SV (6.3 ± 1.1 vs 12.0 ± 3.2 Δ ml/beat), CO (0.5 ± 0.1 vs 1.2 ± 0.3 Δ L/min), and MAP (9.3 ± 1.6 vs 9.2 ± 0.9 Δ mmHg) responses were not different between controls and COPD, respectively ($p > 0.05$), while FBF (482 ± 61 vs 344 ± 53 Δ ml/min) and FVC (5.3 ± 0.5 vs 3.2 ± 0.6 Δ ml/min/mmHg) were significantly lower in COPD compared to the controls, control v. COPD, respectively ($p < 0.05$). **CONCLUSION:** Utilizing PLM, a model that interrogates the vascular responsiveness of locomotor muscles, which are instrumental in activities of daily living, patients with COPD exhibit vascular dysfunction compared to healthy controls. These results suggest that vascular dysfunction in the legs, in combination with the clearly dysfunctional lungs, likely contributes to physical inactivity and an increased risk of CVD in patients with COPD.

2866 Board #6 June 3, 1:00 PM - 3:00 PM
Venous Distension of Locomotor Muscles Influences Blood Pressure during Submaximal Exercise in Healthy Aging Adults

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Group III/IV locomotor muscle afferents contribute to the exercise pressor response (EPR). This relationship is tightly regulated in young healthy individuals, but is augmented in disease conditions such as heart failure. However, it remains unclear how aging may influence this relationship between locomotor muscle afferent neural feedback and the EPR. Venous distension via subsystolic circulatory occlusion of locomotor muscles is proposed to stimulate group III/IV afferents. **PURPOSE:** We aimed to examine the influence of venous distension on the EPR via subsystolic bilateral venous occlusion of locomotor muscles during submaximal exercise in young vs aging healthy adults. **METHODS:** Healthy adults completed 2 visits (10 young [YNG] vs 9 OLD; age 22 ± 1 vs 66 ± 3 yrs, BSA 1.8 ± 0.1 vs 1.9 ± 0.1 m²; % predicted peak VO_2 99 ± 7 vs 115 ± 7 %; peak workload 188 ± 16 vs 144 ± 9 W, respectively; age and workload $P < 0.05$). Visit 1: peak exercise test. Visit 2: constant load cycle ergometry at 30% peak workload (YNG= 56 ± 5 vs OLD= 43 ± 3 W, $P < 0.05$) with the first 3 min without cuffing (0 mm Hg) and intermittent subsystolic bilateral thigh cuff inflations to 20, 40, 60, 80, or 100 mm Hg for 2 min (randomized), with 2 min deflation between inflations. Non-invasive systolic (SBP), diastolic (DBP), and mean arterial (MAP) pressure were measured via continuous hemodynamic photoplethysmography.

RESULTS: In both YNG and OLD, the highest % increase in blood pressure from rest occurred at 100 mm Hg (SBP= 40 ± 3 and 38 ± 4 %; DBP= 27 ± 3 and 22 ± 4 %; MAP= 32 ± 3 and 29 ± 3 %, respectively), which did not differ between group ($P > 0.05$). The % increase from rest to 100 mm Hg in YNG and OLD were significantly greater than the % increase from rest to 0, 20, 40, or 60 mm Hg for SBP (21 ± 3 and 26 ± 5 %; 23 ± 3 and 23 ± 3 %; 23 ± 3 and 23 ± 3 %; 27 ± 3 and 26 ± 5 %, respectively), DBP (5 ± 3 and 9 ± 3 %; 2 ± 2 and 7 ± 3 %; 12 ± 3 and 4 ± 3 %; 14 ± 3 and 11 ± 3 %, respectively), and MAP (11 ± 3 and 16 ± 3 %; 8 ± 2 and 14 ± 3 %; 15 ± 3 and 11 ± 3 %; 19 ± 3 and 17 ± 3 %, respectively) in both groups. However, these % increases in blood pressure from rest did not differ between groups (all $P > 0.05$).

CONCLUSIONS: These data suggest both YNG and OLD demonstrate a similar EPR response to graded venous occlusion of locomotor muscles during submaximal constant-load exercise. However, there may be a graded threshold necessary to evoke the EPR response in older adults.

2867 Board #7 June 3, 1:00 PM - 3:00 PM
Carotid Artery Wall Mechanics During Lower Body Resistance Exercise In Strength Trained and Untrained Men.

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 (No relationships reported)

PURPOSE: To investigate the impact of double-leg press exercise on arterial wall mechanics (peak circumferential strain, systolic and diastolic strain rate) in the common carotid arteries (CCA) of strength trained (ST) and untrained (UT) men. **METHODS:** Short-axis ultrasound images of the CCA were collected in 9 ST (age: 23 ± 3 yrs; stature: 177.5 ± 5.5 cm; body mass: 89.3 ± 11.3 kg; 8 repetition maximum (8RM): 264 ± 42.5 kg) and 9 UT (age: 24 ± 4 yrs; stature: 179.5 ± 6.6 cm; body mass: 83.0 ± 11.9 kg; 8RM: 152 ± 19.9 kg) men at rest, and during double-leg press exercise at 40% and 80% of 8RM. Images were analysed for peak circumferential strain (PCS), peak systolic and diastolic strain rate (S-SR and D-SR, respectively), as well as systolic and diastolic carotid diameter (DiamSYS and DiamDIAS respectively). Systolic and diastolic brachial blood pressures (SBP and DBP, respectively) were also assessed at rest and during exercise. In addition, apical five chamber echocardiography was used to examine stroke volume (SV) in a subset of ten participants ($n = 6$ ST, $n = 4$ UT). **RESULTS:** Whilst S-SR and SV were not influenced by exercise intensity ($P = 0.86$ and $P = 0.08$, respectively), PCS and D-SR decreased significantly from rest to 40% 8RM (-2.7 ± 0.79 %, 95% CI: $1.0 - 4.4$, $P < 0.01$ and -0.26 ± 0.08 1/s, 95% CI: $0.10 - 0.422$, $P < 0.01$, respectively). There was however, no significant difference in PCS or D-SR from 40% to 80% 8RM ($P = 0.126$ and $P = 0.467$, respectively). In contrast, systolic and diastolic diameter (0.06 ± 0.01 cm, 95% CI: $0.35 - 0.75$, $P < 0.01$ and 0.07 ± 0.01 , 95% CI: $0.06 - 0.09$, $P < 0.01$ respectively), SBP and DBP (31 ± 2.3 mmHg, 95% CI: $25.9 - 35.5$, $P < 0.01$ and 18.0 ± 1.7 mmHg, 95% CI: $14.3 - 21.6$, $P < 0.01$, respectively) all increased significantly from rest to 40% 8RM, but continued to increase further between 40% and 80% 8RM (all $P < 0.01$). No significant differences were found between ST and UT men (all $P > 0.05$). **CONCLUSION:** Acute changes in carotid arterial wall mechanics occur with the onset of lower body resistance exercise, irrespective of strength training status. Additionally, during double-leg press exercise, changes in carotid arterial wall mechanics do not occur simultaneously with changes in other haemodynamic variables, and therefore might be reflective of modifications to the intrinsic properties of the vessel wall.

F-11 Thematic Poster - Innovative Techniques to Assess Skeletal Muscle, Bone and Connective Tissue

Friday, June 3, 2016, 1:00 PM - 3:00 PM
 Room: 109

2868 Chair: Joshua F. Yarrow. VA Medical Center, Gainesville, FL.
 (No relationships reported)

2869 Board #1 June 3, 1:00 PM - 3:00 PM
Reliability of Ultrasound Measures for Skeletal Muscle Thickness: Influence of Posture and Anatomical Site
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 (No relationships reported)

PURPOSE: Ultrasound imaging (US) is an affordable and practical alternative to the current gold-standard measures (MRI, CT) of assessing skeletal muscle architecture

in-vivo. The current literature indicates that two predominant US-based strategies are employed to measure skeletal muscle thickness: US captured while the subject stands (STAND) and US captured while the subject is supine (SUP). The purpose of this study was to assess test-retest reliability of these US strategies for measuring muscle thickness and determine the influence of posture and anatomical location.

METHODS: B-mode ultrasound was used to attain muscle thickness measurements of the quadriceps in a within subject, repeated measures design. These data were obtained from four recreationally active individuals (2 female, 2 male; age: 39.7±21.8yr; BMI: 23.5±4.3kg/m²) over two visits. During each visit, repeated measures were made by one examiner, during two subject positions (STAND, SUP), from five anatomical sites along the anterior (A) and lateral (L) plane of each leg corresponding to 59% leg length (A1, L1), 39% leg length (A2, L2), and 22% leg length (L3). Data are from 480 independent muscle thickness measures of the rectus femoris (RF), anterior portion of vastus intermedius (AVI), lateral portion of vastus intermedius (LVI), vastus lateralis (VL), and total muscle thickness (TOTAL).

RESULTS: SUP and STAND resulted in subtle differences in the measurement of RF (mean diff= 0.877cm, 95% CI: 0.547 to 1.206, p<0.05), AVI (0.9606cm, 0.6756 to 1.246, p<0.05), and VL (-0.2486cm, -0.4205 to -0.0767, p<0.05). Compared to STAND, SUP appeared to demonstrate the highest test-retest reliability [intra-class coefficient (ICC): 0.852 to 0.973] for all muscles, except LVI (ICC: 0.897, 0.714; STAND vs SUP). Posture affected the test-retest reliability in a site-specific capacity. During SUP, test-retest reliability was greatest for RF at A1 (ICC: 0.873), AVI at A2 (ICC: 0.973), and LVI, VL, and TOTAL at L1 (ICC: 0.714, 0.852, 0.907, respectively).

CONCLUSIONS: Posture and anatomical site may independently induce subtle differences in the reliability of US measured muscle thickness of the quadriceps. These preliminary data provide highly reliable posture- and site-specific parameters for muscle-specific measures of skeletal muscle thickness.

2870 Board #2 June 3, 1:00 PM - 3:00 PM
The Relationship between Muscle Echo Intensity and Limb Percent Fat: the Influence of Subcutaneous Fat Thickness

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Ultrasound (US) imaging has become an attractive method to assess muscle quality. Echo intensity (EI), a mean gray scale value of a selected region of interest, provides a quantitative measure of muscle quality and has been suggested to reflect the amount of non-contractile tissue. Recent studies are in contrast when examining the relationship between percent body fat (%BF) and EI, which may be due to the influence of subcutaneous fat thickness on EI values.

PURPOSE: The purpose of this study was to examine the relationship between muscle EI values and limb %BF, prior to and after correcting for subcutaneous fat thickness.

METHODS: Thirty-one males (age: 32.2 ± 3.7 yrs; stature: 180.7 ± 5.7 cm; body mass: 106.9 ± 21.0 kg; %BF: 25.0 ± 7.1%) volunteered for this investigation. Subjects were asked to refrain from exercise for 24 hours prior to visiting the lab and arrive following a four hour fast. Limb specific %BF was assessed using Dual-energy X-ray Absorptiometry (DXA) of the right leg. Brightness-mode panoramic US images of the right rectus femoris (RF) muscle were obtained with the subjects in a supine position with the right leg propped at 50 degrees of flexion. The US probe was positioned perpendicular to the skin and moved along the transverse plane of the RF with transmission gel applied to the skin to enhance acoustic coupling. Image-J software was used to determine EI from the entire RF muscle and subcutaneous fat thickness was determined at half the distance between lateral and medial borders of the RF muscle. The EI values were then corrected for subcutaneous fat thickness using an equation described previously. The relationships between limb specific %BF and uncorrected and corrected EI values were examined using Pearson's correlation coefficients (r) with an alpha level set a priori at $P \leq 0.05$.

RESULTS: There was a non-significant negative relationship between the uncorrected EI values and limb specific %BF ($r = -0.267$, $P = 0.146$). However, there was a significant positive relationship between corrected EI values and limb specific %BF ($r = 0.643$, $P < 0.001$).

CONCLUSION: These findings indicated that greater limb %BF was associated with poorer US derived muscle quality when accounting for subcutaneous fat thickness. Future studies utilizing muscle EI values should consider accounting for subcutaneous fat depth.

2871 Board #3 June 3, 1:00 PM - 3:00 PM

Alterations in Quadriceps Morphology Following an Anterior Cruciate Ligament Reconstruction: An MRI Based Assessment

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(No relationships reported)

Quadriceps muscle weakness following an ACL reconstruction limits an athlete's ability to return to sport. While potential reasons for this weakness have been advanced, little work has been done to assess if the underlying morphology of the muscle is altered. Identification of critical features related to force production such as pennation angle, fiber length, volume and the physiological cross-sectional area (PCSA) are needed to fully understand the reasons for this weakness and to develop new treatment strategies. Recent advances in diffusion tensor magnetic resonance imaging (DTI-MRI) allow for the assessment of all of these features.

PURPOSE: The objective of this study was to assess whether the vastus lateralis' PCSA, volume, fiber length, and pennation angle vary after six months of therapy post-surgery.

METHODS: Six subjects (5F, 1M, ages 26.6 ± 8.64yrs) who had an ACL reconstruction and completed physical therapy, underwent DTI-MRI of both the involved and uninvolved legs. The data was processed using Slicer 3D to determine the volumes of the vastus lateralis on each leg, and a custom Matlab code was used to determine the lengths of the fiber tracts and the muscles' pennation angles. The PCSA was then calculated from these values. Between leg comparisons were made with an independent t-test.

RESULTS: We found significant differences in pennation angle (15.1 ± 2.9 degrees involved, 17.9 ± 2.6 degrees uninvolved, p=0.004), muscle volume (241.2 ± 75.0cm³ involved, 341.5 ± 83.2cm³ uninvolved, p=0.032), and PCSA (47.2 ± 14.8cm² involved, 68.6 ± 9.1cm² uninvolved, p=0.007). We found no significant difference in muscle fiber tract length (5.0 ± 1.3cm involved, 4.7 ± 0.8cm uninvolved, p=0.640).

CONCLUSIONS: As expected, the PCSA of the muscle was significantly lower for the involved leg. The changes in PCSA were largely driven by muscle atrophy and pennation angle and not fiber tract length. These results show that despite intensive physical therapy, the underlying structure of the quadriceps does not normalize to the uninvolved leg following surgery.

2872 Board #4 June 3, 1:00 PM - 3:00 PM

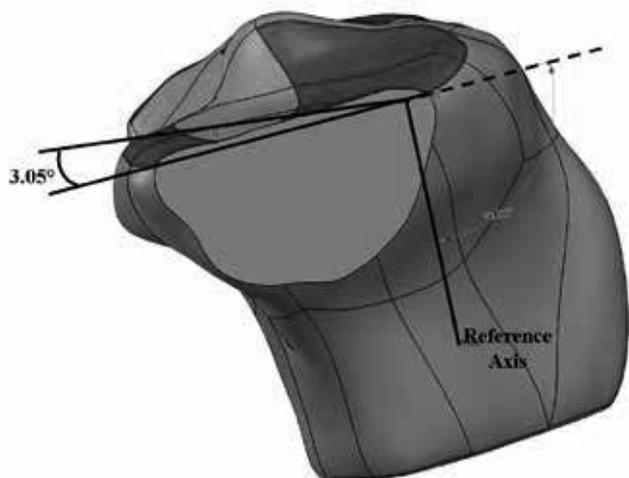
Novel Measurement of Multi-planar Proximal Tibial Slope

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PURPOSE: While established 2D methods can measure posterior tibial slope, limitations to reliability are evident. Our aims were: 1) to explore the reliability of 2D methods, 2) to provide proof of concept for a novel 3D approach, and 3) to compare 3D and 2D data.

METHODS: MRI for three subjects were obtained and tibial slopes measured six times by four trained observers according to established methods. 3D reconstructions were generated, and the process repeated: 1) by adaptation of the 2D method to 3D, and 2.) with novel 3D methodology as follows: A reference axis (Fig. 1) was selected by identification of the most anterior point of the tibial tuberosity and sectioning the tibia at this point. 10mm distally, a line which bisected the tibia, collinear and parallel to the first line, was introduced and the midpoints of the lines connected. Tibial slopes were measured across the plateaus in 2mm increments.



RESULTS: ICC demonstrated that 3D approaches produced more reliable results.

ICC Across Methods			
Method	Coronal Slope	Medial Slope	Lateral Slope
2D Hashemi	0.812	0.527	0.430
3D Hashemi	0.996	0.990	0.995
3D Novel	0.840	0.909	0.968

CONCLUSIONS: 3D methods were more reliable. Further work should enhance computational efficiency in support of clinical applicability. Support by NIH (AR056259-06) and OH Supercomputer Ctr.

2873 Board #5 June 3, 1:00 PM - 3:00 PM
Quantifying The Contributions Of Sodium And Calcium In Bone Using Serial Dxa Scans

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(No relationships reported)

Bone has been hypothesized to serve as a sodium reservoir to buffer acute and chronic derangements in plasma sodium concentration ($[Na^+]$). However, the contributions of sodium in bone have yet to be quantified in imaging studies. **PURPOSE:** To: 1) quantify the contributions of 6g sodium chloride (NaCl) on bone mineral content (BMC) and density (BMD) using dual energy x-ray absorptiometry (DXA) scans; 2) compare the contributions of 6g NaCl vs. 6g calcium citrate (Ca3Cit2) on both BMC and BMD; and 3) assess whole body BMC changes in humans 2hrs after oral ingestion of 6g NaCl. **METHODS:** 1) Ten DXA scans serially performed on a spine phantom (alone) and then with 6g NaCl placed over the spine as: solid 1g tablets; crushed tablets in 1.5mL Eppendorfs (tubes); and as a solution in tubes. 2) Ten DXA scans performed on a spine phantom plus 6g Ca3Cit2 as solid 1g tablets and as crushed tablets in tubes. 3) 14 healthy humans ingested 6g NaCl, (6x1g tablets) with DXA scans taken immediately after ingestion (+tablets; just swallowed) and then repeated 2hrs following oral tablet ingestion (-tablets; due to GI absorption). **RESULTS:** Mean spine phantom BMC ($51.38 \pm 0.26g$; CV=0.51%) was significantly lower compared with spine phantom plus: NaCl tablets (55.39 ± 0.23 ; $p < 0.0001$); NaCl tubes ($54.87 \pm 0.26g$; $p < 0.0001$); NaCl solution ($52.49 \pm 0.28g$; $p < 0.0001$); Ca3Cit2 tablets ($55.05 \pm 0.31g$; $p < 0.0001$); and Ca3Cit2 tubes ($53.68 \pm 0.39g$; $p < 0.0001$). Mean spine phantom BMD ($0.989 \pm 0.004g/cm^2$; CV=0.50%) was statistically lower when compared with phantom plus: NaCl tablets ($1.063g/cm^2 \pm 0.005$; $p < 0.0001$); NaCl tubes ($1.056 \pm 0.005g/cm^2$; $p < 0.0001$); NaCl solution ($1.006 \pm 0.005g/cm^2$; $p < 0.0001$); Ca3Cit2 tablets ($1.058 \pm 0.006g/cm^2$; $p < 0.0001$); and Ca3Cit2 tubes ($1.021 \pm 0.005g/cm^2$; $p < 0.0001$). Absorption of 6gm NaCl tablets into the bloodstream 2hrs after oral ingestion reduced whole body BMC by $-5.5 \pm 27g$. **CONCLUSIONS:** 6g NaCl caused significant increases in BMC and BMD in DXA scans when placed over a spine phantom in: tablet form, when crushed in tubes; and dissolved in solution. Increases in BMC and BMD were similar between 6g NaCl and 6g Ca3Cit2. Alternatively, GI absorption of 6g NaCl tablets after oral ingestion resulted in a $\sim 6g$ decrease in total body BMC. Thus, changes in BMC and BMD may reflect Na^+ and Ca^{++} mobilization in DXA scan measurements.

2874 Board #6 June 3, 1:00 PM - 3:00 PM
Peripheral QCT Sector Analysis Reveals Positive Bone Adaptations Following Osteogenic Index-Optimized Exercise

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(No relationships reported)

Research suggests that including an 8 h rest period between exercise/loading sessions optimizes the osteogenic index (OI), resulting in augmented bone mineral density (BMD). Further, using a novel peripheral quantitative computed tomography (pQCT) sector analysis potentially allows for the detection of early site-specific bone adaptations. **PURPOSE:** To test the hypothesis that performing ballistic, plyometric-type exercise twice (2x/d) vs. once (1x/d) per day (equating for total exercise time/volume) would result in augmented pQCT-assessed bone adaptations. **METHODS:** Men and women volunteers ($n=17$; 23.4 ± 4.6 y) were randomized into 1x/d ($n=11$) or 2x/d ($n=6$) training groups and completed non-linear periodized training on a 3PQ leg press machine 3 d/wk for 11 wk. The 2x/d exercise sessions were separated by 8 h, leading to a 45% greater OI vs. 1x/d. Tibial pQCT scans taken at 38% and 66% from the distal end plate were analyzed using MATLAB to assess whole bone and regional (six, 60° polar sectors: LA, AA, MA, MP, PP, LP; L=lateral, A=anterior, M=medial, P=posterior) parameters including volumetric BMD (vBMD), cortical area and thickness. Data were analyzed with repeated measures ANOVA. **RESULTS:** Following training, there were no changes in whole bone cortical vBMD at the 38% site; however, regional analysis revealed an increase in the LP sector ($P=0.03$) in both groups. Whole bone cortical area at 38% did not change in 1x/d, but increased in the 2x/d group ($p < 0.01$). Sector analysis of cortical area at the 38% site demonstrated similar adaptations, where area was preserved (PP; $P=0.22$) or increased (AA; $P=0.03$) in 2x/d, but decreased (PP; $p < 0.01$) or remained the same (AA, LP; $p > 0.10$ for both) in the 1x/d group. Whole bone cortical thickness at the 38% site tended to decrease ($P=0.07$) in 1x/d, but was preserved ($P=0.15$) in the 2x/d group. Regional analysis revealed that cortical thickness decreased in AA ($P=0.04$) and PP ($P=0.01$) sectors in 1x/d, but was increased (AA; $p < 0.01$) or preserved (PP; $P=0.23$) in the 2x/d group. No changes were observed at the 66% site for any parameter assessed. **CONCLUSION:** Optimizing the osteogenic potential of exercise enhances site-specific bone changes that can be observed in as little as 3 months by exploiting pQCT sector analysis. Not to be construed as official Department of the Army position or policy.

2875 Board #7 June 3, 1:00 PM - 3:00 PM
Calf Muscle Contributions To Achilles Tendon Architectures And Injuries Using Finite Element Modeling

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(No relationships reported)

Clinically the sites of Achilles Tendon (AT) overuse conditions occur primarily within the tendon mid-portion and the osteotendinous attachment. **PURPOSE:** We propose an anatomical and finite element model of the muscle-tendon-bone units that could provide a possible anatomic explanation for these 2 sites of injury. **METHOD:** Twelve cadavers (age 74 ± 7 years) were studied. In both legs, calf muscles (lateral gastrocnemius (LG), medial gastrocnemius (MG) and soleus (SL)) were dissected and their volumes measured. A finite element model based on a von Mises criteria of tendon coupled to a rupture index was developed to investigate the AT response to mechanical load.

Three simulations were performed corresponding to three load cases (Force from GM= Force from GL = Force SL, Force from GM=1.5×Force from GL and Force from GL= 1.5×Force from GM). The SL load was kept constant during the three cases. Histological sections of the enthesis and thickness of both the uncalcified fibrocartilage and subchondral plate were evaluated. **RESULTS:** Muscle volume was highest for the soleus ($p=0.02$), followed by the MG ($p=0.04$), and LG ($p=0.04$). Uncalcified fibrocartilage was significantly thicker medially than laterally ($P=0.02$). Finite element modeling predicted rupture propagation and final patterns depending on the load cases indicating that non-uniform stress in the AT can occur through modifications of individual muscle contributions ($p=0.02$). As the load increased, the pressure converged at the middle area between 4.6cm and 7.9cm from the AT enthesis. **CONCLUSION:** Our data suggest that the AT muscle-tendon-bone units are composed

of anatomically distinct parts that undergo non-uniform mechanical loading. Finite element modeling can be used for identifying localized material property changes due to muscle atrophy or hypertrophy as well as in response to mechanical loading seen during normal gait and running.

2876 Board #8 June 3, 1:00 PM - 3:00 PM
Ultrasonographic Assessment Of Achilles Tendon Properties During A One-leg Jump: A Comparison Between Age And Pathology.

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The prevalence of Achilles tendinopathy increases with age and is accompanied by altered tendon properties resulting in a mechanically weaker tendon. Age-related changes in tendon properties could also be shown, as children demonstrate more compliant tendinous structure compared to asymptomatic adults. However, studies investigating Achilles tendon (AT) properties are restricted to in-vitro and isometric conditions, limiting understanding of the tendon response during functional task. Purpose: To investigate AT compliance during one-leg jump with respect to age and pathology.

Methods: Ten children (C), ten asymptomatic adults (A) and ten tendinopathic patients (T) were included in the study. Ultrasound imaging was used to assess AT length (ATL), cross-sectional area (CSA) and thickness during rest. AT elongation from rest to maximal jump peak during a one-leg jump on a force plate was sonographically assessed. Force was defined as the maximum value 100ms before flight phase (<30N). AT compliance was calculated by dividing tendon elongation by force. Regarding age, results were compared between C and A. Concerning pathology, results were compared between A and T. One-way ANOVA followed by Bonferroni post-hoc correction tests ($\alpha=0.05$) were used.

Results: AT thickness (C=4.6±0.9 mm, A=4.9±0.5 mm, T=6.9±1.4 mm, p=0.001) and CSA (C=59±18 mm², A=58±13 mm², T=83±24 mm², p=0.021) were statistically significant thicker in T than A and C. AT elongation (C=27±3 mm, A=21±4 mm, T=25±5 mm, p=0.004) and AT compliance [mm/N] (C=0.026±0.006 mm/N, A=0.017±0.005 mm/N, T=0.019±0.004 mm/N, p=0.001) were found to be statistically significant higher in C compared to A. In contrast, no statistically significant difference between groups were found for ATL (C=219±17 mm, A=217±24 mm, T=220±24 mm, p≥0.05) and force (C=1068±208 N, A=1287±225 N, T=1389±288 N, p≥0.05).

Conclusion: During one-leg jumps, tendon responds differently in regards to age, with children having the most compliant AT. The higher compliancy found might be considered as a protective factor against load-related injuries in healthy tendons, as prevalence of Achilles tendinopathy is low in children. Moreover, despite a tendency of altered AT response in tendinopathic patients no significant differences were found compared to asymptomatic adults.

F-12 Thematic Poster - Skeletal Muscle

Friday, June 3, 2016, 1:00 PM - 3:00 PM
 Room: 101

2877 Chair: William R. Lunn. Southern Connecticut State University, New Haven, CT.
 (No relationships reported)

2878 Board #1 June 3, 1:00 PM - 3:00 PM
Effects of Periodized Strength Training Regimens on Functional and Morphological Adaptations of Skeletal Muscle

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It has been suggested that periodized strength training (ST) regimens optimize the training-induced adaptations. Purpose: The purpose of current study was to investigate the effects of different periodized and non-periodized regimens on functional performance and morphological skeletal muscle adaptations. Methods: Thirty-four participants (age=24.6 ±5.4 years) were random allocated into four groups: control (C), non-periodized (NP), traditional periodized (TP) and daily undulating periodized

(UP). Experimental groups underwent 12 weeks of ST twice a week, and performed half-squat and knee extensors exercises (i.e. 2-4 sets, 4-12 repetitions). Maximum dynamic strength (1RM) and quadriceps cross-sectional area (CSA) were evaluated at baseline and after six and 12 weeks of training. Results: Training groups had similar total volume load over the experimental period (NP 92.598 ± 15.340kg; TP: 92.973kg ± 10.760kg; UP 108.367 ± 18.316kg [p>0.05]). Only NP and UP increased 1RM after six weeks (17.0 ± 8.7%, p<0.0001; 12.9 ± 9.9%, p<0.01, respectively). After 12 weeks, NP, TP and UP increased 1RM values (19.5 ± 13.2%; p<0.0001; 17.9 ± 13.7%; p<0.0001; 20.4 ± 9.0%; p<0.0001 respectively). All experimental groups increased quadriceps CSA after six (5.1 ± 2.7%, p < 0.0001) and 12 weeks (9.5 ± 4.5% p < 0.0001) of training. Furthermore, only GPL significantly increased quadriceps CSA between six and 12 weeks (6.4%, p<0.0001). Conclusion: Even though experimental groups presented differences in the time-course of functional performance and morphological adaptations, overall between-group effects suggest similar efficiency of the training regimens for healthy male individuals.

2879 Board #2 June 3, 1:00 PM - 3:00 PM
Preconditioning Ischemia Decreases Temperature and Impairs Muscle Contractile Properties

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Ischemic preconditioning (IPC) has been reported to improve performance in some types of exercise, i.e., at maximal and time trial efforts and attenuating the rise in blood lactate concentration. In contrast, IPC does not improve performance during submaximal exercise or time to exhaustion.

PURPOSE: To determine if IPC improves the muscle contractile properties assessed by tensiomyography (TMG).

METHODS: Eight physically active men were recruited for this experiment. Motor point was determined in vastus medialis to conduct TMG measurements (Dm: maximum displacement; Td: delay time; Tc: contraction time; Ts: sustained time; Tr: relaxation time) before and after IPC. A cuff was placed on one leg at groin level and inflated to 300 mmHg for 10 minutes. Baseline measurements of TMG were taken (PRE) and 5', 10', 20', 25' and 30' after IPC treatment (POST). Superficial muscle temperature was also measured by thermography before, during and after IPC treatment.

RESULTS: Dm was lower in POST-15' (7.74±1.07 mm), POST-20' (7.72±0.98 mm) and POST-25' (7.74±1.04 mm) compared to PRE (8.15±0.81 mm) condition (P=0.82; P<0.05; P=0.056; respectively). Ts was also lower in POST-5' (215.6±27.6 ms), POST-10' (217.7±27.0 ms), POST-15' (221.0±31.3 ms) and POST-20' (222.4±26.4 ms) than in PRE (232.7±28.9 ms) condition (P<0.05). No differences were found in other TMG variables. Muscle temperature was 0.42 °C lower at the end of IPC than in basal condition (P<0.05). In POST-5' and POST-10' temperature was similar to baseline due to reactive hyperemia effect. Later, temperature decreased again in POST-15', POST-20', POST-25' and POST-30' (0.23 °C, 0.31 °C, 0.27 °C and 0.30 °C, P<0.05, respectively) compared to baseline.

CONCLUSION: The decrease in Dm and Ts after IPC treatment suggests an activation of lower number of fibers and shorter total contraction respectively, which means worse muscular contraction capabilities. It is well known that muscle temperature and muscle contraction are associated. This finding could be explained because the restriction of blood flow caused by IPC decreases muscle metabolism and, as a consequence, muscle temperature too, deteriorating muscle contraction. In conclusion IPC seems to decrease muscular contraction capacity. However, it does not mean that IPC impairs sport performance.

2880 Board #3 June 3, 1:00 PM - 3:00 PM
Changes in Muscle Architecture and Explosive Ability in Collegiate Volleyball Players throughout a Competitive Season

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 (No relationships reported)

PURPOSE: Limited research exists examining muscle architectural changes in conjunction with performance measures throughout an athlete's competitive season. The purpose was to examine changes in muscle architecture and explosive ability in DI collegiate volleyball players throughout a competitive season. METHODS: Ten female volleyball players (20.4 ± 1.1 y, 178.3 ± 4.8 cm, 72.6 ± 5.3 kg) were recruited for the study. Athletes were tested at pre-season (T1), pre-taper (T2), and post-taper (T3) on measures of vastus lateralis muscle thickness (MT), pennation angle (PA), and fascicle length (FL) using ultrasonography, countermovement jump height (JH), time to takeoff from initiation of the unweighting phase (TTT), and peak power

allometrically scaled (PPa) measured using a force platform. Training load (TL: session RPE·duration) and strength training volume-load times displacement (VLd) were monitored for 15 wks. One-way repeated measures ANOVAs with post-hoc comparisons were used for analysis with alpha level set at $p \leq 0.05$. RESULTS: There was a reduction in VLd/wk (1886 ± 422 to 571 ± 130 kg/wk, $p < 0.001$, $d = 3.1$) and TL/wk (3140 ± 561 to 1656 ± 409 a.u., $p < 0.001$, $d = 2.7$) between in-season (T1-T2) and tapering (T2-T3) training phases. There were time effects for MT ($p < 0.001$) and PA ($p = 0.03$). Post-hoc comparisons revealed changes in MT (T1-T2: 2.1 ± 0.3 to 2.96 ± 0.54 cm, $p < 0.001$, $d = 2.8$; T1-T3: 2.1 ± 0.3 to 2.63 ± 0.36 cm, $p < 0.001$, $d = 1.7$; and T2-T3: 2.96 ± 0.54 to 2.63 ± 0.36 cm, $p = 0.01$, $d = 0.6$), PA (T1-T2: 12.59 ± 0.81 to $15.76 \pm 3.38^\circ$, $p = 0.02$, $d = 3.9$), and no statistical changes in FL, JH, or PPa. Despite the absence of a time effect, a decreasing trend was observed in TTT from T1-T3: 798 ± 98 to 767 ± 106 ms, $p = 0.04$, $d = 0.32$, and T2-T3: 789 ± 101 to 767 ± 106 ms, $p = 0.04$, $d = 0.22$. CONCLUSION: In-season training resulted in favorable changes in muscle architecture, which remained elevated above pre-season values following the taper. These muscle architectural changes did not appear to appreciably alter explosive ability throughout the competitive season. However, the reductions in TL and VLd during the taper might have improved stretch-shortening cycle efficiency as evidenced by the reductions in TTT. Collegiate volleyball athletes may benefit from a taper where both TL and VLd are substantially reduced prior to important competitions.

2881 Board #4 June 3, 1:00 PM - 3:00 PM
Characterization of the Muscular Strength Increase in University Students

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The development of muscle strength is an essential factor for the maintenance of health that brings benefits such as: postural correction, decreased risk of musculoskeletal injuries, increased bone mass, increased metabolic usage and blood circulation improvement.

Purpose: This study has the objective of proving the evolution of Muscular Strength (MS) upon the application of maximal tests on and programmed training sessions for the students of the Physical Activity and Sports elective courses at the Pontifical Xavierian University in Bogota D.C, Colombia.

Methods: Descriptive quantitative study upon the application of ACSM assessment methods for maximum strength (2014): Upper Body Strength (UBS); Leg Press (LP); Push-Up (PU) and Curl-Up (CU). The total population subject to the study was $N = 344$, aged 24.5 ± 7.5 years. The sample worked on was $n = 163$ students corresponding to 47% of the analyzed population, being $n = 72$ (44.2%) females and $n = 91$ (55.8%) males, which passed the sample validation of 95% of the students tested ($p < 0.05$). The students performed a total of 40 hours of training of (MS) within a period of 8 weeks, divided into 24 class sessions (8 supervised and 16 autonomous) using four (4) different (MS) training methods: German, Compound Series, Pyramid and Ladder. Results: The evolution of (MS) within the general average of (LP) showed a superior increase of 20 pounds (8%). In relation to (UBS), the improvement is greater than 10 pounds (21%). Regarding (CU), there was a higher abdominal strength after 10 repetitions (22%) and (PU) generated increase after 12 repetitions (27%). The data obtained from the tests applied reflect that the evolution of (MS) in the context of training of beginners coincides with the increase of 20% with the evidence of 21% in the case of the women and 19% in the case of men.

Conclusion: It was proved that the increase in (MS) indexes was originated by the increase of the frequency in the practice and the structuring and progression of the sessions. These considerations sustain that the increase in (MS) is a significant component for the maintenance of health since this brings benefits that enhance the functional capacity, neuromotor control and lipid profile of people.

2882 Board #5 June 3, 1:00 PM - 3:00 PM
Effect of Eccentric Exercise with Blood Flow Restriction on Muscle Activation and Microvascular Oxygenation

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PURPOSE: To examine the effect of eccentric muscle actions with, and without blood flow restriction (BFR) on microvascular oxygenation and neuromuscular activation. Additionally, the effect of performing a prior bout of eccentric muscle contractions with BFR on attenuating the magnitude of muscle damage during a subsequent bout of maximal exercise was examined. **METHODS:** Participants were randomly assigned to one of three groups, 30% of maximal torque (LOW), 30% of maximal torque

with BFR (LBFR), or control (CON). Participants in LOW and LBFR performed a preconditioning (i.e. protective) bout of low-intensity eccentric exercise 96 h prior to performing a bout of maximal eccentric exercise (6 sets x 10 reps) to induce muscle damage. Participants reported 24, 48, 72, and 96 h later to assess muscle damage and function. Surface electromyography (sEMG) and near-infrared spectroscopy (NIRS) was used to measure neuromuscular activation and microvascular deoxygenation (deoxy-[Hb]) and [total hemoglobin] ([THC]) of the knee extensors during the preconditioning bout, respectively. **RESULTS:** There was a significant difference in sEMG of the vastus medialis (VM-RMS) between LOW and LBFR ($p = 0.05$). During set-2, LBFR resulted in greater activation of the VM-RMS (LOW $47.7 \pm 11.5\%$ MVIC, LBFR $67.0 \pm 20.0\%$ MVIC) compared to LOW, as well as during set-3 (LOW $51.4 \pm 8.6\%$ MVIC, LBFR $69.53 \pm 20.5\%$ MVIC). There was a significant difference in deoxy-[Hb] between LBFR and LOW during set-2 (LBFR 13.1 ± 5.2 μM , LOW 6.7 ± 7.9 μM), set-3 (LBFR 14.6 ± 6 μM , LOW 6.9 ± 7.4 μM), and set-4 (LBFR 13.8 ± 5.9 μM , LOW 7.8 ± 8.5 μM). [THC] was significantly higher during LBFR compared to LOW ($p = 0.03$). Immediately post maximal eccentric exercise, all groups showed a significant decrease in MVIC torque (LOW $74.2 \pm 14.1\%$, LBFR $75 \pm 5.1\%$, CON $53 \pm 18.6\%$); LOW and LBFR resulted in a smaller decrease compared to CON. At 24, 48, 72, and 96 h post maximal eccentric exercise, LOW and LBFR force deficit was not different from baseline. **CONCLUSION:** The sEMG and NIRS results of this study suggest that the neuromuscular and deoxygenation responses were considerably different between LOW and LBFR protective conditions, however these differences did not lead to significant differences in the protective effect inferred by performing LOW and LBFR preconditioning exercise.

2883 Board #6 June 3, 1:00 PM - 3:00 PM
Montmorency Cherry Concentrate Protects Muscle Function and Attenuates Inflammatory Response Following Simulated Invasion Sports Play

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Reported Relationships: P.G. Bell: Employee of an ACCME Defined Commercial Interest; GSK Consumer Healthcare (UK) Trading Limited.

Montmorency cherries have been suggested as a potent exercise recovery supplement due to their reportedly high anti-inflammatory and antioxidative potential. A number of studies have demonstrated positive recovery effects of Montmorency Cherry Concentrate (MC) following mechanical (high-intensity eccentric muscle actions) and metabolic (prolonged high-energy turnover) biased exercise. Conceivably, MC might also be an efficacious intervention for accelerating recovery from a concurrent exercise challenge. **PURPOSE:** To determine the effect of MC on recovery of muscle function and inflammation following simulated invasion sports play. **METHODS:** Sixteen semi-professional soccer players (mean \pm SD age, height, mass, predicted $\dot{V}O_{2\text{max}}$ was 25 ± 4 yrs; 180.8 ± 7.4 cm, 81.9 ± 6.6 kg, 54.9 ± 3.5 mL·kg⁻¹·min⁻¹, respectively) completed baseline tests of muscle soreness (DOMS), isometric knee extensors strength (MVIC), countermovement jump (CMJ), 20m sprint, and agility (5-0-5). Participants were equally and randomly assigned to either MC or Placebo (PLA) groups and completed 8 days of supplementation (2 x 30 mL per 24 h) whilst adhering to dietary and exercise restrictions. Participants performed the Loughborough Intermittent Shuttle Test on day 5 and returned on days 6-8 to repeat baseline performance tests. DOMS assessment and performance measures were repeated at 24, 48 and 72 h, whilst venous blood samples were taken pre-exercise, post-exercise and at 1, 3, 5, 24, 48 and 72 h for analysis of inflammatory markers (IL-6 and hsCRP). Repeated-measures ANOVA's were conducted for all variables with *post-hoc* comparisons where necessary ($\alpha = 0.05$). **RESULTS:** Post-exercise performances (peak % difference) of MVIC (19%), CMJ (6%), 5-0-5 (3%) were superior in the MC group ($P < 0.05$). Additionally, an interaction effect for 20m sprint (4%) times with MC was also shown at 48h ($P < 0.05$). DOMS and the acute inflammatory response (IL-6) in the MC group were also lower ($P < 0.05$) with MC. **CONCLUSION:** Montmorency Cherry Concentrate accelerates the recovery of functional performance and reduces muscle soreness following simulated invasion sports play and is associated with an attenuation of the acute inflammatory response.

2884 Board #7 June 3, 1:00 PM - 3:00 PM
Effects Of Rest-pause Vs Traditional Bench Press Training On Muscle Strength, Electromyography, And Lifting Volume.

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(No relationships reported)

EFFECT OF REST-PAUSE VS TRADITIONAL BENCH PRESS TRAINING ON MUSCLE STRENGTH, ELECTROMYOGRAPHY AND LIFTING VOLUME

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 This study compared one repetition maximum (1RM), muscle activity (EMG), and volume differences between rest-pause or traditional resistance training. Trained males ($N = 20$) were randomly assigned to either a rest-pause or a traditional training group. Training sessions were completed twice a week for 4 weeks and consisted of four sets of bench press to volitional fatigue at 80% of pretest 1RM with 2-minutes rests between sets. Each participant completed a bench press 1RM before and after the training intervention. Total volume completed was recorded on each training day. Muscle activity of the pectoralis major was measured on the first and last training days. The RMS signals of the last repetition in the last set were normalized to the RMS peak values of the first repetition in the first set for each participant during the 1st and 8th training sessions. A 2-way repeated measures ANOVA indicated both groups significantly increased their 1RMs following the four week training protocol ($p < .05$). However, no significant differences were found in 1RM and muscle activity between the two groups ($p > .05$). Lastly, an independent samples t-test indicated total volume lifted was significantly higher for the rest-pause group ($M = 56,778\text{lbs}$, $SD = 23,522\text{lbs}$, $N = 10$) in comparison to the traditional training group ($M = 38,315\text{lbs}$, $SD = 7,870\text{lbs}$, $N = 10$). $T(18) = 2.354$, $p < .05$. While strength and muscle activity changes did not differ between groups, the rest-pause group achieved greater increases in volume than the traditional group. If volume is the focus of training (i.e., hypertrophy phases), the rest-pause resistance training method should be utilized. Future studies should assess changes in muscle size between these bench press methods.

2885 Board #8 June 3, 1:00 PM - 3:00 PM
Sex-related Differences In Neuromuscular Efficiency During The Bench Press At 70 And 90% Of 1 Rm

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>Neuromuscular efficiency (NE) is the ability of the nervous system to properly recruit the correct muscles to produce force, reduce force as well as dynamically stabilize the body's structure in all three planes of motion (NASM). Although NE is closely allied with fiber recruitment and rate coding, hormonal differences between sexes may influence NE, the number of repetitions performed at a given % 1RM and the resistance training (RT) response. A 1RM requires the individual to use both neurological and muscular ability in order to recruit many motor units into contraction. Often males recruit more motor units than females during a 1RM which provides a greater absolute working load. **PURPOSE:** The purpose of this study was to examine the number of repetitions males and females can achieve during the bench press using 70% and 90% of 1RM. **METHODS:** 20 recreational athletes (10♀) with a minimum of one year of RT experience (age 24.3 ± 5.0 yrs, ht 170.4 ± 8.9 cm, body mass 73.9 ± 16.5 kg) performed a familiarization trial with submaximal and 1RM bench press lifts. Trials at 70% and 90% 1RM were randomly assigned, terminated at momentary muscular fatigue (MMF), and conducted with a minimum of 48 hrs between trials. All lifts were conducted at a standard movement cadence of 3-1-3 sec (concentric-pause- eccentric muscle contraction). The number of repetitions (R) performed at each percentage of their 1RM were recorded. **RESULTS:** Statistical analysis by an independent T-test revealed a significant difference ($P < .05$) of R at 70% (10.7 ± 2.1 vs 6.8 ± 1.1) and 90% (4.3 ± 1.2 vs 2.9 ± 0.6) for females and males, respectively. A Pearson correlation also revealed a significant correlation between R at 70% and 90% trials. **CONCLUSION:** The ability of females to perform a greater number of repetitions prior to MMF at both 70% and 90% of their 1RM, when compared to their male counterparts, may indicate that the traditional percentage based resistance training exercise prescriptions may be inappropriate for women. Females may require resistance training at a higher percentage of their previously determined 1RM in order to achieve MMF in a given repetition range.

F-13 Thematic Poster - Thermoregulation and Heat Stress

Friday, June 3, 2016, 1:00 PM - 3:00 PM
 Room: 110

2886 **Chair:** Lawrence E. Armstrong, FACSM. *University of Connecticut, Storrs, CT.*
 (No relationships reported)

2887 Board #1 June 3, 1:00 PM - 3:00 PM
Influence Of Aerobic Fitness On The Thermophysiological Responses In Compensable And Uncompensable Heat Stress

Ella F. Walker, Jo Corbett, James R. House, Michael J. Tipton. *University of Portsmouth, Portsmouth, United Kingdom.*
 (No relationships reported)

PURPOSE: To examine the influence of aerobic fitness in groups matched for anthropometric characteristics on the thermal and thermoeffector responses in compensable (CO) and uncompensable (UN) heat stress, during exercise at matched relative and absolute work rates. Previous work has been confounded by differences in body characteristics and the selection of external work rate.

METHODS: Eight high (HI) (mean [SD] $\dot{V}O_{2max} = 58.73[6.28]$ mL.kg⁻¹.min⁻¹) and eight low aerobic fitness (LO) ($46.53[6.73]$ mL.kg⁻¹.min⁻¹) males, matched for body mass, surface area and % body fat volunteered. LO cycled at 60 W (ABS) in 34 °C, 20 % rh. HI completed the same condition, plus an additional test to match the relative intensity of the LO at ABS as a % of $\dot{V}O_{2max}$ (REL). There were two phases in each trial: **1) Compensable phase** - 60 minutes at the specified external work rate, CO was confirmed by a plateau in rectal temperature (T_{re}). **2) Uncompensable phase** - immediately following the compensable phase, ambient temperature (T_{amb}) was increased by 1 °C every 5 minutes, UN was confirmed by an inflection in T_{re} (T_{reinf}). T_{db} , T_{re} , change in T_{re} from rest (ΔT_{re}), metabolic heat production (M) back sweat rate (SR_{back}) and laser Doppler forearm skin blood flow (SkBF) were measured at end of the compensable phase and T_{reinf} identified. Data were analysed by independent t-tests. **RESULTS: 1) Compensable phase** - there were no differences in T_{db} , T_{re} , ΔT_{re} or SkBF between fitness groups in ABS or REL (all $p > 0.05$) or M in ABS ($p = 0.633$). HI had higher SR_{back} in both ABS ($p = 0.002$) and REL ($p < 0.001$) and M in REL ($p = 0.011$). **2) Uncompensable phase** - there were no differences in T_{db} , T_{re} , ΔT_{re} or SkBF between fitness groups in ABS or REL (all $p > 0.05$) or M in ABS ($p = 0.361$) at T_{reinf} . HI had higher SR_{back} in both ABS ($p = 0.005$) and REL ($p < 0.001$) and M in REL ($p = 0.012$) at T_{reinf} . **CONCLUSION:** When anthropometric characteristics are controlled between HI and LO, HI have greater SR than LO regardless of M. This greater SR is likely due to an earlier onset and greater sensitivity of sweating as an adaptation from aerobic training. This improved thermoregulatory function appears to allow the HI to offset the greater M at the matched REL and thermoregulate and transition into UN at a similar T_{re} with a similar T_{re} if the greater SR is able to evaporate freely into the environment.

2888 Board #2 June 3, 1:00 PM - 3:00 PM
Does the Rate of Heat Storage Define Exercise Intensity Level During Self-paced Exercise at a Fixed Rating of Perceived Exertion?

Brian J. Friesen¹, Martin A. Lauzon¹, Denis P. Blondin², Francois Haman¹, Martin P. Poirier¹, Glen P. Kenny¹. ¹University of Ottawa, Ottawa, ON, Canada. ²University of Sherbrooke, Sherbrooke, QC, Canada.
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 (No relationships reported)

Studies evaluating whether exercise intensity during self-paced exercise at a fixed rating of perceived exertion (RPE) is primarily modulated by the rate of body heat storage have yielded mixed results due to the different methods used to calculate the rate of body heat storage (i.e., thermometry and partitioned calorimetry). **PURPOSE:** To evaluate via direct calorimetry whether changes in the rate of whole-body heat storage mediates exercise intensity during self-paced exercise at a fixed RPE. **METHODS:** Ten trained male cyclists participated in three experimental trials conducted on separate days. Following a 20-min baseline period, participants cycled in a direct air calorimeter during HOT (35°C), NORMAL (25°C) and COOL (15°C) conditions at a fixed RPE of 16, self-regulating their workload in order to maintain this RPE until they could no longer maintain 70% of their starting workload. Whole-body heat loss (evaporative and dry) and metabolic heat production were measured by direct and indirect calorimetry respectively. Body heat storage was measured as the temporal summation of heat production and heat loss. **RESULTS:** The starting self-selected workload was lower in HOT compared to NORMAL and COOL (151 ± 30 vs. 165 ± 26 vs. 165 ± 35 W, respectively). Power output declined over time in all

conditions ($P < 0.05$), however a faster decrease was observed in HOT ($P < 0.05$). This led to a shorter exercise time in HOT relative to NORMAL and COOL (57 ± 19 vs. 73 ± 22 vs. 68 ± 26 min, respectively). The rate of heat storage decreased over time in all conditions ($P < 0.05$), however it was greater in COOL and lowest in HOT throughout exercise. In general, the rate of heat storage was significantly greater in COOL relative to HOT and greater in NORMAL compared to HOT after the 5th min of exercise. Further, the rate of heat storage was generally greater in COOL relative to NORMAL after the 15th min of exercise ($P < 0.05$). Taken together, the change in body heat storage during exercise was ~2-fold greater during COOL and ~1.5-fold greater during NORMAL compared to HOT (961 ± 438 vs. 740 ± 258 vs. 478 ± 186 kJ, respectively). **CONCLUSIONS:** We show that self-paced exercise intensity at a fixed RPE is not primarily mediated by differences in the rate of body heat storage. **SUPPORT:** Natural Sciences and Engineering Research Council of Canada (held by Glen P. Kenny).

2889 Board #3 June 3, 1:00 PM - 3:00 PM
The Influence Of A Menthol/ethanol Solution On Thermoregulation During Exercise In Warm, Humid Conditions.

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In warm, humid conditions, the thermal gradient between the skin and environment is reduced, along with the capacity for evaporative heat loss. Consequently, heat may be stored within the body during exercise. Interventions to offset heat stress may be beneficial to perception and performance. **PURPOSE:** To assess whether donning a garment saturated with menthol and ethanol (M/E) could improve evaporative cooling and thermal perceptions versus water (W) or no nothing (CON) during rest and exercise in warm, humid conditions. It was hypothesized there would be no difference in rectal (Tre) and skin (Tsk) temperature, thermal imagery of the chest/back, thermal comfort (TC) and rating of perceived exertion (RPE) between M/E, W and CON, but participants would feel cooler in M/E versus W or CON.

METHODS: Six volunteers (mean [SD] 22 [4] years old, 72.4 [7.4] kg and 173.6 [3.7] cm) completed (separate days) three, 60-minute tests in warm, humid conditions (30 °C, 70 % rh) in a balanced order. After 15-minutes of seated rest participants donned a dry (CON) or 80 mL soaked (M/E, W) long sleeve shirt appropriate to their intervention. They then undertook 30-minutes of low intensity stepping exercise at a rate of 12 steps per minute, followed by 15 minutes of seated rest. Measurements included heart rate (HR), Tre, Tsk (chest, back, forearm), thermal imaging (back/chest), thermal sensation (TS), TC and RPE. Data were reported every fifth minute as they changed from baseline and the area under the curves were compared by condition using one-way repeated measures ANOVA, with an alpha level of 0.05.

RESULTS: Tre differed by condition, with the largest heat storage response observed in M/E ($p < 0.05$). Skin temperature at the chest/back/forearm, and thermal imaging of the back/chest all differed by condition, with the greatest rate of heat loss observed in W and M/E respectively ($p < 0.01$). Thermal sensation differed by condition, with the coolest sensations observed in M/E ($p < 0.001$). No other differences were observed.

CONCLUSIONS: Both M/E and W enhanced evaporative cooling compared CON, but M/E causes cooler sensations and a heat storage response, both of which are likely mediated by menthol, a well-established cold receptor TRPM8 agonist.

2890 Board #4 June 3, 1:00 PM - 3:00 PM
Increasing Skin Temperature During Exercise Lowers Stroke Volume Without Increasing Cutaneous Blood Flow.

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Both skin (Tsk) and core temperature (Tc) are elevated in most studies of heat stress during exercise and this is accompanied by increased heart rate (HR) and decreased stroke volume (SV). However, only a few studies have systemically investigated the effect of progressively increasing Tsk on cardiovascular responses during exercise. **PURPOSE:** To systemically investigate how progressive increases in Tsk (32 to 40°C) affects cardiovascular responses and Tc during moderate exercise.

METHODS: Subjects ($n=8$, active men 25 ± 1 y) cycled at 60% $\dot{V}O_{2peak}$ for 20-30 min. Tsk was manipulated by wearing a water perfused suit that covered the whole body, except head, hands, and feet and maintained a perfused water temperature of 20, 30, 40, and 50°C. Subjects performed all four trials separated by at least 72 h. Esophageal temperature (Tes), Tsk, $\dot{V}O_2$, Q, HR, mean arterial pressure (MAP),

cutaneous blood flow (CBF), and forearm venous volume (FVV) were measured during exercise.

RESULTS: Tsk was significantly different between all trials ($P < 0.01$) and averaged 32.4 ± 0.2 , 35.5 ± 0.1 , 37.5 ± 0.1 , and 39.5 ± 0.1 °C, respectively. Tes was significantly different between each trial after 16 min of exercise ($p < 0.05$) and at the end of exercise were 37.6 ± 0.2 , 38.3 ± 0.1 , 39.2 ± 0.1 , and 39.2 ± 0.2 °C, respectively. The graded heating of Tsk resulted in a graded increase of HR and decrease of SV. However, CBF during exercise reached a similar average plateau value in all trials when Tes was above 38°C independent of Tsk. There was no apparent effect of Tsk on FVV, $\dot{V}O_2$, Q, and MAP.

CONCLUSIONS: Graded increases of Tsk from 32 to 40°C progressively increased Tes and HR and decreased SV during moderate exercise. Tsk had no effect on CBF when Tes was above 38°C. High Tsk (39.5 ± 0.1 °C) did not elicit higher CBF and FVV compared to low Tsk during moderate exercise. CBF and FVV responses suggest no further blood pooling in the forearm skin when Tsk is increased from 32.4 to 39.5°C. The decrease of SV during exercise when heating the skin is related to an increase of HR but not an increase in CBF.

2891 Board #5 June 3, 1:00 PM - 3:00 PM
Control of Skin Blood Flow at the Boundaries of the Thermal Comfort Zone

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Purpose: The control of skin blood flow in the thermal comfort zone is largely unknown. We tested the hypothesis that skin blood flow at the boundaries of the thermal comfort zone is predominantly under reflex control.

Methods: Ten healthy subjects (age: 26 ± 4 y, 4 females) wearing shorts and a t-shirt underwent a 90 min behavioral test in which they voluntarily moved between a warm (39.9 ± 0.2 °C, RH: $20 \pm 0\%$) and a cool (16.9 ± 1.4 °C, RH: $49 \pm 3\%$) room when they felt 'too warm' or 'too cool'. This test defined the boundaries of the thermal comfort zone for each subject. Skin blood flow was measured continually on the ventral forearm at two locations using laser Doppler flowmetry. One of these locations was maintained at 34°C, ensuring skin blood flow was under reflex control (RFX). The temperature of the other location was not controlled, and thus, skin blood flow was under local and reflex control (L+RFX). Blood pressure (Finometer), and weighted mean skin and rectal temperatures were also measured continually. Data are reported as a 30 s average immediately prior to moving from cool to warm (C→W) or warm to cool (W→C). Data were averaged across behaviors for a given subject (behaviors/subject = 9 ± 3). Skin blood flow data are reported as absolute values, the change from pre-test baseline, and as cutaneous vascular conductance (CVC).

Results: Mean skin temperature was different at C→W (33.5 ± 0.7 °C) compared to W→C (36.1 ± 0.5 °C, $P < 0.01$), but rectal temperature did not differ at these points (C→W: 36.8 ± 0.2 °C, W→C, 36.7 ± 0.2 °C, $P = 0.17$). At baseline, C→W and W→C, absolute skin blood flow and CVC were higher at RFX compared to L+RFX ($P < 0.01$). However, at both locations absolute skin blood flow and CVC were higher ($P < 0.01$) at W→C compared to C→W ($P < 0.01$), which was also consistent with the change from baseline data ($P < 0.01$). Nevertheless, whether expressed as skin blood flow or CVC, the change from baseline at RFX compared to L+RFX was not different at either W→C (RFX: $+21 \pm 23$ PU, $+0.27 \pm 0.24$ mmHg/PU vs. L+RFX: $+29 \pm 15$ PU, $+0.33 \pm 0.16$ mmHg/PU; $P \geq 0.10$) or C→W (RFX: -6 ± 15 PU, -0.09 ± 0.16 mmHg/PU vs. L+RFX: -3 ± 6 PU, -0.04 ± 0.06 mmHg/PU; $P \geq 0.39$)

Conclusion: These data indicate that changes in skin blood flow at the boundaries of the thermal comfort zone are largely under reflex control in young healthy adults.

2892 Board #6 June 3, 1:00 PM - 3:00 PM
Attenuated Increases In Cardiac Output Limit Cutaneous Vasodilation During Heat Stress In Healthy Aged Humans

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Background: Cardiac output and cutaneous vasodilation are attenuated in healthy aged humans during heat stress. It is well established that changes in peripheral vascular control limit the extent of cutaneous vasodilation in the aged. However, it remains unknown if the attenuated increase in cardiac output seen in older individuals during heat stress also contributes to reduced cutaneous vasodilation. **Purpose:** We

tested the hypothesis that an acute increase in cardiac output, via rapid saline infusion, would augment cutaneous vasodilation in healthy aged humans during heat stress. **Methods:** Right heart catheterization was performed in 9 aged (A: 69 ± 3 yrs, 164 ± 9 cm, 67 ± 9 kg, 3 males/6 females) and 12 young (Y: 26 ± 5 yrs, 165 ± 6 cm, 64 ± 10 kg, 6 males/6 females) healthy individuals exposed to whole-body passive heat stress until pulmonary artery blood temperature increased by 1.5°C. At this increase in blood temperature, cardiac output (thermodilution), forearm vascular conductance (FVC, venous occlusion plethysmography) and cutaneous vascular conductance (CVC, laser-Doppler) were measured before and after rapid (~7 min) infusion of 15 mL/kg warm saline. **Results:** Prior to saline infusion, cardiac output (A: 6.6 ± 0.6 vs. Y: 9.2 ± 1.2 L/min), FVC (A: 0.09 ± 0.02 vs. Y: 0.17 ± 0.04 mL/100 mL/min/mmHg), and CVC (A: 1.23 ± 0.50 vs. Y: 1.94 ± 0.50 units/mmHg) were each lower in the aged (all *P*<0.01). Saline infusion significantly increased cardiac output (A: +29 ± 9 vs. Y: +21 ± 12%, *p*=0.13), FVC (A: +17 ± 13 vs. Y: +29 ± 16%, *p*=0.09), and CVC (A: +21 ± 8 vs. Y: +15 ± 12%, *p*=0.22) to a similar extent in both groups. Pulmonary artery blood temperature increased slightly during saline infusion (A: 38.1 ± 0.2 to 38.2 ± 0.2°C vs. Y: 38.4 ± 0.3 to 38.5 ± 0.2°C), but the increase not differ between groups (*p*=0.46). **Conclusions:** These data suggest that attenuated increases in cardiac output contribute to attenuated cutaneous vasodilation during passive heat stress in healthy aged humans. Funding support: National Institutes of Health (GM-068865), Department of Defense (W81XWH-12-1-0152), and ACSM Foundation Research Endowment.

F-14 Free Communication/Slide - Advancing Physical Activity Assessment Methods - Part II

Friday, June 3, 2016, 1:00 PM - 3:00 PM
Room: 206

2893 **Chair:** Kate Lyden. *University of Massachusetts, Belchertown, MA.*
(No relationships reported)

2894 June 3 1:00 PM - 1:15 PM
Can a Single Algorithm Accurately Estimate Steps Per Minute from Acceleration Data Measured by Different Wearable Devices?

Kate Lyden¹, Loc Bui², Steve Diamond¹, Huy Haong², Trong Dung Nguyen², Matthew Diamond¹. ¹Misfit, Inc, San Francisco, CA. ²Misfit, Inc, Ho Chi Minh City, Viet Nam. (Sponsor: Patty Freedson, FACSM)

Reported Relationships: K. Lyden: Salary; Misfit, Inc.

Misfit Shine and Flash are accelerometer-based activity trackers with the flexibility to be worn at different body sites (e.g., wrist, hip). The algorithms used to estimate features of physical activity (PA) (e.g., steps) from Misfit Shine and Flash have been validated against gold standards and yield comparable results across wear site. Conversely, some research-grade actigraphs that were initially validated on the hip and are being increasingly used at the wrist, lack data on their validity at the wrist. This is problematic given that such tools are used at the wrist in clinical and national surveillance research. **PURPOSE:** To test the feasibility of applying a step count algorithm developed for consumer activity trackers to data collected from a popular research-grade device worn at the wrist. **METHODS:** Participants wore an ActiGraph GT3X+ (AG) accelerometer on their dominant wrist while completing four treadmill conditions for four minutes each. Data were sampled at 80 Hz and processed using the proprietary AG and Misfit (MF) step-count algorithms. Manual counts (MC) from videos of the sessions served as the criterion. **RESULTS:** Data from the first participant are reported. The MF algorithm improved estimates of steps/min for each speed compared to AG (mean absolute difference ± SD: MF = 2.5 ± 2.4, AG = 77.5 ± 26.6).

Speed (MPH)	MC Steps/Min	AG Steps/Min	MF Steps/Min
2.0	100	46	100
2.3	107	52	106
6.0	171	73	166
6.5	176	74	172

CONCLUSION: These data demonstrate the feasibility of applying algorithms across accelerometer-based activity monitors. Data are being processed on additional participants and wear site locations. Algorithms that are valid across wear site and device would be an important first step to standardizing measurement of PA from accelerometers and offer the opportunity for higher accuracy in more diverse experimental conditions.

2895 June 3 1:15 PM - 1:30 PM
Feasibility Of A Novel Accelerometer Attachment-site For The Measurement Of Energy Expenditure

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Energy expenditure (EE) is an important behavioral contributor to the current obesity pandemic, therefore accurate measures of EE are needed. It has been suggested accelerometers are affordable devices to provide valid estimates of EE, however, the controversy over which attachment-site for an accelerometer is the most accurate and feasible/compliant for this purpose continues. The Waist and Wrist sites are commonly used in research and both have well-documented strengths and weaknesses. Recently, there has been a growing interest in the Chest attachment-site as it has the advantages of being hidden from view but close to the center of mass and therefore the potential to provide accurate estimates of EE.

PURPOSE: To determine if wearing the GT3X+ at the Chest (like a neck-pendant, beneath clothing) can provide valid estimates of EE.

METHODS: A group of 10 young adults (20-26 years) wore GT3X+ accelerometers simultaneously at their Waist, Wrist, and Chest, whilst undertaking bouts of slow, medium and fast speeds (4.0, 6.4 and 8.0 kph, respectively) of walking and jogging on a treadmill. EE was measured by a primary criterion (indirect calorimetry, Cortex Metamax 3B), and a secondary criterion (BodyMedia SenseWear). For each attachment-site, a Friedman test was used to compare GT3X+ estimated EE (3-min of steady-state at each speed) against the primary criterion EE. Pairwise comparisons were performed with a Bonferroni correction for multiple comparisons.

RESULTS: The median total EE measured by GT3X+ was significantly different across the attachment-sites (*p* < 0.005). Post hoc analysis revealed significant differences between the primary criterion EE (17.2kcal) and GT3X+ measured EE at the Wrist (9.0kcal, *p* < 0.005) but not the Chest (16.5kcal, *p*=0.79) or the Waist (16.2kcal, *p*=0.25). The Chest site (16.5kcal) and secondary criterion (15.5kcal, *p*=0.66) were also similar.

CONCLUSIONS: Preliminary results of this study suggest that the novel Chest attachment-site is able to provide valid estimates of EE compared to both the primary and secondary criterion. We are currently undertaking further data collection to increase our sample size.

Funding: Hong Kong University Seed Fund for Basic Research.

2896 June 3 1:30 PM - 1:45 PM
Accuracy Of Energy Expenditure Measurement Using The Sensewear Pro3 And The Activpa3 Micro Devices

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Purpose: Proprietary algorithms of the SenseWear Pro3 (SWP3) and the activPAL3 Micro (aP3M) provide estimates of the metabolic cost (METs) of activities. This study examined the accuracy of the SWP and aP3M against criterion METs from indirect calorimetry. **Methods:** 56 participants (39.9 (±11.5) years) performed eight activities while wearing a SWP3, aP3M and the criterion measure Cosmed K4B2 (K4B2). Paired samples T-tests were used to examine differences between predicted METs (SWP3 and aP3M) and criterion METs (K4B2). Bland-Altman Plots examined the mean bias and limits of agreement for predicted METs. **Results:** All SWP3 predicted METs were significantly different to the K4B2 (*p* ≤ 0.004), excluding sweeping (*p*=0.122). All aP3M predicted METs were significantly different (*p*<0.001) (Table 1). The largest mean bias for the SWP3 was seen for cycling (-3.25) and for the aP3M was jogging (-5.16).

Table 1 - Mean (±SD) MET values for all devices;

	MET values		
	K4B2	SWP3	aP3M
Sitting	1.06 (0.16)	0.99 (0.15)*	1.25 (0.00)*
Standing	1.12 (0.18)	0.96 (0.17)*	1.40 (0.00)*
Dish handling	1.57 (0.29)	2.19 (0.59)*	1.40 (0.00)*
Sweeping	3.48 (0.93)	3.66 (1.09)	1.96 (0.40)*
Slow walking	3.21 (0.49)	4.23 (0.61)*	3.56 (0.21)*
Fast walking	4.25 (0.82)	5.13 (0.64)*	3.90 (0.18)*
Cycling	5.84 (1.17)	2.59 (1.25)*	4.45 (0.33)*
Jogging	9.55 (1.58)	8.52 (0.75)*	4.40 (0.25)*
All activities	3.72 (2.79)	3.53 (2.44)	2.77 (1.35)

*denotes significant difference from the criterion measure

Conclusion: The SWP3 predicted METs were significantly different from the K4B² values for all activities, excluding sweeping. The average mean bias was -0.20. Previous research has shown the SWP3 to underestimate higher intensity activities. All aP3^M predicted METs were significantly different from the K4B² values. The average mean bias was -0.95. Although the aP3^M provides MET output, it is more commonly used to determine postural position. Issues surrounding the predicted MET values from aP3^M may be attributed to the step-based algorithm. While the SWP3 predicted METs are more accurate than their aP3^M equivalent, the predicted MET values from both devices are significantly different from the criterion measure for the majority of activities.

2897 June 3 1:45 PM - 2:00 PM

Examination Of The Effect Of Monitor Location And Reliability Of A Consumer Activity Tracker

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The Misfit Shine (MS) activity tracker is waterproof, does not require daily charging and can be worn at multiple locations. These features are attractive to users/researchers who wish to maximize wear compliance and collect data over prolonged periods. However, it is unknown whether there is agreement in steps among the different locations and between repeated trials. **PURPOSE:** To examine agreement in steps among different MS wear locations and between repeated treadmill trials. **METHODS:** Thirteen participants wore three MS devices (hip, wrist, foot). Activities were performed for 4-min, and steps/min from each of the activities were categorized into groups: 1) Treadmill (TM) locomotion: 2.5, 3.5, 5.5, 7.5 mph; 2) Over-ground locomotion: self-paced slow, brisk walking, jogging; 3) ADLs: computer work, sitting, laundry, vacuuming. TM 2.5, 3.5, and 5.5 mph were repeated. Intraclass correlation coefficients (ICCs) were calculated to assess agreement among wear locations and between repeated treadmill trials. **RESULTS:** Mean(SE) steps/min (all activities) for hip, wrist, and foot were 97.6(4.87), 93.3(4.66), and 97.6(4.73) and there was no location effect. ICCs for wear location by activity category are below:

	All Activities	TM	Over-ground	ADLs
Hip vs. Wrist	0.95*	0.90*	0.85*	-0.07
Hip vs. Foot	0.99*	0.94*	0.94*	0.73*
Wrist vs. Foot	0.94*	0.86*	0.86*	0.00

* $p < 0.0001$

ICCs between TM trial 1 and 2 were 0.91, 0.92, and 0.98 ($p < 0.0001$) for hip, wrist, and foot locations, respectively. **CONCLUSION:** There was excellent agreement among locations during locomotion. Low agreement between the wrist and other locations was observed during simulated laundry. This is not surprising given participants were stationary, but moved their upper body. The high repeatability of MS between identical TM trials suggests MS may be used in individuals to track steps overtime and detect changes in stepping.

2898 June 3 2:00 PM - 2:15 PM

Comparison Of Outcomes Between Raw Acceleration And Counts-based Methods For Processing Wrist-worn Accelerometers: The Flashe Study

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Evolution of accelerometry-based activity monitors has led to novel processing techniques of raw acceleration data collected at the wrist as opposed to the waist. However, few analyses have compared accelerometer-based activity estimates between emerging wrist thresholds.

Purpose: The purpose was to compare moderate to vigorous physical activity (MVPA) time and prevalence of meeting youth physical activity guidelines (PAG) when using intensity thresholds for raw acceleration versus activity counts data.

Methods: Data are from the National Cancer Institute's FLASHE study: a cross-sectional, surveillance study of youth/family behaviors related to cancer prevention. A sub-sample of 409 adolescents (11-17yrs; 50% female) wore an Actigraph GT3X+ monitor on the wrist over 7 days to provide objective data on physical activity.

ActiLife software (version 6.10.2) was used to download all data. Raw data were processed with the R package GGIR and associated Hildebrand millig (mg) cut points.

Counts data were processed using both Crouter and Chandler cut-points for vertical axis (VA) and vector magnitude (VM). MVPA was defined as METs ≥ 4 . To compare the different processing techniques, differences in MVPA time and adherence to the youth PAG were evaluated using repeated ANOVAs with Bonferroni adjustments and Kappa statistics, respectively.

Results: The Hildebrand cut points yielded significantly fewer minutes of MVPA (M \pm SD: 10.6 \pm 14.7 min/d) compared to estimates from the Crouter cutpoints (107.3 \pm 56.4 min/d for VA; 126.4 \pm 63.4 min/d for VM) and Chandler cutpoints (52.3 \pm 34.3 min/d for VA; 67.3 \pm 40.8 min/d for VM); p -values < 0.0001 for all comparisons. The prevalence of children meeting the PAG was 0% with Hildebrand, but ranged substantially from 7% with Chandler VA to 64% with Crouter VM with the counts data. The mg method and counts methods showed very low classification agreement for the PAG (i.e. Kappa ranges from 0.01 to 0.06). Similar patterns were found when analyses were stratified by sex and weight status.

Conclusions: Large discrepancies in MVPA estimates and PAG adherence rates were observed between the raw and counts data processing techniques. Using these different threshold-based methods may lead to disparate conclusions about youth behavior patterns and their relationships with health indicators.

2899 June 3 2:15 PM - 2:30 PM

Thigh Accelerometer Placement Accuracy for Physical Activity and Energy Expenditure Prediction in a Semi-Structured Setting

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An inclinometer-based accelerometer (PAL) worn on the thigh, coupled with proprietary software, may provide accurate estimates of sedentary time. However, its accuracy for estimating other physical activity (PA) intensities and energy expenditure (EE) is unknown.

PURPOSE: To evaluate accuracy of the PAL software for prediction of time spent in PA intensities [sedentary, light, and moderate-to-vigorous (MVPA)] and EE and compare its accuracy to that of a machine learning model (ANN) developed from raw PAL data.

METHODS: Participants ($n=39$ [19 male]; age=22.1 \pm 4.3) completed a 90-min, semi-structured protocol in which they performed 13 activities for 3-10 min each, choosing activity order, duration, and intensity. Participants wore a PAL accelerometer on the right thigh and a portable metabolic analyzer (OXY). Time spent in sedentary, light, and MVPA was determined using MET values of ≤ 1.5 , 1.6-2.9, and ≥ 3.0 , respectively, calculated from OXY. Estimated times in each PA intensity from the PAL software and ANN were compared with OXY using difference scores and 95% confidence intervals; non-overlap of confidence intervals with zero indicated significant differences from OXY. Window-by-window EE prediction was assessed using correlations and root mean square error (RMSE).

RESULTS: PAL software-predicted sedentary time was not different from OXY (-1.6 min; 95% CI: -3.6 - 0.4 min), but light PA was over-predicted (6.2 min; 95% CI: 4.1 - 8.3 min) and MVPA was under-predicted (-4.6 min; 95% CI: -6.5 - -2.7 min). ANN-predicted sedentary time and light PA were not different from OXY, (-0.7 min, 95% CI: -2.3 - 0.8 min; -0.9 min; 95% CI: -2.8 - 1.1 min, respectively), but MVPA was over-predicted (1.6 min; 95% CI: 0.1 - 3.2 min). For EE prediction, the PAL software had lower correlations ($r=0.76$ vs. $r=0.89$) and higher RMSE (1.74 vs. 1.07 METs) than the ANN. Under-prediction by the PAL software was more pronounced at intensities > 5.0 METs.

CONCLUSIONS: The PAL software distinguished between sedentary and non-sedentary activities but had high error for EE prediction, especially for higher-intensity PA. The ANN had high accuracy for prediction of sedentary and light PA and EE prediction, indicating strong potential for raw data from a thigh-worn PAL to be used in PA assessment.

Supported by Blue Cross Blue Shield of Michigan Foundation.

2900 June 3 2:30 PM - 2:45 PM

Validity of Accelerometer Methods to Estimate Activity Energy Cost in Adults With and Without Functional Limitations

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 (No relationships reported)

Purpose: The purpose of this study was to evaluate the validity of two published accelerometer analysis methods to estimate energy cost of physical activities in adults with and without functional limitations.

Methods: 62 healthy and functionally limited ambulatory adults underwent measures of strength and functional testing to cluster into 1) no functional limitations [HLTHY], or 2) lower and/or upper body limitations [LIM]. All subjects completed a variety of simulated activities while wearing accelerometers and a portable metabolic system. Estimated METs were derived from a hip-worn accelerometer (Freedson et al.(HIP)), and a wrist-worn accelerometer (Staudenmayer et al.(WRIST)). Model predictions were compared to measured METs and evaluated on the types of activities for which they were developed (HIP=locomotion, WRIST=all activities). Statistical significance was assessed with a linear mixed model. **Results:** Mean (95% CI) measured METs across all activities were HLTHY (n=17, 48.1 ± 16.7 yrs) 3.17 (1.59) and LIM (n=45, 61.0 ± 12.9 yrs) 2.32 (1.08).

Fig.1. Accelerometer Model Prediction Performance. Mean (95% CI).

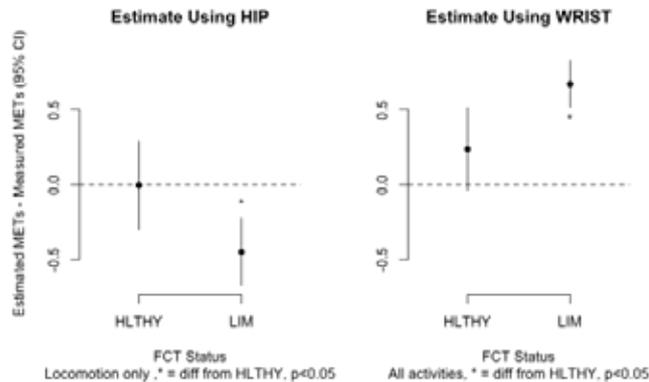


Fig.1. shows neither the HIP nor the WRIST methods are significantly biased for the HLTHY group, and both methods are biased for the LIM group. Estimates for the LIM group are significantly different from the HLTHY group for both methods. The HIP and WRIST methods under- and over-estimate respectively for the LIM group.

Conclusion: Accelerometer energy cost model performance is influenced by whether or not an individual has functional limitations. Future research efforts should examine how to improve accelerometer model performance within individuals with functional limitations.

Supported by NIH-1R21HD080828.

2901 June 3 2:45 PM - 3:00 PM

Effect of Raw Acceleration Filtering Methods on the Relationship Between Accelerometer Outputs and Energy Expenditure

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Despite the ubiquity of accelerometers in physical activity research, there remains no consensus method for processing raw acceleration data into end-user appropriate metrics. One aspect of accelerometer data processing that has received limited attention is the manner in which raw acceleration data are filtered to remove non-physical noise prior to computing summary outputs. **PURPOSE:** To evaluate how raw acceleration filtering methods affect the relationship between accelerometer outputs and measured energy expenditure in children and adolescents. **METHODS:** 122 children and adolescents (61 boys, 13.0 ± 4.3 years, 22.4 ± 6.2 kg/m²) wore an ActiGraph GT3X+ triaxial accelerometer (80 Hz) on their non-dominant wrist while performing jumping jacks (JJ), dribbling a basketball (DB), and ambulating on a treadmill at 2.4 (T1), 4.8 (T2), and 7.2 km/h (T3). Raw data for each axis were filtered nine times using 4th

order Butterworth bandpass filters defined by all combinations of three lower (0.15, 0.25, and 0.35 Hz) and upper (2.5, 4.5, and 8.5 Hz) cutoff frequencies. Average signal vector magnitude (SVM) was calculated each second for all nine filters and the average 1 s value for the last 2 min of each 5 min activity trial was retained. Oxygen uptake (VO₂) was measured by the COSMED K4b² system concurrent with accelerometry measures. METs were derived by dividing mass relative VO₂ by resting energy expenditure (Schofield equation estimate). Pearson correlations were used to quantify associations between SVM and METs for each activity/filter combination. Meng's Z-test was used to evaluate differences between dependent correlations within each activity. **RESULTS:** Correlations between SVM and METs across the evaluated filters for JJ, DB, T1, T2, and T3 ranged from 0.43–0.55, 0.10–0.25, 0.11–0.15, 0.19–0.32, and 0.11–0.22, respectively. Significant between-filter differences (*p* < 0.05) in the magnitude of association between SVM and METs were noted for JJ (n = 20), DB (n = 20), T2 (n = 9), and T3 (n = 8). **CONCLUSION:** Filter choice can significantly influence the relationship between an accelerometer's output and measured energy expenditure. Further study is needed to identify filtering methods which produce accelerometer outputs that best reflect the energy cost of human movement.
 Support: NIH NICHD 1R21HD073807-01A1

F-15 Free Communication/Slide - Brain Power

Friday, June 3, 2016, 1:00 PM - 3:00 PM
 Room: 313

2902 **Chair:** Kevin Guskiewicz, FACSM. University of North Carolina, Chapel Hill, NC.

(No relationships reported)

2903 June 3 1:00 PM - 1:15 PM

The Brain-Behavior relationship after Anterior Cruciate Ligament Reconstruction

Dustin R. Grooms¹, Ajit M.W. Chaudhari, FACSM², Stephen J. Page², Deborah Nichols-Larsen², Susan E. White², James A. Onate². ¹Ohio University, Athens, OH. ²Ohio State University, Columbus, OH. (Sponsor: Ajit Chaudhari, FACSM)
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Anterior cruciate ligament injury may induce neural adaptations that are unresolved with conventional reconstruction and rehabilitation techniques. Visual-motor function appears to be a key driver of this neuroplasticity. However, the relationship between the neuroplasticity after ACLR (anterior cruciate ligament reconstruction) and visually perturbed neuromuscular control is unknown. **PURPOSE:** To determine if a relationship exists between brain activation during knee movement and visually perturbed drop landing neuromuscular control, and if ACLR alters this relationship. **METHODS:** Participants consisted of 26 recreationally active individuals from the local university community (13 ACLR, 13 control matched on height, mass, extremity dominance, education level, history and current physical activity level). A drop vertical jump was completed to assess functional neuromuscular control (knee flexion and adduction). Stroboscopic eyewear provided a visually perturbed condition. The effect of disrupting visual feedback was calculated with a mean change score from the full vision to the disrupted condition. Brain functional magnetic resonance imaging was collected during a unilateral knee motor task of the involved or matched control knee consisting of repeated cycles of extension-flexion. The percent signal change of the motor cortex and lingual gyrus were calculated and correlated against the stroboscopic effect on knee flexion and adduction.

RESULTS: Lingual gyrus activation was correlated with the stroboscopic effect on knee flexion for the ACLR (r=0.582, p=0.037) and control (r=0.688, p=0.009) cohorts. Motor cortex activation was correlated with the stroboscopic effect on knee adduction for only the ACLR (r=0.683, p=0.005) cohort.

CONCLUSIONS: The motor neuroplasticity associated with ACLR is moderately related to visually perturbed drop landing neuromuscular control. These findings indicate visual-motor control maybe a driving factor behind neuromuscular control changes after ACLR, and a possible contributing mechanism to the continued poor neuromuscular control despite current therapy. Additional attention to the sensory-motor and visual-motor interaction after injury and during therapy may provide a means to improve neuromuscular therapy.

2904 June 3 1:15 PM - 1:30 PM

Associations of Brain Structure with Postural Control Variability and Health-Related Quality of LifeMasafumi Terada, Phillip A. Gribble, Nathan F. Johnson.
University of Kentucky, Lexington, KY.
(No relationships reported)

Previous literature has reported that various health conditions influence the perception of health related quality of life (HRQOL), but also function, which can be estimated with postural control variability. These simultaneous alterations have been attributed individually to altered sensorimotor communication within the central nervous system. The sensorimotor communication is depended on the structural integrity of the underlying white matter (WM) tracts in the brain. However, there is little investigation that has examined associations of WM integrity of the brain with postural control variability and HRQOL. Determining these associations may help to establish neurophysiological mechanisms that cause altered postural control variability and decreased HRQOL. **PURPOSE:** Determine if white matter integrity of the brain is associated with static postural control variability and HRQOL. **METHODS:** Ten participants (2M, 8F; 23.8±4.5yrs; 164.6±7.1cm; 63.3±12.24kg) performed 3, 20-second trials of single-leg static balance on a force platform under an eyes-open condition. Sample Entropy (SampEn) analysis was used to assess postural control variability. To assess corticospinal and cerebellar WM integrity, fractional anisotropy (FA) was quantified using diffusion tensor imaging collected on a 3-Tesla Siemens TIM scanner with a 32-channel head coil. HRQOL was assessed using physical and mental components summary (MCS) of the short-form 36 (SF-36). Pearson Product Moment Correlations was used to examine associations of corticospinal and cerebellar FA values with measures of postural control variability and HRQOL. Significance was set a priori at $p < 0.05$. **RESULTS:** Cerebellar FA was moderately correlated with SampEn in the medial-lateral direction ($r = 0.57$, $p = 0.04$). Corticospinal FA was moderately correlated with SampEn in the anterior-posterior direction ($r = -0.72$, $p = 0.01$) and MCS of the SF-36 ($r = 0.68$, $p = 0.02$). **CONCLUSION:** These findings indicate the potential for associations of WM integrity of the brain with postural control variability and HRQOL. Further study with a large sample size is needed to examine these associations in specific pathological condition in order to develop effective intervention strategies for individuals with clinical dysfunctions and disability.

2905 June 3 1:30 PM - 1:45 PM

Transcranial Direct Current Stimulation (tDCS) To Broca's Area: Persisting Effects On Non-Verbal Motor BehaviorsKathleen E. Hupfeld¹, Caroline J. Ketcham¹, Harry D. Schneider². ¹Elon University, *Elon, NC.* ²Yale University School of Medicine, *New Haven, CT.* (Sponsor: Eric E. Hall, FACSM)
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(No relationships reported)

BACKGROUND: Low-cost, portable, and user-friendly, transcranial direct current stimulation (tDCS) has been investigated as a novel therapy for treating various neurological impairments, including motor, cognitive, and speech deficits. tDCS passes a constant, weak electrical current between two electrode sponges—the anode and cathode—placed on the subject's head; anodal tDCS modulates neuronal membrane potentials to facilitate neuronal activity. While a substantial body of literature has found that anodal tDCS to the primary motor cortex (M1) may elicit improvements in motor behaviors, few studies have examined whether stimulation to other cortical areas associated with motor output is able to produce similar or long-lasting effects. Although Broca's area is associated with speech production and grammar acquisition due to cortical-striatal connections, it may also significantly contribute to motor planning/output even in non-speech tasks—especially in more complex tasks that require sequence-learning (Ullman, 2006). **PURPOSE:** This study involved anodal tDCS stimulation of Broca's area to observe the effects on non-verbal motor output. **METHODS:** Twenty neurotypical young adults completed an experimental vs. sham testing session separated by 1 week. During each session, participants received one of two stimulation conditions: (1) 30 minutes of 1.0 mA of anodal tDCS to Broca's area (FC5; cathode on right supraorbital) or (2) sham stimulation. During stimulation (or sham), participants completed two motor tasks: (1) a limits of stability dynamic balance task (Biodex Balance System) and (2) a simple/choice reaction time task (MOART Reaction Time and Movement Time Panel). **RESULTS:** Initial results indicate that subjects who received stimulation of Broca's area first performed significantly better on simple reaction time, ($p < 0.05$), dynamic balance time ($p < 0.05$), and dynamic balance accuracy ($p < 0.001$) when tested one week later compared to participants who received sham stimulation first. **CONCLUSIONS:** These findings indicate that Broca's area is also involved in non-verbal motor behavior. This persisting cortical motor response to stimulation has obvious implications for time consuming novel combined speech and movement therapy interventions.

2906 June 3 1:45 PM - 2:00 PM

Lower Extremity Injury Risk in Youth Female Basketball Athletes with and without a History of ConcussionSamantha E. Scarneo¹, Eleanor M. Beltz¹, Hayley J. Root¹, Jessica C. Martinez², Lindsay J. DiStefano¹. ¹University of Connecticut, *Storrs, CT.* ²Northern Illinois University, *DeKalb, IL.* (Sponsor: Douglas J. Casa, FACSM)
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(No relationships reported)

Recent literature has identified a link between history of concussion and risk of sustaining a lower extremity injury in professional and collegiate male athletes. The Landing Error Scoring System (LESS) is a valid and reliable clinical movement assessment that is predictive of injury risk in youth athletes. Compared to males, youth female basketball players are at an increased risk of sustaining a lower extremity injury. It is unknown if female basketball athletes with a history of concussion are at increased risk for lower extremity injury.

PURPOSE: To examine the relationship between concussion history and lower extremity injury risk in competitive youth female basketball players. **METHODS:** Sixty-seven youth female basketball athletes volunteered to participate. Athletes were tested at the beginning (PRE) of the season using the LESS. Each athlete completed a pre-season injury history baseline questionnaire. A single rater blinded to concussion history graded the jump-landing task using the LESS at a later date. Nine youth female basketball players reported a previous history of a concussion (age: 13±2 years, height: 163.8±4.0cm, mass: 53.9±8.2kg). An independent t-test was performed between LESS total score for athletes with and without a history of concussion ($\alpha = 0.05$). Chi squared analyses were performed between concussion history and individual errors of the LESS ($\alpha = 0.05$) and odds ratios were calculated. **RESULTS:** There was no statistical significance between the LESS and concussion history ($p > .05$) (with concussion 6.2±2.5errors; without concussion history 6.73±2.1errors). There is a moderate association between concussion history and medial knee displacement at initial contact (Pearson chi-square: 1.15, odds ratio: 2.95, 95%CI=[0.664, 13.13]). **CONCLUSIONS:** While previous literature suggests overall injury rates are higher following a concussion, lower extremity injury risk, as measured by the LESS, was not related to past history of a concussion in this population. However, athletes who reported a history of concussion displayed medial knee displacement at initial contact at a greater rate compared to athletes without a history of concussion. Therefore, future research should investigate specific movement patterns associated with concussion history.

2907 June 3 2:00 PM - 2:15 PM

Adolescents With Convergence Insufficiency Exhibit Gait Stability Deficits Acutely After ConcussionDavid R. Howell, Michael O'Brien, Aparna Raghuram, William P. Meehan, III. *Boston Children's Hospital, Boston, MA.* (Sponsor: Louis R. Osternig, FACSM)
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(No relationships reported)

Gait assessments assist in monitoring motor function and dynamic balance control recovery after concussion. Additionally, initial ocular deficits post-concussion are risk factors for developing persistent symptoms. Limited data exist, however, examining the association between gait and visual deficits post-concussion.

Purpose: We examined the post-concussion gait characteristics of adolescents who initially presented to a sport-concussion clinic with and without convergence insufficiency (CI) compared with a group of uninjured, healthy control participants. **Methods:** Patients were examined within 3 weeks of concussion (mean 9.1 ± 5.7 days post-injury). They completed a post-concussion symptom scale (PCSS) and underwent assessments of near point convergence (NPC) and gait measures. NPC was assessed by measuring the distance from the tip of the nose to the point where the patient reported diplopia while moving a fixation target slowly toward their nose. CI was defined as a NPC distance > 5cm. Gait measures (gait speed, cadence, stride length, and double support time) were obtained using 3 inertial sensors while patients walked at a self-selected speed. Univariate ANOVAs were used to compare gait performance among those with CI, without CI, and uninjured controls.

Results: Eleven patients presented with CI (mean age = 16.2 ± 2.8 years), 7 presented without CI (mean age = 14.2 ± 2.2 years). There were 37 healthy controls (mean age = 15.4 ± 5.7 years). Mean PCSS scores not significantly different between concussion patients with CI and those without (25.6 vs. 24.0). Those with CI had slower mean gait speed (1.04±0.11 m/s vs. 1.22±0.16 m/s; $p = .002$) and shorter mean stride lengths (1.12±0.07 m vs. 1.30±0.16 m; $p = .003$) than the uninjured participants. No gait differences between those without CI and the healthy participants were found.

Conclusion: Adolescents with CI post-concussion exhibited significant gait-related deficits compared with healthy controls, while those without CI did not display such deficits. Vergence deficits present after concussion may be related to motor system dysfunction. Gait and vergence measures may each contribute useful information to multifaceted post-concussion evaluations.

2908 June 3 2:15 PM - 2:30 PM

Landing Kinetics Differences In Individuals With And Without A History Of ConcussionAndrew Lapointe, Aniela Sosnowski, Eva Andrews, Douglas N. Martini, Steven P. Broglio. *University Of Michigan, Ann Arbor, MI.*

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(No relationships reported)

Title: Landing Kinetics Differences In Individuals With And Without A History Of ConcussionAuthors: Andrew Lapointe¹, Aniela Sosnowski¹, Eva Andrews¹, Douglas N Martini, Steven P. Broglio¹¹University of Michigan

Abstract Category: 402 Sport biomechanics

PURPOSE: The current study aimed to evaluate differences in ground reaction forces between individuals with and without a history of concussion during a jump-cut maneuver. It was hypothesized that individuals with a history of concussion would show a greater variation in force as a function of time from the previous concussion.**METHODS:** A total of 16 (8 males, 8 females) subjects were recruited, 8 had a self-reported previous history of concussions (5 males, 3 females), and 8 (3 males, 5 females) did not. Participants jumped with both feet a distance of 120% of their leg length, made contact with a force plate with their right foot and then leapt to the left or right landing on their left foot. Participants were informed which direction to jump prior to each trial. Five trials of each condition were performed and a mean was computed for ground reaction forces in the x, y and z direction.**RESULTS:** Exploratory factor analysis indicated that all force plate variables loaded on a single component with the exception of the mean force in the z direction resulting from the left jump condition. Analysis of variance demonstrated a significant difference between control (M=366.9±75.0 Newtons) and concussed (M=483.2±94.1 Newtons) individuals when the mean z-force was calculated over the five trials [$F_{(1,15)}=7.462, p<.05, \eta^2=.348$]. Given that gender was unequally represented in each group, a follow up ANCOVA was performed and demonstrated that the effect remained significant when covarying for gender differences [$F_{(1,15)}=5.716, p<.05, \eta^2=.263$].**CONCLUSION:** It is unclear why differences between concussed and controls were prominent only during leftward trials, but this finding supports a larger body of evidence demonstrating chronically impaired motor control following concussive injuries. The results provided from this study require further validation with a larger sample size and more complex motions. The results also warrant a more in-depth study with the use of motion capture to evaluate for participant kinematics.

2909 June 3 2:30 PM - 2:45 PM

Gait And Cognitive Assessments Of Concussed Athletes During Dual-task WalkingKlarie M. Ake¹, Nathan R. D'Amico¹, Katelyn E. Grimes¹, Megan E. Mormile¹, Douglas W. Powell², Thomas A A. Buckley³, Barry A. Munkasy¹, Nicholas G. Murray¹. ¹Georgia Southern University, Statesboro, GA. ²Campbell University, Buies Creek, NC. ³University of Delaware, Newark, DE.

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(No relationships reported)

Dual-task (DT) scenarios, which increase cognitive load, may be a method of assessing gait abnormalities in concussed athletes during walking. This may be a means of objectively differentiating between healthy and concussed athletes during the acute phase of recovery. **PURPOSE:** The purpose of this study was to examine the effect of DT scenarios on gait in concussed athletes (CA) within 48 hours of the concussive injury as compared to a group of healthy athletes. **METHODS:** Gait parameters of 24 collegiate athletes (14 male, 10 female, age: 19.7±1.4 years) with concussions were assessed within 48 hours of the injury and a gender-matched control group that consisted of 24 (14 male, 10 female, age: 18.6±1.3years) collegiate athletes using the GAITRite electronic walkway. All participants completed five DT gait trials which included mental math, attention, and spelling tasks. Gait velocity, cadence, average stride length, and right and left heel-to-heel base of support (HH BOS) values were measured, normalized to height, averaged, and further analyzed. The total answers for the separate DT scenarios and number correct were also assessed. **RESULTS:** The normalized variables of gait velocity, average stride length, and both right and left HH BOS were not significantly different between groups. Normalized cadence was significantly greater in the CA group, at 105 steps/min, compared to the healthy athletes at 97 steps/min (p=0.006). With regards to the cognitive tests, CA group provided significantly fewer total responses in months of the year (MOY) (4±2.1 answers) (p=.015) and days of the week (DOW) (6.5±1.9 answers) (p=0.019) tasks, compared to healthy (MOY: 6.5±4.2 answers; and DOY: 8.4±3.4 answers). CA also had fewer correct responses (3.3±2.0 answers) in the MOY task (p=0.005) compared to healthy athletes (6.1±4.2 answers). **CONCLUSIONS:** The increased cadence exhibited by CA may be a function of decreased attention to the accuracy of the DT presented and more focus on the motor (gait) task. This is supported by the fact that the

CA had fewer total responses in two DT scenarios (MOY and DOW), and in MOY had fewer total correct responses. These data suggest concussed athletes may have reduced capacity to perform a cognitive and motor task simultaneously.

2910 June 3 2:45 PM - 3:00 PM

The Effect Of Restricting Full Contact Football Practice On Repeated Head Impact ExposureSteven P. Broglio, FACSM, Richelle M. Williams, Kathryn O'Connor. *University of Michigan, Ann Arbor, MI.*

(No relationships reported)

PURPOSE: Fears over the long term effects of repeated head impacts have resulted in sporting organizations to place restrictions on full contact football practice at the professional, collegiate and high school levels. Prior to the 2014 season, the Michigan State High School Athletic Association limited full contact practices to no more than two days per week. This investigation sought to evaluate head impact exposure during interscholastic football prior to and following the rule change.**METHODS:** As part of a larger investigation on head impact exposure and cognitive function, 41 athletes participated in the 2013 (n=26) and 2014 (n=24) seasons. Nine athletes participated in both years. Following informed consent/assent, each athlete's helmet was fitted with a Head Impact Telemetry (HIT) System encoder to monitor head impact frequency during all games and practices. Impact exposure was evaluated by player position for each year of the study.**RESULTS:** In 2013, 15,398 impacts were recorded and 8,269 in 2014. In 2013, the average football athlete sustained 592±391 head impacts, compared to 345±236 in 2014. Overall, there was a 41.8% decline in head impacts between the two seasons. Quarterbacks had the largest decline (-48.1%); followed by the Linemen (-37.3%); Receivers, Corners, and Safeties (-22.8%); and Tight Ends, Running Backs, and Linebackers (-18.5%).**CONCLUSIONS:** This investigation demonstrated a substantial reduction in head impacts following restriction of full contact football practices that goes beyond previous estimates. How this change influences long term cognitive health is not clear, but reduced impact exposure during practice has been shown to diminish overall concussion rates.

This investigation was funded by The National Institutes of Health: National Institute of Neurological Disorders and Stroke (1R15NS081691-01)

F-16 Free Communication/Slide - Exercise Immunology

Friday, June 3, 2016, 1:00 PM - 3:00 PM

Room: 102

2911 **Chair:** Jeffrey A. Woods, FACSM. *University of Illinois, Urbana, IL.*

(No relationships reported)

2912 June 3 1:00 PM - 1:15 PM

Time Course of Progenitor Cell Mobilization During Exercise in Endurance Trained MenGrace M. Niemi¹, Justin Parel¹, Joseph Beals¹, Stephan van Vliet¹, Daniel R. Moore², Nicholas A. Burd¹, Michael De Lisio¹.¹University Of Illinois at Urbana - Champaign, Urbana, IL.²University of Toronto, Toronto, ON, Canada.

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(No relationships reported)

Hematopoietic cell transplant (HCT) is an effective therapy for the treatment of various hematological malignancies, such as leukemia. Pharmacologically mobilized hematopoietic stem and progenitor cells are collected from the peripheral blood for use in HCT; however, unwanted side effects are common. Previous reports have demonstrated that various stem/progenitor cell populations are transiently mobilized to peripheral blood in response to an acute bout of endurance exercise in sedentary adults. The kinetics of stem/progenitor cell mobilization in endurance trained adults remains to be elucidated. **PURPOSE:** We aimed to determine the time course of circulating progenitor cell (CPC), hematopoietic stem/progenitor cell (HSPC), mesenchymal stromal cell (MSC), and endothelial cell (EC) mobilization into peripheral blood during and after exercise in endurance trained athletes. **METHODS:** Seven endurance trained men (mean age: 26±2 yrs.; mean BMI: 23.2±1.0 kg/m²) were recruited to participate in the study. Participants ran on a treadmill for 60 min at 70% of their VO_{2peak}. Blood was collected before (PRE) and during exercise [20 min (20E), 40 min (40E), 60 min (60E)], as well as during recovery [15 min (15P), 60 min (60P), 120 min (120P)] for quantification of CPCs (CD34⁺/CD45^{low}), HSCs (CD34⁺/CD45^{low}/CD38⁻), MSCs (CD45⁺/CD34⁺/CD31⁻/CD105⁻ and CD45⁺/CD34⁺/CD31⁻/CD105⁻), and ECs (CD45⁺/CD34⁺/CD31⁻) via flow cytometry. **RESULTS:** CPCs

(86%) and ECs (131%) increased at 40E (both $P < 0.05$). In addition, ECs increased 96% at 15P ($P < 0.05$) and CPCs trended to increase at this same time point (30%, $P = 0.12$). Circulating HSC and MSC content did not change during or after exercise. **CONCLUSION:** Our data demonstrate that 40 min into endurance exercise CPCs and ECs are increased in circulation and remain increased until 15 min after exercise, while HSCs and MSCs are not responsive in endurance-trained men. These data provide information for the design of more effective strategies that use exercise as an adjuvant therapy in stem cell collection in the context of HCT. Funding provided by Center for Health, Aging, and Disability and the Faculty of Kinesiology and Physical Education Research Grant.

2913 June 3 1:15 PM - 1:30 PM

Predictors of Change in Plasma Cytokines and Muscle Cytokine mRNA and Protein After 75-km Cycling

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(No relationships reported)

PURPOSE: The signaling mechanisms for cytokine gene expression and production during exercise are still being investigated, with a focus on muscle damage and metabolic demands including glycogen depletion, exercise workload, and stress hormones. This study correlated changes in these factors following 75-km cycling with changes in plasma cytokines, and muscle cytokine mRNA and protein levels. **METHODS:** Male cyclists (N=20, age 38.4±6.0 y, 351±57.6 watts_{max}) participated in a 75-km cycling time trial on their own bicycles using computerized trainers. Blood and vastus lateralis muscle samples were collected before and after exercise, with IL-6, IL-8, and MCP-1 measured in plasma and muscle (mRNA, protein). Additional measures included serum myoglobin and cortisol, and muscle glycogen. **RESULTS:** The cyclists completed 75-km cycling in 168±26.0 min at 193±57.8 watts (54.2±9.6% watts_{max}). Muscle glycogen decreased 77.2±17.4%, muscle IL-6, IL-8, and MCP-1 mRNA increased 18.5±2.8-, 45.3±7.8-, and 8.25±1.75-fold, respectively, and muscle IL-6, IL-8, and MCP-1 protein increased 70.5±14.1%, 347±68.1%, and 148±21.3%, respectively (all, $P < 0.001$). Serum myoglobin increased from 32.1±3.3 to 242±48.3 mg/mL, and serum cortisol increased from 295±27.6 to 784±63.5 nmol/L (both $P < 0.001$). Plasma IL-6, IL-8, and MCP-1 increased from 0.42±0.07 to 18.5±3.8, 4.07±0.37 to 17.0±1.8, and 96.5±3.7 to 240±21.6 pg/ml, respectively (all $P < 0.001$). Performance measures (time, %watts_{max}), and changes in muscle glycogen, serum myoglobin, serum cortisol, and plasma IL-6, IL-8, and MCP-1 were unrelated to change in muscle IL-6, IL-8, and MCP-1 mRNA. Muscle glycogen change was related to change in plasma IL-6 ($r = 0.462$, $P = 0.040$), with relationships shown for serum myoglobin with plasma IL-8 ($r = 0.582$, $P = 0.007$) and plasma MCP-1 ($r = 0.457$, $P = 0.043$), and muscle MCP-1 protein ($r = 0.588$, $P = 0.017$); serum cortisol was related to plasma IL-8 ($r = 0.613$, $P = 0.004$), muscle IL-8 protein ($r = 0.681$, $P = 0.004$), and plasma MCP-1 ($r = 0.442$, $P = 0.050$). **CONCLUSION:** Increases in muscle IL-6, IL-8, and MCP-1 mRNA after 75-km cycling were unrelated to muscle damage and metabolic measures. Change in muscle glycogen was related to plasma IL-6, and changes in serum myoglobin and cortisol were related to the chemotactic cytokines IL-8 and MCP-1.

2914 June 3 1:30 PM - 1:45 PM

Exercise Training Rescues Hematopoietic Stem and Progenitor Cell Content and Reduces Senescence Following High-Fat Diet.

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(No relationships reported)

Obesity is associated with increased risk of colon cancer perhaps due decreased immune function. Hematopoietic stem and progenitor cells (HSPCs) within the bone marrow are responsible for maintenance of the mature immune and blood system throughout the lifespan. We and others have shown that exercise training has beneficial effects on HSPC function; however, the effects of exercise on HSPCs in the context of obesity and cancer have not been examined. **Purpose:** To investigate how a progressive exercise training program impacts HSPC populations following consumption of a high fat diet (HF) in a mouse model of colon cancer. **Methods:** 36 C57Bl/6J mice were divided into three groups: sedentary (SED n=12), HF-SED (n=12), and HF-exercise (HF-EX n=12). HF mice received a diet consisting of 45% fat for 8 weeks. All mice received 4 Azoxyethane (AOM) injections to induce colon cancer and were returned to the control diet after the first injection. Mice in the HF-EX group underwent a 24-week progressive treadmill training program (1 hr/d, 3 d/wk) beginning after AOM injection. HSPC subpopulations: long-term hematopoietic stem cell (LT-HSCs, LSK⁺ CD150⁺ CD48⁻), short-term hematopoietic stem cells (ST-HSCs,

LSK⁺ CD150⁺ CD48⁻), and multi-potent progenitors (MPP, LSK⁺ CD150⁺ CD48⁺) were quantified via flow cytometry. **Results:** LT-HSC content was significantly decreased in HF-SED compared to SED (3.8±0.4% vs. 1.9±0.2%, $p < 0.05$), but was restored to SED levels in HF-EX. HF-EX had a significantly increased quantity of ST-HSCs as compared to both CNT and HF-SED groups (8.2±0.7% vs. 8.9±0.9% vs. 14.7±2.0%, $p < 0.05$). Conversely, MPPs were significantly increased in HF-SED compared to HF-EX (75.9±1.1% vs. 69.4±2.1%, $p < 0.05$). Gene expression for the senescence marker p21 was significantly decreased in HF-EX compared to HF-SED ($p < 0.05$) in bone marrow cells. **Conclusions:** Our data suggest that a high fat diet promotes differentiation of HSPCs at the expense of more primitive populations, and increases senescence in cells in the bone marrow compartment even after cessation of HF feeding. The negative effects of a HF on HSPCs can be rescued by exercise training. Funding provided by UIUC Research Board.

2915 June 3 1:45 PM - 2:00 PM

Apoptosis Affects Mobilization Of Hematopoietic Progenitors Into Blood After Exercise

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(No relationships reported)

PURPOSE: Apoptotic cells are suggested to have immunomodulatory properties. The current study investigated first the effect of trainings status on exercise-induced apoptosis and exercise-induced mobilization of progenitor cells. Furthermore, the effect of apoptotic cells on progenitor cell mobilization was investigated. **METHODS:** Male CD1 SWISS-mice were subjected to 10 weeks endurance training or served as untrained controls. Mice of both groups performed an intensive exercise test group corresponding to 80% VO₂max for 30min. Lymphocytes from blood were isolated and apoptosis was analyzed via Annexin V labeling. PBMCs were incubated with specific antibodies against Sca-1 (PE, BD Sciences) and c-Kit (CD117, FITC, Immunotools, Friesoythe, Germany) to detect hematopoietic progenitor cells. All samples were analyzed by flow cytometer (Beckmann Coulter EPICS XL). In a further experiment apoptotic cells were transferred into recipient mice and mobilization of progenitor cells was analyzed. **RESULTS:** In untrained animals the exhaustive exercise was followed by an enhanced rate of Annexin V positive CD3⁺ cells in blood (5.51±0.52 to 10.54±0.87%) ($p < 0.05$), while no increase was found in trained mice (8.07±0.72 to 8.56±0.47%). Regarding progenitor cell mobilization, acute exercise mobilized Sca-1⁺/c-kit⁺ cells in untrained mice (1.09±0.34 to 1.99±0.21%) ($p < 0.05$), while no mobilization occurred in trained mice. The cell transfer experiment revealed that application of apoptotic cells mobilized Sca-1⁺/c-kit⁺ cells into the blood ($p < 0.05$). **CONCLUSIONS:** The current study demonstrated that both lymphocyte apoptosis as well as mobilization of progenitor cells are related to subjects' trainings status. Thereby, apoptotic cells seem to induce signals which effectively mobilize hematopoietic progenitor cells. The relevance of this effect for the adaptation to exercise stimuli remains to be shown.

2916 June 3 2:00 PM - 2:15 PM

Redeployment Of Immune Cell Subsets Across Multiple Exercise Intensities In The Context Of Cytomegalovirus Infection

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(No relationships reported)

The immune response to acute exercise is directly related to exercise intensity, with a greater number of leukocytes mobilized by higher intensities. Within leukocytes, antigen experienced cells with effector functions are more exercise responsive. We have previously shown that factors driving accumulation of these high differentiated cells, including cytomegalovirus infection (CMV⁺), are associated with greater leukocyte redeployment after exercise. It is not known if the differences in the immune response to exercise between CMV⁺ and CMV⁻ individuals depends on exercise intensity. **PURPOSE:** To determine if CMV infection affects T cell and monocyte redeployment across multiple exercise intensities. **METHODS:** 17 cyclists (9 CMV⁺; Mean ± SD: Age: 31 ± 5 yrs, BMI: 23.1 ± 1.9 kg/m²) completed three 30min cycling trials at -5, +5, and +15% of blood lactate threshold (LT). Monocyte and T cell subsets present in the blood pre-, post-, and 1h post-exercise were enumerated using flow cytometry. Cytokine expression by T cell subsets was also characterized. The impact of CMV and intensity on exercise-induced changes in cell subsets was analyzed with linear mixed models. **RESULTS:** CD14hiCD16⁻ monocytes, low differentiated (CD27⁺CD28⁺, CD27⁺CD28⁻, CD45RA⁺CD62L⁺, CD45RA⁻CD62L⁺), and high differentiated (CD45RA⁻CD62L⁻) CD4⁺ T cells were mobilized to a greater extent by exercise above LT compared to -5%LT. Mobilization of low differentiated (CD27⁺CD28⁺, CD27⁺CD28⁻, CD45RA⁺CD62L⁺, CD45RA⁻CD62L⁺) and high

differentiated (CD45RA-CD62L-, CD45RA+CD62L-) CD8+ T cells was significantly greater with +15%LT than -5% and +5% LT. All cells returned to pre-exercise numbers by 1h post-exercise. Larger increases in the number of CD8+T-cells expressing IL-6, IL-10, and IFN- γ were observed after +15% than -5%LT. CMV+ subjects mobilized a greater number of high differentiated CD4+ and CD8+ T cells than CMV- at all intensities. **CONCLUSIONS:** The mobilization of monocyte and T cell subsets by exercise was directly related to exercise intensity, as were exercise-induced changes in T cell cytokine expression. Although CMV+ mobilized more of the exercise responsive high differentiated T cells than CMV-, this occurred above and below LT. Therefore the augmenting effect of CMV on T cell mobilization is independent of exercise intensity.

2917 June 3 2:15 PM - 2:30 PM

Apoptosis Of T Cells Subpopulations Is Differently Affected By High-intensity Interval Exercise Compared To Isocaloric Continuous Exercise

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(No relationships reported)

PURPOSE: High intensity interval training (HIIT) has gained much interest in both performance and recreational sports. However, the effect of acute high intensity interval exercise (HIIE) on immune cell regulation is scarcely understood. Therefore, this study aims to compare the effect of HIIE versus continuous exercise with regard to changes of circulating T cell subpopulations.

METHODS: Healthy young men (n=23) completed a HIIE session (5 intervals of 3 minutes, intensity of 90 % of PPO, 3 minutes active break) and a isocaloric continuous exercise test (CONT, 30 minutes at 70% VO_{2max}) on a bicycle ergometer. Blood samples were collected before, immediately after, as well as 3 h and 24 h post-exercise for flow cytometric assessment of less differentiated T cells (CD28+CD57-), highly differentiated T cells (CD28-CD57+) and regulatory T cells (Tregs) (CD4+, CD25+, CD127-). Detection of apoptosis was performed by using additional labelling with Annexin V. In order to analyse potential mechanisms affecting T cells, several hormones and metabolites were analysed.

RESULTS: Both exercise tests induced an increase of catecholamines and cortisol (p<0.05) with no differences between the protocols. Similarly, both tests mobilized T cells and induced apoptosis in several T cell subsets. Thereby, the CONT induced a higher increase of apoptosis in CD28+CD57- cells (3.66±0.24 to 6.81±0.29%) compared to HIIE (3.41±0.19 to 4.77±0.26%) (p<0.05), while the HIIE was followed by a higher rate of apoptotic CD28-CD57+ cells (23.51±1.31 to 27.14±1.56%) (p<0.05). Regarding regulatory T cells, HIIE induced a mobilization, while the CONT induced apoptosis in these cells (p<0.05).

CONCLUSIONS: These results suggests that HIIE seems to affect the adaptive immune system in a different way than continuous exercise as it enhances cellular immune competence by deleting senescent T cells and mobilising regulatory T cells.

2918 June 3 2:30 PM - 2:45 PM

Anti-inflammatory And Anti-fibrotic Effects Of Aerobic Exercise In Asthma: Role Of Socs-jak-stat Signaling

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Purpose: Airway epithelium and peribronchial leukocytes presents a key role in asthma pathogenesis. A complex signaling involving suppressor of cytokine signaling protein family (SOCS), janus kinase (JAK) and signal transducer and activator of transcription (STAT) modulates asthma. Aerobic exercise (AE) reduces airway inflammation, but the role of SOCS-JAK-STAT mediating anti-inflammatory effects of exercise is unknown. **Methods:** Thus, 40 C57Bl/6 male mice were distributed in Control (Co), Exercise (Ex), Asthma (As) and Asthma+Exercise (As+Ex) groups. House dust mite (HDM - Dermatophagoides pteronyssinus; 100ug/mouse) was orotracheally administered once a week on days 0, 7, 14, 21, 28, 35 and 42. Low intensity treadmill aerobic training (1h/session, 5x/week, 4 weeks) was performed, beginning after the establishment of airway inflammation (day 17). Animals were euthanized on day 45. **Results:** The results demonstrated that AE reduced HDM-increased total leukocytes (p<0.001), eosinophils (p<0.001), lymphocytes (p<0.05), macrophages (p<0.01) and neutrophils (p<0.01) in BAL, as well as the number of eosinophils (p<0.001), lymphocytes (p<0.01) and neutrophils (p<0.01) in the airways wall. AE reduced HDM-induced IL-4 (p<0.001), IL-5 (p<0.001), IL-13 (p<0.05), IL-23 (p<0.01), IL-33 (p<0.05) in BAL. AE reduced HDM-increased collagen (p<0.05)

and elastic (p<0.05) fibers and mucus (p<0.01) accumulation. In addition, AE reduced HDM-induced airway hyperresponsiveness to methacholine (p<0.01). Of note, AE have reestablished HDM-reduced SOCS2 expression (p<0.01), while AE have reduced HDM-increased SOCS3 expression in airway epithelium and in peribronchial leukocytes (p<0.01). AE also reduced HDM-increased JAK2 (p<0.001), STAT5 (p<0.01), STAT6 in airway epithelium and in peribronchial leukocytes (p<0.001).

Conclusions: We conclude that AE reduces asthma phenotype by modulation of SOCS-JAK-STAT signaling in airway epithelium and in peribronchial leukocytes.

2919 June 3 2:45 PM - 3:00 PM

Impact Of High-intensity Interval Exercise On Cellular And Molecular Markers Of Inflammation In Individuals With Type 2 Diabetes

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(No relationships reported)

Inflammation, which can be measured at the level of individual immune cells, plays a prominent role in the pathogenesis of type 2 diabetes (T2D) and its complications. High-intensity interval exercise (HIIE) is touted as a time-efficient exercise option for improving cardiometabolic health in people with T2D but the impact of HIIE on inflammation is unknown. **PURPOSE:** To determine the impact HIIE on a comprehensive array of cellular and molecular markers of inflammation in patients with T2D.

METHODS: Ten individuals with T2D and 10 age-matched normoglycemic controls completed a single bout of HIIE (7 X 1-min @ ~90% VO_{2peak}, 1-min recovery @ ~40% VO_{2peak}) with blood samples obtained before, after, and at 1-h recovery. We analyzed cellular markers of inflammation that have been linked with T2D and cardiovascular disease, including: i) leukocyte toll-like receptors (TLRs) and interleukin receptors (ILRs); ii) non-classical CD16+ "pro-inflammatory" monocytes; and iii) a panel of 13 plasma cytokines.

RESULTS: In both T2D and control participants, HIIE led to an immediate reduction in TLR2 expression on CD14+ classical monocytes (-17%), CD16+ monocytes (-7%), and CD16+ granulocytes (-6%, P<0.05 for all). IL6Ra was also reduced on CD14+ classical monocytes (-8%) and CD16+ granulocytes (-4%) in response to HIIE, which persisted throughout recovery (-8% and -6%, respectively; both P<0.05) in both T2D and control participants. The proportion of non-classical CD16+ monocytes was reduced at 1-h recovery (5.0±2.4%) when compared to rest (3.7±1.8%, P<0.05) in healthy controls but not in T2D participants. There were no appreciable changes in plasma cytokines in response to acute HIIE.

CONCLUSIONS: A single bout of HIIE can reduce cellular markers of inflammation in humans with T2D without changes in circulating cytokines. However, T2D participants may be resistant to exercise-mediated lowering of non-classical CD16+ monocytes that is seen in age-matched normoglycemic controls.

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F-17 Free Communication/Slide - Macronutrient Metabolism

Friday, June 3, 2016, 1:00 PM - 3:00 PM

Room: 202

2920 **Chair:** D. Enette Larson-Meyer, FACSM. *University of Wyoming, Laramie, WY.*

(No relationships reported)

2921 June 3 1:00 PM - 1:15 PM

Effect Of Exercise Intensity On Postprandial Lipemia And Oxidative Stress Markers After A High-fat Meal

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Exercise may attenuate postprandial lipemia and oxidative stress after the consumption of a high-fat meal. Still, it remains the debate about the most effective exercise intensity that can reduce lipemic curve and oxidative stress.

PURPOSE: To compare the effect of two isocaloric sessions of exercise performed in different intensities on lipemic curve and markers of oxidative stress after a high-fat meal.

Abstracts were prepared by the authors and printed as submitted.

METHODS: 11 young and physically active men participated in three randomized protocols with two-day trials each: Low Intensity exercise (LI); Moderate intensity exercise (MI); or Rest. On the evening of day 1, participants performed one of the three protocols. On day 2, participants arrived at the laboratory in a fasted state (12h) and a high-fat meal was provided. Blood collections for analysis of Triglycerides (TG), Thiobarbituric Acid Reactive Substances (TBARS), Nitrites and Nitrates (NOx) and Total Thiols were taken in fasted state and every post-prandial hour until complete 5 hours of the meal consumption. A mixed model ANOVA followed by Bonferroni correction was used to test the effect of the protocols in different times.

RESULTS: Lower levels of TG were observed in LI compared to Rest at 4h (112.20 ± 25.08 vs. 152.17 ± 42.94 mg·dl⁻¹, $p < 0.05$) and in MI compared to Rest at 3h (86.57 ± 33.91 vs. 160.01 ± 44.25 , $p < 0.05$); 4h (109.02 ± 34.88 vs. 152.17 ± 42.94 mg·dl⁻¹, $p < 0.05$) and 5h (91.98 ± 13.23 vs. 124.34 ± 39.13 , $p < 0.05$). The total area under the curve (AUC) of TG was lower in LI and MI than Rest (21.13% and 29.03% lower than Rest, $p < 0.05$). Levels of TBARS in LI and MI were lower than Rest at 1h (1.84 ± 0.55 and 2.57 ± 1.26 vs. 3.88 ± 0.14 μ M de MDA.L-1, $p < 0.01$). Differences between LI and Rest were found in AUC of TBARS (26% lower than Rest, $p = 0.02$) and NOx (48.3% higher than Rest, $p = 0.01$). At baseline, the concentrations of TBARS for LI were lower than MI (1.77 ± 0.70 vs. 2.78 ± 1.37 μ M de MDA.L-1, $p = 0.04$) and concentrations of NOx were higher than Rest (12.12 ± 5.15 vs. 5.83 ± 5.8 μ M.L-1, $p = 0.012$). There was no difference between the protocols for Total Thiols.

CONCLUSIONS: Both exercise intensities were effective to reduce postprandial lipemia and markers of oxidative stress. Yet, there is an acute effect of LI exercise that can reduce baseline concentration of TBARS and increase NOx compared to MI and Rest.

Supported by FAPERGS (Brazil).

2922 June 3 1:15 PM - 1:30 PM

Bioactive Lipids And IMTG Are Not Influenced By 14 Days Prolonged Exercise In Older Men

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Reported Relationships: J.W. Helge: Honoraria; Novo Nordic A/S, consulting.

In a recently published study (Rosenkilde et al., 2015) we observed that older men were able to sustain near maximal energy expenditure during very prolonged exercise, but their energy balance was negative -4.8 ± 2 MJ/day. The effect of prolonged exercise on muscle bioactive lipid content is unresolved and the coupling to and importance of bioactive lipids for insulin sensitivity is controversial. **PURPOSE:** We investigated the effect of 14 days of very prolonged exercise on muscle content of ceramide and IMTG and the muscle expression of lipid handling proteins in lean trained older individuals. **METHODS:** Six lean (BMI; 24 ± 1 kg/m²) trained (VO₂max: 48 ± 2 mlO₂/kg/min) men (age 61 ± 4 yrs.) participated in the study (described in full detail in Rosenkilde et al.). During 14 days the subjects cycled a total of 2706 km averaging a duration of 631 ± 37 min cycling per day. Before and after the 14 days a basal blood sample and a biopsy from the vastus lateralis were obtained. The post testing was done after 28-33 hours of rest. Muscle protein expression was measured by Western blotting. **RESULTS:** Subjects maintained their body weight but were in negative energy balance (Rosenkilde et al. 2015). VO₂max was decreased by 6 ± 2 % across the 14 days. The plasma glucose and adiponectin concentration remained unchanged whereas the plasma insulin concentration and an index of insulin sensitivity (HOMA) tended ($P < 0.07$) to increase after 14 days. The plasma FFA concentration decreased from 560 ± 70 to 160 ± 35 μ mol L⁻¹ ($P < 0.002$) after 14 days. Muscle triacylglycerol and muscle total ceramide content remained unchanged. The muscle expression of DGAT1 and 2, CD36, FABPpm and HSL and PLIN2, 3, and 5 remained unchanged whereas ATGL protein expression was increased ($P < 0.05$) and LPL protein expression tended to increase ($P = 0.06$) after 14 days. **CONCLUSION:** In the present study no effect of prolonged repeated exercise on muscle ceramide or muscle TG was observed after the 14 days despite a trend towards lower insulin sensitivity. Interestingly only the lipolytic capacity in muscle indicated by ATGL and LPL content was up regulated after 14 days very prolonged exercise.

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Rosenkilde et al. Am J Clin Nutr. 2015 Oct 21. pii: ajcn109918. (Epub ahead of Print)

2923 June 3 1:30 PM - 1:45 PM

Resistance Exercise Sustains p70S6K1 Activity in Response to Protein Ingestion at 4 hours

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(No relationships reported)

The additive effect of protein feeding and resistance exercise on the stimulation of muscle protein synthesis is well established. However, it is unclear whether the activity of the signalling protein p70S6K1 is enhanced when protein feeding is combined with resistance exercise compared with protein feeding alone.

PURPOSE: To directly compare the response of p70S6K1 activity to protein feeding alone vs protein feeding combined with resistance exercise.

METHODS: Retrospective signalling analysis was carried out on muscle tissue from a previously published study. Twenty-three resistance trained males consumed a high protein breakfast before resting for 3 h. Following a bout of unilateral resistance exercise (8×10 leg press and leg extension exercises; 80% 1 RM) participants consumed a whey protein isolate drink (containing 10, 20 or 40 g protein). The activity of p70S6K1 was measured at 0 and 4 h in rested and exercised legs using a [³²P] ATP kinase assay. Statistical analysis of the fold change (0-4 h) in p70S6K1 activity between rested and exercised legs was conducted using a paired samples t-test (protein doses were pooled). Linear regression analysis was performed on the difference in fold change of p70S6K1 between rested and exercised (x-axis) against the previously published myofibrillar muscle protein synthesis data (y-axis). Effect sizes were calculated and reported as Cohen's d with confidence intervals (CI). **RESULTS:** The fold change in p70S6K1 activity in response to protein ingestion from 0-4 h was 62% higher ($p = 0.004$; $d = 0.61$; $CI = 0.14$ to 1.08) in the exercised leg (1.8 ± 1.3 fold; mean \pm SD) compared with the rested leg (1.1 ± 0.8 fold). Regression analysis revealed a significant linear relationship between the difference in p70S6K1 activity fold change between rested and exercised legs and previously published myofibrillar muscle protein synthesis data ($p = 0.031$; $r^2 = 0.204$; $y = 1.28 + 0.11 * x$). **CONCLUSIONS:** Resistance exercise enhances the response of p70S6K1 activity to protein feeding and likely contributes to the enhanced response of myofibrillar muscle protein synthesis when protein feeding and resistance exercise are combined. Partially funded by GSK Consumer Healthcare.

2924 June 3 1:45 PM - 2:00 PM

Sucrose Ingestion Accelerates Post-exercise Liver-, But Not Muscle Glycogen Repletion When Compared To Glucose Ingestion

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PURPOSE: This study aimed to assess the effect of sucrose versus glucose ingestion on post-exercise liver and muscle glycogen repletion.

METHODS: Fifteen well-trained male cyclists (age: 22 ± 1 y; Wmax: 4.8 ± 0.1 W·kg⁻¹) were studied on 2 different occasions. Each test day started with a glycogen-depleting exercise session. This was followed by a 5 h recovery period, during which subjects ingested 1.5 g·kg⁻¹·h⁻¹ sucrose or 1.5 g·kg⁻¹·h⁻¹ glucose. Blood samples were collected frequently and ¹³C magnetic resonance spectroscopy and magnetic resonance imaging were applied at 0, 2, and 5 hours after cessation of exercise to determine liver and muscle glycogen concentrations and liver volume.

RESULTS: During the 5 hour recovery period, muscle glycogen concentrations increased significantly from 85 ± 7 vs 86 ± 9 mmol·L⁻¹ to 140 ± 6 vs 136 ± 7 mmol·L⁻¹ following sucrose and glucose ingestion, respectively (no significant differences between treatments: $P = 0.673$). Post-exercise liver glycogen concentrations increased significantly from 183 ± 12 vs 167 ± 17 mmol·L⁻¹ to 280 ± 19 vs 234 ± 21 mmol·L⁻¹ following sucrose and glucose ingestion, respectively (time x treatment, $P = 0.051$). Liver volume increased significantly over the 5 hour period after sucrose ingestion only (time x treatment, $P < 0.01$). As a result, total liver glycogen content increased over the 5 hour period to a greater extent after sucrose ingestion (from 54 ± 4 to 87 ± 7 g), compared to after glucose ingestion (from 49 ± 7 to 66 ± 7 g; time x treatment, $P < 0.01$). **CONCLUSION:** Ingestion of sucrose (1.5 g·kg⁻¹·h⁻¹) during recovery from exhaustive exercise accelerates liver, but not muscle glycogen repletion rates when compared to the ingestion of glucose in well-trained cyclists.

This study was co-funded by Sugar Nutrition UK and Kenniscentrum Suiker en Voeding Nederland.

2925 June 3 2:00 PM - 2:15 PM

Cadence Dependent Carbohydrate Management at Prolonged Constant Workload: an Experimental and Modelling ApproachRalph Beneke, FACSM, Renate M. Leithäuser. *Philipps-University, Marburg, Germany.**(No relationships reported)*

Competitive cyclists prefer cadences above 90 revolutions per minute (RPM) during racing, testing in the laboratory and training although metabolic rate and blood lactate concentration (BLC) are increased compared to 50 to 60RPM. The maximal lactate steady state (MLSS) depicts the BLC that can be maintained over time without a continual accumulation at constant prolonged workload. In cycling no difference in the MLSS was combined with lower power output related to peak workload (IMLSS) at 100 than at 50RPM. MLSS coincides with a respiratory exchange ratio (RER) close to 1. Recently, at incremental exercise an RER of 1 was found at similar workload and similar intensity but higher BLC at 100 compared with 50RPM. **PURPOSE:** To re-assess a potential effect of cycling cadences on the MLSS and test the hypothesis that the MLSS is higher at 105 than at 60RPM with no difference in IMLSS as input parameters for modelling potential cadence effects on whole body carbohydrate management at MLSS and endurance training relevant lactate concentrations. **METHODS:** MLSS and IMLSS were determined in a between-subject design (n=16; age:25.1±1.9yrs, height:178.4±6.5cm, body mass:70.3±6.5kg vs. n=16; 23.6±3.0yrs, 181.4±5.6cm, 72.5±6.2kg; Study I) and confirmed using a within-subject design (n=12; 25.3±2.1yrs, 175.9±7.7cm, 67.8±8.9kg; Study II). Modelling IMLSS and cycling at a BLC of 2.0mmol/l revealed cadence specific fractions of aerobic rates used for carbohydrate consumption (relCHO). **RESULTS:** In Study I the MLSS was lower at 60 than at 105RPM (4.3±0.7 vs. 5.4±1.0mmol/l; p=0.003) with no difference in IMLSS (68.7±5.3 vs. 71.8±5.9%). Study II confirmed these findings on MLSS (3.4±0.8 vs. 4.5±1.0mmol/l; p=0.001) and IMLSS (65.0±6.8 vs. 63.5±6.3%; p=0.421). Modelling revealed that for a given relCHO a higher BLC is required at 105 than at 60RPM indicating that steady state cycling at a BLC of 2.0mmol/l at 60RPM resulted in a relCHO of 76% compared to 58% at 105RPM. **CONCLUSIONS:** The higher MLSS at 105 than at 60RPM combined with an invariance of IMLSS and RER close to 1 at MLSS support the hypothesis that higher cadences can induce a preservation of carbohydrate at given BLC levels during low intensity high volume training sessions.

2926 June 3 2:15 PM - 2:30 PM

Deranged Glucose Oxidation in Primary Human Myotubes from Type 2 Diabetic PatientsKai Zou¹, J Matthew Hinkley¹, Sanghee Park¹, Donghai Zheng¹, Terry E. Jones¹, Pamela J. Hornby², James Lenhard², Walter J. Pories¹, G. Lynis Dohm¹, Joseph A. Houmard, FACSM¹. ¹East Carolina University, Greenville, NC. ²Janssen Research & Development, Spring House, PA. Email: zouk14@ecu.edu *(No relationships reported)*

Type 2 Diabetes (T2D) is associated with severe derangement in skeletal muscle glucose oxidation. Reduced capacity to increase glucose oxidation in response to insulin stimulation have been described both in vivo and in vitro studies. However, the mechanisms responsible for this defect have not yet been fully identified. **PURPOSE:** The purpose of this study was to determine whether impaired glucose oxidation is retained in cultured myotubes established from T2D humans and the potential mechanisms behind the impairment. **METHODS:** Human skeletal muscle cells obtained from control (n=8, Fasting blood glucose = 87.6 ± 4.1 mg/dl) and T2D (n=7, Fasting blood glucose = 146.4 ± 17.8 mg/dl; HbA1C = 7.4 ± 0.4 %) muscle biopsies were differentiated to myotubes. Radiolabeled 1-14C glucose was used to measure complete glucose oxidation (GO) and non-oxidized glycolysis (NOG) rates in the presence or absence of insulin. Radiolabeled 1- and 2-14C pyruvate were used to measure pyruvate oxidation (PO) rate. **RESULTS:** GO rate was significantly lower in myotubes from T2D subjects than the control at baseline (485.8 ± 34.5 vs. 626.1 ± 25.8 pmol glucose/mg/min, P<0.05). In addition, GO rate in myotubes from T2D subjects was less sensitive to insulin stimulation than the control (2.8 ± 1.6% vs. 12.8 ± 2.6%, P<0.05), resulting in a significantly reduced GO rate after insulin stimulation in comparison to the control (505.0 ± 35.1 vs. 702.9 ± 47.1 pmol glucose/mg/min, P<0.05). In contrast, NOG production virtually did not change in myotubes from control donors in response to insulin (2.3 ± 3.5 %), but largely increased (26.7 ± 8.2 %) in T2D, resulting in a significantly higher NOG rate in myotubes from T2D (6684.5 ± 1331.2 vs. 4220.3 ± 601.5 pmol glucose/mg/min, P<0.05). Finally, both 1- and 2-14C PO rates were significantly lower in myotubes adapted from T2D subjects when compared to the control (4551 ± 635.5 vs. 5694.0 ± 181.6 and 308.9 ± 41.9 vs. 406.3 ± 22.3 pmol pyruvate/mg/min, respectively, P<0.05). **CONCLUSIONS:** These data suggest that myotubes established from T2D humans have impaired glucose oxidation in a manner that partitions glucose towards non-oxidized glycolysis rather than

complete oxidation. Pyruvate oxidation data further suggests that this derangement may be due to the defective pyruvate dehydrogenase activity and TCA cycle flux.

2927 June 3 2:30 PM - 2:45 PM

Acute Post-exercise Glucose Disposal: Exploring The Role For Exercise Intensity In Overweight/obese MalesAaron Raman¹, Jeremiah Peiffer¹, Gerard Hoyne², Jill Kanaley, FACSM³, Timothy Fairchild¹. ¹Murdoch University, Perth, Australia. ²University of Notre Dame, Perth, Australia.³University of Missouri, Columbia, MO. (Sponsor: Professor Jill Kanaley, FACSM)

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(No relationships reported)

PURPOSE: To examine the effect of work- and duration-matched exercise on subsequent glucose disposal in overweight males.

METHODS: Fifteen sedentary, overweight males (mean ± SD; Age: 28.2 ± 6.9 y; BMI: 29.0 ± 3.1 kg/m²) completed two trials in randomised order. During each trial, participants completed an oral glucose tolerance test (75g; OGTT) at the same time on three successive mornings. On day 2, participants completed a duration and workload matched bout of either high-intensity interval exercise (HIIE; alternating at 100% and 50% of $\dot{V}O_{2peak}$) or continuous moderate-intensity exercise (CME; 60% $\dot{V}O_{2peak}$) prior to the OGTT. Glucose area under the curve (AUC) and peak glucose differences were calculated during the oral glucose tolerance tests. Additionally, venous blood samples were collected before exercise, immediately post-exercise and one-hour post exercise for measurement of insulin, C-peptide and adiponectin.

RESULTS: There was a main effect of time on glucose AUC, indicating a reduced AUC after exercise on day 2 when compared to day 1 (3.6%; p<0.05) and day 3 (8.0%; p<0.01). Similarly, peak glucose was lowest on day 2 when compared to day 1 (10.5%; p<0.05) and day 3 (19.6%; p<0.05). Insulin concentration was higher immediately following HIIE when compared to CME (441.3 ± 69.1 vs 348.8 ± 6.0 pg/ml; p<0.05); while both insulin and C-peptide were significantly reduced at 1 hr post-exercise (insulin: 268.3 ± 39.1 pg/ml; C-peptide: 934.0 ± 83.3 pg/ml) when compared to Pre- (insulin: 359.4 ± 58.0 pg/ml; C-peptide: 1078.5 ± 108.6 pg/ml; p<0.05) and immediately post-exercise (insulin: 395.1 ± 55.1 pg/ml; C-peptide: 1224.4 ± 110.9 pg/ml; p<0.05) in adiponectin were found either within or between the two exercise conditions, suggesting the acute exercise did not induce any anti-inflammatory benefit.

CONCLUSIONS: Exercise was effective in acutely reducing glucose AUC and peak glucose, although these effects disappeared within 24 hours. There were no differences in acute glucose tolerance between the adopted exercise conditions.

2928 June 3 2:45 PM - 3:00 PM

An Acute Increase of Dietary Protein Intake Elicits Positive Cellular Metabolic Adaptations in Healthy Males.Matthew J W Furber¹, Ana Anton-Solanas¹, Emma Koppe², Charlotte Ashby³, Michael G. Roberts³, Justin D. Roberts⁴. ¹GSK Human Performance Lab, Brentford, United Kingdom. ²GSK, Stevenage, United Kingdom. ³University of Hertfordshire, Hatfield, United Kingdom. ⁴Anglia Ruskin University, Cambridge, United Kingdom. (Sponsor: Glyn Howatson, FACSM)

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(No relationships reported)

There is emerging literature demonstrating that restricting dietary carbohydrate (CHO) intake might upregulate cellular markers of mitochondrial biogenesis. Mitochondria quantity and density has been linked with increased endurance performance, reduction in type 2 diabetes and improved insulin sensitivity. A number of transcriptional cellular markers have been identified as key regulators of this process. **PURPOSE:** To determine the influence of 7 days dietary manipulation on resting metabolic rate (RMR), body composition and transcriptional markers of mitochondrial biogenesis. **METHOD:** Forty-six healthy male participants (mean ± SD; age (years), body mass (kg), height (cm); 28 ± 5, 75.6 ± 11.1, 178.0 ± 4.9, respectively) were recruited and randomised to one of four conditions: energy matched high protein (PRO-EM), energy restricted high protein (PRO-ER), energy matched high carbohydrate (CHO-EM) or energy restricted high carbohydrate (CHO-ER). Macronutrient ratios (PRO:CHO:FAT) of 40:30:30 and 60:10:30 were used for high protein and high carbohydrate conditions, respectively. Caloric intake for energy restricted groups was matched to RMR. Participants visited the laboratory on 3 occasions across 15 days. On days 0, 7 and 15 participants completed assessments of body composition (DEXA) and RMR (indirect calorimetry), prior to providing a muscle biopsy from the vastus lateralis for later analysis of transcriptional markers via real-time polymerase chain reaction. Between days 1 & 7 and 7 & 14 participants consumed their habitual and prescribed diets, respectively. Laboratory testing was completed following an overnight fast and at the same time of day on each occasion. **RESULTS:** No difference in RMR was observed in any group across all time points. AMPK, PGC-1α, SIRT1 and PPAR expression

was increased in the PRO-ER group (1.32, 1.20, 1.45 and 1.41 fold, respectively). Transcriptional markers were not affected in either CHO group. The CHO-ER group demonstrated a greater loss in lean mass relative to the PRO-EM (-2.22 vs -0.35%) and body mass loss relative to both CHO-EM and PRO-EM (-2.85 vs -0.95 vs -1.47%) ($P < 0.05$). **CONCLUSION:** A restriction energy intake combined with increased protein consumption for 7 days increases transcriptional markers of mitochondrial biogenesis.

F-18 Free Communication/Slide - Neuroscience

Friday, June 3, 2016, 1:00 PM - 2:30 PM

Room: 203

2929 **Chair: J. Carson Smith, FACSM. University of Maryland, College Park, MD.**

(No relationships reported)

2930 June 3 1:00 PM - 1:15 PM

Exercise Training Alters Resting Cerebral Blood Flow: Implications for MCI and Healthy Older Adults

Alfonso J. Alfini¹, Lauren R. Weiss¹, Katherine Reiter², Theresa J. Smith¹, Kristy Nielson³, J. Carson Smith, FACSM¹.

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(No relationships reported)

Mild Cognitive Impairment (MCI) afflicts ~8.6 million Americans over the age of 65 and increases one's risk for Alzheimer's disease (AD). Although a cure remains elusive, exercise training has shown to improve both brain structure and function in older adults with and without MCI. Alterations in cerebral blood flow (CBF), including a compensatory hyper-perfusion in MCI, likely precede and facilitate changes to the brain's neural infrastructure, making it a candidate biomarker of both health and disease.

Purpose: Our objective was to examine the effects of a 12-week aerobic exercise intervention on regional CBF (rCBF) in healthy older adults (HOA) and those with MCI. We hypothesized that individuals with MCI would experience the greatest rCBF changes over time.

Methods: Sixteen HOA and 16 individuals with MCI (age 60-88 years) engaged in 12-weeks of moderate intensity exercise training (4-days/week for 30-minutes). Perfusion weighted images were acquired both before and after the intervention using a GE 3T MR system. The data were preprocessed and analyzed using AFNI and SPM8, and CBF quantification (ml/100cc/min) was performed using FreeSurfer v5.3.0. A repeated measures ANOVA (AFNI 3dLME) was used to test changes over time and group differences. Whole brain family-wise error correction was maintained at $p < 0.01$ using an individual voxel probability threshold of $p < 0.001$ and a cluster size threshold ≥ 14 voxels.

Results: 12-weeks of moderate intensity exercise resulted in significantly decreased rCBF within both groups (total cluster volume: MCI = 7,664 mm³, HOA = 272 mm³). Individuals with MCI experienced decreased rCBF in bilateral insula, cingulate, and (L) inferior frontal lobule. HOA experienced small but significant decreases in (R) angular gyrus, precuneus, and inferior parietal lobule.

Conclusions: Three months of exercise training reduced resting rCBF in those with MCI and to a lesser extent in HOA. These results corroborate existing evidence that exercise training may mitigate the overcompensation often observed in MCI and may improve neural efficiency during memory retrieval (Smith et al. 2013). These effects further suggest that exercise training in those with MCI may promote a normalization of rCBF within a vulnerable and perhaps pathologically disrupted neurovascular system.

2931 June 3 1:15 PM - 1:30 PM

Effect Of Acute Active Playing Upon N450 Amplitude In Children

Stephany V. Brito¹, Isabela A. Ramos¹, Isabela A. David², Jessica Sanchez², Eduardo B. Fontes³, Carmen Campbell¹. ¹Universidade Catolica de Brasilia, Brasilia, Brazil. ²Universidade Federal Fluminense, Niteroi RJ, Brazil. ³Universidade Federal do Rio Grande do Norte, Natal RN, Brazil.

(No relationships reported)

Event-related brain potentials (ERPs) have been instrumental for discerning the relationship between physical activity and aspects of cognition in children. **PURPOSE:** to verify and compare the waveform of N450 ERP component in Stroop task between active play, passive play and control sessions in children.

METHODS: 13 girls and boys (9.5±0.8yr; 32.05±5.9kg; 1.38±0.1m; 16.36±4.2%body fat) participated on this study. Firstly, they were performed anthropometric evaluations. Thereafter, three sessions lasting 30min were performed in randomized order: 1) Control - seated watching a documentary (92.4±8.9bpm); 2) Active Play - games with movement, eg. jumping jacks, running, jumping (152.8±16.31bpm); 3) Passive Play - playing games seated, eg. puzzles of colors, animals and numbers (99.6±28.2bpm). Subsequently, they completed a Stroop task (GO/No-go) while brain electrical activity was recorded with EEG. ERPs were recorded and calculated from electrodes at Fz, F3, F4, Cz, C3, C4, Pz, P3 and P4. Mean peak amplitude of N450 component were used to compare the electrical brain responses between sessions.

RESULTS: The ANOVA of N450 mean amplitudes revealed a significant main effect for interaction of factor frontal anterior between sessions $F(2,36) = 3.63$, $p = 0.04$ (fig 1). The N450 amplitude in the incongruent condition was less negative in active play than in control session in the frontal sites ($p=0.11$). In the Incongruent condition, the mean of Reaction Time was slower to the Active Play (859ms) than for Control (886ms) and Passive Play (893ms), ($p=0.84$).

CONCLUSIONS: 30min of active play could contributed to improve cognitive performance, in the component N450 about incongruent condition, in children. Supported by CNPq and CAPES.

Figure 1. Electroencephalographic analysis

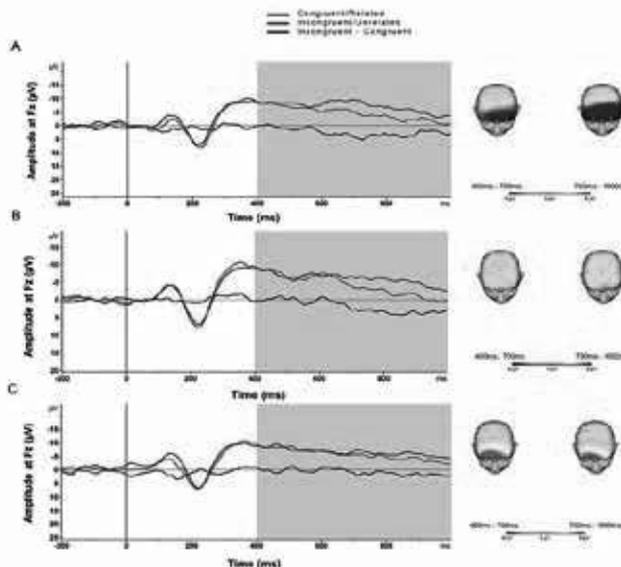


Figure 1. Grand averages of ERPs of frontal electrode (Fz) are shown for the congruent-related (blue), incongruent/unrelated (red), difference congruent-incongruent (black) conditions and Topographical maps of the N450 averaged in the 400-700 and 700-1000 ms time window at the sessions: A, Control Session; B, Passive Session and C, Active Session.

2932 June 3 1:30 PM - 1:45 PM

Influence Of VO₂ peak Criteria On Aging And Alzheimer's Research

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(No relationships reported)

There is increasing evidence that physical activity may reduce pathological brain changes that occur in aging and Alzheimer's disease (AD). Metabolic testing measuring peak oxygen consumption (VO₂peak) is the gold standard for quantifying cardiorespiratory fitness (CRF), which is an index of habitual physical activity. Associations between CRF and various biomarkers associated with aging and AD have been reported, however criteria used to determine VO₂peak have varied. **Purpose:** Explore the consequences of implementing specific VO₂peak criteria on CRF associations with cerebral blood flow (CBF) hippocampal volume (HV) and episodic memory (EM) in an older adult population. **Methods:** 110 cognitively healthy adults (mean age = 64.2) from the Wisconsin Registry for Alzheimer's Prevention participated in this study. Participants performed a graded treadmill exercise test and VO₂peak, according to standardized criteria, was used as the index of CRF. Participants also underwent MRI scanning and cognitive evaluation from which CBF, HV, and EM were obtained. Regression analyses for the entire sample, as well as, limited

to only those meeting criteria were conducted to explore the association between CRF: 1) CBF 2) HV and 3) EM. **Results:** 25 participants (22.7% of the sample) did not satisfy the ACSM criteria for a VO₂ peak test. For the entire sample, CRF was significantly associated with CBF and EM ($p < .05$). When limiting the sample to those who satisfied criteria, CRF was significantly associated with HV for females with familial and/or genetic risk for AD ($p < .05$). No significant associations ($p > .05$) were observed for CBF and EM when applying standardized criteria. The opposite occurred for the association between CRF and HV, where including participants not meeting criteria diminished the observed association ($p > .05$). **Conclusions:** Associations between CRF and biomarkers of AD were modified depending on whether or not criteria for VO₂ peak were applied. These results suggest that implementing standardized criteria with metabolic testing in older adults is an important consideration for interpreting associations between CRF and aging / AD biomarkers. These results have implications for trials aimed at determining whether CRF adaptations play a role in protection against the progression of aging and AD pathology.

2933 June 3 1:45 PM - 2:00 PM
Examining Computerized Neuropsychological Test Performance Scores Pre to Post Season Following a Season of Competitive Interscholastic Girls' Soccer
 Thomas W. Kaminski, FACSM, Margeaux Pantano, Jaclyn Caccese, Joseph J. Glutting, Thomas Buckley. *University of Delaware, Newark, DE.*
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 (No relationships reported)

Purposeful heading of a soccer ball is an inherent and strategic part of the sport. Recent neuroimaging evidence suggests that there may be detrimental effects of repetitive soccer heading on neurophysiology. With neuropsychological testing (NP) part of most sport-related concussion management programs, the ability to access this data and make reasonable conclusions even in the absence of concussion is advantageous. **PURPOSE:** To determine if differences in NP test performance exist pre to post season in a large cohort of female interscholastic soccer players. **METHODS:** A total of 707 interscholastic female soccer players from 19 different schools consented to participate in this study. Subjects were administered the computerized Automated Neuropsychological Assessment Metrics (ANAM) test battery prior to and at the conclusion of their playing season. Throughput scores (T-PUT) (measures of performance speed and accuracy) were taken from the ANAM test battery for the Simple Reaction Time (SRT), Math Processing Test (MTH), Continuous Performance Test (CPT), Matching to Sample (MSP), Sternberg Memory Test (ST6), Repeat Reaction Time (RSRT), and Repeat Continuous Performance Test (RCPT); whereas higher scores are interpreted as better. Data were analyzed using a series of paired-samples t-tests. **RESULTS:** Significant (all p -values $P < .000$) improvements in T-PUT scores occurred in 6 of 7 of the NP variables [SRT 209.1 vs. 212.5, MTH 21.9 vs. 25.0, CPT 92.1 vs. 103.4, MSP 31.0 vs. 33.6, ST6 75.4 vs. 82.7, RCPT 100.1 vs. 109.9]. The only pair that was not significant was RSRT (208.3 vs. 209.3). Calculated effect sizes ranged from small to medium. **CONCLUSION:** The SRT, RSRT, and MSP values reported here are lower than those previously reported in collegiate athletes. Practice effect improvements of +9 for SRT, +2 for MTH, +5 for MSP, and +10 for ST6 have been previously shown and compare favorably to what is demonstrated in our subject pool. Having hypothesized that we would find deficits in NP test performance, we unexpectedly report that in all NP variables this cohort actually improved performance. Our large scale research effort involving female interscholastic soccer players is important in providing evidence surrounding issues related to the subconcussive head impacts that take place during soccer competition.

2934 June 3 2:00 PM - 2:15 PM
Interappendicular Neurological Coupling During Various Locomotor Tasks In Persons With Spinal Cord Injury
 David W. McMillan, Ivana Melgar, Christine Dy. *CSU Los Angeles, Los Angeles, CA.*
 (No relationships reported)

It has been suggested that neurological coordination between the upper and lower limbs during human locomotion is accomplished largely via subcortical centers, but the functional implications of spinal limb coupling during walking have not been fully explored. However, emerging evidence exists showing that active arm movements during locomotion can augment leg muscle activity in persons with paralysis. **PURPOSE:** To determine the influence of upper limb actions on muscle activity during various locomotor tasks in persons with spinal cord injury (SCI). **METHODS:** Six ($n = 5$ male, 1 female) persons (31 ± 8 yr, 69.2 ± 9.3 kg, 1.78 ± 0.09 m) with SCI (4 cervical & 2 thoracic injuries) were suspended above a treadmill via a body weight support (BWS) system which allowed for partial loading of the lower

body (45% body weight). Therapists located on the side of the treadmill manually moved their legs through the gait pattern at a set cadence (85 steps/min) while the treadmill moved at 1.6 mi/hr. During body weight support treadmill training (BWSTT) participants swung their arms (Swing), held parallel bars located on the side of the treadmill (Hold) and held in a similar yet unsupported position as in the parallel bar condition (Sham). Plantar forces (PF) and surface electromyography (sEMG) of six lower limb muscles was measured and averaged for 12 steps during each of the upper body conditions. **RESULTS:** Maximal sEMG of the medial gastrocnemius was significantly greater ($p = .04$) in Swing (18.4 ± 13.1) compared to Hold (12.9 ± 15.9) just before initial contact, when mechanical loading of the legs was not different. No other sEMG measures used for statistical analysis yielded significant differences, but case comparison of participants indicates that differences in individual responses could be largely explained by injury characteristics. **CONCLUSION:** Results suggest that active arm movement during locomotion could augment leg muscle activity in persons with SCI, and that the influence of arm actions differs based on neurological level and extent of injury. Therefore, in persons with paralysis the actions of the arms during walking should be considered in both rehabilitation and community contexts.

2935 June 3 2:15 PM - 2:30 PM
Effects Of Intrinsic Aerobic Capacity And Ovariectomy on Voluntary Wheel Running and Mid-brain Dopamine Signaling
 Young-Min Park¹, Jill A. Kanaley, FACSM², Jaume Padilla², Terese Zidon², Rebecca Welly², Matthew J. Will², Steven L. Britton³, Lauren G. Koch³, Gregory Ruegsegger², Frank W. Booth, FACSM², John P. Thyfault, FACSM⁴, Victoria J. Vieira-Potter². ¹University of Colorado Anschutz Medical Campus, Aurora, CO. ²University of Missouri, Columbia, Columbia, MO. ³University of Michigan, Ann Arbor, MI. ⁴University of Kansas Medical Center, Kansas City, KS. (Sponsor: Jill Kanaley, FACSM)
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 (No relationships reported)

Rats selectively bred for high (HCR) and low (LCR) aerobic capacity show a divergence in wheel running behavior, which may be associated with dopamine (DA) signaling in the mid-brain. HCR possess greater motivation for voluntary running along with greater mid-brain dopamine activity compared to LCR. Post-ovariectomy (OVX) HCR demonstrate attenuated spontaneous cage (i.e. locomotor) activity, but whether HCR_{OVX} modify voluntary wheel running is unknown. **PURPOSE:** To determine whether HCR are protected from OVX-associated reduction in voluntary wheel running. **METHODS:** Forty female HCR and LCR rats (age ~27 weeks) had either SHM or OVX operations, and given access to a running wheel for 11 weeks. Weekly wheel running distance was determined midway through the experiment. Mid-brain nucleus accumbens (NAc) mRNA expression was assessed at sacrifice. **RESULTS:** Compared to LCR, HCR had greater wheel running distance and greater net positive activation of DA signaling, as indicated by mRNA expression of DA receptors in the NAc (both line main effects, $P < 0.05$). In both lines, OVX reduced wheel running ($P < 0.05$). Unexpectedly, although HCR started with significantly greater voluntary wheel running, they also exhibited a greater OVX-induced reduction in wheel running than LCR (line x treatment interaction, $P = 0.025$), which was associated with an OVX-mediated reduction in positive DA signaling in the NAc, as indicated by a reduced ratio of excitatory:inhibitory DA receptor mRNA (interaction, $P = 0.001$). Across animals, wheel running distance was positively correlated with DA activation. **CONCLUSION:** DA activity in the NAc brain region may play a significant role in motivation to run in female rats. Although HCR run significantly more and have greater positive DA signaling in the NAc brain region than LCR, OVX reduced net positive DA signaling to the level observed in LCR whereas, in LCR rats, OVX did not further reduce DA signaling.

F-19 Free Communication/Poster - Aging Gracefully
 Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

2936 Board #1 June 3, 2:00 PM - 3:30 PM
Relationship Between Skilled Motor Performance And Visual Search With Aging
 Adam Harrison, Christopher Perry, Tarkeshwar Signh, Angela Ross, Troy Herter. *University of South Carolina, Columbia, SC.*
 (No relationships reported)

It is widely known that performance of many visuomotor skills deteriorates with aging. Older adults also exhibit declines in their ability to perform visual search, defined as

Abstracts were prepared by the authors and printed as submitted.

voluntary eye movements used to gather visual information from the environment. Recent research has demonstrated that skilled visual search underlies expertise in many visuomotor skills, suggesting that diminished performance of visual search may underlie declines in skilled motor performance with aging.

PURPOSE: To determine if diminished performance of visuomotor skills is linked to declines in performance of skilled visual search.

METHODS: Data was obtained from 67 healthy adults ages 22–72 (51% male). Subjects completed a skilled visuomotor task, the Object Hit and Avoid (OHA) task, on a robotic device coupled with an eye tracking system. In this task, subjects used virtual paddles attached to their hands to hit away targets (n=200) and avoid hitting distractors (n=100) that moved towards them in the horizontal plane.

RESULTS: We observed that OHA performance declined with age ($r = -0.41, p < 0.001$). This was primarily related to a significant correlation between target hits and aging ($r = -0.37, p = 0.002$), whereas distractor avoidance exhibited a weaker correlation with aging ($r = -0.25, p = 0.04$). We also found that the total number of objects that subjects looked at using visual search decreased with age ($r = -0.29, p = 0.01$) and was correlated with target hits ($r = 0.69, p < 0.001$). In contrast, measures of limb motor control were not correlated with task performance.

CONCLUSION: These results indicate that age-related declines in skilled visual search may underlie diminished performance of visuomotor skills. Notably, as adults age, they lose the ability to perform skilled eye movements, thus their ability to gather visual information diminishes. We speculate that as the ability to gather and process visual information diminishes, older adults lose their ability to effectively perform visuomotor skills.

Funding: This research was funded by an ASPIRE II grant received from the Office of Research at the University of South Carolina.

2937 Board #2 June 3, 2:00 PM - 3:30 PM
Determinants Of Manual Dexterity In Middle-aged And Older Adults

Landon D. Hamilton¹, Ewan Thomas², Karim Derqaoui¹, Awad Almuklass¹, Roger M. Enoka¹. ¹University of Colorado Boulder, Boulder, CO. ²Università degli Studi di Palermo, Palermo, Italy. Email: laha3107@colorado.edu

Reported Relationships: L.D. Hamilton: Salary; Supported by T32 Grant AG000279 awarded to Robert S. Schwartz.

As a biomarker of neurologic health and function (NIH Toolbox), manual dexterity is a measure of the ability to coordinate and manipulate objects in a timely manner. The Toolbox measure of manual dexterity is the Rolyan 9-hole pegboard test, whereas the Lafayette 25-hole grooved pegboard test provides greater discrimination in fine motor skills among adults.

PURPOSE: To compare the performance of middle-aged and old adults on the 9- and 25-hole pegboard tests. We hypothesized that pegboard times would be slower for old adults and that the predictor variables would differ for the two groups.

METHODS: In addition to the 9-hole pegboard test (9HPT) and the grooved pegboard test (GPT), middle-aged (MA, 40-60 yrs; n=25) and old adults (OA, 65-89 yrs; n=28) performed tests of maximal grip strength, tactile discrimination, force steadiness, and the NIH Toolbox cognition battery to identify variables that could predict pegboard times. Force steadiness was measured during actions that comprised various combinations of wrist extension, index finger abduction, and precision pinch.

RESULTS: MA adults (51±7 yrs) performed significantly faster than OA (72±5 yrs) on both the 9HPT (18±3 s and 20±3 s, p<0.01) and GPT (60±9 s and 78±16 s, p<0.01) tests. Additionally, MA adults had better tactile discrimination scores (95±11 au and 72±20 au, p<0.01). The predictor variables that explained significant amounts of the variance in pegboard times differed for the two tests and age groups: (1) MA - 9HPT times were predicted (R²=0.441) by grip strength and force steadiness during pinch + wrist extension, and GPT times were predicted (R²= 0.509) by force steadiness during index finger abduction + wrist extension and force steadiness during pinch + wrist extension; (2) OA - 9HPT times were predicted (R²=0.558) by age, grip strength, and force steadiness during wrist extension, and GPT times were predicted (R²=0.754) by age, cognitive working memory, and force steadiness during wrist extension.

CONCLUSION: The predictor variables for the pegboard times (9HPT and GPT) were mainly measures of force steadiness for MA, with the addition of grip strength for the 9HPT. The predictor variables for OA were identical for the two tests, except grip strength was significant for the 9HPT and cognitive memory was significant for GPT.

2938 Board #3 June 3, 2:00 PM - 3:30 PM
Effect Of Water Immersion On Dual Task Performance In Older Adults

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(No relationships reported)

Much is known about cardiovascular and biomechanical responses to exercise during water immersion, yet an understanding of the higher-order neural responses to water

immersion is unclear in older adults. **PURPOSE:** To compare cognitive and motor performance between land and water environments using a dual task paradigm, which served as an indirect measure of cortical processing. **METHODS:** Cross-over research design where ten older participants (age = 78 ± 5.0 yrs) with mild cognitive impairment performed a cognitive (auditory vigilance) and motor (standing balance) task separately (single task condition) and simultaneously (dual task condition) on land and in chest-deep water. Listening errors (# = count) from the auditory vigilance task and center of pressure (CoP) sway area (cm²) for the balance task measured cognitive and motor performance, respectively. Environment (land vs water) and task (single vs dual) comparisons were made with a Wilcoxon matched-pair test. **RESULTS:** Listening errors for the single task in water (3.0 ± 2.3 #) were not different (p = 0.2) from land (7.0 ± 6.8 #). A similar observation was made for the dual task condition (water = 2.8 ± 1.5 # vs. land = 4.8 ± 3.6 #; p = 0.1). CoP sway values for the single task in water (12.7 ± 4.3 cm²) were 123% greater (p = 0.001) from land (5.7 ± 2.2 cm²). Dual task conditions revealed a similar trend (water=11.5 ± 4.2 cm² vs. 4.3 ± 1.6 cm²; p = 0.009) and CoP values between single and dual task conditions were not different (p = 0.86). **CONCLUSION:** Older adults with mild dementia made similar 'cognitive' errors while immersed chest-deep in water than on land. These same participants swayed more in water than on land suggesting they were less stable in the water environment. Finally, the task demands (single vs. dual) did not influence their cognitive or motor performances in either environment.

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2939 Board #4 June 3, 2:00 PM - 3:30 PM

The Relative Effect of an Aquatic Environment on Jumping Kinetics between Older and Younger Adults

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In comparison with the land environment, our previous work suggests that jumping movements performed in the aquatic environment elicit greater propulsive mechanical power production. While this knowledge is insightful, our previous work involved healthy, young participants. It is important to expand this research to populations that may benefit from a powerful, low-impact method of functional movement training.

PURPOSE: The purpose of this study was to evaluate the relative effect of the aquatic environment on jumping kinetics between older and younger adults. **METHODS:** Twelve college-aged males (YA; 23.8 ± 2.5 years) and twelve recreationally active older adults (OA; 57.3 ± 4.4 years) performed 3 countermovement jumps (CMJ) on land and immersed in water at the level of the xiphoid process. Force platform data was processed for the following variables: Peak propulsive power, take-off velocity, and peak take-off force. A 2 (environment) by 2 (age) repeated measures ANOVA was used to identify main effects and interactions. **RESULTS:** Peak propulsive power, take-off velocity, and peak take-off force were lower (p < 0.001) for older adults in both environments (OA: 5.7 kW, 2.8 m/s, 1584 N; YA: 8.9 kW, 4.0 m/s, 2109 N). Regardless of age, peak propulsive power (kW) and take-off velocity (m/s) were greater (p < 0.001) for jumps performed in the water (9.8 kW vs. 4.8 kW; 5.1 m/s vs. 2.3 m/s), while peak take-off force (N) was greater (p = 0.004) for jumps performed on land (1990 N vs. 1703 N). **CONCLUSION:** The absence of age and environment interactions on peak propulsive power and peak take-off force suggest that older and younger adults exhibit similar kinetic responses to jumping movements performed in the aquatic environment. Results of the present study suggest that the aquatic environment may be preferential for older adults performing explosive movements. Specifically, the aquatic environment may enhance training, with a focus on augmenting mechanical power production and take-off velocity. Further research may identify additional justification for prescribing jumping movements in the aquatic environment.

2940 Board #5 June 3, 2:00 PM - 3:30 PM

Jump Landings On Land And In Waist-Deep Water: Comparison Between Young And Middle-Age Adults

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Current research on aquatic jump training has focused on performance benefits in younger, not older, participants. Aquatic jump training may be particularly beneficial for middle-age and older adults given its low impact nature and focus on power and stability, which are often compromised with aging. It is unclear if the same aquatic jumping benefits (e., reduced impact forces) observed in younger adults applies to middle-age adults. **PURPOSE:** To compare landing kinetics and dynamic stability between young and middle-age adults performing jumping movements on land and in water. **METHODS:** Ten young (age = 24 ± 2.6 yrs) and ten middle-age (age = 47 ± 3.0 yrs) adults performed three jump variations (countermovement jump, squat jump, and drop landing) on land and in waist-deep water. Dynamic stability was assessed during

landing using a time to stabilization (TTS) paradigm. Kinetic measures included time to peak force, peak force, rate of force development (RFD), and impulse. Data were collected via a waterproof force platform positioned on an adjustable-depth pool. Data were analyzed using a 2 (environment) X 2 (age) X 3 (jump type) ANOVA. **RESULTS:** Regardless of age and jump type, TTS was greater ($p = 0.02$) on land ($1.42 \pm 0.12s$) than in water ($1.34 \pm 0.13s$). Peak force, RFD, and impulse followed this same trend and were greater on land than in water ($p < 0.01$). Time to peak force for the middle-age group (0.07 s) was lower ($p = 0.001$), while normalized peak force (4.4 BW) and RFD (74 BW/s) were greater ($p < 0.05$) than values for the young group (0.08 s, 3.8 BW, and 53 BW/s, respectively) regardless of environment or jump type. **CONCLUSION:** Regardless of age or jump type, TTS was lower in water suggesting greater dynamic stability in this environment. Additionally, participants displayed lower impact forces in water suggesting this environment might be safer than land when performing jump training. Across environments, middle-age participants landed with greater loading rates and peak forces when compared to the younger group.

2941 Board #6 June 3, 2:00 PM - 3:30 PM
Relationship Between Lower Body Strength Measures and Balance in the Young and Elderly
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(No relationships reported)

PURPOSE: Elderly people are at a greater risk for falls, which may be due to a decreased postural stability or balance with age. We tested the hypothesis that increased medial/lateral sway would be related to strength differences between legs (lateral deficit); and the anterior/posterior sway would be related to differences in strength between the quadriceps and hamstrings muscles (Q/H ratio). **METHODS:** Six elderly (E: avg 74.6±6.8 yrs) and six young (Y: avg 24.5±2.35 yrs) subjects were tested on the Biodex balance master for overall (OS), anterior/posterior (APS), and medial/lateral stability (MLS); and on the Biodex isokinetic dynamometer for maximal hamstring (H) and quadriceps (Q) torque (MVC) at 120 and 60°/sec. Lateral deficits between legs and Q/H ratios were calculated from peak torques. Statistical analyses looked at differences in strength and balance measures between Y and E, and for correlations between strength and balance measures from the pooled data. **RESULTS:** The OS ($E = 1.3 \pm 0.15$, $Y = 0.7 \pm 0.11$; $p = 0.005$) and MLS ($E = 0.867 \pm 0.163$, $Y = 0.40 \pm 0.063$; $p = 0.011$) index scores were significantly lower in Y vs E indicating better balance for the young. The Y group showed higher MVC than E for the Right and left H at 120°/sec (Rt: $E = 39.08 \pm 15.8$ N·m, $Y = 73.4 \pm 20.8$ N·m; $p = .048$, Lt: $E = 39.4 \pm 18.3$ N·m, $Y = 68.35 \pm 16.8$ N·m; $p = .047$), and right Q and H at 60°/sec (Q: $E = 95.2 \pm 27.2$ N·m, $Y = 166.93 \pm 41.4$ N·m; $p = .05$, H: $E = 49.1 \pm 21.2$ N·m, $Y = 86.1 \pm 22.2$ N·m; $p = .043$). There were no significant differences between Y and E for lateral deficits or Q/H ratios. There were moderate to strong statistically significant inverse correlations ($r = -.560$ to $-.758$; $p < 0.05$) between all MVC measures and OS, APS, and between MVC measures at 120°/sec and MLS, indicating that higher MVC was associated with better balance. There were no significant correlations for any balance measure and lateral deficits or Q/H ratios. **CONCLUSIONS:** Contrary to our hypothesis, this pilot study found no relationships between lateral deficits and Q/H ratios that would explain differences in balance between the Y and E. However, there is evidence that strength differences between Y and E may explain some of the differences in balance performance. This finding is in agreement with Catangi et al. (2014) who found relationships between balance and plantar flexor strength in the elderly.

2942 Board #7 June 3, 2:00 PM - 3:30 PM
Characteristics of Postural Sway in Healthy Older Adults in Challenging Stance and Sensory Conditions
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Postural sway in healthy older adults has typically been investigated with participants' feet apart under various sensory conditions. There is minimal research on postural sway in older adults with more challenging stance and sensory conditions. **PURPOSE:** To compare postural sway in healthy older adults with challenging stance and sensory conditions. **METHODS:** 10 healthy older adults (76.4±6.8 years) performed two 30s trials under 5 test conditions: feet together on firm surface eyes open (C1), eyes closed (C2); feet together on foam surface eyes open (C3), eyes closed (C4), and tandem stance on firm surface eyes open (C5). Participants stood on an AMTI force plate and the center of pressure (CoP) data was collected at 600Hz. CoP path length, mean velocity and 95% elliptical sway area were compared across conditions using a 1-way ANOVA. **RESULTS:** See Table 1. Since only 5 subjects could complete

C4 data was not included in statistical analysis. **CONCLUSION:** Feet together eyes open or closed on foam and tandem stance on firm surface may be appropriate tests to evaluate postural control in healthy older adults. Lack of differences between C2 and C3 suggests that even at narrow stance width, sensory contributions by vision and proprioceptive system seem to be equivalent.
 Table 1: Mean and SE of dependent variables and significance for conditions 1-3, 5.

Dependent variable	Condition	Mean	SE	Statistical test result synopsis P-value<0.05
Path length (cm)	1	225.08	8.69	C1 significantly different from C5 C3 significantly different from C5
	2	261.51	11.18	
	3	234.68	8.08	
	5	278.99	11.57	
Velocity (cm/s)	1	7.50	0.29	C1 significantly different from C5 C3 significantly different from C5
	2	8.72	0.37	
	3	7.82	0.27	
	5	9.30	0.39	
Sway area (sq.cm)	1	5.62	0.66	C1 significantly different from C2, C3 and C5 C2 significantly different from C5 C3 significantly different from C5
	2	14.06	2.10	
	3	13.78	1.30	
	5	9.663	1.461	

2943 Board #8 June 3, 2:00 PM - 3:30 PM
Immediate Effects of Vibrotactile Feedback on Postural Sway in Healthy Older Adults
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Previous research has shown the utility of vibrotactile feedback to improve postural sway characteristics in persons with vestibular deficits. Tactile feedback given through vibration has been used more as a modality of training but immediate effects on postural control among older adults have not been investigated. **PURPOSE:** To compare the immediate effects of tactile vibration on postural sway in healthy older adults in challenging stance and sensory conditions. **METHODS:** 10 healthy older adults (76.4 ± 6.8 years), performed five standing balance conditions on an AMTI forceplate for 30s each: feet together on firm surface eyes open (C1), eyes closed (C2); feet together on foam surface eyes open (C3), eyes closed (C4), and tandem stance on firm surface eyes open (C5). Participants did 2 trials of each condition both with and without vibrotactile feedback. The feedback was given using a waist belt with sensors that were activated when participants swayed in a particular direction as detected by an Xbox Kinect camera (Sensory Kinetics system; Engineering Acoustics, Casselberry, FL). Center of pressure sway area was compared within each condition using a paired samples t-test to estimate the effect of vibration. **RESULTS:** See Table 1. Since only 5 subjects could complete C4 data was not included in statistical analysis. **CONCLUSION:** Tactile vibration did not acutely effect postural sway in challenging stance conditions in healthy older adults. Long term effects of tactile vibration on postural sway in challenging stance conditions need to be investigated.

Table 1: Mean & SE of sway area (sq. cm) under different conditions

Condition	Vibrotactile Feedback	Mean	Std. Error Mean	P-value
C1	No	5.62	0.66	0.779
	Yes	5.84	0.84	
C2	No	14.06	2.10	0.332
	Yes	16.62	3.53	
C3	No	13.78	1.30	0.577
	Yes	13.13	1.02	
C5	No	9.66	1.46	0.328
	Yes	10.50	1.25	

2944 Board #9 June 3, 2:00 PM - 3:30 PM
Higher Variability in Power Seen in Older Adults with Increased Fall Risk During Functional Tasks
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Overall reduced power and strength has been associated with increased fall risk in older adults. Often these measurements reflect the maximum capacity available during isometric and isokinetic tests but seldom reflect the capacity to perform functional tasks like standing up and sitting down. **PURPOSE:** To determine the differences in functional lower extremity power between healthy older adults (OA) and those at high fall risk (FA). **METHODS:** 15 participants in each group with mean age of 72.1 (OA) and 77.6 (FA) years completed 5 times sit to stand as a part of the Short Physical Performance Battery (SPPB). Concentric, eccentric and total power were calculated using data collected from the feet positioned on the force plates. An independent t-test and Mann-Whitney U test were run to compare the groups. **RESULTS:** See table 1. **CONCLUSIONS:** A higher variability in power seen in older adults with increased fall risk suggests that the ability to consistently produce the required power may be related to increased fall risk. This could particularly be important when older adults perform functional activities in fatigued state. Though not significantly different, lesser peak force but greater power produced by FA group suggests that they took longer time to complete the task. Further research needs to be done to validate this information.

Table 1: Mean (SE) of Dependent Variables

Dependent variable	OA	FA	P
Concentric Power (W)	480.0 (1.1)	592.8 (1.1)	0.201
Eccentric Power (W)	461.6 (1.1)	565.3 (1.2)	0.288
Total Power (W)	936.7 (1.1)	1168.2 (1.2)	0.209
Concentric Power SD (W)	43.0 (16.2)	70.9 (23.3)	0.025
Eccentric Power SD (W)	49.6 (4.9)	89.4 (13.4)	0.014
Total Power SD (W)	59.6 (6.3)	131.6 (21.7)	0.007
Concentric Power CV %	8.7 (2.8)	10.7 (2.0)	0.155
Eccentric Power CV %	10.0 (1.2)	13.9 (1.2)	0.156
Total Power CV %	5.8 (1.2)	9.6 (1.2)	0.030

SD - Standard Deviation; CV - Coefficient of Variation; $p < 0.05$ – statistically significant

2945 Board #10 June 3, 2:00 PM - 3:30 PM
Sensitivity of Fall Risk Outcome Measures by Age
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 (No relationships reported)

Many balance assessments have been created to identify causes and outcomes of older adult falls, and in turn, help health care providers better assess fall risk. The Activities-Specific Balance Confidence Scale (ABC), Timed Up-and-Go (TUG), Berg Balance Scale (BBS), and Fullerton Advanced Balance Scale (FAB) have been developed to assess physical function and fear of falling. Few studies have considered age as a moderator of the sensitivity of these four tests.

Purpose: The aim was to identify if the sensitivity of the BBS, FAB, TUG, and ABC, changed as a function of age group (60-79 vs. 80-100) for retrospective falls.

Methods: Forty-six community-dwelling older adults (mean age 79.1±10.2 years) were recruited from multiple facilities and asked how many times they had fallen in the past six months. Next, the ABC, TUG, BBS, and FAB were administered in random order to assess the participants' fear of falling, mobility, and balance. Logistic regression was used to determine the discriminative power of these tests related to falls. Logistic regression models had a binary outcome of self-reported history of at least one fall versus no falls. Receiver operating characteristics (ROC) curves were calculated, as well as the corresponding area under the curve (AUC). Specificity and sensitivity were calculated by age group (60-79 and 80-100).

Results: While the ABC, TUG, BBS, and FAB were significantly correlated with each other, their ability to discriminate fallers from non-fallers was poor (AUC = 0.366, 0.554, 0.426, and 0.437, respectively). Most models were better suited to determine non-fallers as opposed to fallers, indicated by a larger specificity than sensitivity. For all outcome measures, the sensitivity was 25.0% for 60-79 years and 37.7% for 80-100 years. The specificity was 100.0% for all outcome measures for 60-79 years, and was ≤68.8% for 80-100 years.

Conclusions: Sensitivity, while poor in both age groups, was greater in the older group. Based on the present data we suggest pairing these tools with other measures to reliably assess and provide a total fall risk prediction.

2946 Board #11 June 3, 2:00 PM - 3:30 PM
Supervised Exercise Leads to Improved Reactions, Balance and Reduced Falls Risk in Older Adults with Type 2 Diabetes
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Older persons with type 2 diabetes (T2DM) often exhibit declines in muscle strength, balance and gait control which can lead to increased likelihood of suffering a fall. Supervised exercise incorporating aspects of balance control is one obvious intervention that can be employed to improve posture and strength and, ideally, reduce the risk of falling in these individuals.

PURPOSE: To assess the impact of 12 weeks of supervised balance and exercise on falls risk, lower limb strength, reaction time and balance in a group of older adults with T2DM.

METHODS: Thirty older individuals with T2DM (mean age 68.0±4.9 yrs, 10 males, 20 females) participated. Balance was assessed using a force platform with subjects standing on a foam surface with eyes open (3 trials). Reaction time (RT) was assessed for the hand (10 trials). Falls risk was measured using the Physiological Profile Assessment, a validated tool including tests of vision, sensation, posture, and leg strength. Values from each test were combined to provide an overall risk score (range -2 to +4) with higher scores denoting greater falls risk. After initial assessment, all subjects participated in a 12-week thrice-weekly supervised exercise training program before being reassessed on the same tests post-training. Training sessions (40 min each) consisted of lower limb stretches followed by a lower limb, abdominal, and lower back exercises.

RESULTS: Following 12 weeks of training, T2DM adults showed significant increases in knee extension strength (pre: 33.7 kg; post: 38.2 kg, $p < 0.05$), faster hand RT (pre: 275.6±8.9 ms; post: 258.2±10.7 ms, $p < 0.05$), and decreased postural motion (pre: 32.5±4.5 cm; post: 24.1±6.2 cm, $p < 0.05$). These changes resulted in an overall significant decline in falls risk score (pre: 0.59±0.12; post: 0.33±0.14, $p < 0.05$). A nonsignificant trend towards reduced average number of falls was also found (pre: 0.33; post: 0.16, $p = 0.12$).

CONCLUSION: Overall, 12 weeks of supervised exercise training led to a reduction in falls risk for older adults with T2DM, based on improvements in a wide range of physiological measures, including increased lower limb strength, improved balance control and faster reaction times. Supervised balance training can safely be used as an intervention to lower falls risk in older adults with T2DM.

2947 Board #12 June 3, 2:00 PM - 3:30 PM
A Validation of the Fullerton Advanced Balance Scale in High Functioning Older Adults
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 (No relationships reported)

The Fullerton Advanced Balance Scale (FAB) is a commonly used assessment for predicting fall risk in high functioning older adults. While it has been shown to be a reliable and valid tool in clinical and therapy settings, a comparison with laboratory measures of balance capable of detecting subtle differences in balance ability has not been conducted. This shortcoming with the current FAB scale allows the possibility of a ceiling effect in the capability to identify balance deficits in high functioning older adults.

PURPOSE: This study investigates whether a ceiling effect exists within the FAB, and specifically investigates the validity of the FAB assessment as a method for detecting subtle balance deficits in highly functioning older adults.

METHODS: 33 community living older adults (age: 62.97 ± 7.14 years) were assessed using the short form of the FAB. While performing the single leg balance test participants were scored 1 through 4 based on observed errors. Simultaneously, center of pressure (COP) movement was recorded using a plantar pressure pad. COP sway, velocity, and variability were quantified using the pressure data. A one way ANOVA was used to examine differences in COP metrics between FAB groups. A k-means cluster analysis was used to separate participants into 4 groups based on COP sway. Ability of the FAB to detect subtle differences in balance was quantified by examining the percent agreement between grouping based on COP sway and grouping based on FAB scores.

RESULTS: Average COP sway was significantly different between FAB groups, with participants who score a 4 demonstrating less sway (6.21 ± 3.08 cm) than those who scored a 1 (13.30 ± 4.56 cm, $p = 0.001$) or a 2 (13.19 ± 2.95 cm, $p = 0.001$). However, there were no differences between FAB groups 1 and 2. The kappa statistic indicated poor agreement between the groups based on COP sway and groups based on FAB scores (Kappa = .210).

CONCLUSIONS: Results suggest that the FAB scale lacks the sensitivity to detect subtle balance changes in high functioning older adults. Further investigations are

necessary to construct a sensitive balance scale which is both clinically useful but does not produce a ceiling effect when assessing high functioning older adults.

2948 Board #13 June 3, 2:00 PM - 3:30 PM
Differences in Trailing Limb Response Between Falls and Recoveries Following a Laboratory-Induced Slip
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Walking is commonly promoted as a way to increase physical activity among older adults. However, walking includes an inherent risk of slips and falls. When a slip occurs upon heel strike, a trailing (non-slipping) limb response is often required to recover balance. A better understanding of the trailing limb response characteristics that are associated with falls and recoveries could lead to training interventions to improve these responses, and reduce the risk of falls from a slip. **PURPOSE:** To identify differences in trailing limb responses between falls and recoveries following laboratory-induced slips. **METHODS:** Seventy-two adults were exposed to an unexpected slip by walking over a slippery surface. Each slip outcome was characterized as a fall or recovery based upon the force applied to a safety harness. Thirty-two slips were excluded from analysis because the slip distance was <20 cm (eliciting minimal trailing limb response), or because the outcome could not be unambiguously characterized as a fall or recovery. **RESULTS:** Of the 40 slips investigated, subjects used one of two trailing limb responses: a forefoot/toe-down (FT) response, where the forefoot or toe of the trailing foot contacted the floor posterior to the slipping foot; or a flat-foot (FF) response, where the entire sole of the trailing foot contacted the floor closer to the slipping foot than during the FT response. The trailing limb response influenced the type of fall experienced. Of 21 subjects who attempted FT responses, 7 fell straight down, 2 fell laterally, and 12 recovered. These falls exhibited 48% longer anteroposterior (AP) flight distance of the trailing foot ($p=0.018$), and 15% longer AP distance between heels at touch down of the trailing foot compared to recoveries ($p=0.037$). Lateral falls did not appear to result from a deficient trailing limb response. Of 19 subjects who attempted FF responses, 4 fell backwards and 15 recovered. These falls did not differ from recoveries in any response parameters ($p>0.05$). **CONCLUSIONS:** The FT response resulted in no backward falls, and exhibited differences in potentially modifiable response parameters between falls and recoveries. As such, training a FT response among older adults may help reduce risk of hip fracture associated with backward falls.

2949 Board #14 June 3, 2:00 PM - 3:30 PM
Comparison of Mayo Clinic and ActiGraph GT3X+ Step Detection Algorithms in Older Adults
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ActiGraph GT3X+ (AG) activity monitors (AMs) are the most widely used research AMs. However, large discrepancies between them and with other research-grade pedometers are reported. We developed and validated an algorithm which accurately detects posture, transitions, and steps. Comparisons between our algorithm and AG could provide new insights on inaccuracy causes.

PURPOSE: To compare the performances of the AG normal (NR), low frequency extension (LFE), and our Mayo Clinic (MC) algorithms.
METHODS: 16 older adults (31% male, 78±8 yrs) wore 3 AG AMs on the waist and ankles to record acceleration data at 100 Hz for slow, normal and fast-paced walking lab trials and for 4 days in free-living. IRB approved the protocol and informed consent was obtained. Steps were detected from acceleration data using MC, NR, and LFE algorithms with 15 s epochs. Lab-based validities were evaluated by comparison to video.
RESULTS: Lab data showed >90% median agreement with video using LFE and MC algorithms with <1% difference between them (Fig 1). Larger differences between LFE and MC step counts were observed in free-living (Fig 1). 96 and 99% of MC steps, and 74 and 85% of LFE steps with waist and ankle AMs were accounted for when comparing 15 s epochs with both MC and LFE detected steps. 67 and 92% of MC steps, and 85 and 97% of NR steps with waist and ankle AMs were accounted for when comparing epochs with both MC and NR detected steps. Remaining LFE and NR steps occurred when the MC algorithm detected transitions, and no activity (Fig 1).
CONCLUSIONS: The data suggest that many inaccuracies using NR and LFE algorithms are due to the absence of postural detection and oversensitivity of the LFE algorithm, and support the ankle as the most accurate AM location.
 Funded by DOD DM090896.

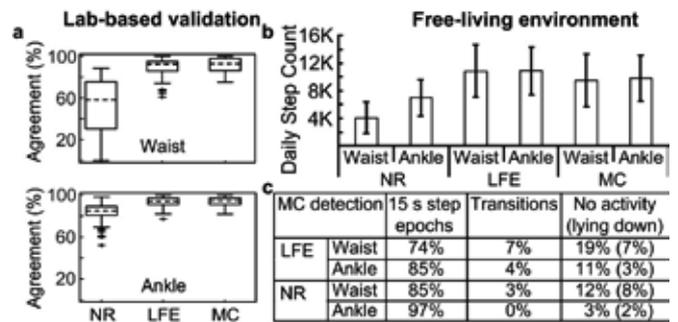


Figure 1. (a) Box plots representing step count agreement using the ActiGraph NR and LFE, and Mayo Clinic (MC) algorithms with video data during lab validation. The central line (dashed) represents the median, the box edges are the 25th and 75th percentiles, and the whiskers extend to ±1.5 of the interquartile range. Outliers are labeled as +. (b) Mean (SD) daily step counts across subjects estimated with the NR, LFE, and MC algorithms from 4 days in free-living. (c) % of detected LFE and NR steps which occurred in the same 15 s epochs that the MC algorithm detected steps, and when the MC algorithm detected transitions, and no activity (including lying down).

2950 Board #15 June 3, 2:00 PM - 3:30 PM
Concurrent Validity of GAITRite and Zeno Walkway Systems
 Sarah Humphrey, Matt McDougal, Alys Cook, Srikant Vallabhajosula, Jane Freund. *Elon University, Elon, NC.*
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 (No relationships reported)

Concurrent Validity of Zeno Walkway versus GAITRite walkway systems
 Sarah Humphrey, Matt McDougal, Alys Cook, Srikant Vallabhajosula, Jane Freund
 The GAITRite (CIR Systems Inc. Sparta, NJ) and Zeno Walkway (ProtoKinetics LLC. Havertown, PA) are electronic, pressure sensitive walkways used to measure spatiotemporal parameters of gait. GAITRite has been used extensively to measure gait characteristics of several populations including older adults. Recently developed, the Zeno Walkway has a non-carpeted and wider surface area than GAITRite and allows for uninterrupted, multiple walks across the mat. However, little information exists on the validity of Zeno Walkway to measure gait among older adults. **Purpose** To determine concurrent validity of the Zeno and GAITRite walkways in healthy older adults. **Methods** Thirty healthy adults (mean age 74.7, SDV 6.44; 11 males) completed 5 walks each at normal and fast walking speeds across both walkways. The intraclass coefficient ICC (2,5) was determined for spatiotemporal gait parameters (listed in Table 1) to determine concurrent validity. **Results** See Table 1. **Conclusion** The concurrent validity of Zeno and the GAITRite systems was generally moderate to strong, and greater for the fast condition. Lower correlations may be related to differences in the walkways (dimensions and surface), methods of collection or analysis.

Table 1. ICC (2,5) values for spatiotemporal gait parameters at each speed.

Dependent Variable	Normal Speed Condition	Fast Speed Condition
Step Length (cm.)	0.892	0.921
Stride Length (cm.)	0.899	0.919
Gait Speed (cm./sec.)	0.721	0.960
Stance Time (sec.)	0.636	0.752
Cadence (steps/min.)	0.495	0.827
Single Support (%)	0.868	0.909

2951 Board #16 June 3, 2:00 PM - 3:30 PM
Posterior Center of Pressure Displacement Is Predictive of Gait Speed
 Amanda E. Stone, Jaimie A. Roper, Madison L. Pello, Logan M. Garfield, Alfred M. Barrozo, Chris J. Hass, FACSM. *University of Florida, Gainesville, FL.* (Sponsor: Chris Hass, FACSM)
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Gait initiation (GI) is a destabilizing activity requiring complex interactions between neural and biomechanical factors to move the body from a static position to a dynamic state. GI begins by generating a posterior shift of the center of pressure (COP), which creates momentum in the forward direction. As posterior shifting of the COP is important for forward progression of the body, investigating the impact of initial

posterior COP displacement and velocities would be important for predicting gait speed in older adults.

Purpose: To investigate the relationship between posterior COP displacement and velocity, and the velocity of the first and second step after GI.

Methods: Three dimensional kinematics and ground reaction forces were collected while 38 healthy older adults completed GI tasks. Pearson's correlation coefficients were used to assess the relationship between posterior COP displacement ($d_{COP,post}$), mean posterior COP velocity ($v_{COP,post}$), first step gait velocity (v_1) and second step gait velocity (v_2). Multiple linear regression was conducted to determine which independent variables were significant predictors of v_1 and v_2 ($p \leq 0.05$).

Results: $d_{COP,post}$ (3.0 ± 1.5 cm) was strongly correlated with $v_{COP,post}$ (9.6 ± 6.2 cm/s) ($r=0.86, p<0.01$). v_1 (101.6 ± 22.8 cm/s) was moderately correlated with $d_{COP,post}$ ($r=0.53, p<0.01$) and weakly correlated with $v_{COP,post}$ ($r=0.36, p<0.05$). v_2 (151.5 ± 26.9 cm/s) was moderately correlated with $d_{COP,post}$ ($r=0.51, p<0.01$), weakly correlated with $v_{COP,post}$ ($r=0.40, p<0.05$). $d_{COP,post}$ was a significant predictor of both v_1 (adjusted $R^2=0.28, p=0.003$) and v_2 (adjusted $R^2=0.22, p=0.033$). Regression equations for v_1 and v_2 are shown below (displacements in centimeters, velocities in cm/s).

$$v_1 = 76.309 + 12.668 * d_{COP,post} - 1.371 * v_{COP,post} \quad (1)$$

$$v_2 = 124.051 + 10.951 * d_{COP,post} - 0.597 * v_{COP,post} \quad (2)$$

Conclusion: This study is one of few to determine the impact of the magnitude of COP adjustments on initial gait velocity. Posterior COP displacement is a strong predictor of first and second step gait velocities, whereas posterior COP velocity may not be as critical. For every centimeter increase in $d_{COP,post}$, increases by 7.9 cm/s and increases by 8.9 cm/s.

2952 Board #17 June 3, 2:00 PM - 3:30 PM

Effect Of Age On Intra-trunk Kinematics Exhibited During Treadmill Running

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Changes in certain gait parameters in walking and running have been reported with advancing age but we have very little understanding of how age affects intra-trunk motions during running, a popular activity among middle-age adults. Studies have also shown a relation between low-back pain and running speeds but its relation to intra-trunk movement patterns is not clear. **PURPOSE:** To determine if middle-age compared to younger adults display lower intra-trunk displacements
METHODS: Two adult groups (n = 30; 15/ group), younger (YA: 18-24 yr; 20.8±1.5 yr) and middle-age (MA: 30-50 yr; 36.1±6.2 yr), participated (respectively): mass = 76.2±3.8 kg, 76.6±4.0 kg; height = 1.7±0.3 m, 1.9±0.4 m; moderate to vigorous physical activity = 5.4±2.9 hr/wk, 5.9±.6 hr/wk). Locations of 24 reflective markers on the trunk and pelvis were captured (7-camera Vicon system, 120 Hz) when participants ran at their self-selected maximal treadmill running speed. Relative angles between adjacent trunk segments (upper [UP]: C7 to T8; middle [MID]: T9 to T12; lower [LOW]: L1 to L5) and pelvis (PEL) were calculated; maximum angular displacements were averaged across 10 strides. For each of the motion planes, angular displacements were compared between groups using MANCOVA ($p<0.05$; running speed = covariate), followed by Tukey's HSD posthoc test ($p<0.05$) and 95% confidence interval for difference (95%CI). Running speed was compared between groups using one-way ANOVA ($p<0.05$).

RESULTS: YA ran faster than MA (4.4 ± 0.6 m/s, 3.9 ± 0.6 m/s, respectively, $p = 0.019$). Groups differences were observed in transverse plane ($F(3,25) = 3.407, p = 0.033$, $Power = 0.697$) but no other differences in the trunk displacements were reported ($p = 0.370-0.533$). Posthoc comparisons for transverse plane showed significantly less Up-Mid trunk displacement for MA group compared to YA ($p = 0.049$; mean difference: 6.5° ; 95%CI = $0.0^\circ-13.1^\circ$).

CONCLUSIONS: Results depict minimal trunk motion differences between the age groups. One explanation could be the fact that normal ranges of the trunk segments are considerably greater than that required to achieve this performance objective. Modest decrease in one segment could be influenced by inter-participant variability in running technique or skills and not so much by age-related factors.

2953 Board #18 June 3, 2:00 PM - 3:30 PM

Relationships between Maximal and Rapid Torque Characteristics and Chair Rise Power in Very Old Adults

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(No relationships reported)

Isometric assessments of leg extensor and flexor strength are commonly used to evaluate muscle function in very old adults. It has been hypothesized that maximal and rapid torque characteristics of the leg extensors and flexors may be important predictors of functional performances for movement activities such as walking and stair climbing. However, limited data exist regarding how these parameters associate with muscle power during a chair-rise task. **PURPOSE:** To examine the relationships between chair-rise power and maximal and rapid isometric torque characteristics of the leg extensors and flexors in very old adults. **METHODS:** Ten very old adults (mean±SD: age=88±6 years) performed 2 chair rises followed by 2 randomly-ordered isometric maximal voluntary contractions (MVCs) of the leg extensors and flexors. Estimated peak power output (Pmax) was measured during the chair rises using a linear velocity transducer. For each MVC, participants sat in an upright position with the ankle-joint immobilized using a custom-built stabilizing apparatus. All MVCs were performed on the right leg at a knee joint of 90° below the horizontal plane, while restraining straps were placed over the trunk, waist, and thigh. Participants were instructed during each MVC to push or pull "as hard and fast as possible" against a load cell for 3-4 seconds. Isometric peak torque (PT; Nm) was determined as the highest mean 500 ms epoch during the entire 3-4 second MVC plateau. Peak rate of torque development (RTD; Nm·s⁻¹) was quantified from the first derivative of the absolute torque-time curve during its initial ascent. **RESULTS:** Significant positive relationships were observed between Pmax and RTD for the leg extensors ($r=0.681, P=0.030$) and flexors ($r=0.634, P=0.049$); however, no relationships were observed for either muscle group between Pmax and PT ($r=0.033-0.262, P=0.465-0.927$). **CONCLUSION:** The present findings of significant relationships between Pmax and RTD of the leg extensors and flexors suggest that explosive strength capacities of the lower extremity musculature may play an important role in chair-rise performances in very old adults. These findings highlight the need for training programs aimed to increase leg extensor and flexor explosive strength for the maintenance and/or improvement of locomotor function in the elderly.

2954 Board #19 June 3, 2:00 PM - 3:30 PM

Age-related Changes In Passive Musculotendinous Stiffness And Muscle Quality Of The Hamstrings

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With a rapidly growing elderly population, it is essential to expand our understanding of the age-related changes in musculotendinous stiffness (MTS) characteristics and their underlying mechanisms. Previous studies have reported that decreases in muscle quality [echo intensity (EI)], which are indicative of greater intramuscular fat and fibrous tissue content, may contribute to the lower muscle strength values typically observed in old compared to young adults. However, we are aware of no previous studies that have examined the contribution of muscle quality to age-related changes in MTS. **PURPOSE:** To determine the effects of aging on MTS and EI of the hamstrings in young and old men. **METHODS:** Fifteen young (age = 25 ± 3 yr) and 15 old (72 ± 5 yr) men underwent two diagnostic ultrasound assessments followed by two passive straight-leg raises (SLR) using an isokinetic dynamometer programmed in passive mode to move the foot toward the head at 5°·s⁻¹. EI of the semitendinosus was measured on the right leg using a portable B-mode ultrasound imaging device and linear-array probe. For each SLR, participants lied in a supine position with the knee- and ankle-joints immobilized with custom-built stabilizing apparatuses. All assessments were performed on the right leg, while the left thigh and ankle were secured with restraining straps. MTS was calculated during each SLR as the slope of the final 10% of the angle-torque curve. **RESULTS:** The old men exhibited greater MTS (old = 2.08 ± 0.99 Nm·deg⁻¹; young = 1.46 ± 0.62 Nm·deg⁻¹; $P = 0.048$) and EI (old = 95.90 ± 10.12 AU; young = 77.60 ± 10.96 AU; $P < 0.001$) values than the young men. There was a significant relationship between MTS and EI in the old men ($r = 0.666; P = 0.007$) but not in the young men ($r = -0.211; P = 0.451$). **CONCLUSION:** These findings demonstrated that hamstrings passive stiffness increases and muscle quality decreases at old age. The significant relationship observed between MTS and EI in the old men perhaps suggests that these age-related declines in muscle quality may play a significant role in the greater passive stiffness values observed in older adults. As a result, practitioners may consider implementing training programs aimed at decreasing EI of the hamstrings in the elderly which may be beneficial for both improving muscle quality and simultaneously reducing passive stiffness.

F-20 Free Communication/Poster - Cancer-Exercise

Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

**2955 Board #20 June 3, 2:00 PM - 3:30 PM
 Baseline Physical Activity Moderates the Effect of Yoga on Pain in Cancer Survivors**

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PURPOSE: Greater than 50% of cancer patients experience pain, including neuropathic pain, arthralgia, and generalized pain, from cancer and its treatments. Pain often persists for years after treatment, significantly impairing recovery, physical function, and quality of life. We previously conducted a phase III randomized controlled trial (RCT) in cancer survivors showing that yoga ameliorates insomnia, fatigue, and impaired quality of life. To date, no phase III RCTs have examined both the influence of yoga on generalized pain and moderators to help understand for whom and when yoga works best. Here, we assessed 1) the effectiveness of yoga for treating pain and 2) factors that may moderate the influence of yoga on pain.
METHODS: Cancer survivors (2-24 months post treatment, 96% female, 77% breast cancer) were randomized to either usual care (N=157) or Yoga for Cancer Survivors (YOCAS[®]; N=167). YOCAS consists of breathing exercises, postures, and meditation in two 75-min sessions/wk for four wks. We assessed pain (0-10) using a Symptom Inventory both pre- and post-intervention. Potential moderators included: 1) Exercise Stage of Change (ESC; ESC question), 2) frequency of vigorous physical activity (Aerobics Center Longitudinal Study sweat question), 3) cancer stage (I-IV), 4) cancer treatment (surgery, chemotherapy, radiation, hormone therapy), and 5) age.
RESULTS: Yoga reduced pain (change score; CS=-0.40, SE=0.18, p<0.01) whereas usual care did not (CS=-0.06, SE=0.18, p=0.38). Moderation analyses (p<0.01) demonstrated that 1) for survivors with frequent vigorous physical activity (>9/wk), pain decreased in yoga but increased in usual care; 2) for survivors with infrequent vigorous physical activity (<3/wk), pain did not change in either group. There was no evidence of moderation via ESC, age, cancer stage or treatment (ps > 0.11).
CONCLUSION: Results suggest that yoga reduces pain in cancer survivors. Survivors with frequent vigorous physical activity (>9/wk) experiencing pain showed reduced pain by changing activity mode to yoga. In contrast, usual care survivors showed increased pain, and survivors with infrequent vigorous physical activity (<3/wk) showed no change in pain. Clinicians should consider yoga for survivors reporting pain. Funded by NCI via NCORP, R25, and K grants.

**2956 Board #21 June 3, 2:00 PM - 3:30 PM
 The Effect Of Exercise 24-hours Before Chemotherapy On Cardiac Function And Symptoms In Breast Cancer**

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Rodent studies have demonstrated that a single submaximal exercise bout can attenuate markers of cardiac damage caused by adriamycin chemotherapy injection 24 hr later. However, it is unclear whether this finding extends to humans. **PURPOSE:** To determine the effects of exercise 24 hr prior to the first chemotherapy treatment on cardiac function in breast cancer patients (BCP).
METHODS: Patients were randomized to either: 1) no vigorous exercise for 72 hr prior to first treatment (n = 8), or 2) no vigorous exercise for 48 hrs, then 30 min of vigorous exercise (70% age-predicted heart rate reserve) 24 hr prior to first treatment (n = 9). Chemotherapy treatment included 60 mg/m² adriamycin and 600 mg/m² cyclophosphamide. Two-dimensional echocardiography and blood pressure were assessed pre- and 24-48 hr post-treatment. Key cardiac measures included speckle

tracking-derived global longitudinal strain (GLS) and standard volumetric measures (e.g., end-diastolic volume (EDV)). Rotterdam Symptom Checklists were administered prior to the first and second treatments. Standardized physical and psychological distress scores were tabulated. Analysis included mixed methods ANOVA with p≤0.05. **RESULTS:** There were no significant interactions or group differences for GLS, EDV, systolic blood pressure, or resting heart rate. There were significant (p≤0.05) main effects for time (pre vs. post treatment) for GLS (-19.3 ± 1.5 to -21.2 ± 1.8 %), systolic blood pressure (107 ± 14 to 102 ± 14 mmHg) and a trend for EDV (80 ± 13 to 88 ± 16 mL, p=0.06). There was no significant change in heart rate (70 ± 10 to 68 ± 11 bpm). Physical distress increased post-treatment (14 ± 8 to 26 ± 11, p<0.01), while there was a trend toward a decrease in psychological distress (26 ± 13 to 18 ± 17, p=0.07). **CONCLUSIONS:** Within this initial small sample of BCP, there does not seem to be an effect of aerobic exercise 24 hr prior to receipt of the first adriamycin chemotherapy treatment on the cardiac function parameters or symptoms measured. The acute effect of chemotherapy is an increase in GLS; and the trend in EDV may be suggestive of an increase in blood volume, but this requires further investigation. Receipt of the first treatment significantly increases physical symptoms, but may decrease the psychological distress associated with anticipation of the first treatment.

**2957 Board #22 June 3, 2:00 PM - 3:30 PM
 The Relationship Between Psychological Distress, Fatigue, and Body Composition in Hodgkin's Lymphoma Survivors**

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BACKGROUND: Cancer treatments are often associated with unfavorable changes in physical activity and diet, altering body composition (increase in % body fat with loss of lean body mass), which have shown to be associated with cancer clinical outcomes, including cancer recurrence. Beyond the physiological aspects, the subjective ones, such as psychological distress and fatigue impact significantly the survivor's quality of life (QoL). However, the relationship between body composition and distress are not well established in Hodgkin Lymphoma Survivors (HLS).
PURPOSE: To explore the relationship between body composition, psychological distress, and fatigue in HLS.
METHODS: This initial exploratory study evaluated 11 HLS (7 females and 4 males) who had completed treatment for at least 6 months. The Distress Thermometer was used to assess psychological distress and the Multidimensional Fatigue Inventory-20 assessed fatigue. Anthropometric measurements were collected and body composition was assessed using dual-energy x-ray absorptiometry (DXA). Descriptive statistics, using mean and standard deviation (SD), were used to describe the sample characteristics. Spearman's correlation coefficient was used to examine the relationship between body composition, distress, and fatigue. The level of significance was set a priori at p<0.05.
RESULTS: 11 survivors, age 32.6 ± 10.8 years, weight 66.4 ± 14 kg, Body Fat Index 23±3.5 kg/m², fat % 35.1±10.6, and lean body mass (LBM) de 41.5 ± 11.7 kg were included in the analyses. Significant correlations were observed between distress and % body fat (r = 0.68; p = 0.032) and BFI (r = 0.69; p = 0, 049), there were no significant correlations between distress and variables LBM and fatigue.
CONCLUSIONS: The results of this exploratory study suggest that, in HLS, distress is associated with % body fat and BFI. Considering the long survival of HLS, this preliminary study suggest that not only % body fat and BFI impact the levels of distress in HLS, the elevated % body fat is concerning due to its association with poor long term prognosis for the development of other cancers and other co-morbidities. Therefore, this results warrants further research so strategies aimed to improve body composition can assist HLS to improve QoL while preventing against development of other co-morbidities.

**2958 Board #23 June 3, 2:00 PM - 3:30 PM
 Naturopathic Cancer Treatment: Associated with Increased Quality of Life**

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PURPOSE: The purpose of this investigation was to assess the effects of an individualized naturopathic treatment plan on the overall quality of life (QOL) of cancer patients as pertaining to fatigue, pain and overall mood. **METHODS:** Twenty-two male and female cancer patients (n = 11 each respectively) ranging in age from 32 to 82 years-of-age volunteered from a cancer rehabilitation center in Kalispell, MT. Subjects were given the option to utilize a naturopathic treatment option via their

physician. Each subject completed a FACT-G questionnaire at the beginning and the end of the study. This short survey asked the subjects a range of questions pertaining to subscales including personal well-being (PWB), social well-being (SWB), emotional well-being (EWB), functional well-being (FWB) and total score. A Dependent t-test was used to examine whether difference (s) existed within the cancer patients from pre to post survey scores ($P < 0.05$). RESULTS: Significant differences were found in PWB, SWB, EWB and total score ($P < 0.05$). In all categories, the QOL subscales favorably increased from the pre to post values.

CONCLUSIONS: These findings demonstrate that naturopathic rehabilitation can be a positive alternative treatment for cancer patients undergoing therapy.

2959 Board #24 June 3, 2:00 PM - 3:30 PM
Anthropometric Measurements and Cardiorespiratory Fitness in Breast Cancer Survivors
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PURPOSE: The purpose of this study was to investigate whether anthropometric measurements were associated with cardiorespiratory fitness (CRF) in breast cancer survivors. CRF refers to the ability of the circulatory, respiratory, and muscular systems to supply oxygen throughout the body during sustained exercise. Low CRF is a strong predictor of incident metabolic syndrome and is associated with an increased risk of cardiovascular disease (CVD) mortality in adults free of metabolic syndrome. Therefore, the measurement of CRF is clinically relevant in cancer survivors who may be at risk for developing metabolic-related diseases. Increased body weight has a negative effect on CRF, with weight gain following breast cancer treatments often experienced, exacerbating one's risk of CVD.

METHODS: Sixty-two sedentary women diagnosed with stage I-III breast cancer, who completed cancer-related treatments within the past 6 months were included in this study. CRF was derived from the Single Stage Submaximal Treadmill Test to estimate maximal oxygen consumption (VO₂max). Body mass index (BMI), body fat (BF), percentage, fat-free mass (FFM) and lean mass (LM) were all obtained from a whole body dual-energy X-ray absorptiometry scan. Waist girth (WG) was measured as the distance around the waist using the navel as the reference point. Hip girth (HG) was measured as the distance around the middle of the buttocks, centered at the greater trochanter. Pearson's correlations were used to determine the associations between anthropometrics and CRF.

RESULTS: Mean values for the outcome measures are as follows: estimated VO₂max 28.5 ± 6.4 mL/kg/min, BMI 30.0 ± 5.3 kg/m², BF percentage 45.1 ± 5.9, LM 4.0 ± 5.4 kg, FFM 6.7 ± 6.4 kg, WG 40.0 ± 4.9 cm, HG 44.0 ± 4.6 cm. BMI was significantly associated to CRF ($p < 0.01$, $R = -.376$) WG ($p < 0.05$, $R = -.301$) and BF percentage ($p < 0.05$, $R = -.064$) and HG ($p > 0.05$, $R = -.158$) were not associated with CRF.

CONCLUSIONS: BMI, WG, and BF percentage are anthropometric measurements significantly associated with CRF in BCS. The significant negative association between BMI, WG, and BF % indicates that as body weight increases, one's level of fitness declines. These results indicate the importance of targeting body fat in effort to improve CRF in BCS.

2960 Board #25 June 3, 2:00 PM - 3:30 PM
Sarah Sayyari, Bkin
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 (No relationships reported)

BACKGROUND: The American College of Sports Medicine recommends that cancer patients participate in a minimum of 150 minutes of aerobic exercise per week. However, others have suggested that for patients who are sedentary, this prescription is not an advisable starting point; recommending instead to start with thrice weekly aerobic exercise for 20-30 minutes.

PURPOSE: To assess the feasibility of the aforementioned exercise prescription used in a supervised exercise program affiliated with a local cancer center.

METHODS: The study was open to women diagnosed with early stage breast cancer who were receiving adjuvant anthracycline and cyclophosphamide chemotherapy (AC) referred by their Oncologist. Participants enrolled within the first half of their chemotherapy treatment to an exercise program for the duration of adjuvant treatment (chemotherapy and radiation) and the 24-weeks following completion of adjuvant treatment. The program included supervision from trainers with experience working with cancer survivors. The progressive prescription used during chemotherapy included 3 weekly aerobic sessions (20-30 min at 50-70% of heart rate reserve) with a standardized approach to reduce exercise intensity if requested due to treatment symptoms. Criteria for determining feasibility of this prescription during the phase of the study undertaken during chemotherapy were: attendance; adherence to prescribed

intensity and duration; and participant retention. RESULTS: Sixty-four participants (age, 49±9 years, BMI, 26.3±5.9 kg/m²) enrolled. Mean duration of the intervention phase during chemotherapy was 8.5±2.5 weeks. Retention rate was 78%. Mean attendance for all participants was 59±30%, and 72±19% with withdrawals excluded. Adherence to the prescribed intensity was 77%, adherence to the prescribed duration was 90%. Total adherence to frequency, intensity, and duration was 44±27%. CONCLUSION: While receiving AC chemotherapy, women with early stage breast cancer were able to exercise twice a week on average, and while they were often able to complete the prescribed duration, were less able to meet the prescribed intensity. This finding has implications for using intention-to-treat analysis for exercise interventions during AC chemotherapy, as considerably larger sample sizes would be required.

2961 Board #26 June 3, 2:00 PM - 3:30 PM
Acute Exercise Effect On Biomarkers Of Carcinogenesis
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Physical activity affects carcinogenesis and mortality. The specific mechanisms for these effects are unknown; researchers are investigating the changes in biomarkers that occur with exercise that influence the microenvironment in which cells live.

PURPOSE: To examine the effect of an acute bout of exercise on adiponectin, leptin, and adiponectin leptin ratio in sedentary and active cancer survivors, and potential baseline differences in these biomarkers. **METHODS:** Sedentary and active cancer (n = 9) and active non-cancer (n = 8) subjects underwent peak oxygen uptake tests (peak) using a modified Bruce protocol. Subjects then exercised at 55-65% peak for 40 minutes with dependent variables measured pre and post exercise. **RESULTS:** No significant difference existed for adiponectin between cancer and non-cancer patients, $p = .15$. No significant difference existed between pre and post values of adiponectin, $p = .91$. A significant difference existed for leptin between cancer and non-cancer patients, $p = .03$. Cancer subjects displayed higher leptin levels than non-cancer patients (133.3% change from non-cancer to cancer subjects). No significant difference, however, existed between pre and post values of leptin, $p = .91$. No significant interaction existed between time and cancer status with regard to leptin, $p = .97$. The difference in leptin may be due to the higher % BF seen in cancer patients. In the current study, %BF was 28.5% greater in cancer subjects vs. non-cancer subjects, 33.13 (± 7.90) vs. 23.70 (± 6.07), $p = .02$. No significant difference existed for A/L ratio between cancer and non-cancer patients, $p = .92$. In addition, no significant difference existed between pre and post values of A/L ratio, $p = .16$. No significant interaction existed between time and cancer status of A/L ratio, $p = .26$. A blunted response was observed in cancer survivors' A/L ratio pre and post exercise compared to non-cancer subjects. The percent change in mean A/L ratio from pre to post exercise in cancer survivors was 22.5% increase vs. non-cancer subjects exhibiting a 226.1% increase; although the A/L ratio was not statistically significant, there was an effect size of -0.61 in non-cancer subjects pre to post exercise. **CONCLUSION:** Cancer subjects had a statistically significant higher leptin level compared to non-cancer patients.

2962 Board #27 June 3, 2:00 PM - 3:30 PM
Autophagic Response In Older Versus Younger Adults
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The autophagic process plays a homeostatic role in cells that is crucial for the metabolic balance between the synthesis, degradation, and subsequent turnover of cytoplasmic materials in a stressful environment, such as caloric restriction or exercise. A decrease in activity of the autophagic process is a shared characteristic of nearly all aged organisms and may have a causative role in the functional deterioration of biological systems during aging. **PURPOSE:** The purpose of this study was to examine the differences in basal and rapamycin-induced autophagy between younger and older individuals.

METHODS: Peripheral-blood mononuclear cells (PBMCs) were isolated from whole blood and incubated at 37°C for a period of 24 hours to allow for cellular homogenization. PBMCs from 10 (five females, five males) younger (21.80±1.87 yr) and 10 (five females, five males) older (64.0±3.68 yr) individuals were treated with either bafilomycin (BAF; inhibits autophagosomal and lysosomal fusion) (100 nM) or BAF and rapamycin (Rapa; a known inducer of autophagy) (.5 µM; treatment) and then incubated for 2 hours at 37°C. Cells were harvested and Western blot analysis was used to determine LC3-II densitometric values, which were normalized to β-actin.

RESULTS: When examining basal (BAF) LC3-II protein expression, older individuals demonstrated lower levels (2.78 ± 0.59 LC3-II/ β -actin) when compared to their younger counterparts (1.79 ± 0.27 LC3-II/ β -actin), indicating higher autophagy in older participants. Following Rapamycin treatment, younger individuals elicited a significant ($p < 0.05$) upregulation (2.07 ± 0.35 LC3-II/ β -actin) of LC3-II protein expression that was not demonstrated in older individuals (3.33 ± 0.75 LC3-II/ β -actin).
CONCLUSIONS: We found that the autophagic response is suppressed in older individuals following rapamycin treatment when compared to younger individuals. The observed autophagic suppression may be due to chronic elevations in basal autophagy in older individuals, leading to a reduced autophagic response compared to younger when exposed to stress.

F-21 Free Communication/Poster - Clinical Cardiorespiratory

Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

2963 Board #28 June 3, 3:30 PM - 5:00 PM Maintenance on Functional Capacity and Hemodynamic Responses after Discharge from Cardiac Rehabilitation

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Cardiac Rehabilitation (CR) improves functional capacity and hemodynamic responses to exercise. Clinicians need to know more about the extent to which CR improvements remain after discharge.

Purpose: To examine the maintenance of functional capacity and hemodynamic responses to exercise in cardiac patients 2 to 3 yrs after completing a Phase 2 CR program.

Methods: We studied fifty-two patients from our University-based CR program between 2011 and 2014 (age = 59.1 ± 14 years, height = 1.67 ± 0.9 m, weight = 77.5 ± 13.2 kg, BMI = 27.6 ± 3.6 kg/m², VO₂max = 15.7 ± 4.6 ml/kg/min). Patients returned 30.7 \pm 9.0 months after CR discharge and performed a 6-minute walking Test (6MWT). Functional capacity and VO₂max were estimated based on the distance walked during the test and hemodynamic responses were also measured. A repeated measure ANOVA was used to compare variables at Pre (baseline), Post1 (at the end of CR) and Post2 (return visit after CR discharge). Significance was accepted at $P < 0.05$ level.

Results: Functional capacity (distance walked during the 6MWT) improved 23.1% with CR (Pre to Post1: 443 ± 95 to 545 ± 87 m, $P < 0.001$) and was maintained at follow-up after discharge (Post1 to Post2: 545 ± 87 to 542 ± 71 m, $P > 0.05$). VO₂max improved by 23.2% with CR (13.8 ± 5.0 to 17.0 ± 5.4 ml/kg/min, $P < 0.001$) but was decreased by 7.6% when measured at follow-up after discharge (17.0 ± 5.4 to 15.7 ± 4.6 ml/kg/min, $P = 0.014$). Body weight only increased 2.2% between CR discharge and follow-up (75.8 ± 12.2 to 77.5 ± 13.2 kg, $P = 0.002$). Resting heart rate decreased 7.0% between CR and follow-up (71 ± 9.0 to 66 ± 11 kg/m², $P = 0.007$). DBP was reduced by 5.6% with CR (71 ± 10 to 67 ± 9.0 mmHg, $P = 0.002$) and was maintained after discharge (67 ± 9.0 to 66 ± 9.0 mmHg, $P > 0.05$). With CR, patients experienced a greater five minute heart rate recovery after 6MWT (24 ± 13 vs 38 ± 16 bpm, $P < 0.001$), which was maintained at follow-up (38 ± 16 vs 39 ± 12 bpm, $P > 0.05$). Greater SBP recovery to the 6MWT with CR (20 ± 12 vs 29 ± 16 mmHg, $P = 0.004$) was also maintained at follow-up after discharge (29 ± 16 vs 27 ± 11 bpm, $P > 0.05$).

Conclusion: Our patients maintained CR improvements in functional capacity and hemodynamic responses to exercise months after discharge from our CR program. CR appears to provide health and fitness benefits that persist long after completing an intensive supervised rehabilitation program.

2964 Board #29 June 3, 3:30 PM - 5:00 PM
Differences in Short-term Observation Post-hospitalization And Readmission Predictors In Cardiac Rehabilitation Participants And Non-participants
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While prior studies have investigated hospital readmissions for subsequent cardiac events in patients with cardiovascular disease these studies have been limited to 30-day readmissions and have ignored short term observation (STO, hospitalizations < 48 hours). **PURPOSE:** The purpose of this study was to assess predictors of STO and readmission at 60 and 180 days after initial hospitalization in cardiac patients who either did or did not participate in cardiac rehabilitation (CR). **METHODS:** Of the 245 patients studied who were referred to Phase II CR following cardiac diagnosis and STO rates were recorded. Several factors which had been previously identified as potential predictors of 30-day readmission rates were recorded. Stepwise regression analyses were then used to identify which of these variables were significant predictors of readmission and STO rates at 60 and 180 days. **RESULTS:** Readmission at 30 days, age, number of atherosclerotic lesions treated at the time of hospitalization, history of depression, unemployed status, and no β -blocker prescription at discharge were all significant predictors of readmission at 60 days. Length of stay after initial event, history of COPD, history of depression, prescribed antiplatelet medication at discharge, being uninsured, number of lesions treated, hypertensive status, and no prescription for angiotensin converting enzyme inhibitor/angiotensin receptor blocker (ACE/ARB) at discharge were predictors of readmission at 180 days. Significant predictors for STO at 60 days were length of initial hospital stay, tobacco use, and absence of heart failure. Predictors for 180-day STO were cardiac arrest upon arrival, chest pain with admission, no ACE/ARB at discharge, severity of myocardial infarction, CR participation, tobacco use, and insurance status ($\Delta R^2 \geq 0.061$, $p < 0.01$ for all). **CONCLUSION:** Predictors of readmission and STO rates at 60 and 180 days could be grouped as: cardiac event severity (e.g., number of lesions, length of hospital stay), presence of comorbidities (e.g., COPD, depression), prescription medications (e.g., ACE/ARB, β -blocker), financial status (e.g., being unemployed, uninsured), and behavioral factors (e.g., tobacco use, CR participation).

2965 Board #30 June 3, 3:30 PM - 5:00 PM
Gender Differences In Physical Activity Measured With Accelerometer 6 Weeks After Exercise-based Cardiac Rehabilitation
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Purpose: to assess physical activity and sitting time in men and women with cardiovascular disease after completing 12 weeks of out-patient cardiac rehabilitation in two hospitals in Norway.

Methods: 80 participants (13 women, mean age 64.2 (± 5.8), body mass index 26.9 (± 5.9) / 67 men, mean age 60.0 (± 9.0), body mass index 26.1 (± 3), were recruited 6 (± 4) weeks after cardiac rehabilitation cessation. Physical activity was measured with an accelerometer (Sensewear Armband, Bodymedia), worn at least three weekdays and a weekend for reliable measurements. The participants were instructed to wear the accelerometer for 24 hours per day, and were only removed during showering or bathing. Daily average of total energy expenditure (TEE), active energy expenditure (AEE), sitting time, time spent in light PA (1.5-3 METs), moderate PA (3-6 METs) and vigorous PA (6-9 METs) were obtained. Sitting time was calculated as sedentary time minus time lying down. Independent T-test was used for analysis.

Results: The accelerometer was worn 6 (± 1) days, 97 (± 10) % of the time. Daily average TEE was 2945 (± 496) Kcal and 2098 (± 264) Kcal ($p < 0.001$), and AEE 1455 (± 546) kcal and 817 (± 288) kcal ($p < 0.001$), for men and women, respectively. Daily average time spent in light PA was 253 (± 74) minutes and 240 (± 110) minutes ($p = 0.677$), moderate PA 113 (± 59) minutes and 65 (± 29) minutes ($p < 0.001$), vigorous PA 15 (± 18) minutes and 5 (± 6) minutes ($p = 0.076$), for men and women, respectively. Daily average sitting time was 8.8 (± 1.9) hours for men and 10.0 (± 2.1) hours for women ($p = 0.051$).

Conclusion: both men and women who had attended an exercise-based CR program met the recommended level of physical activity few weeks after cessation. Women were less physical active than men and spent more time sitting and should be encouraged to reduce sitting time.

2966 Board #31 June 3, 3:30 PM - 5:00 PM

The Comparison Between Respiratory Muscle Strength, Functional Capacity And Sleep Quality In Adult Controlled Asthmatics And Health Controls

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Frequently asthmatic subjects report worsen the symptoms at night. Poor sleep quality is a particularly frequent complaint in patients with asthma and can reflect a negative impact on functional capacity

PURPOSE: The aim of our study was compare respiratory muscle strength, functional capacity and sleep quality in adult controlled asthmatics and healthy controls.

METHODS: 26 adult controlled asthmatics (29±9 years) and 12 healthy controls (27±8 years) were assessed for Pittsburg Sleep quality index (PSQI); Maximum inspiratory pressure (MIP) and estimated functional capacity using the Duke Activity Status Index (DASI).

RESULTS: The MIP was 106.5±31 in asthma group and 122±39 in control group. Asthmatics subjects had poor sleep quality with higher scores in PSQI (p<0.05) and lower estimated VO2 by DASI score (32±3) (p<0.05). MIP was negatively correlated with PSQI (r:-0.45) and positively correlated with estimated VO2 (r: -0.43) only in asthmatic subjects.

CONCLUSIONS: Asthmatic subjects present poor sleep quality and lower functional capacity when compared with matched controls. Lower respiratory muscle strength may reflect in poor sleep quality and reduced estimated functional capacity in asthmatics subjects.

2967 Board #32 June 3, 3:30 PM - 5:00 PM

Changes in Ventricular Function After Vigorous Aerobic Exercise Training in Women with Pulmonary Arterial Hypertension

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PURPOSE: To determine if 10 weeks of vigorous aerobic exercise training (AET) worsens left ventricular diastolic and systolic function in a group of women with pulmonary arterial hypertension (PAH).

METHODS: 18 women with PAH (age 56.2 ± 8.8 years, BMI 28.8 ± 7.3 kg/m²) underwent 10 weeks of vigorous AET at 70-80% heart rate reserve. Indices of cardiac function were measured during a graded exercise test (GXT) to peak exhaustion using bioelectrical impedance cardiography (ZCG) before and after the AET. A small subset (N=7) participated in a 10-week waiting period prior to beginning the AET and performed an additional GXT with ZCG before that period. A cohort of sedentary women serving as healthy controls (N=19) also performed a GXT with ZCG and were used for comparison.

RESULTS: Left ventricular ejection fraction (EF; 48 ± 9.2 vs. 61.5 ± 13.3 %, p=0.034) and the systemic vascular resistance index (SVRI; 2,258 ± 419.1 vs. 2,939 ± 962.4 dyn·s/cm⁵·m², p=0.008) were significantly lower in the baseline PAH group vs. healthy groups respectively at supine rest. At peak exercise, heart rate (HR) was lower in the PAH group vs. healthy control group (140 ± 13.3 vs. 170 ± 13.8 bpm, p<0.001) and SVRI higher in the PAH group (828 ± 141.1 vs. 824 ± 300.9 dyn·s/cm⁵·m², p=0.050) when controlling for age and HR. After AET, the PAH group did not have a significant decline in left ventricular function, but rather a decrease in SVRI (828 ± 141.1 vs. 766 ± 139.6 dyn·s/cm⁵·m², p=0.020) at peak exercise. The subset of subjects with PAH who participated in the 10-week waiting period had a significant decline in the early diastolic left ventricular filling ratio (EDFR; 95.9±19.4 vs. 76.2±18.9%, p=0.043) prior to AET. The EDFR remained unchanged after the AET training period in all subjects.

CONCLUSIONS: Vigorous AET does not appear to be associated with significant declines in either left ventricular systolic or diastolic function in women with PAH. AET may be beneficial for reducing afterload and may be protective against decline in left ventricular diastolic function occurring over time.

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2968 Board #33 June 3, 3:30 PM - 5:00 PM

Oxygen Consumption During Performance Of Functional Activities After Stroke

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PURPOSE: People with stroke have low aerobic capacity and experience increased effort during performance of functional daily activities. The purpose of this study was to examine the test-retest reliability of a portable ergospirometry system in people with stroke during performance of five different daily activities.

METHODS: Patients with the diagnosis of stroke (minimum 4 months and maximum 5 years after onset) were screened for inclusion. Participants performed the following standardized test-course; walking on flat surface, stair walking, stepping over obstacles, walking between 8 cones and from a standing position lifting 5 objects with their non affected arm from one height to another. Participants performed the course on two different days, at least 2 days apart, with simultaneous measurement of oxygen uptake (VO2) with the portable MetaMax II, ergospirometry system. Intraclass correlations coefficients (ICC) for total time, cardiopulmonary parameters, heart rate and ratings of perceived exertion were calculated.

RESULTS: A total of 31 participants (39% women, mean age 54.5 years and 21.1 months since stroke) with mild to moderate stroke were included. The ICC was 0.89 for absolute VO2, 0.80 for relative VO2, 0.82 for minute ventilation, 0.54 for respiratory exchange ratio, 0.91 for heart rate and 0.81 for Borgs rating of perceived exertion. The ICC for total time to complete the test-course was 0.99.

CONCLUSIONS: This study presents evidence on the test-retest reliability of oxygen uptake measures wearing a portable ergospirometry system during ADL in persons with mild to moderate stroke. For most relevant cardiopulmonary parameters there were good test-retest reliability.

2969 Board #34 June 3, 3:30 PM - 5:00 PM

Blood Flow Restricted Exercise with Electrical Stimulation Enhanced Flow Mediation Dilation in Persons with Spinal Cord Injury

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Blood flow restriction (BFR) accompanied with neuromuscular electrical stimulation (NMES) has been shown to increase muscle size of the wrist extensors in individuals with spinal cord injury (SCI). NMES of the paralyzed muscles with occlusion may produce greater lactate concentration, which is likely to increase brachial artery diameter, blood flow velocity and flow mediation dilation (FMD).

PURPOSE: To determine the effects of an acute bout of NMES with BFR on the brachial artery diameter, blood flow velocity and FMD compared to BFR only. **METHODS:** Eight men (age: 48± 6.5 years; weight: 75 ± 9 kg; height: 1.78 ± 0.1 m and BMI: 24 ± 4 kg/m²) with SCI (level of injury C3-L2 and AIS classification A-D) participated in the current study. The right forearm received NMES + BFR (exercise) while the left forearm received BFR only (control). Blood flow restriction was initiated by inflating a pressure cuff (30% greater than resting systolic pressure) placed distal to the participant's elbow joint, around the forearms. Ultrasound (US) images of the brachial artery were collected in order to measure brachial artery diameter and blood flow velocity. The US images were collected during 3 minutes of resting every 30 seconds, 5 minutes of cuff occlusion every minute and for 3 minutes following cuff deflation every 30 seconds. Paired t-tests were used to test for statistical significance.

RESULTS: There was no difference in the baseline diameters or blood velocity of the brachial artery between the exercise and the control arms. Following cuff occlusion, brachial artery diameter increased (P <0.0001) in both the exercise (0.36 ± 0.23 mm) and the control (0.26 ± 0.14 mm) arms when compared to the resting diameters. FMD increased (P = 0.05) in the exercise arm (0.6 ± 0.16 mm; 12 ± 3%) compared to the control arm (0.35 ± 0.3 mm; 6.5 ± 6%). Following cuff occlusion, blood flow velocity increased significantly in both arms. Blood velocity adjusted to the resting values was 69 ± 46% vs. 56 ± 21% (P = 0.4) in the exercise vs. control forearms, respectively. **CONCLUSION:** NMES training with BFR enhanced FMD as demonstrated by a trend towards a greater response in the brachial artery diameter. The findings may suggest that enhancement in FMD may partially contribute to skeletal muscle hypotrophy, which was previously noted in wrist extensors following NMES+BFR training.

2970 Board #35 June 3, 3:30 PM - 5:00 PM

Response To Exercise Training In Cardiac Resynchronization Therapy Patients With Atrial Fibrillation Versus Sinus Rhythm.

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Background:

Exercise training has beneficial effects after implantable cardioverter defibrillator implantation, especially when cardiac resynchronization therapy (CRT) is present. However, most clinical results have been shown in patients with sinus rhythm (SR), whereas 1/3 of the patients with severe heart failure (HF) and left bundle branch block have atrial fibrillation (AF).

Purpose:

We evaluated the response of CRT patients stratified by the presence of AF engaged in High Intensity Interval Training (HIIT) or in a group without adjunctive therapeutic.

Methods:

Thirty-eight CRT patients (67.6 years; AF=16|SR=22) who had end-stage HF (left ventricular ejection fraction; LVEF = 25.98%) participated in a randomized controlled trial with an exercise group (EX; AF=7|SR=12) who underwent a supervised HIIT program at 90-95% peak heart rate twice a week for 6 months and a control group (CON; AF=9|SR=10) without exercise. Echocardiographic parameters, serum biochemical response, quality of life (QOL), exercise and functional capacities were evaluated at baseline and at 6 months. 2x2 repeated measures analysis of variance were used to detect differences between rhythmic etiology groups.

Results:

Baseline characteristics of AF and SR groups were similar ($p > 0.05$). EX SR patients had maximized benefits in TNF- α levels (39.97%; $p = 0.03$), LV Mass (LVM) | 26.17%; $p = 0.002$ and marginally in VO₂max (8.24%; $p = 0.09$) compared to CON SR. No added benefits were found in EX AF compared to CON AF ($p > 0.05$). Regarding EX groups only, analysis of the simple effects of TNF- α (14.5%; $p = 0.02$), BNP (0.54%; $p = 0.03$), LVEF (49.98%; $p < 0.001$) and LVM (26.16%; $p = 0.001$) showed an improvement, or a trends towards it (VO₂max | 8.24%; $p = 0.08$) but only in EX SR. NYHA class (50.0-61.1%; $p < 0.001$) and QOL (45.38-51.78%; $p < 0.05$) improved similarly in EX SR and EX AF.

Conclusion:

CRT patients with AF demonstrated blunted benefits from HIIT compared to SR. This suggests that evaluation of the impact of different rate or rhythm control strategies in CRT patients with AF is warranted.

2971 Board #36 June 3, 3:30 PM - 5:00 PM

The Effect of Cardiac Rehabilitation on 30-Day Hospital Readmission Rates

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PURPOSE: Hospitals are facing financial penalties for excessive thirty-day readmission rates for various chronic diseases. Thirty-day readmission rates are now considered a quality indicator for hospital performance, and previous research suggests that up to 76% of thirty-day readmissions could be prevented. The purpose of this study was to compare thirty-, sixty-, and one hundred eighty-day readmission and short-term observation (STO) rates for participants and non-participants in a Phase II cardiac rehabilitation program.

METHODS: Ninety subjects (participants $n = 45$; non-participants $n = 45$) retrospectively participated in the study. All subjects were referred to Phase II cardiac rehabilitation (CR) following a qualifying cardiac diagnosis, and given the option to participate.

RESULTS: Thirty-day readmission rates approached statistical significance and were higher for non-participants than participants (20% vs. 6.7%, $p = .064$). Sixty-day readmission rates were higher for non-participants than participants (8.9% vs. 2.2%, $p = .170$) but were not statistically significant. One hundred eighty-day readmission rates were significantly higher for non-participants than participants (17.8% vs. 2.2%, $p = .014$). Thirty- and sixty-day STO rates were slightly higher for non-participants than participants (6.7% vs. 2.2%, $p = .309$; 4.4% vs. 2.2%, $p = .559$) but were not statistically significant. One hundred eighty-day STO rates were statistically higher for participants than non-participants (15.6% vs. 2.2%, $p = .027$).

CONCLUSIONS: Participating in Phase II cardiac rehabilitation appears to decrease the likelihood for readmission at one hundred eighty days. STO rates were higher

at one hundred eighty days for Phase II cardiac rehabilitation participants, perhaps indicating a need for increased monitoring without requiring rehospitalization.

2972 Board #37 June 3, 3:30 PM - 5:00 PM

Pulmonary Rehabilitation Improves Exercise Capacity And Molecular Skeletal Muscle Adaptation In Pulmonary Emphysema Patients

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Purpose: Chronic pulmonary emphysema (PE) exerts a sustained reduction in arterial oxygen saturation associated with decreased exercise capacity, habitual movement and impaired structural composition of skeletal muscle. In particular, decreased mitochondrial- and capillary density but an increased expression of glycolytic fibers, serve as indicators for deteriorated skeletal muscle integrity and lack of oxidative capacity in these patients. Hypothesis: Because exercise is a major stimulus for the maintenance of skeletal muscle oxidative capacity, we hypothesized that regular exercise will adapt also skeletal muscle of PE patients towards increased capillary- and mitochondrial density and enhanced exercise capacity. **Methods:** 20 PE patients (Stage 4, 57 \pm 7 years, BMI 27 \pm 7, FeV1% 31 \pm 7) were subjected to 3 weeks pulmonary rehabilitation (PR) including strength and endurance exercise under oxygen application. PRE and POST skeletal muscle biopsies from vastus lateralis were collected and immunohistochemistry and western blotting used to detect changes in molecular signaling and structural skeletal muscle adaptation. 6min walking distance (6MWT) and power output (PWR) were determined on a treadmill and cycling ergometer as markers for general exercise capacity. **Results:** From PRE to POST: 1. Significant increase in 6MWT and PWR during ergometry ($P < 0.01$); 2. Significant increase in capillary to fiber ratio in type I ($P < 0.05$) and type II fibers ($p = 0.16$). 3. Significant reduction in the percentage of fast glycolytic IIA-IIX hybrid fibers ($P < 0.05$). 4. Increased expression of mitochondrial signaling via TFAM (mitochondrial transcription factor A) and PGC-1 α ($P < 0.01$ and $P < 0.05$). 5. Significant increase of cytochrome c-oxidase activity in type I ($P < 0.01$) and type IIA fibers ($P < 0.05$). 6. Significantly increased nuclear localization of transcription factors involved in oxidative fiber type expression (MEF2; NFATC2) (both $P < 0.01$). **Conclusion:** A short term PR stimulates skeletal muscle adaptability and physical performance of stage 4 PE patients towards higher exercise capacity associated with beneficial skeletal muscle adaptation. The obligatory and repeated application of PR might help to sustain minimal exercise capacity, reduce co-morbidity and improve quality of life in these patients.

2973 Board #38 June 3, 3:30 PM - 5:00 PM

Exercise Training Improves Vascular Compliance in Patients with Hypertensive Kidney Disease

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Hypertensive related chronic kidney disease (CKD) is associated with a high degree of vascular stiffness, which contributes to end-organ failure. Exercise training has been shown to improve vascular compliance in other populations, but its efficacy in the CKD population remains largely unknown and conflicting. **PURPOSE:** To investigate the efficacy of 12 weeks of exercise training to improve vascular compliance in participants with stage 3-4 hypertensive related CKD. It was hypothesized that 12 weeks of exercise training would improve vascular compliance compared to a usual medical care control group. **METHODS:** Forty participants with stage 3-4 hypertensive related CKD (24=men, age=70.1 years, BP=143/77 mmHg) were randomized to either 12 weeks, 4x/wk for 45 minutes, walking exercise ($n=20$) or usual medical care control ($n=20$). The common carotid artery was imaged over several cardiac cycles for assessment of arterial distensibility. The radial artery pulse wave contour was examined using a modified Windkessel method for assessment of large and small artery compliance. Analysis was ANCOVA adjusting for baseline values, medication change, and exercise performed. There were no differences between groups at baseline. Log-transformation was used for pulse contour analysis to account for large skewed standard deviations. **RESULTS:** Outcome data was obtained in all 40 participants with no drop-outs in either group. Exercise adherence was 80%. Carotid artery pressure-strain elastic modulus, and Young's elastic modulus were improved in the exercise group compared to the control group (mean difference -47 kPa, $p=.03$, and -.58 kPa/cm, $p=.02$ respectively). There was a trend for improved distensibility coefficient and large artery elasticity in the exercise group (mean difference .005 10-3/kPa, $p=.07$, $R^2=.7$ and .09, $p=.06$ respectively). There was no difference between

groups in small artery compliance ($p=.4$). Aerobic capacity was strongly associated with large artery elasticity at 12-weeks in the exercise group only ($r=.55, p=.03$).
CONCLUSION: Exercise training appears to improve large vessel compliance, but not small vessel compliance in participants with hypertensive CKD. These results provide a mechanistic insight into the potential end-organ protective effect of exercise in this population.

2974 Board #39 June 3, 3:30 PM - 5:00 PM
Cardiorespiratory Fitness, Metabolic Rate, and Body Composition after a Phase 2 Cardiovascular Rehabilitation Exercise Program

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PURPOSE: To assess the effectiveness of a phase 2 cardiovascular rehabilitation (CVR) exercise program.
METHODS: 18 patients participated in a phase 2 CVR exercise supervised program, during 12w (3d/w). Aerobic training was conducted for 3 sessions a week completing a total of 10 to 30 min of light to moderate cycling / walking during several bouts of exercise, at a range of intensities below the previously identified ischemia threshold or anaerobic threshold, following a periodized program. Strength training was conducted for 1 to 2 sessions a week consisting of 1 to 3 sets between 40 and 65% of estimated 1RM in leg press, chest press, lat pull, and leg extension. Training Loads were adjusted based on a previous metabolic graded test and a submaximal strength tests conducted along the program.

Anthropometric (body weight) and body composition (% fat, % muscle mass), blood pressure (BP)(systolic/diastolic BP), metabolic (resting and exercise energy expenditure) and performance variables (peak VO₂, metabolic thresholds) both in rest and graded exercise conditions using a breath-by-breath CPX system were assessed before and immediately after the program. Paired T-Tests were conducted in order to observe Pre-Post differences. Significance Level was set at $p<0.05$.

RESULTS: Significant differences were found showing higher resting metabolic rate (Pre 1548±288 kcal/day vs Post 1700±312), higher energy expenditure both for light (Pre 4.58±1.72 kcal/min vs Post 6.06±2.17), moderate (Pre 6.54±2.66 vs Post 8.76±3.06) and high-intensity (Pre 8.23±3.14 vs Post 10.61±2.91) exercise, and superior Peak VO₂ (Pre 1.65 L/min ±0.58 vs Post 2.07±0.56), and velocities associated to Peak VO₂ (Pre 6.67 km/h±1.60 vs Post 8.03±1.51), Anaerobic (Pre 5.97±1.51 vs Post 7.51±1.51) and Aerobic Threshold (Pre 4.35±1.41 vs Post 5.90±1.24), and Fat Max velocity (Pre 3.98±1.54 km/h vs Post 4.85±1.51). No changes were found at body composition variables, blood pressure, nor resting heart rate ($p>0.01$).

CONCLUSION: It was shown the effectiveness of this particular CVR program in performance (18 to 26% improvements), and metabolic variables (8-9%), whilst it was not for body composition or blood pressure levels.

2975 Board #40 June 3, 3:30 PM - 5:00 PM
Education Attainment and Achieved Treadmill Workload: Differences in Cardiac Rehabilitation Participants

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 (No relationships reported)

Educational attainment and maximal metabolic equivalencies (METs) are strong predictors of health-related behaviors. Studies suggest educational accomplishment is an important predictor in CR participation rates. **PURPOSE:** The study aimed to compare age, gender, attended sessions, and METs of college graduate (CG) and non-college graduate (NCG) Phase II CR participants. **METHODS:** A retrospective comparative design compared 182 participants completing ≥ 12 sessions between November 2012 and September 2015. A Patient Education Assessment Tool, a 9-item educational level questionnaire, was administered at initial CR session. Medical record review collected gender, age, METs, and education. Education was compared to program end METs by age, gender and number of sessions. T-tests and Ordinary Least Squares regression determined statistical significance. **RESULTS:** 143 males (mean = 64.7 years) and 39 females (mean = 70.7 years) completed an average of 26 sessions. 114 participants were CG (mean = 65.8 years) and 68 NCG (mean = 66.2 years). CGs achieved significantly higher mean METs than NCGs (6.9 vs 6.1 mean METs; $t=-2.472; p=0.0145$). There is a significant interaction between age and education adjusting for gender. In the adjusted analysis, METs significantly varied with education and age ($F = 13.88, p < 0.001$). MET levels were significantly lower in

NCGs aged ≥ 65 years ($t = -2.41, p = 0.017$). This finding is significant for men only ($t = 3.03, p = 0.003$). There was no significant difference between CGs and NCGs in session attendance ($t=-0.1209; p=0.903$). Significant associations existed between mean METs and age. For every one year increase in age, percent of average METs completed declines 11%, holding education and gender constant ($p < 0.001 t = -8.43$).
CONCLUSION: CGs achieve higher METs than NCGs. Education achievement did not affect sessions attended. Knowledge of education differences can help CR staff develop strategies to meet needs of participants during rehabilitation. Further research is needed to determine effects of other social and economic variables.

2976 Board #41 June 3, 3:30 PM - 5:00 PM
Effects of 6-month Aerobic Training in Smokers with Multiple Cardiovascular Risk Factors

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PURPOSE: Smoking is a notoriously severe cardiovascular risk, while exercise therapy is a noble multifaceted medicine, especially for cardiovascular disease. Smoking and exercise are conflicting practices, however, some smokers often attempt to exercise in order to be healthy. Moreover, smoking might inhibit exercise performance acutely and chronically. The purpose of this study is to examine the effects of exercise training on adiposity, cardiovascular risks and physical fitness in obstinate smokers who are overweight and with multiple cardiovascular risk factors.
METHODS: A total of 25 smokers (age: 69 ± 5 yrs) and 25 age-matched non-smokers (age: 69 ± 6 yrs) with multiple cardiovascular risk factors were recruited and participated in an examination, followed by exercise training. The subjects were to exercise 2 to 3 times per week for 6 months at a fitness club. Bicycle exercise with a duration of 20-40 min was employed at baseline and after 6 months. At this time, all subjects underwent outcome measurements.

RESULTS: Both groups exercised an average of 2.6 times/week. After 6 months of training, both groups showed significant improvements in blood pressures (BP), body mass index (BMI), waist circumference, and peak oxygen uptake (table). Consequently, a significant reduction in high-sensitivity C-reactive protein (hs-CRP) levels were seen in non-smokers, while no change was seen in smokers.

CONCLUSIONS: Exercise training could reduce conventional cardiovascular risk factors but not hs-CRP, the strongest cardiovascular risk factor in smokers. The evidence might suggest that smokers could not get benefits similar to non-smokers from exercise training.

Effects of exercise training on the main parameters				
	Smokers		Non-smokers	
	Pre	Post	Pre	Post
Systolic BP, mmHg	143 ± 18	137 ± 18*	141 ± 14	133 ± 17*
Diastolic BP, mmHg	84 ± 9	80 ± 9*	83 ± 8	79 ± 8*
BMI, kg/m ²	26.4 ± 1.9	25.9 ± 1.6*	26.3 ± 2.3	25.5 ± 2.3*
Waist circumference, cm	90.2 ± 6.5	87.5 ± 6.4*	90.2 ± 6.6	85.2 ± 6.7*
Peak oxygen, ml/min/kg	21.3 ± 3.8	24.0 ± 4.3*	22.4 ± 4.1	26.0 ± 4.4*
Hs-CRP, mg/L	1.10 ± 1.21	0.91 ± 1.00	1.08 ± 1.17	0.58 ± 0.49*

2977 Board #42 June 3, 3:30 PM - 5:00 PM
Elevated Triglycerides Predict Poor Adherence to Cardiac Rehabilitation in Patients with Metabolic Syndrome

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 (No relationships reported)

Cardiac Rehabilitation (CR) has been shown to be effective at reducing risk factors associated with Coronary Artery Disease (CAD). Despite the benefits of CR, few eligible patients participate and many don't complete the program. Suboptimal adherence to CR has been reported in patients, particularly female, with diabetes and obesity. Metabolic Syndrome (MetS), the presence of three or more of the following risk factors: hypertension, low HDL, and elevated waist circumference, triglycerides or glucose, more than doubles the risk of cardiovascular mortality. The effect of MetS on CR adherence was previously unknown.
Purpose: We sought to determine the relationship between MetS and the number of CR sessions completed. Further, we aimed to determine if any of the five components of MetS are associated with the number of CR sessions completed.
Methods: We examined the records of 878 phase II CR patients at a quaternary medical center. Logistic and linear regression was performed.

Results: The sample was male (65.4%), white (60.2%), and completed a median of 16.0 [Q1, Q3; 5.0, 36.0] sessions. Median sessions completed for non-MetS patients was 21.0 (n = 510, Q1, Q3; 5.0, 36.0) and for MetS patients 13.5 (n = 368, Q1, Q3; 4.0, 35.0; p = 0.008). Patients with MetS were more likely to have fewer CR sessions (OR 0.73 (0.57, 0.92); p = 0.008) and more likely to be female (OR 1.51 (1.14, 2.00); p = 0.004). No significant differences in age, income, race, or ejection fraction were observed. After adjusting for sex, those with MetS continued to have fewer sessions (0.73 (0.57, 0.92); p = 0.008). Of the components of MetS, those with high triglyceride levels were likely to complete fewer sessions (0.73 (0.55, 0.96); p = 0.025). Conclusions: Patients with MetS completed fewer CR sessions than those without. Of the five components of MetS, only elevated triglycerides best predicts poor adherence to CR. These results provide implications for adjustments in CR programming to increase adherence in this patient population. Future studies should also focus on the relationship between elevated triglycerides and motivation to do exercise.

2978 Board #43 June 3, 3:30 PM - 5:00 PM
Effects Of Montmorency Tart Cherry (Prunus Cerasus L.) Consumption On Vascular Function In Males With Early Hypertension.

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Purpose: Tart cherries contain numerous polyphenols that have the potential to improve endothelial function and reduce risk factors associated with cardiovascular disease. The objective was to examine the acute effects of Montmorency tart cherry juice on vascular function in early hypertensive males. Methods: A single-blind, randomized, cross-over design that employed a controlled dietary intervention with a wash-out period of at least 14 days was conducted. Fifteen males with early hypertension [systolic blood pressure (SBP) ≥ 130 mmHg, diastolic blood pressure (DBP) ≤ 80 mmHg, or both] received either a 60 mL dose of a Montmorency tart cherry concentrate (MC) or a placebo (PLA). Microvascular reactivity (laser Doppler imaging with iontophoresis), arterial stiffness [pulse wave velocity (PWV), pulse wave analysis], blood pressure and phenolic acid [protocatechuic (PCA) and vanillic (VA)] absorption was assessed at baseline and 1, 2, 3, 5 and 8 h after consumption. Results: Significant differences in SBP (p=0.002) and MAP (p=0.014) were observed between groups, with peak reductions in postprandial SBP of 16 ± 3 mmHg 2 h post MC consumption. In addition, there was an overall reduction in PWV following MC supplementation when compared to the PLA trial (p=0.014). These vascular improvements returned to near baseline at 8 h post MC consumption. No other vascular variables were altered after consumption of the MC concentrate compared with baseline or after consumption of PLA. Finally, there were significant rises in the phenolic acids PCA and VA peaking at 1-2 h post MC ingestion (p<0.05). Conclusion: Montmorency, tart cherry intake acutely improves measures of vascular function in males with early hypertension. These benefits are likely to be mechanistically linked to the actions of circulating phenolic acids that are seen to increase following juice consumption. This work provides additional information of the potential importance of polyphenol-rich foods in health maintenance; critically this study shows new information on the application of Montmorency tart cherries, in particular positively impacting on vascular function.

2979 Board #44 June 3, 3:30 PM - 5:00 PM
Dietary Supplementation Of Ca++, K+ And NO-3 Upon Blood Pressure And Exercise In Pre-Hypertension Patients

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Dietary supplementations of Ca++, K+, NO3- and acute exercise, produce significant post-exercise hypotension in healthy normotensive subjects. However this nutritional approach and its effects have not been investigated in adults with prehypertension or hypertension. PURPOSE: to examine the effect of dietary supplementation Ca++, K+, NO-3 and maximal exercise in adults with pre or hypertension. METHODS: Sixty five subjects (49 men and 16 women aged 44±4 yr) participated in this study. None had absolute contraindications for a maximal exercise test (maxcap-t). Subjects arrived at 8:00 in fasting conditions without medications for at least 72 hrs. After 10 minutes of sitting rest, blood pressure (BP) was measured twice to verify the diagnosis of prehypertension or hypertension. Patients were admitted if BP was ≥

120/80 mmHg. Immediately after inclusion, they ingested a sandwich and juice of fruit and vegetables containing 900 mg of Ca++, 3500 mg of K+ (~90% of RDA) and 254 gr (8 mmol/L) of nitrate. BP was measured: 10 minutes post arrival, 90 min postDS, immediately after maxcap-t, 10 min after maxcap-t and 150 min after maxcap-t. RESULTS:

Table 1. Blood pressure at rest and after DT and Maxcap-t.

REST	90 min PostDS	Maxcap-T		
		Immediate	10 min	150 min
130 ± 12/86 ± 8	*126 ± 11/82 ± 7*	*152 ± 20/83 ± 11	*126 ± 14/82 ± 9*	*119 ± 10/78 ± 7*

* P < 0.05 vs BP control. Values are mean±SD of SBP/DBP. Both SBP and DBP decreased 3±5/3±4 mmHg at 90 min postDS. SBP increased 22±16/2±8 mmHg and DBP did not change. There was a significant reduction in both BP 11±11/8±7 mmHg at 4 hours postDS (150 min post maxcap-t). CONCLUSIONS: Combined cations-anions and nitrate supplementation reduced blood pressure at rest and after maximal endurance exercise in middle-aged adults with prehypertension or hypertension.

2980 Board #45 June 3, 3:30 PM - 5:00 PM
Blood Pressure And Wave Separation Analysis: Lower Body Negative Pressure In Individuals With Down Syndrome.

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BACKGROUND: Individuals with Down syndrome (DS) have altered autonomic function, which is related to low blood pressure (BP). Properties of the pressure waveform are important contributors to overall blood pressure responses and regulation. Using lower body negative pressure (LBNP) to stimulate the autonomic nervous system can provide important information on how BP is regulated in persons with DS. PURPOSE: To determine if central BP and waveform separation analyses are different between individuals with and without DS, at rest and during LBNP stimulation. METHODS: Individuals with (n=10; 34 yrs; 32.3 kg/m²) and without DS (n=11; 24 yrs; 22.9 kg/m²) were evaluated at baseline and during LBNP after 5 minutes at -20mmHg. Radial applanation tonometry measured the pressure waveforms, and specialized software determined the forward (FP) and reflected pulse height (RP), as well as aortic systolic and diastolic BP (aorSBP, aorDBP), and augmentation index (AIx and AIx75). RESULTS: There were no group differences at baseline for the hemodynamic variables. AIx during LBNP decreased in the DS group, with no change in the control group (p<0.05). There were no interactions or group differences for FP, RP, aorSBP and aorDBP. CONCLUSION: The results suggest differences in BP control between DS and control subjects. The difference in AIx between groups may be due to the decreased RP in the DS group during LBNP. Activation of the sympathetic nervous system may have increased the RP, which is not depicted in the results in the DS individuals. This data corresponds with previous literature, indicating dysfunction of autonomic control of BP in DS. A limitation of this study may be the small number of subjects.

	DS		CONTROL	
	BASELINE	LBNP	BASELINE	LBNP
AIx(%)	9.35 ± 3.25	2.60 ± 4.59*	1.50 ± 3.77	1.00 ± 4.10
AIx75(%)	2.25 ± 3.00	-2.15 ± 4.21	-3.90 ± 2.51	-3.23 ± 3.05
FP(mmHg)	31.30 ± 1.61	29.95 ± 1.48	27.77 ± 2.02	28.60 ± 1.18
RP(mmHg)	16.40 ± 1.96	14.35 ± 1.90	13.23 ± 1.57	13.40 ± 1.24
aorSBP(mmHg)	108 ± 5	102 ± 6	107 ± 3	105 ± 2
aorDBP(mmHg)	72 ± 3	70 ± 4	76 ± 2	75 ± 2
Heart Rate(bpm)	60 ± 4	65 ± 4	63 ± 5	65 ± 5

Mean ± SEM; * Significance level is set at 0.05

2981 Board #46 June 3, 3:30 PM - 5:00 PM

Hemodynamic and Peripheral Vascular Conductance in Individuals with Down Syndrome Following Hypovolemic Pressure Challenge

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Autonomic dysfunction, which contributes to chronotropic incompetence and reduced peak aerobic capacity (VO₂peak), is a common condition in individuals with Down syndrome (DS). Impaired vascular conductance and hemodynamics to sympathoexcitation have been associated with autonomic dysfunction. Lower level of lower body negative pressure (LBNP) has been used to study autonomic function as a controlled stimulus. Purpose: To examine the differences in hemodynamics and peripheral vascular reactivity to sympathoexcitation using hypovolemic lower body negative pressure (LBNP) in individuals with and without DS. Methods: Twenty four volunteers (DS=12, 24 yrs; Control=12, 23 yrs) participated in this study. VO₂peak was obtained via indirect calorimetry by an individualized maximal exercise treadmill protocol. Changes in hemodynamics and vascular reactivity (HR, BP, brachial diameter, blood flow and vascular conductance) were measured before, during and after LBNP (-20 mmHg). Results: Compared with controls, individuals with DS have lower VO₂peak (25.0 ± 1.7 vs. 42.5 ± 1.7 ml/kg/min for DS and controls, respectively) and higher BMI (23.1 ± 1.7 vs. 31.9 ± 1.8 kg/m² for controls and DS, respectively) (p<0.05). There were no group differences in hemodynamics at baseline. There was significant interaction in brachial blood flow (p<0.05) and trend to significant vascular conductance (p = 0.08) with decreased blood flow and vascular conductance in controls, whereas the group with DS did not exhibit changes with hypovolemic challenge. Conclusions: Our results demonstrate absence of vascular reactivity to sympathoexcitation in individuals with DS. This may indicate that individuals with DS exhibit autonomic dysfunction.

	DS (N = 12)			Control (N = 12)		
	Baseline	LBNP (-20mmHg)	Recovery	Baseline	LBNP (-20mmHg)	Recovery
SBP (mmHg)	134±4	129±4	134±4	128±4	125±4	129±4
DBP (mmHg)	73±2	74±2	74±2	71±2	72±2	72±2
MAP (mmHg)	98±3	96±3	99±3	94±3	94±3	95±3
HR (bpm)	64.7±4.6	65.0±4.7	61.3±4.4*	64.1±4.2	64.8±4.2	59.6±4.0*
Brachial Blood Flow (ml/min)	66.7 ± 14.3	73.2 ± 11.8	71.3 ± 10.3	110.1 ± 13.6	99.9 ± 11.3†	83.2 ± 9.8†
Brachial Vascular Conductance (ml/min/100mmHg)	64.47 ± 18.48	72.16 ± 15.26	67.76 ± 12.95	118.64 ± 16.53	110.19 ± 13.65	90.11 ± 11.58

† Significant difference from the baseline. * Significant from other time point. Mean ± SEM, Significance level, p < 0.05

2982 Board #47 June 3, 3:30 PM - 5:00 PM

Intermittent Pneumatic Compression Effects on Leg Blood Flow and Vascular Function in Spinal Cord Injury

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Intermittent pneumatic compression (IPC) applied to the lower legs can transiently increase blood flow (BF) in able-bodied persons. This has important clinical implications for people with spinal cord injury (pSCI) who may not be able to voluntarily engage their legs to perform physical activity. It is currently unknown whether IPC can alter leg BF and vascular function in pSCI. PURPOSE: To test the hypothesis that a single IPC session will acutely increase leg BF, and improve vascular function in pSCI. METHODS: Six pSCI (injury level: T3 and below; A.S.I.A. class A-C; age: 40±19 yrs) were recruited to undergo 1 hour of IPC in one leg (experimental leg; EXP) with the other leg serving as a control (CON). IPC consisted of sequential, foot-to-calf compressions (4-s inflate, 16-s deflate; 3 compressions/min; 60 mins). Posterior tibial artery BF (Doppler-ultrasound) was examined at rest, and following 15 and 45 mins of IPC. Vascular function was assessed using the flow-mediated dilation approach (FMD), both before and after IPC. RESULTS: Resting artery diameter, blood flow, FMD% and FMD normalized to shear stimulus area-under-curve (FMD%/AUC) were similar between legs. A two-way repeated measures ANOVA (leg x time) revealed that during IPC, BF significantly increased (P=0.028) in the EXP leg (9±3 to

13±4 mL/min at 15 mins; +65±27%), with no change occurring in the CON leg (8±4 to 9±6 mL/min at 15 mins IPC). There was no significant main effect of IPC on FMD changes in either leg; however, 5 of 6 individuals did show improvements in the EXP leg for FMD normalized to shear. CONCLUSION: These preliminary findings suggests that 60 mins of IPC can acutely increase leg BF, and improve vascular function in some individuals with SCI.

2983 Board #48 June 3, 3:30 PM - 5:00 PM

Autonomic Responses to Orthostasis after Acetylcholinesterase Inhibition in Tetraplegia

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PURPOSE: We have demonstrated that acetylcholinesterase inhibition (AChI: pyridostigmine bromide: PB) improves orthostatic blood pressure (BP) responses to head-up tilt (HUT) compared to no drug (ND) in some individuals with tetraplegia and theorize that difference between subjects with an orthostatic BP response to PB (responders [R]) and those without a BP response (non-responders [nR]) may relate to the autonomic completeness of injury. Although we cannot directly assess the degree of autonomic cardiovascular impairment, we determined differences in the autonomic response to HUT using heart rate (HR) variability (HFV) and BP variability (BPV) after administration of PB (60 mg) compared to ND in subjects with tetraplegia. METHODS: Mixed factor ANOVA was used to determine main and interaction effects for high frequency HRV (HF: vagal) and low frequency BPV (LFsbp: sympathetic) responses to HUT (0°, 15°, 25°, 35°) following PB and ND administration in the R and nR. Beat-to-beat HR and BP were assessed using a 3-lead ECG and finger photoplethysmography, respectively; data were collected at 500 Hz for 5-minutes at each angle of HUT. RESULTS: Eleven individuals with SCI participated; however, one subject was unable to tolerate the HUT maneuver during ND therefore, results are presented in 10 subjects (age: 38±10 years; duration of injury: 13±10 years; level: C4-6; AIS: A, B, C). Five individuals were R and 5 were nR (+6.9±5.5 vs. -7.1±8.1 mmHg, respectively; p=0.012); demographics did not differ between the groups. Supine HR was lower in R compared to nR (48±3 vs. 57±8 bpm, respectively; p=0.049); supine BP did not differ. Although supine HF did not differ, supine LFsbp was increased in R compared to the nR (4.1±0.12 vs. 3.82±0.24 ln, respectively; p=0.041). The group (R, nR) by condition (PB, ND) by HUT interaction effect was significant for HF (3.639; p=0.044), but not for LFsbp. CONCLUSION: These data suggest that tetraplegic individuals with increased resting sympathetic nervous system activity (LFsbp) respond to AChI with an increased BP and vagal response to HUT, indicative of improved orthostatic baroreceptor function.

2984 Board #49 June 3, 3:30 PM - 5:00 PM

The Effectiveness Of Ischemic Preconditioning In Older Physically (In)active Males

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Reperfusion is critical for the survival of ischemic tissue, but causes significant additional damage to the endothelium (ischemia-reperfusion [IR]). Ischemic preconditioning (IPC) refers to short repetitive episodes of ischemia, which has demonstrated to reduce IR injury. The protective effects of IPC against endothelial IR injury are attenuated with aging. Possibly, regular physical activity is able to 1) attenuate endothelial IR, and 2) restore effectiveness of IPC in older humans.

PURPOSE: To compare endothelial IR-injury and the effectiveness of IPC to protect against endothelial IR-injury between older lifelong physically active versus inactive males.

METHODS: We included 11 older athletes (63±4 years, >5 exercise hours/week) and 3 inactive controls (69±6 years, <1 exercise hours/week). We measured brachial artery endothelial function before and after IR injury using flow-mediated dilation (FMD). IR-injury was induced by 20-minute ischemia followed by 20 minutes of reperfusion. Prior to IR-injury, subjects underwent SHAM (35-minute rest) or IPC (3 cycles of 5-minute cuff inflation to 220 mmHg). The order of SHAM and IPC was randomly assigned to the participants. RESULTS: FMD% did not differ between athletes and inactive controls at baseline for SHAM (4.5±4.4% vs. 4.1±2.4%, p=0.87) or IPC (5.1±3.1% vs. 3.3±1.1%, p=0.37). IR-injury showed no significant decrease in FMD% in athletes (FMD_{pre} 4.5±4.4% vs. FMD_{post} 3.0±2.0%, p=0.32), whereas FMD% markedly decreased in inactive controls (FMD_{pre} 4.1±2.3% vs. FMD_{post} 0.5±2.5%, p=0.036). Applying IPC before IR-injury did not alter the change in %FMD in both athletes

(FMD_{pre} 5.1±3.2% vs. FMD_{post} 2.8±3.3%, *p*=0.17) and controls (FMD_{pre} 3.3±1.1% vs. FMD_{post} 1.5±2.2%, *p*=0.19). No differences were observed in %FMD change between SHAM and IPC in athletes and inactive controls.

CONCLUSIONS: Athletes demonstrate smaller endothelial IR-injury compared to their physically inactive peers. The cardio-protective effects of regular exercise training may, in part, relate to attenuating endothelial IR-injury. Finally, lifelong regular exercise training seems unable to alter the age-related attenuated efficacy of IPC against endothelial IR-injury.

F-22 Free Communication/Poster - Cognition, Emotion, and Sport

Friday, June 3, 2016, 1:00 PM - 6:00 PM
Room: Exhibit Hall A/B

2985 Board #50 June 3, 2:00 PM - 3:30 PM
Perceptive Cognitive Skills of Elite Orienteers and Its Relation with Neurotrophic Factors and Myokines
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Orienteering is a sport in which both endurance fitness and mental skills are needed to achieve performance. On one side, high levels of aerobic fitness and anaerobic power are required, comparable to those of middle-distance track athletes. On the other, attentional, decisional and problem-solving skills are essential, similar to those of sports involving information processing under time pressure.

PURPOSE: The aim of this study was to determine the perceptive cognitive skills of elite orienteers and its relation with brain derived neurotrophic factor (BDNF) and irisin concentrations.

METHODS: Twelve elite orienteers, twelve endurance trained athletes (pentathlon) and twelve sedentary men in the same age group participated to the study. Forty-eight hours after the last exercise session perceptive cognitive skills measured with minimal-state examination test and blood samples were obtained. Plasma irisin and BDNF levels were analyzed by ELISA methods in these samples.

RESULTS: The Mini-Mental State Examination score of the orienteers and endurance trained athletes were higher than sedentary control (*P* < 0.05). Similarly plasma BDNF and irisin concentrations of the orienteers and endurance trained athletes were higher than sedentary control (*P* < 0.05). Positive correlation between the Mini-Mental State Examination score and irisin and BDNF levels were observed.

CONCLUSION: These results showed that higher perceptive cognitive skills of the elite orienteers and endurance trained athletes might be related to the higher levels of the BDNF and irisin.

2986 Board #51 June 3, 2:00 PM - 3:30 PM
Anxiety-state: In Study With Artistic Gymnastics Athletes
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Anxiety can be understood as a tension in consequence of the interpretation of a real or imaginary danger situation, accompanied by unpleasant body feelings such as fear, empty feeling in stomach, increased blood pressure, increased heart and respiratory rate. It can be expressed by several factors such as the athlete's level of experience, importance and difficulty of the event, etc. Thus, the anxiety may contribute beneficially in a harmful way.

PURPOSE: Analyze the profile of anxiety-state in artistic gymnastic athletes preceding the competition.

METHODS: The sample was composed by 35 female artistic gymnastics athletes, aged between 13 and 19 years old. The athletes who fulfilled the criteria for having participated in the survey were evaluated individually during the Open Games of the Interior, held in Bauru city, between 30 and 60 minutes preceding the competitions. The athletes participating answered the Competitive State Anxiety Inventory-2 which aims to measure the pre-competitive anxiety-state. It is divided into: cognitive anxiety, somatic anxiety and self-confidence. The test consists of 27 questions, in which the answers

can vary in the following scales: 1 absolutely not and 4 very much. For interpretation of the data on the variables, cognitive anxiety, somatic anxiety and self-confidence will be used the following classification: low (9-18 points), medium (19-27 points) and high (28-36 points). For the data analysis calculations of descriptive statistics (mean, median, standard deviation, minimum and maximum) were used.

RESULTS:

The results show that preceding the artistic gymnastics tests, the average value of cognitive anxiety (15,49±3,54) was rated as "low". It was also observed that the somatic anxiety (16,17±4,24) and self-confidence (23,69±10,61) were classified as "low" and "average" respectively.

CONCLUSIONS:

The athletes evaluated in this study showed desirable values for cognitive and somatic anxiety components. This result is positive, because in sports that require coordination, concentration and balance, the high level, especially of somatic anxiety, becomes negative for the performance.

2987 Board #52 June 3, 2:00 PM - 3:30 PM
The Role Of Sex As A Moderator Of Cognitive Outcome Following A Sport-related Concussion
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(No relationships reported)

Despite increasing research, results regarding sex as a moderator of outcome following a concussion are conflicting and management guidelines remain uncertain.

PURPOSE: To determine if there is a gender difference in the long-term cognitive outcomes of athletes with a history of concussion (HOC).

METHODS: 196 collegiate athletes (49 HOC women, HOC 49 men, 49 women matched controls, 49 men matched controls) completed a modified Cogstate test battery, to which a 2-back condition (N-back task) was added to increase our ability to detect persistent deficits in higher cognition. All participants were symptom-free at time of testing and those with a HOC were 6+ months from injury (24.0 ± 15.8 months, 1.44 ± 1.3 prior concussions).

RESULTS: A significant interaction of error type × HOC × sex was observed. Specifically, HOC men exhibited a greater number of omission errors relative to HOC women (2.94 ± 2.5 vs. 0.31 ± 0.9, *p*<0.05). Moreover, irrespective of sex, HOC athletes exhibited a greater number of errors on the 1-back (2.30 ± 1.5 vs. 0.79 ± 0.9, *p*<0.01) and 2-back conditions (3.34 ± 2.6 vs. 1.46 ± 1.4, *p*<0.01), relative to controls. HOC athletes also exhibited decreased accuracy on the 1-back (95.45 ± 3.0% vs. 98.21 ± 2.2%, *p*<0.01) and 2-back conditions (93.98 ± 4.1% vs. 96.65 ± 3.3%, *p*<0.05).

CONCLUSIONS: The current results suggest that beyond the acute phase of the injury, sex does not seem as a moderating variable of cognitive outcomes following concussion. Furthermore, the results reaffirm that concussive injuries can result in persistent deficits in aspects of higher cognition.

2988 Board #53 June 3, 2:00 PM - 3:30 PM
An Assessment Of Australian Judo Practitioners' Perceptions Of Motivational Climate, Mindfulness, Aggression, And Social Skills
Susumu Iwasaki¹, Akitoshi Sogabe², Fiona Iredale³, Taketo Sasaki⁴. ¹The University of Kansas, Lawrence, KS. ²Konan University, Kobe, Japan. ³Edith Cowan University, Joondalup, Australia. ⁴Fukushima University, Fukushima, Japan.
(No relationships reported)

PURPOSE: The current study employed the Achievement Goal Perspective Theory (AGPT), Caring Framework (CF), and Mindfulness (MF). The purpose of this study was to examine interrelationships among perceived motivational climate, mindfulness, aggression, and social skills with a sample of Australian judo practitioners.

METHODS: Australian judo practitioners (N=30) volunteered to complete the survey consists of motivational climate (caring; CC; task-involving; TIC; ego-involving climate: EIC), mindfulness (MF), aggression (AG), and social skills (SS). This study obtained the permission from the Human Ethics Committee of Konan University.

RESULTS: Cronbach's alpha reliability coefficients were satisfactory for each construct ranged from .75 to .86. Descriptive statistics provided means of composite scores (M) and standard deviations (SD): M=4.43, SD=.48 (CC); M=4.04, SD=.58 (TIC); M=2.68, SD=.70 (EIC); M=2.76, SD=.43 (MF); M=2.08, SD=.71 (AG); M=3.88, SD=.43 (SS). Pearson correlation analyses revealed significant associations (*p*<.05, 2-tailed) between: 1. CC and TIC (.46). 2. CC and EIC (-.54). 3. EIC and AG (.46). 4. MF and SS (.50). 5. AG and SS (-.38). Finally, three significant linear regression models were highlighted: 1. Judo practitioners' perceptions of EIC were significant positive predictor for their AG (Beta=.47; R square=.21; *p*<.05). 2. Judo practitioners' self-evaluated SS were significant negative predictor for their AG (Beta=-.63; R square=.14; *p*<.05). 3. Judo practitioners' MF was significant positive predictor for their SS (Beta=.49; R square=.25; *p*<.01).

CONCLUSIONS: Results showed three key points: 1. Judo practitioners who perceived high EIC on their dojo (team) were more likely to report high in AG. 2. Those who self-evaluated high in SS were inclined to report low in AG. 3. Those who reported high in MF were apt to report high in SS. These summaries were discussed with the perspectives of AGPT, CF, MF, and the original philosophy/purpose of judo. Future research should consider a larger sample size and longitudinal approach for further examination.

2989 Board #54 June 3, 2:00 PM - 3:30 PM
Gender Differences in Psycho-affective Outcomes of Concussion in University Athletes
 william sauve, Robert Davis Moore, Dave ElleMBERG. *Université de Montréal, Montréal, QC, Canada.*
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 (No relationships reported)

Background: Concussion or mild traumatic brain injuries are known to cause alterations in psycho-affective health (Jorge, 2004). Relative to males, females are thought to be at greater risk for concussion and report more intense symptoms following concussion (Covassin, 2007). Despite this, few studies comprehensively evaluated psycho-affective health between males and females beyond the acute phase of injury (Barnes, 1998; Covassin, 2007). **Purpose:** To assess longitudinally the influence of gender on psycho-affective health following concussion. **Method:** 30 collegiate athletes (14 females, age = 20.79 ± 1.37; 16 males, age = 20.93 ± 1.12) completed the Beck's Depression Inventory-II (BDI-II) and the Profile of Mood States (POMS) at 7 and 30 days following a concussion. **Results:** On the POMS subscales, all athletes had greater anger ($p=0.05$), vigor ($p=0.03$), fatigue ($p=0.01$), confusion ($p=0.01$) and total mood disturbances ($p=0.03$) at day 7 compared to day 30 post-injury. However, analyses failed to reveal any gender differences for any of the POMS subscales at either time point. All athletes also exhibited greater intensity of depressive symptoms on the BDI-II ($p<0.01$) at day 7 compared to day 30. However, at day 7, female athletes had significantly greater scores on the BDI-II than male athletes ($p=0.05$), but no gender difference was found at 30 days post-injury. **Conclusion:** The current results suggest that gender differences in psycho-affective outcomes following concussion are selective to depressive symptoms. Further these differences appear relegated to the acute phase of injury. Thus time since injury, not gender, appears to be the most important factor moderating the intensity of psycho-affective symptoms following a concussion.

2990 Board #55 June 3, 2:00 PM - 3:30 PM
Aggression and Quality Of Life in Collegiate Football Players at Pre-season and One-year Follow Up
 Elliott Bueler, Daniel Epstein, Charlie Hicks-Little, Arwen Fuller, Jennifer DiMuzio, Erin McGlade, Deborah Yurgelun-Todd. *University of Utah, Salt Lake City, UT.*
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Collegiate football players are a group whose success and self-worth may at least partially depend on the exertion of context-appropriate aggression. However, what is not well understood is the degree to which aggressive behaviors may spill over into their lives outside of football and exert an untoward effect on their subjective quality of life.

PURPOSE: The aim of the present study was to determine the relationship between change in self-report ratings of aggression and quality of life at preseason and again at one-year follow up.

METHODS: Fifty members of an NCAA Division 1 football team completed the Displaced Aggression Questionnaire (DAQ) (Denson, Pedersen, & Miller, 2006) and the Buss-Perry Aggression Questionnaire (Buss & Perry, 1992) during preseason camp. Prior to the start of fall football activities one year later, these individuals completed the same questionnaires as well as the Quality of Life Inventory (QOLI) (Frisch, Cornell, Villanueva, & Retzlaff, 1994). We utilized paired t-tests to observe any changes in aggression indices from Time 1 to Time 2. We then examined change scores on these indices across time points with the self-reported QOLI scores collected at Time 2 as a means of determining the extent to which quality of life might be associated with endorsed aggression.

RESULTS: Paired t-tests for all subjects revealed significant changes in aggression at Time 2, with decreases in all DAQ indices and decreases in all but two on the Buss-Perry (Anger and Verbal were elevated). The increase in Buss-Perry Verbal across time points was associated negatively with self-reported QOLI collected at Time 2 ($r=-0.42$; $p<0.01$), indicating that the greater the increase in Verbal aggression the lower the quality of life.

CONCLUSIONS: Our results suggest a relationship between change in a self-report index of aggressive behavior over the course of one year and subjective quality of life in collegiate football players. While research in this area is extremely limited, in light of work from Stephan et al. (2003) into the effects of transitioning out of sport on athletes' subjective well-being, our findings underscore the need to provide collegiate athletes

wellness programming that is tailored to their experience with aggressive behaviors to maximize their quality of life both during and after competition.

2991 Board #56 June 3, 2:00 PM - 3:30 PM
The Influence of Sport-Related Concussion on Autonomic and Cognitive Function
 Christopher J. Brush, Ryan L. Olson, Peter J. Ehmman, Brandon L. Alderman. *Rutgers, The State University of New Jersey, New Brunswick, NJ.*
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 (No relationships reported)

Annually, as many as 3.8 million sport-related concussions are estimated to occur in the U.S. Emerging research has focused on brain and cognitive impairments due to these injuries; however, the impact of concussions on peripheral physiological measures, such as cardiac autonomic function, warrants attention. **PURPOSE:** The primary aim was to examine the relationship between cardiac autonomic function in athletes with and without a history of diagnosed concussion and to determine whether autonomic function was related to cognitive function. A secondary aim was to determine if years of high-risk sport participation was related to impairments in autonomic and cognitive function. **METHODS:** We collected neurophysiological data from sixty-two athletes (20.4 ± 1.7 years) with and without a history of diagnosed concussion. Autonomic function was assessed using low- and high-frequency heart rate variability (LF- and HF-HRV), and pre-ejection period (PEP) at rest and during a paced-breathing challenge. Cognitive function was assessed using behavioral performance (reaction time and response accuracy) and event-related potential (ERP) indices of cognitive control during a modified flanker task. **RESULTS:** No significant differences in autonomic function were found at rest, $p > .05$. Paced-breathing increased LF-HRV for all participants, regardless of concussion status, $p < .001$. Significant differences emerged for PEP, an index of sympathetic cardiac control, suggesting altered autonomic function in individuals with a concussion history. Although there were no significant differences for behavioral performance measures, N2 amplitude was suppressed in athletes with a history of concussion during the flanker task, $p < .05$. No significant relationships were found by years of high-risk sport participation. **CONCLUSION:** The findings suggest potential long-term effects of concussion on autonomic and cognitive function. However, these prolonged effects were not associated with years of playing high-risk sports, suggesting that the important factor is the incidence of concussion. Understanding the persistent effects of concussion on integrated neurophysiological measures may aid in the development of more comprehensive concussion prevention and management strategies.

2992 Board #57 June 3, 2:00 PM - 3:30 PM
Effects of Acute Exercise, Dehydration and Rehydration on Cognitive Function in Well Trained Athletes: Repeatability of Performance on a Choice Reaction Time Task
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 (No relationships reported)

PURPOSE: This study investigated the effects of aerobic exercise, fluid loss, and rehydration on cognitive performance in well-trained athletes. Repeatability of effects was examined across four replicated trials.

METHODS: Ten endurance trained males (25±5 yrs; 175±5 cm; 70.4±5.5 kg; VO₂max, 63.0±7.2 ml/kg/min) lost ~2.5±0.6% body mass via continuous cycling exercise at ~65% peak sustainable power output before consuming different beverages (Water = W1 and W2, Sustagen Sport = SS, Powerade = PD) and food ad libitum on four separate occasions. Cognitive function using a four-choice reaction time task (CRT), body mass, fluid consumption volumes, urine samples, and subjective ratings (alertness, concentration, energy) were obtained before and after exercise, and hourly during recovery.

RESULTS: CRT latency was significantly reduced immediately after exercise compared to pre-exercise measures for all trials (W1 = -16±18ms, W2 = -22±21ms, PD = -22±22ms, SS = -19±26ms). However, this effect was short-lived with subsequent measures not different from pre-exercise values. No difference in CRT accuracy was observed at any time across all trials. Subjective ratings were not different at any time across all trials.

CONCLUSIONS: Aerobic exercise provides a small cognitive performance benefit despite generating fluid losses greater than 2% body mass loss. However these effects are temporary and confined to the immediate post-exercise period.

F-23 Free Communication/Poster - Dance

Friday, June 3, 2016, 1:00 PM - 6:00 PM

Room: Exhibit Hall A/B

2993 Board #58 June 3, 3:30 PM - 5:00 PM

Effect Of A Mother-daughter Dance Intervention On Pre-adolescent African-american Girls' Physical Activity LevelSofiya Alhassan, FACSM, Sarah Burkart, Cory Greever, Ogechi Nwaokemele, Matthew Ahmadi, Lisa Fiorenzo. *University of Massachusetts, Amherst, MA.*

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(No relationships reported)

Maternal health behaviors have been shown to mediate children's health behaviors. Thus, studies exploring interventions to enhance parent and child health behaviors, such as physical activity (PA), are critical. In the African-American culture, maternal figure are thought to be the primary influence on the health behavior of their daughters through late adolescence. Therefore, a joint PA intervention targeting daughters and their mothers could potentially improve African-American girls' PA levels.

PURPOSE: To examine the effects of a 12-week mother-daughter afterschool culturally-tailored dance intervention on the PA levels of pre-adolescent African-American girls. **METHODS:** Seventy-three mother-daughter dyads [girls (n = 73, age = 8.3±1.3 yrs, BMI percentile = 68.2 ± 29.0); mothers (n = 71, age = 37.2±7.8 yrs, BMI = 31.9±7.2 kg/m²)] were randomly assigned to one of three groups [child-mother (CH-M, n = 26), child alone (CH, n = 24), or control (CON, n = 23)] to participate in an afterschool culturally-tailored dance intervention (60 minutes/day, 3 days/week, 12 weeks). Girls in the CH-M group participated in the afterschool dance intervention with their maternal figure, while girls in the CH group participated in the intervention alone. The CON group received weekly newsletters for the duration of the study. PA was assessed with accelerometers for seven consecutive days at baseline, 6 weeks, and 12 weeks. Hierarchical linear modeling was used to examine rates and patterns of change in PA over time. **RESULTS:** During the afterschool intervention time (3:30-6:30pm), girls in the CH-M group displayed a significantly steeper rate of increase in their percent time spent in vigorous PA compared to both the CH ($\gamma = 0.80, p < 0.001$) and the CON group ($p < 0.001$). For total daily PA, mothers in the CH-M group displayed a significantly steeper rate of increase in their percent of time spent in moderate-to-vigorous PA compared to the CH group ($\gamma = 0.07, p = 0.01$). No significant changes were observed in daughters' total daily PA. **CONCLUSION:** A culturally-tailored afterschool mother-daughter intervention can improve PA in African-American girls. However, to improve total daily PA, future research should also target the PA home environment.

Supported by: NIH:NIDDK (K01 DK087812)

2994 Board #59 June 3, 3:30 PM - 5:00 PM

Movement Discordance Between Healthy And Non-healthy Us AdultsAnn M. Swartz, FACSM, Young Cho, Whitney A. Welch, Scott J. Strath, FACSM. *University of Wisconsin-Milwaukee, Milwaukee, WI.*

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(No relationships reported)

Physical activity is known to significantly impact cardiometabolic health.

Accelerometer data, as a measure of physical activity, can be used to objectively identify a disparity in movement (movement discordance) between healthy and unhealthy adults. **PURPOSE:** To examine the Movement Discordance between healthy and unhealthy adults in a large US sample.

METHODS: Data from the National Health and Nutrition Examination Study (NHANES) 2003-2004 and 2005-2006 cohorts were used for this study. Participants were classified as having a "normal" or "abnormal" value for each cardiometabolic health parameter examined, based on published criteria. Linear regression analyses were performed to determine significance of each abnormal health parameter (risk factor) in its unique effect on accelerometer counts, controlling for age and gender. **RESULTS:** 6091 individuals met our inclusion criteria (20+ years of age, valid accelerometer data with one or more of the health variables measured). Average cpm for those with healthy levels of each individual cardiometabolic health parameter range from 296 cpm (C reactive protein) to 337 cpm (waist circumference), while average cpm for those with abnormal levels of each individual cardiometabolic health parameter range from 216 cpm (insulin) to 291 cpm (LDL-cholesterol). After controlling for age and gender, waist circumference, HbA1c, Insulin, homocysteine, and HDL-Cholesterol were the cardiometabolic health parameters that showed significant, independent effects on cpm. Overall, individuals who have abnormal values for all significant cardiometabolic health parameters ("unhealthy") averaged 267 cpm (SE= 15 cpm), while the healthy sample of this study averaged 428 cpm (SE=

10 cpm). The difference in cpm between the unhealthy and healthy groups was similar between males and females. Further, for both males and females, the cpm gap between unhealthy and healthy was largest in the 30s (males: 183 cpm; females 144 cpm) and lessened as age increases, with the lowest gap seen in those 80+ years (males, 81 cpm; females, 85 cpm).

CONCLUSIONS: This Movement Discordance between healthy and unhealthy adults represents a gap in movement and a target that needs to be closed to improve the health of individuals with, or at risk for cardiometabolic disease.

2995 Board #60 June 3, 3:30 PM - 5:00 PM

The Association between Pain Severity and Attendance Rate in Older Adults Participating in an Exercise ProgramSatoshi Nagae¹, Elisa Ogawa¹, Saurja Thapa¹, Huan Zhang², Lauren Tierno¹, Netsanet Tsegai¹, Ling Shi¹, Suzanne Leveille¹, Tongjian You, FACSM¹. ¹University of Massachusetts Boston, Boston, MA. ²Huan's Tai Chi, Cambridge, MA. (Sponsor: Tongjian You, FACSM)

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(No relationships reported)

Regular exercise could benefit older adults with chronic musculoskeletal pain who are at risk for falls. However, it is unknown if exercise attendance/dropout rate is related to pain severity in older adults with chronic multisite pain. **PURPOSE:** To examine the association between baseline pain severity and attendance at a light exercise program for older adults with multisite pain who are at risk for falls. **METHODS:** Twenty four community-dwelling older adults (77±9 years, 19 females and 5 males) with multisite pain (≥ 2 pain sites) who reported falling in the past year or currently used an assistive device were recruited from the Boston area. All participants enrolled in a 12-week light exercise program supervised by trained exercise instructors at a community facility. The exercise program comprised either light physical exercise (stretching, walking and weight training) or mind-body exercise (tai chi exercise) for 2 x 1 hour sessions each week. Global pain severity was measured at baseline using the Brief Pain Inventory by the pain severity subscale (0-10). A multinomial logistic regression was used to evaluate the association between baseline pain severity and exercise attendance. **RESULTS:** The average pain severity score at baseline was 4.92±1.60. Of all 24 participants during the 12-week exercise intervention, 12 attended at least 80% of the exercise classes, 8 attended less than 80% of the classes, and 4 dropped out of the program. Compared to those who dropped out, participants who attended at least 80% of the classes had less severe pain at baseline (Relative Risk Ratio (RRR)= 0.34, p=0.05). Multivariable adjustment by age and gender slightly changed this difference (RRR=0.32, p=0.07). There was no difference in baseline pain severity between those who dropped out and those who attended fewer than 80% of classes. **CONCLUSION:** Global pain severity is an important factor that may interfere with exercise class attendance and dropout rate among older adults with multisite pain who are at risk for falls.

(Supported by NIH Grant R21 AG043883)

2996 Board #61 June 3, 3:30 PM - 5:00 PM

Predicting Energy Expenditure for Ballroom Dancing With Accelerometry-Based Activity Monitors in Experienced DancersDaniel P. Heil, FACSM¹, Katie Boehming², Cheryl Juergens³, Sarah Ludlow², Anna Tambasco², Eli Lankford, FACSM².¹Montana State University, Bozeman, MT. ²Brigham Young University - Idaho, Rexburg, ID. ³University of Montana Western, Dillon, MT.

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Previous work determined that recreational ballroom dancing, regardless of dance style, exceeded the vigorous intensity threshold using indirect calorimetry procedures. Future physical activity intervention studies that use ballroom dance, however, will need a more practical method for tracking the metabolic demands of the dance intervention without indirect calorimetry. **PURPOSE:** This study sought to predict the energy cost of recreational ballroom dancing using accelerometry-based activity monitors (AM) for use in future intervention studies. **METHODS:** Eighteen experienced lead (men = 9) and follow (women = 9) (Mean±SD: 23±2 yrs; 25.6±4.0 kg/m²) dance pairs each performed a series of ballroom dances (cha-cha, foxtrot, salsa, swing, waltz) in a randomized order. Beginning with 5-mins of quiet sitting to measure sitting resting metabolic rate (SRMR), each dance was performed for 5 mins (3 min breaks between) using standardized music. Both dancers wore portable indirect calorimetry systems (backpack on the back) and omnidirectional AMs on the wrist, hip and ankle for all testing. Data were summarized as averages over the last 2 mins of each dance bout with calorimetry data converted to relative activity energy expenditure rate (RAEE; kcals/kg/min) using total mass (body mass + 1.4

kg equipment mass) and subtracting SRMR. RAEE prediction models were then generated using standard step forward multiple linear regression (P to enter/exit = 0.05; $\alpha = 0.05$) for each dance separately, as well as using the pooled data for all dances. Independent variables included those for AMs (counts/min), demographics, and categorical (dancer code, D; lead = 1, follow = 0). **RESULTS:** The best models were those that pooled all dance data with one model using the wrist AM (RAEE = $0.08171 + 0.01123xD + 1.394E-04 \times \text{WristAM}$; SEE = $\pm 5.845E-04$; $R^2 = 0.31$; $P < 0.0001$), and another using the ankle AM (RAEE = $0.0654 + 0.0124xD + 2.351E-04 \times \text{AnkleAM}$ - $2.589E-07 \times \text{AnkleAM}^2$; SEE = $\pm 6.153E-04$; $R^2 = 0.28$; $P < 0.0001$). **CONCLUSIONS:** These results show that a single AM worn on either the wrist or ankle can reasonably predict the energy the energy cost of recreational ballroom dancing.

2997 Board #62 June 3, 3:30 PM - 5:00 PM
Ballroom Dance for Persons with Multiple Sclerosis: Physical and Cognitive Efficacy

Stephanie Raab¹, Katelyn Dato-on¹, Jimin Suh¹, Sheri L. Bunyan², Shannon Gambon¹, Tyler Gregory¹, Lauren Kalita¹, Alexander V. Ng, FACSM¹. ¹Marquette University, Milwaukee, WI. ²Concordia University, Milwaukee, WI. (Sponsor: Alexander V. Ng, FACSM)
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PURPOSE: Ballroom, or recreational social dance is a recreational physical activity that can allow participants to use each other as support during partnered dance. We have previously showed in a small sample that ballroom dance is a feasible, fun, social form of mild to moderate physical activity that may improve quality of life for people with multiple sclerosis (PwMS). The purpose of this study was to further investigate physical and psychological/emotional efficacy resulting from a ballroom dance program.

METHODS: 18 PwMS participated in an 8 out of 10 week, dance program comprising two 1hr sessions per week (MSD) and 7 PwMS comprised a time control group (C). A professional dance teacher with knowledge of MS taught dances. Subjects were ambulatory with minimal assistance. All MSD subjects were paired with a non-MS partner during the program. Pre- and post-test measures included: Berg Balance Scale, Dynamic Gait Index (DGI), Timed Up and Go (TUG), PROMIS Global Well-Being, MS Self-Efficacy (Control, Function), Fatigue Impact Scale, Beck Depression Inventory, MS Functional Composite (timed 25-Foot Walk (25FW), Paced Auditory Serial Addition Test (PASAT), and 9-Hole Peg Test (9HPT), and 6 Minute Walk Test (6MWT).

RESULTS: Results are mean (SD). Improvements in the MSD group were noted in the DGI (pre=19 (6), post=21 (4), $p=0.02$), TUG (pre = 10.0(3.4)s, post 8.6(3.9)s, $p = 0.003$) PASAT (pre=40 (19), post=45(19), $p=0.01$), 9HPT (pre=22.3 (2.6)s, post=21.2 (2.2)s, $p=0.02$), and 6MWT (pre=447 (112) m, post=485 (113) m, $p=0.010$). In contrast, there were no differences over 8 weeks in any of these variables in C. For C, DGI (pre=19 (6), post=20 (5), $p=0.2$), TUG (pre = 8.0(1.7)s, post 7.8(1.9)s, $p = 0.60$), PASAT (pre=44 (10), post=44(17), $p=0.01$), 9HPT (pre=21.9 (5.3)s, post=20.6 (4.0)s, $p=0.2$), and 6MWT (pre=491 (80) m, post=519 (66) m, $p=0.07$).

CONCLUSIONS: A partnered ballroom dance program can lead to some significant improvements in physical function and cognition in PwMS. This study was supported by The Greater Milwaukee Foundation.

2998 Board #63 June 3, 3:30 PM - 5:00 PM
Effects Of A Dance Intervention On Physical Activity And Sedentary Behavior Preference In African-American Girls

Matthew N. Ahmadi, Cory Greever, Sarah Burkart, Sofiya Alhassan, FACSM. *Umass, Amherst, Amherst, MA.* (Sponsor: Sofiya Alhassan, FACSM)
 (No relationships reported)

African-American (AA) girls' physical activity (PA) declines while their sedentary behavior (SB) increases in the progression from pre-adolescence to adolescence. AA girls' preference for PA and SB have been related to their level of PA and SB. Currently, it is unknown if participation in a PA intervention can alter PA or SB preference. **PURPOSE:** To examine if a 12-week culturally-tailored dance intervention can alter PA or SB preferences and its subsequent effect on SB levels in AA girls. **METHODS:** Data from pre-adolescent AA girls ($n=49$, age = 8.3 ± 1.3 yrs; BMI = 19.3 ± 5.1 kg/m²) participating in the Mothers and Girls Dancing Together Trial were used for this secondary analysis. The PA intervention consisted of 60 minutes of culturally-tailored moderate-to-vigorous dancing delivered 3 days/week for 12 weeks. PA and SB preferences were assessed using validated questionnaires. SB levels were assessed using Actigraph GT3X accelerometers for seven days. Associations between PA preference and SB preference were examined using Spearman correlations. Changes in PA and SB preferences were assessed using 2x2 ANOVA and changes in SB levels were assessed using MANOVA. **RESULTS:** There was a significant association between PA preference and SB preference ($r=0.45$, $p<0.0001$). No other

significant findings were observed. **CONCLUSION:** In the current sample of AA girls, participation in a culturally-tailored dance intervention was not effective in altering SB and PA preferences. The lack of change in PA or SB preference could be due to the fact that the intervention did not directly target changing PA or SB preferences. Future culturally-tailored dance interventions should include intervention strategies that directly target altering an individual's PA and/or SB preferences. Supported by: NIH:NIDDK (K01 DK087812)

2999 Board #64 June 3, 3:30 PM - 5:00 PM
The Metabolic Equivalent for Tinikling: A Philippine Folkloric Dance

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Tinikling, or bamboo dance, is a traditional Philippine folk dance that is also popular among many Filipino-American communities. As a popular form of physical activity, Tinikling dance may be used as a moderate-to-vigorous physical activity (MVPA) intervention tool for at-risk Filipino communities. However, the energy cost of Tinikling is currently unknown. **PURPOSE:** The purpose of this study was to evaluate the energy expenditure of Tinikling dance within experienced adult Filipino dancers, as well as whether the MET value would exceed either the 3.0 or 6.0 MET thresholds for MVPA. **METHODS:** Twenty-two "low risk" healthy Filipino-American adults from Las Vegas, NV, all of whom self-reported having practiced Tinikling dance within the previous 12 months, were recruited. Test subjects included 15 women (Mean±SD: 32 ± 10 yrs, 24.8 ± 4.5 kg/m²) and 7 men (38 ± 12 yrs, 27.0 ± 4.9 kg/m²). During a single 60-min visit, subjects performed 5 mins quiet sitting, 4-min warm-up, 5 mins of dance, 3 mins active recovery, 5 mins of quiet sitting. While testing, subjects wore a telemetry-based portable indirect calorimetry system to assess energy expenditure (EE). Subjects danced to the same track of music that had been looped to allow for 5 mins of continuous dancing. An average of the last two mins of EE data were then converted to activity energy expenditure (AEE, kcals/kg/min), relative oxygen update (VO₂, ml/kg/min) and METs for each subject using total mass (body mass + 1.5 kg equipment mass). One-sample t-tests were used to compare the resulting mean MET values for women, men, and all subjects, to 3.0 and 6.0 MET MVPA thresholds (0.05 alpha level). **RESULTS:** Mean METs were significantly greater than both 3.0 ($P < 0.0001$) and 6.0 METs ($P = 0.0015$). The mean measures of energy expenditure were as follows: METs (Mean±SD; 6.9 ± 1.4 , 7.0 ± 1.0 , 6.9 ± 1.3), VO₂ (24.1 ± 4.9 , 24.4 ± 3.5 , 24.2 ± 4.4 ml/kg/min), and AEE (0.1083 ± 0.0243 , 0.1064 ± 0.0161 , 0.1077 ± 0.0216 kcals/kg/min) for the women, men, and all subjects, respectively. **CONCLUSIONS:** The mean MET values for Tinikling dance exceeded both 3.0 and 6.0 MET thresholds for moderate and vigorous intensity thresholds, respectively. These results support the use of Tinikling dance as a culturally-specific means of promoting and accumulating weekly MVPA.

F-24 Free Communication/Poster - Elite Athletes

Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

3000 Board #65 June 3, 3:30 PM - 5:00 PM
EMG Changes In Fatigue: Meta-analysis And Application To Elite Instrumental Music Performance

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INTRODUCTION: Instrumental musicians frequently undergo similar levels of physical strain to sport athletes, yet the physical demands of musicianship are rarely considered during practices/rehearsals. **PURPOSE:** To develop a quantitative model of fatigue in violin performance and provide a basis for smarter practice/rehearsal programming. **METHODS:** This study was conducted in three distinct phases: (1) MEDLINE, PubMed, Web of Science, SportDISCUS, and Cochrane Library were searched for articles reporting changes in electromyographic (EMG) amplitude and/or frequency data during constant force isometric, intermittent isometric, or dynamic contraction protocols ≥ 20 seconds. Meta-analysis was conducted using general regression models to model the relations between initial EMG levels and both the rate of change in EMG and time to failure. (2) Professional/university violinists ($n=55$; ≥ 10 years experience) performed 5 randomly ordered 45-second music excerpts designed to elicit 5 typical right arm movements. Surface EMG data were obtained for 16 relevant muscles of the core, shoulders, chest, and right arm during excerpt performances. (3) Models from the meta-analysis were applied to the EMG data during violin performance. **RESULTS:** Database searches identified 7273 articles;

after removal of duplicates, 5079 articles were screened and 82 articles were included in the meta-analysis. Meta-analysis revealed that a higher initial EMG contraction intensity was associated with a greater rate of change of EMG amplitude (%MVC/min) and a shorter time to task failure (min). During violin performance, average EMG amplitude $\leq 12.5\%$ MVC for investigated core, shoulder, and upper arm muscles across all excerpt performances; wrist flexors and extensors ranged from 11.8% MVC (excerpt #5) to 55.8% MVC (excerpt #4). Applying the results of the meta-analysis, the rate of EMG amplitude increase and time to task failure were estimated to range from 0 - 38.9 %MVC/min and .88 - 42.4 min, respectively, during violin performance. CONCLUSION: The physical demands of instrumental music performance vary widely with repertoire and must be considered during practice/rehearsal programming to minimize fatigue and injury risk. **Research supported by the Australian-American Fulbright Commission and Australian Research Council**

3001 Board #66 June 3, 3:30 PM - 5:00 PM
Descriptive Analysis of Cardiovascular Demands During Elite Curling

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Heart rate (HR) response has been shown to effectively reflect metabolic expenditure during physical activity. While HR response has been heavily studied during athletic events such as soccer and running, there has been little research conducted on the physiological responses, such as HR variability, of athletes while participating in the sport of curling. PURPOSE: The aim of exploratory study was to establish the HR response in elite curling athletes and examine how various positions and their physiological demands influence HR in a curling match. METHODS: HR was continuously collected on three elite male curlers during one match of an elite level competition. The match lasted approximately 120 minutes and consisted of each player rotating through three specific positions: house, sweeping, and throwing. HR data was collected using heart rate monitors specifically designed for team use and was analyzed using SPSS software. RESULTS: HR ranges were 61-192 bpm while in the house position, 110-207 bpm in the sweeping position and 86-203 bpm for when in the throwing position. The mean HR was 91 +/- 31 bpm for the house position, 151 +/- 22 bpm for the sweeping position and 120 +/- 27 bpm for the throwing position. CONCLUSION: This exploratory study indicates a high level of physical and cardiovascular demand in elite curling athletes, which has not been established previously, thus reflecting a high level of metabolic expenditure. These data suggest implications for metabolic expenditures in curling that may be similar to the metabolic demand in other sports requiring high intensity efforts.

3002 Board #67 June 3, 3:30 PM - 5:00 PM
Accelerometry and Muscle Fatigue in Elite Paralympic Athletes

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The U.S. Paralympics Research and Sport Science Consortium (PRSSC) identified electromyography (EMG) analysis of wheelchair sport performance to be a major research need. The reasoning is that EMG analysis can be used to design evidence-based training programs through the understanding of sport-specific fatigue; however, the equipment may not always be feasible in sport-specific settings. Accelerometry is an alternative for examining fatigue in wheelchair sport that may be more practical in sport-specific settings. PURPOSE: The purpose of this study was to compare the relationship between EMG fatigue measures and accelerometry counts among wheelchair push and recovery muscles during wheelchair rugby training. METHODS: Wheelchair rugby players were recruited from a U.S. Olympic & Paralympic Training Site (Lakeshore Foundation, AL). Three national team wheelchair rugby players completed 5 training sessions (3 hours each) over 2 days. A 16-channel EMG system was used to assess EMG data of the pectoralis major (PM), anterior deltoid (AD), and posterior deltoid (PD). In addition, an accelerometer monitor was placed on each player's dominant forearm. To assess fatigue, changes in EMG median frequency and mean amplitude across each training session and each training day were examined and correlated with the sum vectors of acceleration. RESULTS: EMG data indicated general fatigue, upwards of 20%, was seen in all muscle groups, and there was a significant decrease of acceleration during this time. There was a strong correlation ($p < 0.05$) between acceleration and fatigue in both the AD and PM ($r = 0.63$ and 0.64 , respectively) but not in PD ($r = 0.40$).

CONCLUSIONS: There was a strong, positive relationship between EMG-detected fatigue and accelerometer scores in shoulder flexor muscles, namely pectoralis major and anterior deltoid. These findings lend support that accelerometer data is an alternative to investigating sport-specific fatigue in this athletic group and is less intrusive than EMG.

3003 Board #68 June 3, 3:30 PM - 5:00 PM
An Evaluation Of Agonist:Antagonist Strength Ratios And Posture In An Elite Powerlifter

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Evidence suggests that long-term weight training in some bodybuilders and competitive weight lifters may result in decreased flexibility, decreased range of motion (ROM), or postural changes. Some suggest this may be related to abnormal agonist:antagonist strength ratios, but this is largely unfounded. Strength imbalances may exist among elite powerlifters where the training focus is only on three lifts: bench press, squat, and deadlift. However, these variables remain unexamined in this population. PURPOSE: Examine the presence of muscle imbalances, ROM limitations, and postural abnormalities in an elite male powerlifter (age= 37 yrs; body mass=121.2 kg; percent body fat=28.9 %; training experience=24 yrs; three lift total=1013 kg). METHODS: This case-study employed isometric strength testing measured via handheld dynamometry to determine agonist:antagonist strength ratios. ROM was assessed using handheld goniometry and the Apley's Scratch test. Postural assessments included pelvic tilt, pectoralis minor length, and spinal curvature (kyphosis and lordosis) via unilevel inclinometry. Z-scores were generated using a control sample of 15 males (age=34.8±14.6 yrs; body mass=96.5±19.1 kg; percent body fat=24.2±9.4 %). RESULTS: The subject's strength ratios for shoulder horizontal adduction:abduction ($z=7.7$) and cervical flexion:extension ($z=2.7$), as well as the ROM achieved during the scratch test ($z=5.5$), were all significantly different from the mean of the control group ($p < 0.001$, $p = 0.007$, and $p < 0.001$, respectively). The z-score for hamstring flexibility (knee extension angle) was 1.27 and while not significantly different from the mean of the control group ($p = 0.204$), this indicates that the subject's hamstring flexibility was in the lower 10%. Pelvic tilt, pec minor length, kyphosis, and lordosis were all within 1 SD and not significantly different from the mean of the control group. CONCLUSION: Despite strength imbalances (stronger shoulder horizontal adductors and weak neck flexors) and decreased upper extremity range of motion, there were no postural imbalances noted in this elite powerlifter.

3004 Board #69 June 3, 3:30 PM - 5:00 PM
Prediction of 2,000 meter Rowing Time in Elite Heavyweight Oarswomen

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Performance testing of rowers is often conducted on rowing ergometers (erg) at a distance of 2,000 meters (m). Research with elite male rowers has shown power and maximal oxygen consumption (VO2 max) as the best predictors of 2,000 m erg time (2K). However, elite oarsmen of similar VO2 max and body mass often have differing 2K performances. Further, true elite oarswomen remain understudied and the best predictor of 2K performance is unclear. PURPOSE: Therefore, we examined the relationship between certain anthropometric and physiologic measures to 2K time in elite heavyweight oarswomen. METHODS: Anthropometric measures were conducted on heavyweight oarswomen ($n=41$, $X \pm SD$: age 24.9 \pm 2.1 years, height 183 \pm 4.5 cm, weight (WT) 79.5 \pm 4.97 kg, body fat 17.6 \pm 3.91%, fat free mass (FFM) 65.4 \pm 3.72 kg), all with competitive international rowing experience who were training for the United States national team. Oarswomen performed an incremental 3-stage exercise bout of 4-minutes each on a rowing erg (Concept II Model D) with constant drag factor. Exercise intensities (60, 70, 80%) were assigned as a percentage of the average wattage from a recent 2K test in which athletes had an average time of 402.9 \pm 6.37 sec. Heart rate (HR) and VO2 were measured during each stage, and blood lactate (BLA) was determined from samples collected during 1-minute periods between stages. Multiple regression analysis was used to predict 2K from anthropometric data, average 2K power, power per kg, and power per kg FFM, in addition to the following at 60/70/80%: HR, BLA, VO2, O2 pulse, mechanical efficiency, and power. RESULTS: Assumptions of linearity, independence of errors, homoscedasticity, unusual points, and normality of residuals were met. The best model, power at 80% and FFM statistically significantly predicted 2K time, $F(2, 38)=3622.23$, $p < 0.0001$, adj. $R^2=0.995$. The 2K was found to correlate significantly ($p < 0.0001$) with power at 80% ($r=-0.997$), average 2K power ($r=-0.998$) and FFM ($r=-0.498$). WT ($r=-0.473$;

$p=0.001$), power per kg ($r=-0.292$; $p=0.032$), and power per kg FFM ($r=-0.367$; $p=0.009$) were also significantly correlated. CONCLUSION: The strongest correlates to 2K are power and FFM. It is recommended that training goals for elite heavyweight oarswomen focus on increasing FFM, power generation, and improving power per kg of body WT.

3005 Board #70 June 3, 3:30 PM - 5:00 PM

Accelerometer Load During Basketball Drills In Professional Basketball Players

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PURPOSE: To examine the player load (accelerometer data expressed per minute; AL.min) during basketball-specific training drills, according to different confrontation formats and court size, in professional basketball players. METHODS: A convenience sample of twelve professional male basketball players (Spanish 1st Division; ACB), participated in the study. Data were collected during training sessions over 4 weeks. Acceleration data, interpreted as external load, were obtained from a tri-axial accelerometer at 100Hz frequency. Specific-ball-drill exercises, the SSGs and the 5v5 scrimmage in full court were analyzed. RESULTS: The higher values were identified when playing 3v3 and 5v5 scrimmage drills in full court (18.7±4.1, 17.9±4.6, respectively), and the lowest when playing 4v4 (13.8±2.5). Differences ranged between small and moderate, with most likely lower values in 2v2 compared with 3v3 and 5v5 (EF ± 90% CL: -31.1; ±12.7; and -29.3; ±10.6, respectively), and 4v4 compared with 5v5 (-29.5; ±7.3). CONCLUSIONS: This study provides insight into the specific requirements of a range of exercises typically performed in basketball sessions. The use of accelerometer data it is presented as a reliable and useful tool in monitoring the training of an indoor sport like basketball. It also shows that systematic monitoring of the physical demands during training would likely improve coaching and basketball-specific training drills.

3006 Board #71 June 3, 3:30 PM - 5:00 PM

Correlation Between Elite Women's Wheelchair Basketball Skills Testing And Future Success In The Sport

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INTRODUCTION: Wheelchair basketball practices are built around developing technical and tactical skills required in game situations. To assess performance of these skills, testing protocols have been developed. This allows both player and coach to determine improvements. However, does achieving high scores on skills tests translate to success on the basketball court during competition.

PURPOSE: The purpose of this analysis was to determine the relationship between skills test results and performance during competition as determined by the average efficiency scores.

METHODS: In April, 2013, 25 female wheelchair basketball players were invited to compete for positions on the 2014 National Wheelchair Basketball Association (NWBA) Senior Women's National Team. Skills tests were similar to those used at NWBA/PVA National Wheelchair Basketball Camps. Strength testing assessments were developed by a panel of NWBA Coaches with a history of National and International coaching experience. The results were then correlated with the box scores and player efficiency ratings obtained during the playoffs at the International Wheelchair Basketball Federation (IWBF) Women's World Wheelchair Basketball Championship in Toronto, June, 2014. The USA Women's team was divided into two groups by classification (players with functional classifications of 1.0, 1.5 and 2.0 represented Group 1 and players with functional classification of 2.5, 3.0, 3.5, 4.0 and 4.5 represented Group 2) for analysis.

RESULTS: Player efficiency was differentially related to skills tests based on player classification. Among Group 1 players, higher player efficiency ratings during the World Championship games corresponded directly with better non-dominant passing (accuracy $r = .95$, $p = .05$; stationary distance $r = 1.00$, $p < .001$; moving distance $r = 1.00$, $p < .001$). In contrast, higher percentage of free throws was directly related to better player efficiency for the players in Group 2 ($r = 1.00$, $p < .001$).

CONCLUSIONS: Findings may represent differential skill sets needed by lower and higher class players. Passing, in particular non-dominant passing skills, may give players with a lower classifications an advantage on the court; whereas, accuracy of free throws (and more opportunity) may be a skill that sets players with higher classification apart.

3007 Board #72 June 3, 3:30 PM - 5:00 PM

Age of Peak Performance in Olympic Sports: A Comparative Research among Disciplines

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(No relationships reported)

PURPOSE: The aim of this research was to study the ages of peak performance in Olympic sport disciplines, and to distinguish age groups among them. METHODS: The ages (in decimal years) of athletes with the best performances in the last Summer Olympics (London 2012) were considered ($n = 3548$). A total of forty sport disciplines were included; the athletics events were classified in six disciplines: Sprint, Middle-distance, Long-distance, Combined, Jumping and Throwing. A full statistical summary was produced. A regression tree was proposed for each gender to discriminate groups of sport disciplines according to age. ANOVA method was selected to do the splits; the complexity parameter was fixed at 0.01. RESULTS: The ages ranged from 14.0 to 52.8 years. The 72% of the athletes aged between 20 and 30 years, and the 99% aged below 40 years. The mean ages for men and women were 27.0 and 26.2 years, respectively. The regression tree analysis generated four groups of sport disciplines in men, and five in women. In men, the mean ages of the groups were: Group 1 = 24.4 ($n = 468$), Group 2 = 25.9 ($n = 362$), Group 3 = 28.0 ($n = 760$) and Group 4 = 30.8 ($n = 247$). In women, the mean ages of the groups were: Group 1 = 19.9 ($n = 88$), Group 2 = 22.7 ($n = 159$), Group 3 = 24.6 ($n = 327$), Group 4 = 26.5 ($n = 416$) and Group 5 = 28.3 ($n = 721$). The ranges of the means within the groups 1 to 4 in men were, respectively: 23.2 to 25.0, 25.3 to 26.7, 26.9 to 29.2 and 29.5 to 32.6. In women, the ranges of the means within the groups 1 to 5 were, respectively: 19.4 to 21.0, 22.2 to 22.7, 23.8 to 25.3, 25.8 to 27.3 and 27.5 to 30.2. CONCLUSIONS: Combat, gymnastics and swimming disciplines located mostly in the youngest groups in men; a similar tendency was evidenced in women, except for combat sports. Apart from Combined, all athletics disciplines located in the groups 4 and 5 in women. On the contrary, these disciplines sited mainly in the groups 1 and 2 in men. All game and nautical sports placed in the two eldest groups in both genders, excluding women Waterpolo. Among cycling disciplines, BMX showed in men and women the lowest mean age.

3008 Board #73 June 3, 3:30 PM - 5:00 PM

The Physical Profile of Elite Boardercross Snowboarders

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(No relationships reported)

Boardercross Snowboarding is an increasingly popular sport where snowboarders race through a downhill course for the fastest time. Boardercross has recently become an Olympic Sport; however, limited data exists regarding these athletes' physical characteristics. PURPOSE: This study gathered data to further define the physical profile of an elite boardercross snowboarder so that coaches and athletes will be more able to set training benchmarks and identify athlete potential. METHODS: NorAm level boardercross snowboarders ($n=10$ males; $n=9$ females) completed a series of tests designed to measure anthropometrics and parameters important to physical performance. Each participant's height and weight were measured. Body fat percentage was measured using skin fold calipers. The MBASS test was used to measure dynamic balance. A vertical jump test was used to assess leg power. A T-Test was used to measure speed and agility. A one-minute 12-inch soft hurdle jump test was used to measure lower body muscular endurance. A one-minute sit-up test was used to measure core endurance. RESULTS: Body height and mass were: males 176.4±7.0 cm and 75.4±11.3 kg, females 164.1±6.1 cm and 60.8±10.2 kg. Body fat percentage for males and females was 11.6%±4.5% and 18.9%±6.4%. MBASS error scores were dominant/non-dominant leg: males 23.1±22.4/33.9±22.5, females 15.9±16.6/31.1±25.21. Male leg power (mean and peak) was 1,538.2±334.8 and 4,402.9±722.7 watts. Female leg power (mean and peak) was 778.2±216.1 and 2,634.6±350.1 watts. Male and female T-test times were 11.43±0.60 and 12.57±0.89 seconds. Leg endurance test scores were 85.3±14.0 (male) and 59.6±8.4 (female) jumps. Male and female core endurance test scores were 37.8±8.4 and 36.9±6.5 sit-ups. CONCLUSION: In the future, additional data sets from other boardercross athletes should be added to this existing set and attempt to quantify the relationship between physical performance measures (as collected in this study) and actual NorAm competition rankings.

3009 Board #74 June 3, 3:30 PM - 5:00 PM
Energy Expenditure By Elite Midget Male Ice Hockey Players In Small-sided Games
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PURPOSE: The purpose of this study was to investigate the energy expenditure (EE) and heart rate (HR) responses elicited in elite male Midget ice hockey players during small-sided games (SSGs). **METHODS:** Nine players (aged 15.89±0.33 years) participated. Maximal, progressive treadmill testing in the laboratory measured the relationship of oxygen consumption to HR before on-ice assessments of HR during SSGs. Six different SSG patterns were tested: 1v1, 2v2, 2v2 with support player, 3v3 with support player, 3v3 with transitions and 4v4 with 2 support players). HR was recorded continuously in each game. Four intensity markers were analyzed: 1) average peak HR expressed as percentage of maximal HR reached during each SSG (%HR_{effort-peaks}), 2) mean HR during the whole SSG (including active and recovery segments) expressed as percentage of maximal HR (%HR_{mean-total}), 3) average peak EE expressed as L of O₂/min (oxygen consumption) reached during each SSG (EE_{effort-peaks}), and 4) total EE (resting and active) (EE_{mean-total}). **RESULTS:** Repeated-measures analysis of variance verified differences between SSGs (F=9.60 to 15.91). 3v3 T SSG was the most intense for all 4 intensity markers. All 6 SSGs reached equal 89% HR_{max} or beyond with HR peaks in active effort repetition. **CONCLUSIONS:** These findings demonstrate that such SSGs can be considered as high intensity games and are an effective training method for ice hockey players.

3010 Board #75 June 3, 3:30 PM - 5:00 PM
Nutritional Knowledge and Behavior of Elite Brazilian Athletes
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Dietary intake is considered an important determinant of exercise performance, adaptation to training and recovery from exercise. However, it is unknown whether elite athletes have sufficient knowledge to optimize their nutritional practices for maximum performance. **PURPOSE:** to determine (1) the influence of nutritional knowledge on the dietary behavior of elite Brazilian athletes (2) if there are gender differences. **METHODS:** A total of 126 Brazilian athletes (61 males, 24.9±4.7 yrs, and 65 females, 24.0±4.10 yrs) who participated in individual or team events during the 2015 Pan-American Games were recruited. Athletes were asked simple nutritional questions as a part of a larger questionnaire. They were asked to mark "agree" or "disagree" for a given knowledge statement regarding nutrition. Questions were also asked to determine the use of supplements and the rationale for using them. The questionnaire was administered when it did not interfere with their training routine or competitive events. **RESULTS:** Almost all athletes (96.8%) recognized that optimal nutritional practice was required during training, recovery and to maximize performance. Most athletes knew the caloric and nutritional requirements for training (77.2%) and recovery (77.3%). However, only half (50.4%) knew the nutritional requirement to optimize performance. Most of the athletes were taking supplements. Only 53.4% of the athletes knew whether the supplements were certified to be contaminant free and 11% considered it safe to use supplements. Protein (57.5%) and creatine (79.5%) were the two supplements most commonly recommended by dietitians. Protein supplements were used by 73.8% of males and 62.5% of females. The purpose for protein supplementation was for increasing muscle mass (34.5%), delay fatigue (62%) and improve muscular recovery (24.2%). Creatine was used by 16.6% if athletes to increase performance in power events. Both genders had misconceptions that protein (65%), vitamins and minerals (86.5%) are major energy requirement for muscle contraction. **CONCLUSION:** There was a large variance in basic nutritional knowledge in both male and female athletes. The greatest concern was the use of supplements by the athletes and their lack of knowledge in the safety and the purity of the supplements.

3011 Board #76 June 3, 3:30 PM - 5:00 PM
Gender Differences on Hydration Knowledge and Behavior of Elite Brazilian Athletes
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 (No relationships reported)

Optimal hydration is an important determinant of exercise performance, training adaptation, recovery and health. However, it is unknown whether elite athletes have attained the knowledge about appropriate hydration and apply this knowledge to maximize performance. **PURPOSE:** To determine: 1) the knowledge and behaviors of hydration and fluid replacement of elite Brazilian athletes. 2) if there are gender differences. **METHODS:** A total of 126 Brazilian athletes (61 males, 26.4±4.7 yrs, and 65 females, 25.5±4.10 yrs) who participated in individual or team events during the 2015 Pan-American Games were recruited. Athletes were asked simple hydration questions as part of a larger questionnaire. They were asked to mark "agree" or "disagree" for a given knowledge statement on hydration. Questions were also asked to determine the use of sports drinks and the rationale for using them. The questionnaire was administered when it did not interfere with their training regime or competitive events. **RESULTS:** Most athletes (81.3%) agreed that sports drinks are important for rehydration for prolonged exercise, with no gender difference (78.7 and 84.4%). More males than females (69.2 vs 47.5%, p=0.04) had the misconception that high intake of pure water is sufficient to replenish the electrolytes lost in sweat. The use of sports drinks was not different between males and females (76.7 and 68.8%); however, more (p=0.02) males (37.7%) than females (18.8%) use sports drinks with the purpose of improve performance. No gender differences existed for those who use sports drinks for the purpose of: replenishing electrolyte loss in sweat (41.0 and 46.9%), preventing dehydration (62.3 and 59.4%), improving muscular recovery from exercise (41.0 and 26.6%), and for refreshment (9.7 and 7.8%). **CONCLUSION:** Although most of the athletes knew about the importance of sports drinks for rehydration, many had misconceptions regarding the rationale for their use. Two gender differences were observed: females were more aware that pure water does not replenish the electrolytes from sweat and more males used sports drinks to maximize performance. It appears that these athletes would benefit from an educational program to clarify the benefits of proper hydration for performance.

3012 Board #77 June 3, 3:30 PM - 5:00 PM
Do Pregnancy And Childbirth Improve Elite Marathon Performance? An Analysis Of Available Evidence.
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It has been reported that pregnancy and childbirth lead to improved athletic performance in women, often referred to as "pregnancy doping". This ergogenic phenomenon is said to occur for up to one year following childbirth. The mainstream media regularly reports on this theory, citing performances of elite marathoners such as Paula Radcliffe, Kara Goucher, and Ingrid Kristiansen as evidence. **PURPOSE:** To assess evidence that childbirth has a performance enhancing effect on female marathoners.

METHODS: LexisNexis Academic and Google News databases were searched for news articles discussing pregnancy doping theory. Search terms included ("pregnancy doping" OR "childbirth" OR "pregnancy") AND ("performance enhancing" AND "athletes" OR "runners" OR "marathoners"). Leads to other news stories on the topic were also explored. Elite marathoners who competed in marathons before and after childbirth were identified from retrieved articles. Information on each identified athlete was collected from IAAF profile and other reputable resources, including athlete's birthdate, pre-childbirth marathon personal record (PR) and post-childbirth PR, dates of each PR, and date of childbirth. Pre- and post-childbirth marathon PR's were compared relative to time of childbirth.

RESULTS: Eight elite marathoners were identified. Five of the seven elite marathoners (Goucher, Keitany, Kristiansen, O'Sullivan, and Tulu) had faster marathon PR's after childbirth. However, only Goucher ran faster within a year after childbirth. Keitany achieved a PR 15 months after childbirth, and the three others achieved lifetime PR's >3.5 years post-childbirth. Radcliffe, Kastor, and DeReuck never improved upon their pre-pregnancy PR's after childbirth.

CONCLUSIONS: Though physiologic adaptations to exercise during pregnancy have been studied, there are no scientific studies regarding the effect of childbirth on competitive racing performance. Only one of eight marathoners commonly cited as evidence for the ergogenic effects of pregnancy actually improved her marathon PR within a year of childbirth. While anecdotal evidence is commonly used to support expert opinion that pregnancy has a year long ergogenic effect on marathon performance, actual performance outcome data are currently insufficient to support this theory.

Abstracts were prepared by the authors and printed as submitted.

3013 Board #78 June 3, 3:30 PM - 5:00 PM
Wingate Test As A Predictor Of 1500m Performance In Elite Speed Skaters

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Wingate test scores are strongly associated with anaerobic capacity in athletes involved in speed endurance sports. In speed skating Wingate results are known to predict performance cross-sectionally, but have not been investigated relative to their ability to predict performance longitudinally.

PURPOSE: To investigate in elite speed skaters whether Wingate tests performed during summer training are predictive of 1500m speed skating performance the subsequent winter.

METHODS: Wingate test results from the summer training periods and 1500m performances during the subsequent winter were analyzed over a 3-year period, in 5 female and 8 male elite speed skaters. Regression analyses using generalized estimating equations (GEE) were used to estimate the relation between Wingate test variables and 1500m performance. Wingate peak power (PP), mean power (MP) and fatigue index (FI) were used to predict 1500m time, split times and lap times.

RESULTS: The results indicate that an improvement of 1 W/kg on PP and MP in women predict an improvement of -0.75s and -2.05s, respectively, on 1500m time (World Record 1:11.79s). In men, PP and MP were also associated with performance, predicting improvements of -0.2s and -2.33s on 1500m time per 1 W/kg (World Record 1:01.04s). Split times on the 1500m in women were also associated with Wingate PP and MP.

CONCLUSION: These data indicate that Wingate tests performed during the summer training period are a good predictor of 1500m speed skating performance in the subsequent winter. Relative to the World Records on 1500m, a 1 W/kg improvement in MP predicts a 2% improvement in performance.

3014 Board #79 June 3, 3:30 PM - 5:00 PM
Transfer of Off-Ice Agility to On-Ice Performance in Elite Canadian Collegiate Hockey Players

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In an effort to optimize the physiological adaptations of a training program, specificity in training prescription is necessary. Agility is an important component of any hockey player's skillset that is often trained off-ice.

PURPOSE: Examine the relationship between the off-ice pro-agility and standing long jump tests with agility tests performed on-ice in collegiate hockey players.

METHODS: Nineteen elite Canadian university hockey players (age = 22.5±1.4, height = 70.85±2.61 inches, weight = 192.93±16.16 lbs, body fat = 15.82±4.21%) participated in an off-ice physical evaluation and on-ice testing. Players were assessed off-ice with the standing long jump and pro-agility tests with one trial on each side of the body (left and right). Within the same week, players were assessed a second time on-ice using the same pro-agility test, the weave agility test, and the transition agility test. On-ice agility tests are a novel method that specific NHL teams using to test the on-ice performance of their players. All tests, except the standing long jump (measured in cm), assessed time duration using advanced laser technology.

RESULTS: There was a negative correlation ($r = -.479, p \leq .05$) between the off-ice standing long jump and on-ice weave agility tests. The off-ice pro-agility test executed on the left side was positively correlated ($r = .473, p \leq .05$) with the on-ice pro-agility test done on the same side.

CONCLUSION: The off-ice pro-agility and standing long jump tests may predict on-ice performance in certain aspects of game play. New off-ice agility tests should be designed that would be more representative of the different types of movements executed on-ice. Teams could consider more on-ice testing to more accurately identify players' sport specific agility level.

3015 Board #80 June 3, 3:30 PM - 5:00 PM
Elite African Male Marathoners Start and Peak at a Younger Age than Non-Africans.

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African marathoners have dominated their non-African counterparts in recent years, both in terms of performance times and head-to-head competition. While many factors are likely to contribute to the differences in performance between the two groups, specialization in the marathon distance by Africans at a younger age may play a role in the performance gap between African and non-African marathoners.

PURPOSE: To compare the differences in age at marathon debut, personal best time achievement, and rate of performance improvement between elite African and elite non-African male marathon runners.

METHODS: The world best performances list (from certified legal marathon courses) from the years 2001 to 2015 were used to identify all 552 male performers who ran faster than 2h 10 min. Using athletes' citizenship, the top 90 African marathoners and the top 90 non-African marathoners were grouped and compared on the basis of age at best marathon, age at debut marathon, and the time interval between their debut and best marathons. Independent t-tests were used to identify significant difference between the African and non-African groups.

RESULTS: The average performance of the African group was significantly faster than the non-African group (2:05:47 ± 0:00:59 vs 2:08:41 ± 0:01:00). The mean age at marathon debut for the African group (24.5 ± 3.4 years) was found to be significantly younger ($P < 0.01$) than the mean age at marathon debut for the non-African group (26.1 ± 3.5 years). The mean age at best marathon for the African group (27.1 ± 4.1 years) was found to be significantly younger ($P < 0.01$) than the mean age for the non-African group (30.1 ± 3.8 years). Additionally, the mean time interval between marathon debut and marathon best in the African group (2.6 ± 2.2 years) was found to be significantly shorter ($P < 0.01$) than the time interval for the non-African group (4.1 ± 3.3 years).

CONCLUSIONS: African marathoners made their debut and ran their best times at a younger age than their non-African counterparts and attained their best marathon in a shorter time interval following their debut. These results suggest that non-African marathoners may want to consider making their marathon debuts at a younger age if they wish to be truly competitive at the international level.

3016 Board #81 June 3, 3:30 PM - 5:00 PM
The Age of Elite Swimmers Decreases as Freestyle Event Distance Increases

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Allen, Vandenbogaerde, and Hopkins (2014) reported that age at peak swim performance for elite-level swimmers decreased as event distance increased in the freestyle events. They suggested that their findings might result from distance swimmers dropping out of the sport prematurely or switching to shorter events. If they are correct, then the elite distance swim population should be younger than the corresponding populations for sprinters and mid-distance swimmers.

PURPOSE: To determine whether or not the age of the elite American swim population varies with freestyle event distance.

METHODS: The mean age of all competitors (ALL ENTRANTS) and the top-8 finishers (FINALISTS) in the 50-m and 100-m freestyle (SPR), 200-m and 400-m freestyle (MD), and 800-m and 1500-m freestyle (DIST) events was determined for United States Long Course National Swim Championships from 1982 to 2012. Three-way ANOVA was used to determine if event distance affected ALL ENTRANTS and FINALISTS, and if event distance interacted with the sex of the athletes or the year in which the meet occurred. Tukey's HSD was used to make pairwise comparisons when significant main effects were detected.

RESULTS: ALL ENTRANTS was significantly older for SPR (20.27 years, SD 1.05) than for MD (19.31 years, SD 0.87), which was significantly older than DIST (18.50 years, SD 0.88). Similarly, FINALISTS was significantly older for SPR (21.89 years, SD 1.71) than for MD (20.04 years, SD 1.40), which was significantly older than for DIST (18.85 years, SD 1.30). ALL ENTRANTS and FINALISTS were both significantly greater for men than for women, and both significantly increased across the time period in question, but neither factor interacted with event distance.

CONCLUSIONS: While these findings agree with the suggestion posed by Allen et al., it remains unclear as to why elite distance swimmers are younger than mid-distance swimmers, who are in turn younger than sprinters. Research is needed on the reasons elite athletes choose to end their careers in order to better understand this relationship.

3017 Board #82 June 3, 3:30 PM - 5:00 PM

Prediction of Body Density with the Use of Anthropometric Equations in Elite Puerto Rican Judokas

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Many judokas undergo dangerous practices of rapid weight loss and gain to have access to competitors in lower weight categories, triggering dehydration and other negative consequences. Dehydration interferes with performance when the total sweat loss is higher than 2% of body weight. Judokas should increase their lean body mass and reduce body fat to optimize body density. Vicente (1978) derived six equations to estimate body density in a Puerto Rican male college sample and reported a high linear relationship ($R = 0.91$, $SE = 0.0078$) between anthropometric measurements and body density. The use of anthropometric equations for estimating body density has not been documented in judokas in Puerto Rico. Purpose: To identify the relationship between anthropometric measurements and body density obtained by five equations in athletes who practice the sport of Judo. Methods: Twelve elite male judokas between the ages of 18-23 and weight categories 60 to 90 kg were recruited. Body weight, height, skinfolds (triceps, subscapular, abdominal, chest, thigh), circumferences (waist, forearm, chest), and a diameter (bideltoid) were measured by an ISAK Level 3 certified anthropometrist. A Spearman's rank correlation coefficient (ρ) was conducted to determine the relationship between measures of body density and effect size (r^2), and a Wilcoxon signed-rank test to compare the average of two related samples. Results: There were no significant differences between the body density values obtained by the Vicente 1 and the Jackson & Pollock equation ($p = 0.272$). A high correlation ($r = .937$, $SE = 0.0793$) was obtained between these two equations. An $r^2 = 0.8779$ was obtained which explained the 87.79 % variability. Conclusion: Of five equations used to predict body density, we found that the Vicente 1 and the Jackson & Pollock rendered similar results in the sample of judokas.

3018 Board #83 June 3, 3:30 PM - 5:00 PM

Key Performance Indicators Differentiating Between Senior and Junior Elite Male Fencers

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(No relationships reported)

Purpose

Explosive attacks and rapid changes of direction (COD)¹ are hallmarks of Olympic fencing. Nevertheless, evidence-based training methods in line with the needs of the sport are still lacking. The purpose of this study was to investigate potential KPIs that would be able to discriminate between senior and junior elite male fencers.

Methods

22 male fencers (11 senior and 11 junior), competing on the international circuit, were tested in their pre-season evaluation. Athletes performed: squat jumps (SJ), countermovement jumps (CMJ), drop jumps (DJ), single leg broad jumps (SLBJ) and triple hops for distance (THD) and a COD test for time using fencing footwork (202_{mod}). Pearson r correlations ($P < 0.05$) were used to determine relations between physical tests and 202_{mod}. Furthermore, t tests ($P < 0.05$) were performed between senior and junior results in order to investigate the physical tests' discriminatory ability.

Results

For senior males, very large correlation between CMJ height (h) and 202_{mod} ($r = -0.79$, $P < 0.01$) were observed. Additionally, a modest to strong correlation between CMJ ratio of flight time to contraction time (FT:CT)² and 202_{mod} was evident ($r = -0.66$, $P < 0.05$). SLBJ performance on front and back legs had strong and nearly perfect correlations to 202_{mod} ($r = -0.86$, $P < 0.001$; $r = -0.90$, $P < 0.001$, respectively)³. THD performance of both front and back legs also had a strong correlation to 202_{mod} ($r = 0.89$, $P < 0.001$; $r = 0.85$, $P < 0.001$, respectively). For junior males, THD performance on the front leg had a modest to strong correlation to 202_{mod} ($r = -0.68$, $P < 0.05$). Moreover, DJ FT:CT was well correlated to 202_{mod} ($r = -0.72$, $P < 0.05$). The only significant differences ($P < 0.05$) in testing results between senior and junior athletes were CMJ h and DJ h.

Conclusion

Our study set out to investigate the relationship between general physical tests and a fencing specific COD test. Though certain relationships were found, it appears that general physical tests have a varying degree of relevance to fencing performance,

as measured by 202_{mod}. This relevance is dependent on athlete level, though THD appears to be important at all levels. Nevertheless, most tests, including 202_{mod} did not demonstrate discriminatory ability. Only CMJ h and DJ h may be used to discriminate between senior and junior male fencers.

F-25 Free Communication/Poster - Exercise Psychology - Neuroscience

Friday, June 3, 2016, 1:00 PM - 6:00 PM

Room: Exhibit Hall A/B

3019 Board #84 June 3, 2:00 PM - 3:30 PM

Association Between Anxiety-like Behaviors and Neuronal Nitric Oxide Synthase in Old Mice Under Enriched Environment

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(No relationships reported)

Nitric oxide is produced by neuronal nitric oxide synthase (nNOS) in the brain. Because inhibiting it improves anxiety-like behaviors, nNOS is thought to play a key role in regulating affect. Rearing animals in enriched environments (EE) reduces some anxiety-like behaviors in young mice. Whether EE works by altering nNOS expression levels and whether it lowers anxiety in old mice remains unclear, especially because anxiety-like behaviors have been reported to increase with age. PURPOSE: To determine the effects of EE on anxiety-like behaviors and nNOS expression levels in old mice.

METHODS: Fifty male C57BL/6J mice were used. At age 78 weeks, mice were divided into standard (SE) and enriched (EE) environment groups ($n = 10$ /group). The EE group was equipped with a running wheel, nest box and tunnels, and two cage-mates. At 78 and 84 weeks, mice were tested with a runway test to assess anxiety-like behaviors. The runway apparatus consisted of a light runway (12.0 × 53.5 × 14.0 cm, 80 lux) and dark start box (12.0 × 12.0 × 14.0 cm, 0 lux), and simulated rodent ecology. The runway had five sections (A, B, C, D, and E). Behavior was recorded for 5 min. We used 12-, 48-, and 72-week-old mice ($n = 10$ /age group) to examine the kinetics of nNOS expression levels with ageing. nNOS expression levels in the hippocampus of each group was determined using western blots.

RESULTS: No significant differences were found in body weight, food intake, or muscle weight between the SE and EE groups. On the runway test, the EE group traversed significantly more sections than the SE group after 6 weeks of enrichment (SE: 38.4 ± 5.4 times, EE: 60.7 ± 9.1 times; $p < 0.05$). This suggested that EE induced an antianxiety-like effect. Compared with the 12-week baseline, nNOS expression levels increased significantly with age (48 weeks: 2.58 ± 0.32 fold increase; 72 weeks: 4.08 ± 0.43; $p < 0.01$). nNOS expression levels significantly differed in the SE and EE groups (SE: 2.76 ± 0.27 fold increase, EE: 1.71 ± 0.37; $p < 0.05$). Compared with nNOS expression levels in the 72-week group, those in the EE group were significantly lower ($p < 0.01$), and approximated those of 12-week-old mice.

CONCLUSION: Our results suggest that EE reduces anxiety-like behaviors in old mice and is associated with reduced nNOS expression levels in the hippocampus.

3020 Board #85 June 3, 2:00 PM - 3:30 PM

Neuro-Cognitive Performance Is Enhanced During Short Periods Of Microgravity

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(No relationships reported)

In order to maintain and improve space mission safety and success, there has been growing interest in the effects of microgravity on cognitive processing. While findings today are quite inconsistent, those studies reporting a decrement in cognitive performance have not been able to distinguish between the direct influence of microgravity and any associated impact of stress. Furthermore, the currently available findings rely primarily on behavioral observations and there has been no study of the underlying neurophysiological responses.

PURPOSE: To determine the effects of microgravity on neurophysiological processing during a mental arithmetic task (executive function). METHODS: During the normal- and microgravity phases of a parabolic flight, four levels of a mental

arithmetic task were presented on a touchscreen tablet. The latency between the appearance of the problem and the participants' response was identified as reaction time. In addition visual evoked potentials N1 and P2 were determined using an active electroencephalography system (EEG) and analyzed using source localization algorithms.

RESULTS: An increase in reaction time occurred with increasing levels of task difficulty. During the most complex levels, reaction time was significantly reduced during microgravity. This observation was independent of previous parabolic flight experience as well as the use of anti-motion-sickness medication. P2-amplitude in the superior frontal and medial frontal gyrus was significantly reduced in the microgravity condition localized.

CONCLUSION: Cortical processes seem enhanced during microgravity, and previously reported impairments in cognitive performance are attributable to an increased amount of stress rather than weightlessness itself.

Supported by DLR Grant 50WB0819

3021 Board #86 June 3, 2:00 PM - 3:30 PM
Central Neuronal Modulations of Motor Behaviour in Right-handed Grasping Movements at Laboratory versus Everyday Kinematics

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(No relationships reported)

Targeted movements are widely thought to involve motor behavioural strategies that result, at least in part, from central neuronal modulations. However, evidences mainly refer to movements performed in laboratory settings that differ from everyday movements; this is, explicitly instructed movements and awareness of being measured in the laboratory versus purposeful and motivated behaviour in everyday movements.

PURPOSE: This study directly determined central neuronal modulations during laboratory and everyday grasping movements at equivalent kinematics.

METHODS: 21 (13 males, 8 females) right-handed healthy participants (22.9 ± 2.9 years, 178.0 ± 9.1 cm, 73.0 ± 10.4 kg) performed two counterbalanced randomly assigned series of 40 targeted, right-hand grasping movements; 10 participants began in laboratory, 11 in everyday settings. With identical mechanical constraints, differences between settings were exclusively related to the behavioural setting, i.e. instructed ("laboratory") versus gaming-induced movements ("everyday"). Equivalent kinematics and EEG over 32 Ag/AgCl-electrode channels were recorded and synchronized to a "go-grasp" signal. Ocular corrected EEG was segmented based on stimulus onset (-100 to 500 ms). Grand averages identified event-related potentials N200 and P300 over distinct electrode sites (Fz, Cz, Pz, Oz).

RESULTS: Kinematic variables ($p < 0.01$) decreased in laboratory compared to everyday settings (grasping speed 133.3 ± 21.5 vs. 153.9 ± 19.6 cm/s, grasping force 18.0 ± 13.7 vs. 30.2 ± 19.7 N/mm). P300 amplitudes ($p < 0.05$) decreased during grasping movements in the everyday compared to the laboratory setting (μV : Fz 0.1 ± 2.0 vs. 0.7 ± 2.9, Cz 1.8 ± 1.1 vs. 2.2 ± 1.4, Pz 4.9 ± 2.8 vs. 6.7 ± 4.5, Oz 7.0 ± 4.2 vs. 7.9 ± 5.6). N200 amplitudes ($p < 0.001$) increased at anterior electrode sites during grasping movements in the everyday compared the laboratory setting (μV : Fz -1.9 ± 1.6 vs. -1.8 ± 1.8, Cz 0.2 ± 0.8 vs. -0.4 ± 1.1), while inverted at posterior electrode sites (μV : Pz -0.3 ± 1.9 vs. -0.5 ± 1.1, Oz -1.6 ± 3.1 vs. -2.5 ± 2.4).

CONCLUSIONS: Decreased P300 and increased anterior N200 during everyday grasping movements indicate attentional demand that may be related to central inhibitory processes compared to laboratory settings.

Supported by German Sport University grant HIFF 920106.

3022 Board #87 June 3, 2:00 PM - 3:30 PM
Brain Derived Neurotrophic Factor, Cerebral Activation and Memory Responses to Five Weeks of Aerobic Exercise Training

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(No relationships reported)

Studies have shown that the production of brain derived neurotrophic factor (BDNF) in the hippocampus increases following exercise which may be the molecular link between physical activity and the improvements reported in memory and learning.

PURPOSE: To determine if moderate intensity exercise training leads to an increase

in plasma [BDNF] which may be associated with improvements in cognitive function, increased brain activity and/or structure. **METHODS:** 11 healthy males (23 ± 7 yrs (±SD)) completed a 5 week aerobic training program (92 ± 5% compliance) at an intensity of 65% maximal heart rate, 5 days/wk on a cycle ergometer. Prior to, and following training, each subject performed a ramp exercise test to fatigue for the determination of peak VO_2 (VO_{2pk}), work rate (WRpk), and estimated lactate threshold (LT). Arterialized-venous blood samples were obtained from a dorsal hand vein at rest, exhaustion and during recovery for the determination of plasma [BDNF]. Subjects underwent magnetic resonance imaging (fMRI) and a memory task before and after the training program. All exercise was performed on a cycle ergometer; pulmonary gas exchange was measured using standard techniques. **RESULTS:** While there was no difference in VO_{2pk} between pre- and post-training (pre, 43.9 ± 9.2; post, 45.4 ± 8.5 ml/kg/min), the VO_2 at LT was higher ($p < 0.05$) following training (pre, 1773 ± 262; post, 2047 ± 289 ml/kg/min). Similarly, WRpk was higher ($p < 0.05$) following training (pre, 288 ± 50; post, 313 ± 56 W). Brain volume in right hippocampus and left cerebral cortex was significantly decreased following training. Compared to pre-training, fMRI showed an increase in the activation of the left hippocampus after training. There was no difference in plasma [BDNF] at rest between pre- and post-training; plasma [BDNF] increased ($p < 0.05$) at exhaustion and was higher following training (pre, 15.4 ± 3.7; post, 17.5 ± 4.4 ng/ml; $p < 0.05$). **CONCLUSION:** A moderate intensity training program resulted in small, but significant increases in exercise tolerance, brain structural and functional activation, particularly in the hippocampal region. However, there was little evidence for a relationship between changes in plasma [BDNF], brain structure and memory function.

3023 Board #88 June 3, 2:00 PM - 3:30 PM
Neural Reserve Induced By Practice Of Physical Activity In Adolescence: A Study Of The Intracellular Signaling Pathways Linked To Cellular Growth And Proliferation

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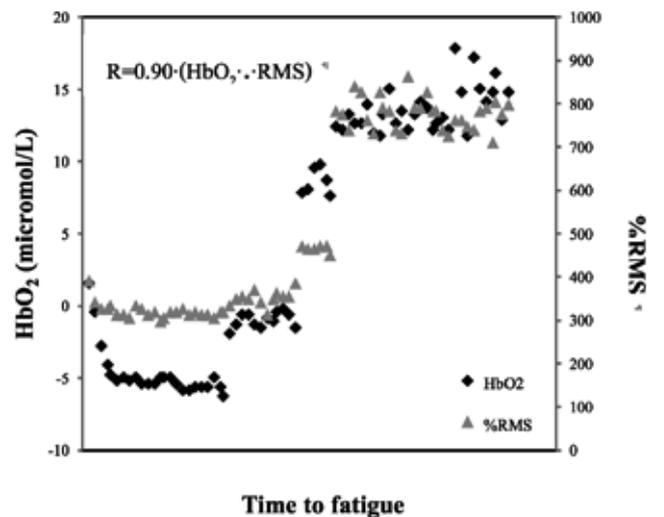
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(No relationships reported)

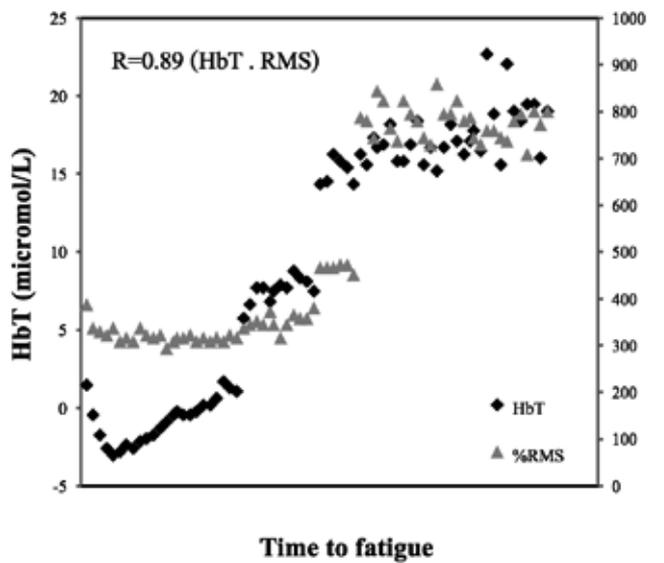
PURPOSE: The present study was designed to investigate the hypothesis of neural reserve induced by early physical activity. To do this, we evaluated the intracellular signaling pathways linked to cellular growth and proliferation (Akt, mTOR, p70S6K, CREB and p38) during the aging course of rats submitted to physical exercise during adolescent period. **METHODS:** Male Wistar rats aged 21 postnatal days old (P21) were divided into two groups: exercise ($n=24$) and control ($n=24$). Animals in the exercise group were submitted to daily exercise on the treadmill between P21 and P60. After the aerobic exercise program (P60), the cortical and hippocampal expressions of Akt, mTOR, p70S6K, CREB and p38 (total and phosphorylated) from the exercise and control groups were investigated at different life stages: P60, P90, P120 and P150 ($n=6$ in each group and age). Statistical analysis was made using ANOVA with Bonferroni correction. **RESULTS:** After the last physical training session (at P60), a significant increase in cortical expression of total ($p = 0.005$) and phosphorylated ($p = 0.020$) mTOR protein was detected in exercise group in relation to control group. At P90, no significant difference in the cortical and hippocampal expression of signaling proteins (total or phosphorylated) was noted between exercise and control groups. At P120, it was observed a decrease in the expression of phosphorylated mTOR ($p = 0.039$) and p70S6K ($p = 0.042$) and an increase in expression of total CREB ($p = 0.024$) in the hippocampal formation of the exercise group compared to control group. At P150, the phosphorylation of p70S6K protein ($p < 0.001$) and CREB ($p = 0.043$) significantly increased in cortex of exercise group compared to control group. In the hippocampal formation, the total mTOR ($p = 0.004$) and phosphorylated Akt ($p < 0.001$) significantly increased in the exercise group compared to the control group at P150. No significant difference in cortical and hippocampal expression of total p38 protein (protein related apoptosis and autophagy) between the exercise and control groups was found. **CONCLUSION:** Our results indicate that changes in the cortical and hippocampal expression and activation of intracellular proteins linked to cellular growth and proliferation may occur throughout of life of rats exercised in youth.

3024 Board #89 June 3, 2:00 PM - 3:30 PM
Associations Between Sleep Time, Body Composition And Levels Physical Activity In Obese Adolescents Of Monterrey, Mexico.
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 (No relationships reported)

Currently sleep disorders the unhealthy eating habits, consumption of foods high in calories and low in nutritional value, combined with sedentary activities have resulted in a considerable increase in weight and body fat in adolescents, leading to a more likely to have more and noncommunicable chronic diseases earlier ages .
PURPOSE: Analyze associations between sleep time, body composition and intensity levels of physical activity in obese adolescents of Monterrey, Nuevo Leon. México
METHODS: A total of 66 obese adolescents from 12 to 14 years participated in a cross sectional study. The body composition assessments were performed using a BOD POD. Sleep time and levels physical activity (PA) were monitored by triaxial accelerometer (ActiGraph wGT3X -BT) for at least 7 consecutive days. The outcome variables for (PA) were percentages of time spent in sedentary, light PA and moderate-to-vigorous PA (MVPA) and for sleep (Total sleep time).
RESULTS: RESULTS. Sleep time was positively correlated with and fat mass (kg) ($r=0.44$ $p<0.01$) There was also a positive correlation between the time spent on sedentary PA and fat mass ($r=0.58$, $p<0.01$) Higher time of MVPA. were positively correlated with longer sleep duration ($r=0.48$, $p<0.01$)
CONCLUSIONS: Sleep time might be an important modifiable factor associated with obesity also it requires to be included in the prevention and treatment and intervention in obesity in adolescents. Implications are provided for educators and health professionals .



3025 Board #90 June 3, 2:00 PM - 3:30 PM
A Strong Correlation Between Dorsolateral Prefrontal Cortex And Vastus Lateralis Activity During Running To Fatigue
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Fatigue is a phenomenon of pronounced importance in sports. Recently, there is strong evidence of interplay between the prefrontal cortex and motor output during fatiguing contractions. The dorsolateral prefrontal cortex (DLPFC) due to its large involvement in cognitive and motor activities is believed to be involved but this requires physiological clarification. AIM: We investigated the relationship between DLPFC activity - responses in oxyhemoglobin (HbO2) and total hemoglobin (HbT) measured by near-infrared spectroscopy (NIRS), and the vastus lateralis muscle (VL) activity - quantified as root-mean-square (RMS) of the EMG signal, during a fatigue protocol. METHODS: Four male runners (32±12 yrs) with probes for NIRS over the DLPFC and EMG over the VL performed a track running test at a constant speed to fatigue (exhaustion). The running speed was individually determined as the average speed of a 1200-m time trial performed ~3 days prior to testing. For NIRS changes in $\mu\text{mole/L}$ of HbO2 and HbT were computed. The VL EMG-RMS of the contraction of each step was normalized as a percent of a submaximal reference contraction (%RMS), thus removing the non-activity between steps. Data of 10s epochs at 20, 40, 60, 80 and 100% of time for each lap were averaged for analyses. Regression analyses performed with HbO2 and with HbT as dependent variables and %RMS as the independent variable. RESULTS: Over time there was an increase in HbO2 and HbT in the DLPFC, and in VL-%RMS. Both HbO2 and HbT correlated strongly with EMG-RMS during running to fatigue (see figures below); $p<0.001$ for both. CONCLUSION: The strong relationship between DLPFC and VL activities during running to fatigue suggests the involvement of the DLPFC in the central processing of fatigue.

3026 Board #91 June 3, 2:00 PM - 3:30 PM
Central Nervous System Activation in Blood Flow Restricted versus Non-Restricted Exercise: A Pilot Study
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 (Sponsor: Pat Vehrs, FACSMS)
 (No relationships reported)

Functional magnetic resonance imaging (fMRI) can be used to track neural activation in the brain during functional activities. **PURPOSE:** The purpose of this study was to investigate central nervous system neural responses to blood flow restricted (BFR) versus non-BFR hand grip exercise.
METHODS: Using a randomized crossover design, 4 adults (24.6±1.9 y; 3 males, 1 female) completed hand grip exercises during two conditions: BFR vs. non-BFR. fMRI scans were done at the same time of day, separated by 48 hours. The exercise protocol consisted of 5 30-second sets of squeezing a non-metallic hand grip exerciser, to complete as many repetitions as possible, with 20-second rest intervals between sets. The participant followed screen prompts and performed the exercise under the appropriate randomized exercise condition for a 4 minute 10 second exercise scan. Our primary dependent variable was the BOLD contrast (using fMRI). The fMRI data were preprocessed and analyzed using the Analysis of Functional NeuroImages (AFNI) suite of software. For group level comparisons, a repeated measures ANOVA of the whole brain analysis was used. The conditions of interest were: BFR early response, BFR late response, non-BFR early response, and non-BFR late response. To correct for multiple comparisons the results of these tests were thresholded with a voxel-wise p-value of $p < 0.05$ and 40 contiguous voxels for the spatial extent threshold.
RESULTS: We found a significant phase (early/late) by exercise type (BFR/non-BFR) interaction ($p<0.05$) in bilateral motor cortex, right somatosensory cortex, and

right thalamus. In the right thalamus, activation increased from the early phase to the late phase for the non-BFR condition but remained relatively unchanged for the BFR condition. In the remaining regions (motor cortex and somatosensory cortex) activation decreased for the non-BFR condition from early to late phases while activation increased for the BFR condition from early to late phases.

CONCLUSIONS: From these results we can see that the neural activation patterns in the brain are different between BFR and non-BFR conditions. Further investigation with a greater number of subjects is needed to make stronger inferences and to more fully describe these different activation patterns.

3027 Board #92 June 3, 2:00 PM - 3:30 PM

Endurance Training And Mct Changes In The Ventromedial Hypothalamus

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It is well established that endurance training can induce changes in monocarboxylate transport proteins (MCTs) in skeletal muscle. Monocarboxylate transport proteins are found throughout the body, and can shuttle lactate, pyruvate, and ketone bodies. These MCTs may influence cellular energy metabolism in the ventromedial hypothalamus (VMH), which plays a role in systemic energy substrate sensing. **PURPOSE:** To determine whether a chronic endurance training program previously used to elevate skeletal muscle mitochondria approximately 50% leads to changes in MCT concentrations in the VMH. **METHODS:** Male Sprague Dawley rats were randomly assigned to either progressive exercise training (n=17) on a motor driven treadmill [5 days/week ending at 30m/min for 1 hr up a 10.5% grade], or equivalent sedentary time on a stationary treadmill (n=18) for 5-7 weeks. Animals were sacrificed, and the VMH was extracted, homogenized, and analyzed via western blotting for MCT1, MCT2, MCT4, and GAPDH, as a loading control. QualityOne software was used to determine band density and the ratio of each MCT:GAPDH was calculated for the level of each MCT in the VMH. An ANOVA was run to determine whether there were statistically significant differences between an exercise trained and sedentary group for each MCTs within the VMH. **RESULTS:** There was not a significant difference between groups for GAPDH values ($\lambda=0.947$, $p=0.927$; MCT1 $f=0.09$, $p=0.767$; MCT2 $f=0.27$, $p=0.616$; MCT4 $f=0.43$, $p=0.525$), or MCTs ($\lambda=0.754$, $p=0.497$; MCT1 $f=0.16$, $p=0.696$; MCT2 $f=0.62$, $p=0.449$; MCT4 $f=1.66$, $p=0.227$). **CONCLUSION:** Although endurance training has been shown to increase MCT concentrations in skeletal muscle, no change was seen in the VMH between the exercised and sedentary group after 5-7 weeks of training. If the VMH has changes in energy substrate sensing in response to endurance training, it does not seem to be mediated through changes in MCTs.

3028 Board #93 June 3, 2:00 PM - 3:30 PM

Reliability Of Glutamate And Gaba Quantification Using Magnetic Resonance Spectroscopy

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(No relationships reported)

Proton magnetic resonance (MR) spectroscopy is a non-invasive technique used to determine relative concentrations of target metabolites in the brain. **PURPOSE:** The aim of this study was to determine the reliability of glutamate and GABA measures using a single-voxel proton MR spectroscopy protocol in healthy men and women. **METHODS:** Seven (4 female) healthy college age participants were tested at two time points separated by two weeks. The study was performed at 3T using a single voxel PRESS sequence for glutamate (TR/TE=1500/30ms) and an adapted MEGA-PRESS sequence for GABA (TR/TE=2000/68ms). Quantitation of glutamate and GABA was performed at two regions of interest, the primary motor cortex and the dorsolateral prefrontal cortex (DLPFC). Reliability across days was assessed with the intraclass correlation coefficient (ICC 2,1). **RESULTS:** There was no significant difference across time or region for glutamate ($p=0.50$ and $p=0.06$ respectively) or GABA ($p=0.57$ and $p=0.91$ respectively). There were no significant time-by-region interactions for glutamate ($p=0.19$) or GABA ($p=0.26$). Reliability across days was very strong for both glutamate ($R=0.96$) and GABA ($R=0.88$). **CONCLUSIONS:** These results support the use of MR spectroscopy measurements to reliably quantify concentrations of glutamate and GABA within the motor cortex and DLPFC.

3029 Board #94 June 3, 2:00 PM - 3:30 PM

Physical Activity, Mood Symptoms, and White Matter Integrity in Gulf War Veterans with Chronic Pain

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(No relationships reported)

Approximately 25% of Gulf War Veterans are affected by chronic musculoskeletal pain (GVCMP) and this associated with significant psychological distress. Neuroimaging data suggest that symptoms of CMP are maintained by abnormal brain processing of sensory information and altered brain structure. Although efficacious treatments for GVs are lacking, exercise has been shown to reduce pain and improve well-being in civilians, yet the mechanisms for these improvements are unknown. **PURPOSE:** To investigate the relationship between WM integrity, physical activity (PA) and sedentary behavior (SB) and mood symptoms in GVCMP. **METHODS:** Thirty GVCMP and 31 pain-free, matched Veteran controls (GVCO) completed an MRI scan with diffusion tensor imaging (DTI). Encoding occurred along 48 non-collinear directions with a diffusion weighting of 1000 s/mm² and non-diffusion weighted T2 reference images. PA was measured with an ActiGraph accelerometer. Mood symptoms were measured using validated questionnaires. Tract-based Spatial Statistics were used to estimate WM fractional anisotropy and mean, radial, and axial diffusivity over the whole brain ($p < 0.05$) corrected using threshold-free cluster enhancement. For group comparisons, linear mixed-effects analyses were conducted controlling for group status and age. Spearman's Rho correlations were performed to examine relationships between PA and mood symptoms, and the relationships between mood and each DTI variable within clusters found to be significantly different between groups. **RESULTS:** Greater PA and less SB were associated with lower tension, anger, depression, fatigue, confusion, and total mood disturbance in GVCMP ($p < 0.05$). Compared to GVCO, GVCMP had lower WM integrity in several brain regions implicated in chronic pain and mood ($p < 0.05$). WM integrity was associated with mood symptoms and PA in the corona radiata, corpus callosum and posterior thalamic radiation of GVCMP ($p < 0.05$). **CONCLUSION:** This provides evidence that WM microstructure is disrupted in GVCMP and is related to PA, SB and mood. Interventions aimed at increasing PA or reducing SB and determining the impact of these changes on both WM integrity and symptoms are needed to further explore the benefits of a physically active lifestyle in GVCMP. Supported by Dept. of Veterans Affairs grant: 561-00436.

3030 Board #95 June 3, 2:00 PM - 3:30 PM

Neural Responses To Pictures Of Food After Exercise In Children

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(No relationships reported)

PURPOSE: To examine neural responses to pictures of food with and without exercise in children (8-11 y) using fMRI.

METHODS: Methods: Using a randomized cross-over design, 26 children (9.42±1.16 y; 16.67±2.37 kg/m²; 19.21±9.79% body fat; and 69% male) completed two separate laboratory conditions (exercise vs. no-exercise). Each subject completed a 30 min bout of exercise on a motor-driven treadmill (~70% of HRmax). In the non-exercise condition, each subject sat at a table and played with games or read books for a period of 30 minutes. Neural responses to high- and low-calorie pictures were determined immediately following each 30 minute condition using fMRI. Thresholds were a voxel-wise p-value was $p < 0.001$ and 40 contiguous voxels for spatial extent threshold. SAS was used to test for a condition (exercise vs. no-exercise)*picture (high- or low-calorie) interaction and for the main effects of condition and exercise.

RESULTS: There was a significant condition*picture interaction in the left hippocampus and right medial temporal lobe ($p < 0.05$). In the left hippocampus, beta mean was highest in response to the high-calorie foods after exercise (0.56±0.53) and lowest for the low-calorie foods during rest (-0.09±0.66). Similarly, in the right medial temporal lobe, beta mean was highest in response to the high-calorie foods after exercise (0.57±0.62) and lowest for the low-calorie foods during rest (0.05±0.46). Main effects for picture type (greater activation to high-calorie foods) were observed in the visual cortex, medial prefrontal cortex, the right middle frontal gyrus, the right and left superior temporal gyrus, the right inferior frontal gyrus and the right posterior central gyrus ($p < 0.05$). Main effects for exercise condition were observed in the left posterior central gyrus (greater activation after exercise) and the right anterior insula (greater activation after rest).

CONCLUSIONS: Acute exercise may influence neural activation to pictures of food in the left hippocampus and right medial temporal lobe. Similar to studies in adults,

neural responses to high-calorie foods tended to be greater in the children in this sample. More work needs to be completed regarding the role of exercise in neural activity to a food cue and how this relates to or predicts eating behavior.

F-26 Free Communication/Poster - Fatigue

Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

**3031 Board #96 June 3, 3:30 PM - 5:00 PM
 Effect of Exercise Fatigue Protocol on Lower Extremity Functional Movement**

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 (No relationships reported)

Muscle fatigue has been reported to be an important factor that results in lower extremity injuries in soccer. Even though previous research regarding soccer specific functional fatigue protocol (FFP) have reported decreased strength as well as the advent of abnormal lower extremity kinematics, no studies have been conducted with the purpose of investigating the functional changes after sports specific FFP. **PURPOSE:** Pre and post FFP was examined to investigate functional characteristics of lower extremities that may be altered after fatigue. **METHODS:** Twenty subjects (10 men, 10 women; 22.5±2.7yrs; 67.0±13.0kg; 168.0±8.9cm) participated in the study to measure the effect of the FFP on lower extremity Functional Movement Screening (FMS). Using the FMS kit, four out of seven specific tests (a total of 12 scores) that are associated with the screening of lower extremity functions were assessed, those of which included squatting, stepping, lunging, and leg raising. Functional fatigue drills from previous studies which were identified as effective drills that induce fatigue were selected for the FFP for this study. The participants were hopping with their knees at a 90° angle forward running for 5m, side running for 5m, back pedaling for 5m, L drill, making 20 side jump with knees at a high angle, and making 3 consecutive countermovement jumps with cones. A polar heart rate monitor, their lactate concentration levels, and their Rate of Perceived Exertion (RPE) were monitored to check the level of fatigue. **RESULTS:** RPE score after FFP was 18.14±0.91, heart rate was 176.25±18.22bpm (resting: 72.13±22bpm), and lactate concentration level was 14.5±2.8mmol/l (resting: 2.1±2mmol/l). The results of this study showed that the total level of FMS declined after fatigue (pre: 6.60±1.27points, post: 5.70±1.13points, p<.05), which may describe the lower extremity functional movement deficit after fatigue sets in. **CONCLUSIONS:** Four selected FMS can be used to screen fatigue induced functional changes to prevent injuries that can be resulted from fatigue. Since FFP seems to induce fatigue, it can be used for fatigue resistance endurance training as well. Sponsored by IOC Medical and Scientific Commission Research Center for Prevention of Injury and Promotion of Athletic Health Grant

**3032 Board #97 June 3, 3:30 PM - 5:00 PM
 The Effects of Submaximal Load on Peak Power Output and Fatigue During the Bench Throw**

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 (No relationships reported)

There have been no studies comparing peak power output (PPO) fatigue across multiple sets and with different loads with the bench throw. While the subject of optimal load for power production has been studied extensively, the effect of load on PPO fatigue is an unexplored topic that could yield important training prescription guidelines for strength coaches and trainers **PURPOSE:** To determine whether load (30%, 45%, 60% 1RM) affected PPO, fatigue across reps and sets, and average work performed during 3 sets of 10 repetitions during bench throws. **METHODS:** 10 resistance-trained males volunteered for the study (mean ± SD): age 20.58 ± 1.36 years, height 176.05 ± 9.09 cm, weight 78.65 ± 9.93 kg, bench press experience 4.95 ± 2.23 years. In a randomized order, subjects performed 3 sets of 10 repetitions bench throws during three weekly sessions. A Humac 360 Device was utilized to collect concentric phase PPO data during each repetition. The data were analyzed using one-way (Treatment) and two-way (Treatment × Time) analysis of variance, with repeated measures ANOVA. **RESULTS:** A significant decrease in PPO was observed during reps 5-7 at 30%, reps 3-4 at 45%, and reps 2-3 at 60%. An analysis of the average PPO during the entire 10 rep set revealed that 45% 1RM produced significantly greater average PPO during the three sets than 30% and 60%. **CONCLUSIONS:** The authors recommend performing upper body plyometrics at 45%1RM rather than 30% or 60% 1RM and keeping sets of 30% 1RM to 7 repetitions, 45%1RM to 4 repetitions, and 60%1RM to 3 repetitions to maximize power training efficacy and efficiency.

**3033 Board #98 June 3, 3:30 PM - 5:00 PM
 The Effect of Caffeine Supplementation on Power and Fatigue in Recreationally Trained College Aged Males**

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Caffeine (CAF) is consumed regularly by approximately 90% of adults worldwide, primarily to reduce fatigue and increase wakefulness. The benefit of caffeine consumption on athletic performance in large doses (3-9 mg/kg body weight or BW) is well documented in aerobic athletes. However, the benefits of caffeine consumption on resistance training (RT) variables such as power are less clear. **PURPOSE:** The purpose of this study was to investigate the effect of consumption of 7 mg/kg BW of CAF on power production in experienced, resistance trained college-aged males, who are habitual caffeine consumers. **METHODS:** Eighteen young, healthy college aged males (21.7 ± 2.0 yrs) were included in this double blind, placebo controlled study. Subjects performed a battery of tests that included a vertical jump (VJ), isometric squat (ISO), and Smith Machine squat (SQF) and Smith Machine bench press (BPF) to failure at 60% 1RM. Subjects consumed either 7 mg/kg BW of CAF or placebo (P), 60 minutes prior to testing. Test sessions were separated by a minimum of 7 days. Power production during VJ, SQF and BPF exercises was evaluated. Power obtained during SQF and BPF was used to find the fatigue index (F.I.). Also, force production during an ISO was assessed. A repeated measures ANOVA was used to determine differences between treatments. Significance for all analysis was set at p≤ 0.05. **RESULTS:** There were no significant differences between treatments (CAF vs P) in measures of VJ (3924.2 ± 617.1 vs 3930.9 ± 627.5W, p=0.925), ISO (2512.3 ± 555.8 vs 2585.3 ± 528.2N, p=0.270), SQF (36.9 ± 12.6 vs 33.6 ± 10.6%, p=0.234), or BPF (40.5 ± 12.5 vs 42.0 ± 8.3%, p=0.591). **CONCLUSION:** 7 mg/kg BW of CAF does not improve measures of force, power, or fatigue during single-set to failure resistance training exercises in habitual caffeine users. These results indicate that CAF supplementation may be affected by training bout volume (sets x reps), due to the lack of improvement in F.I., i.e. local muscular endurance.

**3034 Board #99 June 3, 3:30 PM - 5:00 PM
 Effects of AquaTitan Bracelet on Quadriceps Muscle Soreness after Fatiguing Exercise**

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 (No relationships reported)

Muscular soreness can be a hindrance for athletes in exercise performance. Many use ionized bracelets during training and competition to reduce muscular soreness and increase exercise performance. **PURPOSE:** To examine the effect of Phiten's Rakuwa S Cross Bracelet on quadriceps muscle soreness after fatiguing exercise (FE). **METHODS:** 15 recreationally active male volunteers (age: 23.87±1.55yrs, height: 174.09±5.06cm, weight: 68.69±9.70kg) participated over five weeks in a single-blinded, balanced, random crossover study. Three experimental trials (AquaTitan (AT), Placebo (P), and Control(C)) were administered, with a five-day washout period between trials. Each participant performed a FE protocol of 100 repetitions of isokinetic contraction at 60°/s on an Isokinetic Dynamometer. Perceived muscle soreness was measured using a Visual Analog Scale (VAS) immediately (Post-1) and 24 hours (Post-2) after FE. Muscle soreness tests (MST) were conducted at the vastus lateralis (VL), rectus femoris (RF), and vastus medialis (VM) muscles, followed by knee extension while seated (EXT) and knee flexion while standing (FLX). OMNI Resistance Exertion Scale (RES) was used to measure rate of perceived exertion (RPE) for muscular strength (S) and endurance (E) tests performed after MST. **RESULTS:** Repeated Measures ANOVA revealed significant differences in muscle soreness between Post-1 and Post-2 in VL (26.42±6.29 vs. 17.96±3.75, p=0.04), VM (38.78±5.69 vs. 28.35±4.56, p=0.02), EXT (58.73±6.46 vs. 30.38±4.31, p<0.05) and FLX (55.69±7.63 vs. 35.24±5.94, p=0.01). No significant differences were found in RF (30.62±6.55, 24.27±4.43, p=0.21), as well as between AT, P and C (39.60±5.37, 41.65±5.59, 44.89±6.17, p=0.40). There were no significant interactions between trials and post tests (VL: p=0.38, RF: p=0.05, VM: p=0.62, EXT: p=0.19, FLX: p=0.06), and no significant correlation between VAS and RPE. Participants performed maximal effort for all trials as indicated in their RPE estimation (S: AT: 8.91±0.29, P: 8.58±0.28, C: 8.76±0.27; E: AT: 9.27±0.25, P: 9.33±0.23, C: 9.31±0.22). **CONCLUSION:** Post-2 scores were significantly lower than post-1 regardless of the type of bracelet worn,

suggesting that AquaTitan bracelets may not have an effect on increased muscular performance with a reduction of muscle soreness.

3035 Board #100 June 3, 3:30 PM - 5:00 PM
The First Muscle Oxyhemoglobin Inflection Point Is Correlated To Gas Exchange Threshold And Time-To-Exhaustion During Heavy Intensity Exercise

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PURPOSE: The twofold aim of the study was to: 1) compare the gas exchange threshold (GET), the first oxyhemoglobin inflection point ([O₂Hb]-T), and perceptual threshold as determined during an incremental exercise test, and 2) investigate the link between each threshold and time-to-exhaustion during heavy intensity exercise.

METHODS: Fourteen competitive cyclists performed an incremental exercise test to exhaustion on a cycloergometer to determine the different thresholds and peak workload (Wpeak). The participants then performed a sub-maximal constant workload test (90% Wpeak) to exhaustion to determine time-to-exhaustion. The thresholds were identified from: 1) the first breakpoint in the oxygen uptake vs carbon dioxide output curve (GET), 2) the first muscle oxyhemoglobin inflection point ([O₂Hb]-T), and 3) a rating of 13 in perceived exertion (perceptual threshold: RPE13-T).

RESULTS: Oxygen uptake at the different thresholds was not significantly different ($P > 0.05$). Moreover, GET and [O₂Hb]-T were significantly correlated: (1) to each other ($r \geq 0.79$; $P \leq 0.001$) and (2) to time-to-exhaustion ($r = 0.81$ and $r = 0.72$, respectively; $P < 0.01$). RPE13-T, however, was not significantly correlated with the time-to-exhaustion ($P = 0.148$).

CONCLUSIONS: The 'anaerobic threshold' as identified from GET was concomitant to [O₂Hb]-T. Both thresholds were correlated to time-to-exhaustion, and could therefore be used as a performance index in middle-duration events.

3036 Board #101 June 3, 3:30 PM - 5:00 PM
The Effect Of Fatigue And Elevated Heart Rate On Archery Shot Performance

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 (No relationships reported)

PURPOSE: The purpose of this study was to determine the effects of fatigue and elevated heart rate on archery shot performance with both single cam (SC) and double cam (DC) compound bows. **METHODS:** Participants consisted of experienced archers ($n=15$). Participants were outfitted with two styles of bows, a SC and DC. Participants performed 15 familiarization shots at a distance of 20 yds prior to testing. Each participant then completed a series of shots in a fatigued (F) and non-fatigued (NF) state with both SC and DC bows. NF testing: Participants performed 4 shots (NF1, NF2, NF3, NF4) at a 20 yd target. During this time participants were asked to shoot the arrows as quickly as possible, but without compromising accuracy. The worst arrow was dropped and the x mark was calculated as the center of the diameter that encompassed the top 3 shots (NFT3). F testing: Participants were asked to walk on a treadmill at 10% grade, 2.5 mph for 5 min, followed by a 30 sec rest and subsequent 300 yd run at 7 mph and 1% grade. Following the run, participants performed 4 shots (F1, F2, F3, F4) at a 20 yd target as quickly as possible, but without compromising accuracy. Heart rate (HR) was continuously recorded during both NF and F tests. Aim time in seconds was also recorded for each shot. Precision was determined by comparing NFT3 to F1 for both SC and DC tests. Accuracy was determined by comparing NFT3 to the center of a diameter that encompassed the top 3 F shots (FT3) for both SC and DC tests. SC and DC tests were performed in a random cross-over design. A Pearson test was used to determine the relationship between F1 precision and HR. **RESULTS:** Aim time was not significantly different between the DC (NF=3.49 ± 1.41sec, F=3.72 ± 1.41sec; $p=0.15$) or SC (NF=3.62 ± 1.14sec, F=3.59 ± 1.33sec; $p=0.67$) tests. Precision between F1 and NFT3 was not different between the DC (59.07 ± 49.83mm) and SC (59.27 ± 52.69mm, $p=0.96$) tests. There were weak relationships between HR and F1 precision for SC ($r=-0.024$) and DC ($r=0.24$). There were significant differences between NFT3 (80.36 ± 32.38mm) and FT3 (56.43 ± 31.09mm, $p=0.16$) during the DC test only. However these differences were not associated with F1, which could be considered the most critical shot. **CONCLUSION:** Elevated heart rate does not impair aim time or initial shot performance in archery with either a SC or DC compound bow.

3037 Board #102 June 3, 3:30 PM - 5:00 PM

The Impact Of Lower-body Aerobic And Anaerobic Exercise On Upper-body Muscular Fatigue

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The Impact of Lower-body Aerobic and Anaerobic Exercise on Upper-body Muscular Fatigue

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Purpose: This study compared the effects of lower body aerobic and anaerobic exercise performed on a Wingate bike on upper body muscular performance. **Methods:** Fourteen physically active participants (20.6±1 yrs, 178.9±10 cm, 75.7±10 kg) completed three trials. The first trial consisted of familiarization to modified pull-ups. All pull-up repetitions were performed at a rate of 2 seconds per repetition. Participants were paced by a metronome, failure to complete a full range of motion or maintain pace was considered fatigue. For the second trial, participants completed four 15-second maximal effort sprints on a stationary cycle while connected to a metabolic cart (Parvo Medics TrueOne 2400). Immediately after the 4th sprint, participants completed modified pull-ups to exhaustion. The total number of pedal revolutions was determined for the sprint trial. The final trial consisted of a timed steady state cycling bout while utilizing metabolic cart. The aerobic cycling bout was matched to the sprinting trial by number of total pedal revolutions during the exercise bout while pedaling at 40 revolutions per minute. The participants pedaled at the constant rate of revolutions until the total number matched the sprint trial. Immediately after the aerobic exercise, participants completed modified pull-ups to exhaustion. Exercise trials were separated by 3 to 5 days. **Results:** There was a significant increase in RPE ($p=0.004$) for the anaerobic exercise bout (RPE, 13.71) compared to the aerobic exercise bout (RPE, 11.32). In the initial control trial, participants averaged 26.77 repetitions of the modified pull-up. The anaerobic trial significantly reduced the number of modified pull-up to exhaustion (21.98 repetitions, $p=0.001$), while the aerobic exercise had no effect on the number of modified pull-ups (24.07 repetitions, $p=0.07$). There was no difference between exercise bouts ($p=0.17$). **Conclusions:** Upper-body muscular endurance is significantly reduced by anaerobic exercise while an aerobic exercise bout matched for work does not impact upper-body muscular endurance.

3038 Board #103 June 3, 3:30 PM - 5:00 PM

Respiratory Muscles Fatigue After A Simulated Taekwondo Match In College Level Athletes

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Taekwondo (TKD) athletes have high-intensity intermittent challenges in a match which is typically structured across three 2-min rounds with a 1-min interval separating each round. After such kind of intermittent high-intensity efforts, we observed that the athletes breathed heavily and they also complained about that shortness of breath interfered with their performance during a match. Respiratory muscle fatigue occurs in endurance type exercise, and has been shown to affect sports performance. However, whether TKD athletes experience respiratory muscles fatigue during a match is still unclear.

PURPOSE: To determine if and how much the respiratory muscles fatigue after a TKD match.

METHODS: Seven college TKD athletes (3 males & 4 females, age 22.0 ± 3.5 yrs.; height 166.8 ± 7.7 cm; weight 64.6 ± 13.1 kg) participated in simulated matches that followed the rules of World Taekwondo Federation. Maximal inspiratory pressure (MIP) was measured via a respiratory pressure meter (CareFusion®, microRPM, California, United States) before and right after the simulated match. Subjects were instructed and familiar themselves before the MIP test. Five MIP trials were conducted and the highest value was used for comparison. Three cameras were set up on the court to record each athlete's attack types and repetitions.

RESULTS: MIP significantly decreased from 108.8 ± 21.2 to 96.7 ± 19.4 (cmH₂O) ($p=0.02$). Moreover, the amount of attack was 77.7 ± 25.4, and the amount of the most performed attack type, round kicking, was 53.7 ± 25.5. The amount of attack in the present study was comparable with those of elite athletes in previous studies. The average of every athlete's attack times in the 1st, 2nd, and 3rd round were 28.8, 25.0, 23.6 respectively. The decline of the sum of attack times expressed decreased performance of the athletes.

CONCLUSIONS: Based on the result of the MIP test, it was concluded that the respiratory muscles of TKD athletes was fatigued after matches, and could affect the performance during competition.

3039 Board #104 June 3, 3:30 PM - 5:00 PM

Effect of 12 Weeks Training on Fatigue-Induced Postural Sway in Volleyball Players

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A positive correlation exists between balance ability and athletic performance in several sports. Further, research reveals that muscular fatigue impairs both postural stability and balance. **PURPOSE:** To determine if 12 weeks of balance training will improve postural control following fatigue-induced exercise in female volleyball players.

METHODS: Two professional volleyball teams from Turkish 2nd league were randomly divided into two experimental groups: 1) Balance training group (N= 12; age 21.8±3.7 years); and 2) Control group (N=11; age 20.4±3.5 years). Subjects assigned to the balance training group added 12 weeks of balance training to their normal exercise training program whereas the control group performed only their normal exercise routine. Prior to beginning the balance training, all subjects were familiarized with the balance assessment system and on a separate day, all subjects performed a treadmill test to exhaustion (Bruce protocol). Balance test measures were performed immediately following the exhaustive exercise and at 10, 20, and 30 minutes post exercise. Following 12 weeks of balance training, all subjects then performed another treadmill to exhaustion and balance test measurements were repeated. The balance tests measured the anteroposterior (AP), mediolateral (ML) and total (T) postural sway. Data were analyzed as a two-way factorial repeated measures design using non-parametric statistics. In this method the data were provided as Relative Treatment Effect (RTE). RTE can range between 0 and 1 and if the null hypothesis is accepted, all groups would have a RTE 0.50.

RESULTS: Prior to beginning the balance training, exhaustive exercise impaired AP, ML, and T postural sway immediately following exercise in both experimental groups. At the completion of 12 weeks of balance training, exhaustive exercise did not impair postural sway in the trained group at any time period following exercise. In contrast, the control group exhibited impaired postural sway immediately following exhaustive exercise and at 10 and 20 minutes post-exercise.

CONCLUSIONS: These findings suggest that balance training can improve fatigue-induced postural sway instability. Additional research is warranted to determine if training-induced improvement in balance can decrease the risk of injury in selected sports.

3040 Board #105 June 3, 3:30 PM - 5:00 PM

Effect of Near Infrared Laser Light on Muscle Fatigue

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Laser therapy has been used for many years to assist in wound healing, attenuate inflammation, and reduce pain, all with the goal of improving performance. Recently, research has suggested that low intensity near infrared light may work by impacting oxygen - hemoglobin binding and improving aerobic metabolism via cytochrome c oxidase stimulation. **PURPOSE:** Thus, this study aims to look at the impact of low intensity near infrared light on muscle fatigue. **METHODS:** Young adults (N=9) were randomly exposed (The Flexor Pollicis Longus, Flexor Digitorum Superficialis and Flexor Digitorum Profundus muscles were targeted) to either 800-nm laser light (K-LaserUSA, Franklin, TN), a combination of 800 and 905-nm light or a placebo while completing 50 maximal contractions on a hand grid dynamometer (Model DHD-1, Saehan Medical). The cadence for contraction and relaxation was set using a multimedia platform and the force of each contraction was recorded and used to generate a force/time curve. **RESULTS:** Both treatment and control groups exhibited the expected decrease in force production, however the treatment groups showed less force decrement than did the placebo group ($p=0.0121$ for 800 nm and $p=0.0101$ for the combination). **CONCLUSIONS:** These data indicate that treatment with an 800-nm laser light during exercise and treatment with 800-nm + 905-nm laser light may attenuate muscular force decreases. More work is needed to determine the mechanisms of action for both the 800-nm and 905-nm laser lights.

F-27 Free Communication/Poster - HIIT

Friday, June 3, 2016, 1:00 PM - 6:00 PM
Room: Exhibit Hall A/B

3041 Board #106 June 3, 2:00 PM - 3:30 PM

Effects Of 4-week High-intensity Interval Training Protocols On The Heart Rate Variability In Judo Athletes

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PURPOSE: The aim of this study was to investigate the effects of three different types of high-intensity interval training on the heart rate variability (HRV) in judokas. **METHODS:** 29 judo experienced judokas randomly distributed in 4 groups: Lower-body (LB); Upper-body (UB); Uchi-komi (arm or hip technique repetition) (UT) and Control group (CG). The groups trained twice per week for 4 weeks, with 2 blocks of 10 x 20s effort interspersed by 10s passive recovery between sets and 5-min between blocks, added to the judo training sessions. The LBG and UBG trained in cycle-ergometer using 4.5% and 3.0% of body mass, respectively. The CG was submitted only to the judo training. The HRV was monitored at rest before the first session of each week. The frequencies analyzed were: MRR (s), rMSSD (ms), LF (Hz), HF (Hz), LF/HF and rMSSD/MRR ratio. For data analysis, a two-way analysis of variance with repeated measurements was performed, followed by a Bonferroni test, using $P<0.05$. The effect size was calculated using eta squared (η^2) and Cohen's d. **RESULTS:** For the MRR and LF/HF there were no significant differences. Group effect was detected for rMSSD, with higher ($P<0.05$, $\eta^2=0.365$) values for the UT in comparison to all other groups. Additionally, an effect of moment was detected, with higher values in the fourth week compared to the first ($P<0.05$, $\eta^2=0.101$; LB $d=0.80$; UB $d=0.32$; UT $d=-0.71$ and CG $d=0.10$). For LF, a group effect was found ($P<0.05$, $\eta^2=0.393$), with higher values for the UT compared to all others. For HF, a group effect was observed ($P<0.05$, $\eta^2=0.310$), with higher values for the UT compared to the LB ($P=0.04$). For rMSSD/MRR, a group effect was found ($P<0.05$, $\eta^2=0.362$), with higher values for the UT compared to the LB ($P=0.04$) and CG ($P=0.01$). Moreover, an effect of moment was detected ($P<0.05$, $\eta^2=0.137$), with higher values in the fourth week compared to the first ($P=0.02$; LB $d=1.79$; UB $d=1.23$; UT $d=1.00$ and CG $d=0.38$). **CONCLUSION:** The results showed increases in parasympathetic activation in fourth week of training and higher values from sympathetic activity in UT when compared to LB and CG. Finally, HRV has proven to be sensitive to high intensity interval training can be used for monitoring and control of the training process.

3042 Board #107 June 3, 2:00 PM - 3:30 PM

The Perceived Demands of CrossFit®

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Rhabdomyolysis is the breakdown of muscle tissue causing myoglobin, creatine kinase, and other intracellular proteins and electrolytes to leak into circulation, disrupting cell homeostasis. Exertional rhabdomyolysis (ER) occurs after extremely rigorous physical training that could include high amounts of strenuous eccentric exercise. There has been an increase in reports for mild to severe ER as well as other musculoskeletal injuries as the popularity of extreme conditioning programs (e.g., CrossFit®) increases.

PURPOSE: The main purposes of this investigation were to identify: primary risk factors associated with ER during CrossFit®, CrossFit® workouts that might induce a higher risk for the development of ER, and ratings of perceived exertion (RPE) for CrossFit® vs. American College of Sports Medicine (ACSM) training guidelines. **METHODS:** An online questionnaire (Qualtrics, Qualtrics, LLC) was completed by 101 CrossFit® participants and 56 ACSM guided participants ($n = 157$). Statistical analysis utilized an independent t-test analysis via SPSS (IBM® SPSS® Statistics Version 21). This was used to compare the statistical significance of the means for each group related to the average RPE for workouts, the number of weeks the individual participated in the program, and the perceived average number of hard days completed during a week. **RESULTS:** CrossFit® and ACSM groups reported significantly different RPEs of 7.29 ± 1.74 and 5.52 ± 1.35 ($p \leq 0.001$), and performed significantly different hard days per week of 3.99 ± 1.07 and 3.55 ± 1.39 ($p = 0.044$), respectively. The top five perceived hardest workouts based on frequency were Fran (47), Murph (27), Fight Gone Bad (10), Helen (9) and Filthy 50 (9). One occurrence of ER was

reported out of 101 CrossFit® participants. **CONCLUSION:** The overall risk of developing ER may be minimal, especially if a participant understands their body's limitations in regard to the intensity of CrossFit®. Supported by Northern Michigan University Spooner Grant Winter 2014

3043 Board #108 June 3, 2:00 PM - 3:30 PM
Effects of Sprint Vs. High-Intensity Aerobic Interval Training on Cross-Country MTB Performance: A Randomized Trial

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 (No relationships reported)

Aerobic and anaerobic power and capacity are important factors underlying performance in mountain biking (MTB) races. Although there is an increase interest in high-intensity aerobic training (HIT), to the best of our knowledge, no studies have examined the effects of HIT and sprint interval training (SIT) in mountain bikers. **PURPOSE:** The current study compared the effects of HIT and SIT on MTB race simulation performance and physiological variables, including peak power output (PPO), lactate threshold (LT) and onset of blood lactate accumulation (OBLA). **METHODS:** Sixteen mountain bikers (mean \pm SD: age 32.1 \pm 6.4 yr, body mass 69.2 \pm 5.3 kg and VO_{2max} 63.4 \pm 4.5 mL \cdot kg⁻¹ \cdot min⁻¹) completed graded exercise and MTB performance tests before and after six weeks of training. The HIT (7-10 x [4-6 min - highest sustainable intensity / 4-6 min - CR100 10-15]) and SIT (8-12 x [30 s - all-out intensity / 4 min - CR100 10-15]) protocols were included in the participants' regular training programs three times per week. **RESULTS:** Post-training analysis showed no significant differences between training modalities (HIT vs. SIT) in body mass, PPO, LT or OBLA ($p=0.30$ to 0.94). The Cohen's d effect size (ES) showed trivial to small effects on group factor ($p=0.00$ to 0.56). The interaction between MTB race time and training modality was almost significant ($p=0.08$), with a smaller ES in HIT vs. SIT training (ES=-0.43). A time main effect (pre- vs. post-phases) was observed in MTB race performance and in several physiological variables ($p=0.001$ to 0.046). Co-variance analysis revealed that the HIT ($p=0.043$) group had significantly better MTB race performance measures than the SIT group. Furthermore, magnitude-based inferences showed HIT to be of likely greater benefit (83.5%) with a lower probability of harmful effects (0.8%) compared to SIT. **CONCLUSION:** The results of the current study suggest that six weeks of either HIT or SIT may be effective at increasing MTB race performance; however, HIT may be a preferable strategy. Supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico Grant (CNPq 131148/2009-5).

3044 Board #109 June 3, 2:00 PM - 3:30 PM
Effectiveness Of A 16-week High-Intensity Cardio-Resistance Training (HI CRT) Program In Adults

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High-intensity exercise is gaining popularity in the public sector; empirical research on the efficacy of these types of activities is emerging. **PURPOSE:** To determine the efficacy of a novel, 16-wk training program on measures of aerobic fitness, agility, aerobic power, muscular endurance, lower body explosive power, & self-reported activity level. **METHODS:** The intervention group (N=129; 63 f, 24.65 \pm 5.55 yrs) had a baseline VO_{2max} of 39.83 \pm 9.13. These individuals participated in 26, 70-min exercise sessions, & 4 fitness testing sessions over the course of 16 wks. Participants were matched with a non-exercise control group, paired by sex, age, & baseline VO_{2max} . The control group (N = 129, 63 f, 24.26 \pm 5.59 yrs) had a baseline VO_{2max} of 39.86 \pm 8.59 & completed pre & post VO_{2max} testing only. **RESULTS:** Participants in the fitness intervention group significantly increased their VO_{2max} (2.72 \pm 0.31, M_{diff} \pm SE; $p<.001$) & reported being more physically active (0.42 \pm 0.11, M_{diff} \pm SE; $p<.001$) after the 16-wk intervention. Participants in the control group showed no significant pre-post changes. Participants in the fitness intervention showed a significant improvement in 3 of 5 components of the fitness field tests. Specifically, significant improvements were observed for the 1-min rowing test (5.32 \pm 0.505, M_{diff} \pm SE; $p<.001$), the 1-min push-up test (8.168 \pm .709, M_{diff} \pm SE; $p<.001$), & the 1.5-mile run test (1.79 \pm 0.169, M_{diff} \pm SE; $p<.001$). No significant improvements were observed for the shuttle run ($p=.173$) or standing long jump ($p=.137$).

CONCLUSIONS: These findings demonstrate the efficacy of a novel, HI CRT intervention across multiple dimensions of fitness for young & middle aged adults. The research is based upon work supported by the Office of the Director of National Intelligence (ODNI), Intelligence Advanced Research Projects Activity (IARPA), via Contract 2014-13121700004 to the University of Illinois at Urbana-Champaign. The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of the ODNI, IARPA, or the U.S. Government. The U.S. Government is authorized to reproduce and distribute reprints for Governmental purposes notwithstanding any copyright annotation thereon.

3045 Board #110 June 3, 2:00 PM - 3:30 PM
Methodological Comparison of PWCFT Estimation in Response to High Intensity Interval Training

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 (No relationships reported)

Purpose: To compare the estimation of physical working capacity at fatigue threshold (PWC_{FT}) during cycle ergometry using two different methods prior to and following high intensity interval training (HIIT). **Methods:** Twenty-one subjects (age: 22.9 \pm 3.0 years; height: 172.5 \pm 10.3 cm; body mass: 72.7 \pm 13.2 kg) performed incremental cycle ergometer rides to exhaustion with bipolar surface EMG signals recorded from the vastus lateralis prior to and following four weeks of HIIT. PWC_{FT} was determined using two different mathematical procedures, referred to as the original (ORG) and the Dmax methods. ORG was used to identify the work rate at which a significant slope in the EMG-Time relationship occurs, whereas the Dmax method was used to examine the breakpoint in the EMG-time relationship for the entire duration of the GXT. Two-Way (method x time) ANOVA was used to examine the effect of HIIT on PWC_{FT} . A dependent t -test was used to compare pre-training (Pre) and post-training (Post) PWC_{FT} values between the Dmax and ORG methods. Pearson correlation was used to determine the relationship between the Dmax and ORG for Pre and Post values. The Bland and Altman approach was used to assess agreement between methods. **Results:** There was no significant interaction ($p=0.957$), however, there was a significant main effect for time ($p<0.001$). HIIT training improved PWC_{FT} regardless of method from Pre (174.7 W) to Post (194.7 W) assessment. A strong, positive relationship between Dmax and ORG was identified for Pre ($r^2 = 0.823$) and Post ($r^2 = 0.844$) PWC_{FT} values. Despite limited bias in this relationship (ORG-Dmax Δ : -0.43 \pm -36.4 W), broad limits of agreement were identified (-29.4 W to 85.5 W). **Conclusions:** No significant differences were observed between methods prior to or following the 4-week HIIT intervention. The Dmax method offers an alternative approach to quantifying training-based changes in PWC_{FT} .

3046 Board #111 June 3, 2:00 PM - 3:30 PM
Effects Of High-intensity Intermittent Training And High-intensity Intermittent Cross Training On Maximal Oxygen Uptake

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PURPOSE: The purpose of this study was to elucidate effects of high-intensity intermittent training (HIIT) and high-intensity intermittent cross-training (HICT) on maximal oxygen uptake ($V(\bullet)O_{2max}$). **METHODS:** Exercise Protocol: The protocol for HIIT exercise was bouts of 20-s bicycle exercise carried out at an intensity of 170% of the subject's $V(\bullet)O_{2max}$. Each bout was separated by 10-s rest, and subjects were encouraged by the supervisor to complete six to seven exercise bouts until exhaustion. The HICT exercise consists of totally 7 intermittent 20 sec exercise bouts with 10 sec rest between the bouts. The subjects bike on bicycle ergometer and run on a treadmill alternatively for the 1st, 3rd, 5th, 7th bouts and 2nd, 4th, 6th bouts, respectively. Exercise intensity (170% $V(\bullet)O_{2max}$) for both bicycle and running of the HICT exercise was as same as of the HIIT. **Training Procedure:** Twenty-four healthy male subjects were allocated randomly to the HIIT group (n=8), HICT group (n=8, 1 dropout) or control group (n=8). Two training groups underwent the HIIT and HICT for 2 days/week for 6 weeks. $V(\bullet)O_{2max}$ was determined for the training and control groups before, at 3wks, and after training. **RESULTS:** The bicycling $V(\bullet)O_{2max}$ of HIIT and HICT group were significantly increased by 10.0 \pm 1.9% ($p<0.001$) and 9.9 \pm 3.0% ($p<0.001$), respectively. Both HIIT and HICT groups improved bicycling $V(\bullet)O_{2max}$ significantly compared

with the control group ($p < 0.05$, $p < 0.05$). No significant difference was observed in improvement of bicycling $V(\bullet)O_2\text{max}$ between the HIIT and HIICT group. The treadmill running $V(\bullet)O_2\text{max}$ of HIIT and HIICT group had significantly increased by $3.9 \pm 3.4\%$ ($p < 0.01$) and $9.7 \pm 3.9\%$ ($p < 0.001$), respectively. Compared with the control group, only $V(\bullet)O_2\text{max}$ of HIICT group improved significantly ($p < 0.05$).

CONCLUSIONS: HIICT improves $V(\bullet)O_2\text{max}$ measured for two exercises involved in the training to the same extent, while impact of HIIT on $V(\bullet)O_2\text{max}$ of the exercise which was not used during the training was relatively weak.

3047 Board #112 June 3, 2:00 PM - 3:30 PM

Survey of Incidence of Injuries in Crossfit Training

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PURPOSE: To determine whether or not there is any association of injuries with Crossfit training.

METHODS: A Crossfit, Inc. affiliated gym was contacted and agreed to have its members participate in an anonymous de-identified survey that asked questions regarding past medical history, injuries prior to training, how long participants were training, if injuries were sustained during training, how long into training injuries occurred, where the injuries occurred, and what exercises were being performed at the time, and what treatment, if any, was sought. An injury was defined as a physical complaint either warranting modification of activities for greater than two weeks or warranting seeing a healthcare professional.

RESULTS: We were able to enroll 28 participants in the survey. 16 of the participants developed an injury after starting Crossfit with a total of 20 injuries altogether. Of those, 10 had prior injuries. 11 of the injured participants were injured after being in Crossfit training for greater than 6 months. The most commonly injured region was the shoulders (seven injuries) and spine (seven injuries). There was also one instance of a participant having rhabdomyolysis and kidney failure requiring inpatient IV fluids. The exercises that most commonly caused injury were the overhead press (3 reports) and deadlift (3 reports).

CONCLUSIONS: Most injuries occurred with increased time spent crossfit training, and most participants that were injured had a previous injury. The highest area of injury were the shoulders and spine and the exercises that most commonly caused injury were the overhead press and deadlift. Most participants used rest to help treat their injuries. The most common timespan of modification of activities during Crossfit post-injury was 2-6 weeks. Due to the limited participant number, this data warrants further study to determine what is causing these injuries.

3048 Board #113 June 3, 2:00 PM - 3:30 PM

Response to Heavy Rope Interval Training and Active Recovery in Division I College Football Players

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(No relationships reported)

Heavy rope interval training is widely used to improve athletic performance, but there has been very little research conducted on the physiological effects of acute bouts of heavy rope interval training. There is also a lack of research concerning the impact of active recovery following bouts of interval training in college football athletes. **PURPOSE:** To examine the physiological response to acute bouts of heavy rope high-intensity interval training and compare the influence of active recovery (AR) and passive recovery (PR) on blood lactate clearance in Division I college football players. **METHODS:** The study population was comprised of 13 male Division I college football players (20.2 ± 1.4 years, 183.3 ± 6.0 cm, 89.5 ± 7.9 kg). The study used a randomized crossover groups design. Participants were randomly assigned to one of two groups based on the order of the recovery type. During the heavy rope protocol, participants performed six, 15 s bouts of vigorous exercise separated by 30 s rest intervals. Participants recovered either actively or passively depending on their group assignment. The active recovery protocol consisted of walking at two miles per hour on a treadmill, and the passive recovery required the participant to sit still between exercise bouts. After a minimum rest period of 48 hr, participants in both groups repeated the intervention and the method of recovery was switched. Blood lactate concentration was measured at four time points; after a 4 min warm-up period, immediately after the heavy rope interval exercise, and at 2 and 5 min post exercise. **RESULTS:** Results of a two-way repeated measures ANOVA demonstrated a significant recovery by time interaction $F(3, 12) = 15.6$, $p < 0.01$. Pairwise comparisons revealed that blood lactate concentration using active recovery was significantly lower than passive recovery immediately following the heavy rope high-intensity interval training bout (AR: 6.81 ± 1.06 mmol/l; PR: 7.69 ± 1.55 mmol/l, $p < 0.05$) and at 2 min (AR: 7.34 ± 1.26 mmol/l; PR: 8.92 ± 1.83 mmol/l, $p < 0.01$) and 5 min post exercise (AR: 7.07 ± 1.17 mmol/l; PR: 9.00 ± 1.82 mmol/l, $p < 0.01$).

CONCLUSION: Active recovery following acute bouts of heavy rope interval training is more effective than passive recovery to enhance blood lactate clearance in Division I college football players.

3049 Board #114 June 3, 2:00 PM - 3:30 PM

The Effects of High Intensity Interval Training on Recreational Wheelchair Athletes

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Engagement in upper body (UB) aerobic activity improves cardiovascular fitness. It is not known whether UB high intensity interval training (HIIT) will show similar physiological adaptations when compared to lower extremity HIIT. **PURPOSE:** The effects of UB HIIT on recreational wheelchair athletes (WA). **METHODS:** The study consisted of 11 recreationally trained WA. The mean age was 17.63 ± 4.45 ranging from 12- 26 years. Disabilities represented included: cerebral palsy ($n=3$), spina bifida ($n=3$), arthrogyposis ($n=1$), paraplegia ($n=2$), right leg paralysis ($n=1$), and above the knee single amputation ($n=1$). Baseline aerobic metabolism was assessed using a continuous submaximal test on a Monark 891E with a Jaeger™ OxyconPro metabolic system. Exercise intensity level was measured using the Borg CR10 rating of perceived exertion Scale (RPE). Physical tests included 20 meter wheelchair forward and backward sprints. Measurements of VO_2 , RHR, exercise HR, exercise duration, and RPE were taken during testing. WA were instructed to maintain 50 rpm while cranking asynchronously until volitional exhaustion, based on the results of pilot testing conducted prior. The HIIT protocol consisted of two sessions a week for eight weeks, consisting of 30 second sets of a maximal effort asynchronous cranking performed at an RPE of 8-9. WA performed four sets per session the first two weeks and every two weeks an additional set was added, completing the intervention with seven sets. **RESULTS:** WA completed 11 ± 3.16 HIIT sessions. Complete pre-intervention data was collected on FW sprint, BW sprint, exercise duration, and RHR. Five WA were able to provide data for the four measurable variables. There was significantly decreased resting heart rates ($t(9) = 2.40$, $p = .043$), significantly decreased forward sprint times ($t(5) = 4.44$, $p = .011$), a non-significant decrease in backward sprint times ($t(5) = 2.060$ $p = .108$) and a significant decrease in exercise duration ($t(9) = 4.72$ $p = .001$). **CONCLUSION:** The current study shows that when a HIIT protocol is implemented on recreationally active WA, the result is improved heart rate adaptations and improved sprint outcomes.

3050 Board #115 June 3, 2:00 PM - 3:30 PM

The Comparison of Two High Intensity Interval Training Regimes on Endurance Performance in Female Athletes

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(No relationships reported)

It was suggested that high-intensity interval training (HIT) leads to improvements in both aerobic and anaerobic fitness and improves endurance performance. However, typical Wingate-based HIT needs to be keeping high motivation and extremely demanding. Therefore, we sought to design a more practical model of HIT.

PURPOSE: The purpose of this study was to compare the effects of two different HIT regimes on aerobic capacity and endurance performance.

METHODS: Sixteen college female distance runners were assigned to either a "Load Constant type" (CON: $n = 8$, 20.1 ± 1.4 yrs.) or a "Load Decrement type" (DEC: $n = 8$, 20.0 ± 1.6 yrs.) group. They performed repeated 30-s "all-out" efforts sprint exercise on an electronically braked cycle ergometer for 2 weeks with 1-2 days rest between sessions. Each training session consisted of 5 sets of 30-s maximal sprint with 4 min rest periods between set. Resistance load of NOR was equivalent to 0.075 kg/kg body mass in all set, whereas the DEC was 0.075 kg/kg body mass for the first set and then decreased in every set (0.065, 0.055, 0.045, and 0.035 kg/kg body mass). $VO_2\text{max}$ and 3,000m time trial were performed before and after training period.

RESULTS: After the 2 weeks of HIT, peak power and mean power in 30-s maximal sprint exercise were not increased significantly in both groups. $VO_2\text{max}$ was significantly ($P < 0.05$) increased in the CON (45.4 ± 5.9 vs 49.9 ± 5.1 ml/kg/min), however, DEC was not significantly increased (48.2 ± 4.5 vs 47.9 ± 7.6 ml/kg/min). On the other hand, 3,000m running velocity was significantly increased ($P < 0.05$) in the DEC (254 ± 8 vs 265 ± 10 m/min), however, the CON was not significantly increased (252 ± 12 vs 256 ± 15 m/min).

CONCLUSIONS: It was suggested that HIT training method to improve the endurance running performance, load decrement type was suitable than load constant type.

Abstracts were prepared by the authors and printed as submitted.

3051 Board #116 June 3, 2:00 PM - 3:30 PM

The Energy Cost and Metabolic Stimulus of High Intensity TrainingRobert M. Otto, FACSM, Ryan Page, Kaitlyn Monteith, John Petrizzo, Lauren Chandler, Luisa Echeverry, Richard Happel, John Wygand, FACSM. *Adelphi University, Garden City, NY.*
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>Since the introduction of the Tabata Protocol (TP) in 1996, debate has enveloped the value of this 4 minute (8 x 20 sec work: 10 sec recover), high intensity protocol (170% of max VO_2 workload) for providing a sufficient metabolic stimulus through work and recovery (excess post-exercise O_2 consumption[net VO_2):EPOC). Despite the controversy, TP, which was originally performed on a cycle ergometer, is one of the most popular training programs for athletic performance improvement and has expanded to multiple modes of exercise (i.e. running, swimming, stepping).

PURPOSE: The purpose of this study was to determine the energy cost and metabolic stimulus of performing a TP and a submaximal steady state (SS) protocol at a matched total workload. **METHODS:** 13 subjects (age 21.6 ± 1.2 yr, ht. 1.70 ± 7.2 m., body mass 69.8 ± 16.8 kg, max VO_2 2.76 ± 0.8 L/min, Max workload 223.1 ± 47.3 W, 10♂) were familiarized with the Lode Cycle Ergometer and the TP, one week prior to performing a max VO_2 test on the Lode (100 W plus 25W/3 min until volitional exhaustion). Continuous open circuit spirometry and heart rate by telemetry were used for TP and SS trials with 10 min rest, 5 min warm-up @ 60% max workload, TP w 10 sec @ 20 W recovery intervals or SS @ 80% max workload matched for TP total work over 4-6 minutes, and 30 min cool-down with 2 min @ 20 W active and 28 min passive. Lactate samples were obtained at 3, 15, and 30 min recovery. **RESULTS:** Matched total work (62320 joules) was achieved with 379.5 ± 80.4 and 178.5 ± 37.8 W, at % HR max of 99.3 ± 0.1 and 92.4 ± 0.1 , for TP and SS trials, respectively. Net exercise VO_2 (L) were 9.7 ± 3.7 and 11.1 ± 2.4 , 3 min EPOC were 2.6 ± 1.3 and 1.8 ± 0.5 , 15 min EPOC were 4.1 ± 2.2 and 2.3 ± 0.5 , 30 min EPOC were 4.5 ± 2.4 and 2.5 ± 0.6 and peak lactate were 12.3 ± 2.8 and 7.4 ± 2.7 mmole for TP and SS trials, respectively. Statistical analysis by paired T test revealed significant difference ($p < .05$) between TP and SS for all VO_2 variables. **CONCLUSION:** The highly anaerobic workload combined with minimal recovery of TP provides ample stimulus for aerobic and anaerobic metabolism with a net aerobic requirement of 87% of the SS VO_2 and a glycolytic contribution 66% greater than SS exercise. The 30 min net caloric recovery of 22.5 for TP and 12.5 for SS reveals limited energy cost for recovery from either protocol.

3052 Board #117 June 3, 2:00 PM - 3:30 PM

EPOC Following High Intensity Aerobic Intervals and Moderate Intensity Aerobic ExerciseRachel Simmons, David P. Swain, FACSM. *Old Dominion University, Norfolk, VA.* (Sponsor: David Swain, FACSM)
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In the past few years, much attention has been directed toward shorter-duration vigorous intensity aerobic exercise as opposed to longer-duration moderate intensity exercise. There is conflicting evidence as to whether vigorous exercise can result in a greater excess post-exercise oxygen consumption (EPOC) and thus more calories burned when compared to moderate continuous exercise performed for a longer duration.

PURPOSE: To quantify EPOC following moderate intensity aerobic exercise (MOD) and high intensity aerobic intervals (HIAI) of equal energy expenditure. **METHODS:** Nine subjects (5 male, 4 female; age 26 ± 2 yr; height 170 ± 3 cm; mass 68.5 ± 3.3 kg; $\text{VO}_{2\text{max}}$ 41.9 ± 2.1 mL \cdot min $^{-1}$ kg $^{-1}$) participated in MOD and HIAI trials in a counterbalanced order separated by at least 48 hours. HIAI was ten 1-min intervals at 90% maximal aerobic power (P_{max}), alternated with 1-min intervals at 60% P_{max} . MOD was 30 min at 50% P_{max} . Warm-ups and cool-downs were also matched for total work. All exercise was performed on a cycle ergometer. Data are reported as mean \pm SE. **RESULTS:** VO_2 at rest was 0.27 ± 0.02 L/min preceding the MOD trial, and 0.28 ± 0.03 L/min for HIAI. Net VO_2 during exercise (inclusive of warm-ups and cool-downs) was 47.0 ± 3.5 L MOD, and 46.5 ± 4.0 L HIAI. EPOC during minutes 0-10 post-exercise was 1.41 ± 0.22 L MOD, and 2.51 ± 0.35 L HIAI. Following a one-min water break, EPOC during minutes 11-41 post-exercise was 0.84 ± 0.44 L MOD, and 0.86 ± 0.31 L HIAI. Following a 30-min break, EPOC during minutes 71-81 post-exercise was 0.01 ± 0.15 L MOD, and -0.06 ± 0.08 L HIAI. EPOC was significantly above rest for minutes 0-10 and 11-41, but not minutes 71-81, post-exercise. EPOC 0-10 following HIAI was significantly higher than following the MOD condition. **CONCLUSION:** High intensity aerobic intervals resulted in greater EPOC than moderate aerobic exercise of the same energy expenditure, but only for the first 10 minutes post exercise. VO_2 following both types of exercise returned to resting levels approximately 70 minutes post-exercise.

3053 Board #118 June 3, 2:00 PM - 3:30 PM

Effect of Interval and Endurance Training on Selected Performance Indices in Club Level Gaelic FootballDavid T. Kelly¹, Cathal J. Cregg², Paul L. O'Connor³, Bryan D. Cullen², Niall M. Moyna, FACSM². ¹*Athlone Institute of Technology, Athlone, Ireland.* ²*Dublin City University, Dublin, Ireland.* ³*Central Michigan University, Mount Pleasant, MI.**(No relationships reported)*

High-volume endurance training (HVET) has been traditionally used to improve aerobic capacity in Gaelic football players. More recently, low-volume short-duration high-intensity interval training (LS-HIT) has been found to improve aerobic capacity. This type of training involves a markedly lower training volume than HVET. To date, no published studies have compared the effect of LS-HIT and HVET on maximal aerobic capacity (VO_2max), running economy (RE), vVO_2max , blood lactate levels, Wingate test performance, and intermittent endurance performance (IEP) in club level Gaelic football players.

PURPOSE: To compare the effects of 6 weeks of HVET and LS-HIT on maximal aerobic capacity, vVO_2max , running economy, blood lactate levels, peak power output and intermittent endurance performance in Gaelic football players.

METHODS: Club level male Gaelic football players were randomly assigned to a LS-HIT ($n=13$; 27.2 ± 3.6 yr) or a HVET ($n=12$; 24.7 ± 4 yr) group. Participants trained 3 d.week $^{-1}$ for 6 weeks. VO_2max , RE, vVO_2max , blood lactate levels, Wingate test performance, and IEP were measured at baseline and after 6 weeks.

RESULTS: VO_2max , vVO_2max , peak power output and IEP were significantly higher in both LS-HIT and HVET at week 6 compared to pre-training. RE at 10 km.hr $^{-1}$ decreased significantly and treadmill velocity corresponding to the lactate threshold (LT) increased significantly in HVET after training. Compared to baseline, post-training % VO_2 and %HRmax values were significantly decreased in LS-HIT at both LT and at a blood lactate concentration corresponding to 4.0 mmol.L $^{-1}$. The treadmill velocity at a fixed blood lactate concentration of 4.0 mmol.L $^{-1}$ was greater in HVET than LS-HIT following the 6 week training program.

CONCLUSIONS: The total training time and total exercise time (exercise only) was 56% (840 min vs. 374 min) and 90% (840 min vs. 88 min) lower in LS-HIT than HVET. Despite the large difference in total training time and total exercise time, VO_2max and IEP increased significantly in both LS-HIT and HVET after training. LS-HIT is a time efficient training method for improving aerobic capacity and IEP, and maintaining indices of running economy, blood lactate and lower body power in Gaelic football players.

Funded by Science Foundation Ireland (INSIGHT)

3054 Board #119 June 3, 2:00 PM - 3:30 PM

Effects Of An 8-week Kettlebell And Plyometric Training Program On Muscular Strength In AdolescentsJoseph T. Warning, Karin A. Pfeiffer, FACSM, Allie Diltz, James M. Pivarnik, FACSM. *Michigan State University, East Lansing, MI.* (Sponsor: Karin Pfeiffer, FACSM)*(No relationships reported)*

Resistance training is associated with positive health outcomes and has traditionally involved use of free weights or machines as a way to improve muscular strength in both adults and youth. Non-traditional modes of training are available and should be evaluated for their effectiveness in enhancing muscular strength. Kettlebells and plyometrics are two non-traditional training modes that have been utilized to improve strength, but few studies have evaluated their effects in youth. **PURPOSE:** The purpose of this study was to examine the effects of a kettlebell plus plyometric versus kettlebell only training program on muscular strength in adolescents. **METHODS:** Participants were 21 adolescents from East Lansing, Michigan, who were randomized into a combined kettlebell and plyometric program (KBP; $n=11$) or a kettlebell only program (KB; $n=10$). The training program consisted of training twice per week on non-consecutive days for eight weeks. Participants performed one repetition maximum for both bench and leg press pre- and post-training. A repeated measures analysis of variance was used to determine the effects of the training program. Effect sizes (Cohen's d) were calculated. **RESULTS:** A main effect of time (pre-test to post-test) was significant for both upper- ($F(1,19) = 15.136, p=0.001$) and lower-body ($F(1,18) = 16.412, p=0.001$) strength. Training groups did not significantly differ for upper- ($p=0.969$) and lower-body ($p=0.899$) strength. There were no group by time interactions for upper- ($p=0.116$) or lower-body ($p=0.962$) strength. Effect sizes were $d=0.13$ for upper-body strength and $d=-0.11$ for lower-body strength. **CONCLUSION:** Both training groups were able to improve upper- and lower-body strength after eight weeks of resistance training, with no differences between the training groups. More research is needed in evaluating the effectiveness of non-traditional training modes, such as kettlebells and plyometrics, on muscular strength outcomes in youth.

Funded by North American Society for Pediatric Exercise Medicine and Michigan State University College of Education.

3055 Board #120 June 3, 2:00 PM - 3:30 PM
Does one Bout of High Intensity Resistance Training Change Circulatory Levels of Irisin?
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The recently novel identified myokine, irisin, has gained attention as a way to increase energy expenditure by enhancing metabolic function. Exercise and active lifestyle increase the synthesis of contraction-regulated myokines that have direct effect on cells metabolism. **PURPOSE:** The objective of this study is to analyze the effects of one bout of high intensity exercise on circulatory levels of irisin in healthy young adults. **METHODS:** A total of 24 participants (age 21.3 ± 2.1 years, body mass index [BMI] 22.12 ± 1 kg/m², lean body mass [LBM] 46 ± 10.1 kg, and relative body fat [%BF] 25.9 ± 9.9) were recruited. Subjects were blocked by sex, BMI, LBM, and %BF content and randomized to either control (n=13) or intervention (n=11). Physical Fitness was assessed by means of dual-energy x-ray absorptiometry (DXA), strength tests (Bench press and Leg press one repetition maximum [1RM]), and cardiopulmonary maximal stress test. Blood samples were collected to assess irisin at baseline, during (45 minutes), and post-intervention. **RESULTS:** Irisin (ul/ml) levels for control and intervention groups were 6.1 ± 1.7 and 5.77 ± 0.9 at baseline, 5.6 ± 1.3 and 6.03 ± 1 at 45-min, and 6.3 ± 1.9 and 5.8 ± 1.1 at post respectively. Interaction effect (time x intervention) was close to statistical significance (F[2,44]=3.106, p=0.055), and time (F[2,44]=0.837, p=0.440) and intervention (F[1,22]=0.091, p=0.766) factors were not significant. **CONCLUSIONS:** In addition to heterogeneous research findings, the lack of changes on serum concentrations of irisin after intervention shown in this study adds controversial results to the literature. Furthermore, values obtained on irisin concentrations in the control group resulted in more questions rather than answers. We hypothesize that, if irisin is an exercise-induced hormone, other confounding variables such as room temperature, or body temperature might be critical factors to control for future studies.

3056 Board #121 June 3, 2:00 PM - 3:30 PM
The Durational Effects of High Intensity Interval Training on Physiological Variables in Recreationally Active Individuals
 Neil McMillan¹, Taylor Wirth¹, Sydney Berger¹, Lidia Ouk¹, Levi Skog¹, Nicholas Beltz², Jeffrey Janot¹, Saori Braun¹. ¹University of Wisconsin-Eau Claire, Eau Claire, WI. ²University of New Mexico, Albuquerque, NM. (Sponsor: Mark Blegen, PhD, FACSM)
 (No relationships reported)

PURPOSE: The purpose was to compare the effects high intensity interval training (HIIT) and steady-state aerobic exercise (AER) had on VO_{2max} and visceral fat and to quantify the effects of a two week detraining period. **METHODS:** 27 college-aged participants (17 males, 10 females), who met minimal ACSM aerobic guidelines for aerobic exercise, were randomly assigned to a HIIT or AER training group. Each group underwent 30 minutes of treadmill-based exercise during their respective session. Both HIIT and AER sessions included a five minute warm-up, a 20 minute training period, and a five minute cool-down. The HIIT period consisted of 10 intermittent bouts of one minute high intensity exercise (90-95% HR_{max}) followed by one minute of moderate intensity exercise (60-65% HR_{max}). The AER group maintained a pace at 60-65% HR_{max} for 20 minutes. Participants completed two sessions per week over a three week period. Following training participants engaged in a two week detraining period. Values for dependent variables were assessed pre-training (PreT), post-training (PT), and post-detraining (PDT). **RESULTS:** A significant main effect for time was determined for visceral fat (p < .05) with post hoc testing showing a decrease in visceral fat occurred from PreT to PT in the AER group. Combined as a whole, there was significant decrease (p < .05) in visceral fat from PreT (50.24 ± 23.07) to PT (47.05 ± 21.67), and significant increase from PT (47.05 ± 21.67) to PDT (49.22 ± 22.93). No significant change in VO_{2max} (p > .05) in either group over time was noted.

	HIIT (n = 14)			AER (n = 13)		
	PreT	PT	PDT	PreT	PT	PDT
VO _{2max} (mL · kg · min ⁻¹)	55.53 ± 8.29	55.48 ± 10.21	55.20 ± 10.17	53.62 ± 7.46	53.76 ± 6.89	52.70 ± 7.2
Visceral Fat (cm ²)	50.38 ± 20.44	47.5 ± 16.71	49.33 ± 16.38	50.1 ± 26.47	46.55 ± 26.73*	49.09 ± 29.13
	*Significance versus PreT (p < .05)					

CONCLUSION: A three week, six-session HIIT and AER program elicit significant reductions in visceral fat mass. HIIT is a viable, time efficient method to improve measures of fitness among college-age individuals.

3057 Board #122 June 3, 2:00 PM - 3:30 PM
Influence of High-Intensity Training on Power Production in High School Field Hockey Players
 T. Brock Symons, Alexandra H. Roberts, Amy J. Walden, Kathleen A. Carter. University of Louisville, Louisville, KY. (Sponsor: Ann M. Swank, FACSM)
 (No relationships reported)

Many sports, including field hockey, ice hockey, lacrosse, and soccer, require the production of skeletal muscle power from the lower-limbs. Previous research has shown that high-intensity interval training (HIIT) increases maximal sprint speed and overall performance in field sports. Very little research has been conducted into quantitative measures of skeletal muscle power production and subsequent field performance. **PURPOSE:** To determine the effects of 12 weeks of HIIT in combination with field hockey specific training on lower-limb skeletal muscle power production and strength in high school field hockey players (15 ± 2 yrs.); and to determine if the combined training would also give rise to improved functional performance. **METHODS:** Fifteen healthy female field hockey players from a local competitive high school performed HIIT three times per week in addition to their specific field hockey training program across 12 weeks (preseason plus competitive season). Right lower-limb skeletal muscle performance was evaluated pre and post training with concentric contractions of the knee-extensors at two angular velocities (90°/s and 180°/s). Outcome measures included: average power (W); peak torque (Nm); static jump height (cm); and static jump height average power (W). **RESULTS:** Average concentric power was not altered by the combined HIIT and field hockey specific training demonstrating a 3.4% (90°/s) and 12.1% (180°/s) improvement (p>0.05). Combined training had no impact on static jump height average power (Pre: 748.8±208.8 W; Post: 754.1±227.9 W; p>0.05) or static jump height (Pre: 32.9±4.6 cm; Post: 33.2±7.6 cm; p>0.05). Peak torque production at 90°/s and 180°/s was improved by 4.4% and 5.6% across the 12-week period but did not reach significance (p>0.05). **CONCLUSIONS:** Previously, high-intensity interval training was found to improve overall performance in field sports. Our result in female high school field hockey players are not in agreement and demonstrated that high-intensity interval training, in combination with field hockey specific conditioning, had no impact on skeletal muscle power production and strength.

3058 Board #123 June 3, 2:00 PM - 3:30 PM
What Percentage Of Crossfit Workouts Are Interval Based?
 Victor Andrews. Kansas State University, Manhattan, KS.
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 (No relationships reported)

Background and Purpose: CrossFit (CF) is defined as constantly varied, high intensity, functional movement. High Intensity Interval Training (HIIT) is defined as alternating work and rest periods within a workout session, with work periods performed at 80-95% of estimated heart rate max(HRM) and rest periods performed at 40-50% estimated HRM. Although both are considered high intensity exercise, it is unclear to what extent they overlap each other. The purpose of this study was to determine what percentage of CF workout are interval based. **Methods:** This study used a mixed-methods design where six months of daily workouts posted online between April-September 2015 by CrossFit Headquarters (CFHQ) were analyzed to evaluate whether they met the HIIT standards by looking at work to rest periods within a planned exercise routine. A one-way ANOVA was used to determine difference by month of programming. **Results/Findings:** CFHQ workouts containing intervals averaged ≤10% per month (Apr 10%±.06, May 9.6%±.05, June 6.7%±.05, Aug 3.2%±.03, Sep 9.7%±.06). No significant differences were found between groups, f(5,181) = .31, p = .91. **Conclusion:** A minimal percentage of CF workouts contained intervals and this did not significantly vary over time. CF seems to share more characteristics with high-intensity functional training (HIFT): a training modality that emphasizes functional movements that can be modified to any fitness level and elicit muscle recruitment, thereby improving cardiovascular endurance, strength, and flexibility. Research results from CF training programs may not be comparable to those from HIIT.

F-28 Free Communication/Poster - Injury Epidemiology

Friday, June 3, 2016, 1:00 PM - 6:00 PM
Room: Exhibit Hall A/B

3059 Board #124 June 3, 3:30 PM - 5:00 PM Player Position and Injury Type in Division I College Football

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(No relationships reported)

The effects of athletic surface and the types, locations, and mechanisms of injury have been extensively studied in American football. However, there is a paucity of evidence comparing these injury specifics between and within player positions. **PURPOSE:** To examine the relationship between football player positions and the specifics of injury in order to maximize and develop new techniques to optimize safety and prevent injury. **METHODS:** During the 2012-14 fall seasons, all players (totaling 323 athlete seasons) were evaluated by team clinicians for musculoskeletal injuries (and concussion) as defined by the NCAA Injury Surveillance System. Players were divided into three position groups: *skill* (running backs, wide receivers, and defensive backs), *line* (offensive and defensive lineman), or *other* (linebackers, tight ends, and quarterbacks). Injury counts and proportions for type, location, and mechanism were compared by group. One-way ANOVA was used to determine statistical significance with the alpha level set to 0.05 *a priori*. **RESULTS:** Over the three year period, 142 injuries were recorded. Significantly more injuries occurred in the *skill* group (48%, $p < 0.05$). *Line* players were the next most injured (30%) and the *other* group was the least injured (23%). Sprains were the most frequent type of injury (32%), followed by strains (22%), and concussions (20%). There were no differences in the type of injury by group. *Skill* players had significantly more thigh injuries (77%, $p < 0.05$) compared to the other groups. Within the *skill* group, knee injuries were most frequent (21%). Contact was the most frequent mechanism of injury (59%), but there were no group differences. With non-contact injuries, the *skill* group had significantly more. Lastly, *skill* players had a balance with 34 contact and 33 non-contact injuries; whereas the *line* and *other* groups had almost a 2:1 ratio of contact to non-contact injuries. **CONCLUSION:** *Skill* players suffered more non-contact injuries and the most injuries overall, particularly to the thigh and knee. Future work will continue identifying the best ways to tailor training to position-specific needs, thus providing better injury prevention for these athletes at a high risk of injury.

3060 Board #125 June 3, 3:30 PM - 5:00 PM Injury Surveillance of Female Adult Zumba® Dancers

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Zumba® is a popular form of Latin-themed aerobic dance exercise engaged in by an estimated 14 million people in over 150 countries, yet little (ie in class participants) to no (ie in registered instructors) information exists in terms of the injury surveillance of this activity.

PURPOSE: To describe the injury incidence rates and patterns of injury associated with engagement in Zumba®.

METHODS: Zumba® dancers were invited to complete an anonymous web-based survey containing 13 demographic background and 14 (1 yr retrospective) injury history questions. Recruitment was undertaken using four web-based social networking services. Inclusion criteria stated that the respondents had to be aged 18 - 64 yr and currently involved in group-based classes of Zumba®, either as a registered instructor or class participant. Binomial logistic regression analysis was used to predict the odds of injury during Zumba® and Mann-Whitney tests were employed to ascertain differences between groups.

RESULTS: The survey response rate was 74%. The final sample of respondents ($N = 138$; female = 100%) included 19 registered instructors and 119 class participants, of which 58% and 16%, respectively, sustained ≥ 1 injury during Zumba® in the past year. The median ($Q_1 - Q_3$) number of injuries for registered instructors and class participants was 2 (1 - 2) and 1 (1 - 1), respectively. Of the physical complaint injuries, only 5% required medical attention. The majority (80%) of time-loss injuries were minor in severity and none required medical attention. The injury incidence rate for registered instructors and class participants was 5.7 (95% CI 3.1 - 8.2) and 3.9 (95% CI 2.5 - 5.3) injuries per 1000 h of exposure, respectively. The odds of injury was 7 (95% CI 2 - 19) times greater ($p < 0.01$) for registered instructors than for class participants.

Zumba® dancers had a 17 (95% CI 7 - 28) % greater ($p < 0.01$) odds of injury for every 1 h of non-Zumba®-related moderate to vigorous physical activity (MVPA) engagement per week. Age, Zumba® experience, and Zumba® engagement per week were found to be non-significant (all $p > 0.05$) covariates in the analysis. **CONCLUSIONS:** Zumba® is a relatively safe form of exercise. For registered instructors, the increased risk of injury observed during Zumba® is likely due to the high total volume of MVPA engaged in weekly.

3061 Board #126 June 3, 3:30 PM - 5:00 PM The Musculoskeletal Readiness Screening Tool- Injury Predictor for United States Military Academy Preparatory Cadets?

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(No relationships reported)

Unique aspects of military service put our nation's military at increased risk for injury that may not already be captured in the FMS and other injury prediction tools. The Musculoskeletal Readiness Screening Tool (MRST) was developed to combine evidence from physical performance tests used to predict injury and tasks unique to military personnel. Tests include the weight bearing forward lunge, modified deep squat, closed kinetic chain upper extremity stability test (CKCUEST), forward step down with eyes closed, stationary tuck jump, unilateral wall sit hold, and individual perceived level of risk for injury. The Feagin hop and self-reported history of injury were added to the screen.

PURPOSE: To examine whether MRST scores, as a composite or further broken down into individual components, were predictive of a United States Military Academy Preparatory School (USMAPS) cadet candidate sustaining a future musculoskeletal injury. **METHODS:** MRST scores were collected for 141 cadet candidates (mean age 18.63 \pm 1.31) at USMAPS. Injuries were tracked for the academic school year. Preparatory cadets participated in military specific training and various sports. After 9 months, mean scores were compared between injured and uninjured groups, a ROC curve analysis, and a logistic regression model was analyzed. **RESULTS:** Seventy preparatory cadets sustained an injury. Top sports resulting in injury included football (36%) and basketball (11%) with injuries predominantly in the lower extremity including the knee (24%), hip (15%), and ankle (14%). Composite MRST scores were no different between injured (10.83) and uninjured (10.93) groups ($p = 0.78$), 95% CI (-0.64, 0.85). No association observed for those with a personal concern for future injury and actual injury ($p = .13$), ($df = 2$), 95% CI (-0.3, 0.04). However, there was an association between those reporting a previous injury in the previous 12 months and those incurring an injury at USMAPS ($p = .04$), ($df = 1$), 95% CI (-0.3, -0.01). A score of ≤ 12 revealed a sensitivity .50, specificity .57, +LR 1.17, and -LR .89. The ROC area under the curve was .53 with 95% CI (0.44, 0.63). **CONCLUSION:** The 6 components of the MRST and the Feagin hop were not predictive of injury in this military academy prep school population; previous injury was the only significant injury predictor.

3062 Board #127 June 3, 3:30 PM - 5:00 PM The Association of Sport Specialization and the History of Lower Extremity Injury in High School Athletes.

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(No relationships reported)

Sport specialization has been shown to be associated with lower extremity injuries (LEI) in samples of injured adolescent athletes presenting in clinic settings. However, the association of sport specialization and history of LEI has not been reported in large samples of athletes participating in high school sports.

PURPOSE: To determine the association of sport specialization and history of LEI in a sample of active high school athletes.

METHODS: Athletes, (age = 16.1 \pm 1.1 years) were recruited from 18 schools in Wisconsin and completed a survey to identify the sports they participate in and degree of sport specialization (classified as low, moderate, or high using a validated 4 point scale). Subjects and their parents provided information regarding their history of previous LEI (injury that occurred during sports, caused them to seek medical care and miss time from their sport). Analyses included group means, standard deviations and proportions (%). Odds Ratios were calculated to investigate association of previous LEI and specialization category.

RESULTS: A total of 768 subjects (females $n = 296$, 38.9%, males $n = 462$, 61.1%) enrolled in the study. A total of $n = 248$ (32.2%) reported sustaining a total of $n = 313$ LEI. Nineteen (7.6%) of the injured subjects reported undergoing surgery. The ankle ($n = 105$, 33.5%) was injured most often followed by the knee ($n = 86$, 27.5%) lower leg ($n = 34$, 10.9%), hip / pelvis ($n = 34$, 10.9%) and foot ($n = 29$, 9.2%). Common injuries included ligament sprains ($n = 153$, 48.9%), muscle strains ($n = 65$, 20.7%) tendonitis ($n = 44$, 14.0%) and fractures ($n = 31$, 9.9%). Subjects were classified as having low (females $n = 178$, 60.3%, males $n = 329$, 71.2%), moderate (females $n =$

91, 30.8%, males n = 108, 23.4%), or high (females n = 26, 8.8%, males n = 25, 5.4%) specialization. Subjects in the high specialization (n = 32, 59.3%) group were more likely to report an injury than subjects (n = 118, 23.1%) in the low specialization group (OR = 4.83, 95% CI: 2.70 - 8.63, P<0.001) Subjects in the moderate specialization group were also more likely to report an injury than subjects in the low specialization group (OR = 3.07, 95% CI: 2.17 - 4.32., P<0.001)
CONCLUSION: Athletes with moderate or high levels of sport specialization sustained more LEI than their peers who did not specialize.

3063 Board #128 June 3, 3:30 PM - 5:00 PM
Injury Rates and Types at a Small Recreational Ski Area in the Upper Midwest

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Approximately 20 million individuals in the US participate in snow sports annually, including alpine skiing, snowboarding, telemarking, snow-shoeing, cross-country skiing, and snow tubing. Small recreational ski areas (SRSA) are convenient, relatively inexpensive, beginner-friendly venues for many participants in the US. However, injury occurrence at SRSA has not been previously reported. **PURPOSE:** To perform a multi-year analysis of the frequency and types of injuries that occurred at a SRSA located in the Upper Midwest. **METHODS:** Injury incident reports compiled by the National Ski Patrol over eight seasons (2006-14) were obtained from a SRSA operating in the Upper Midwest. This SRSA has one chair lift with a peak vertical height of 55.5 m. The SRSA includes a terrain park, snow tubing area, and three downhill runs. Data from 1226 de-identified incident reports were transferred and coded into a database for analysis. Only incident reports from injuries sustained in the activities of skiing, snowboarding and snow tubing, as well as injuries related to entering and exiting the ski/tube lift, were included in the study. Attendance records during the study period were also obtained from the SRSA. **RESULTS:** 1,199 reports fit the inclusion criteria for this study. The average age of the injured SRSA guests was 17.2 years for females, 15.4 years for males and 16.0 years for all subjects. Overall, 367 (31.2%) of the injured guests were female and 809 (68.8%) were male. Peak injury rates occurred between 8 PM and midnight. The most common injuries were fracture (29%), sprain/strain (23%), bruise/contusion (18%) and concussion (11%). Injuries were unevenly distributed among the ski slopes (60%), the terrain park (30%) and the snow tube run (10%). Injury type also differed among ski park activities, with fractures, sprains/strains, and bruise/contusion being most common while snowboarding, skiing and snow tubing, respectively. The overall injury rate decreased 52.9% (P = 0.047) throughout the study period, declining from an initial rate of 5.0 injuries per 1,000 guest visits in 2006-07 to 2.6 injuries per 1,000 guest visits in 2013-14. **CONCLUSION:** Injury occurrence at this SRSA varied by snow sport activity and time of day. Knowledge of injury patterns at a SRSA could guide appropriate staffing and park maintenance efforts.

3064 Board #129 June 3, 3:30 PM - 5:00 PM
Injury Epidemiology And Risk Factors For Injury In Group-based High Intensity Power Training

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Group-based high intensity power training (HIPT) is an exercise program designed to improve fitness using constantly varied metabolic exercise. Because of its unorthodox combination of power movements and endurance training, HIPT has become a controversial sport. Concerns regarding safety have arisen along with its increase in popularity. However, there is a dearth of research on injury rate and risk factors for injury in HIPT athletes. **PURPOSE:** To examine injury epidemiology and risk factors for injury in HIPT athletes and to compare the rate of injury in competitors and non-competitors. **METHODS:** A survey was administered to athletes at four owner-operated facilities in South Florida. Respondents reported number and location of injury from the preceding six months and answered questions regarding potential risk factors for injury. **RESULTS:** The response rate was 75% (191/255). Fifty out of 191 athletes sustained a total of 62 injuries during HIPT participation in the preceding six months. The rate of injury was 2.5 injuries per 1000 hours of participation. The most frequently injured locations were the shoulder (14/62), knee (10/62), and low back (8/62). Competitors were more likely to be injured (40% v 19%, p=0.002) and had greater weekly athlete-hours (7.1 v 4.7, p=0.008) than non-competitors. Competitors and non-competitors had similar injury incidence (2.8 v 2.1). Athletes who reported injury also reported significantly higher values for the following risk factors: years of participation in HIPT (2.7 v 1.8, p=0.001), weekly HIPT athlete-hours (7.3 v 4.9,

p=0.020), weekly HIPT participations (6.4 v 4.7, p=0.003), height (67.7 in v 66.1 in, p=0.011), and weight (172.5 lb v 160.7 lb, p=0.037). **CONCLUSION:** Rate of injury during HIPT and location of injuries were similar to those previously reported. Rate of injury was similar to HIPT-related sports, including gymnastics, powerlifting, and weightlifting. While being a competitor was related to injury, increased exposure may have confounded this association. Increased exposure to injury in the form of greater weekly athlete-hours and weekly participations may contribute to injury. Increased height and weight were also related to injury. Biomechanical factors associated with greater height and ability to lift greater loads may increase risk of injury.

3065 Board #130 June 3, 3:30 PM - 5:00 PM
Injury Profile In Portuguese Children And Adolescents According To Their Level Of Sports Participation

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It is becoming increasingly apparent that sports can present a danger to health in the form of sports injuries. The extent of sports injury problem calls for preventive actions based on the results of epidemiological research. **PURPOSE:** Determine the prevalence and injury profile in Portuguese children and adolescents from different groups of sports participation and identify significant predictors of injury. **METHODS:** Two questionnaires (LESADO and RAPIL 2) were distributed to 651 subjects aged between 10 and 18 years involved in different levels of Physical Activity (PA). Bone age and anthropometric measures were also evaluated. Descriptive statistics was used to determine prevalence and injury profile, chi-square test and binary logistic regression to identify significant predictors of injury. **RESULTS:** A total of 247 subjects (37.9%) reported experiencing a sports injury during the previous 6 months. The most injured body areas were lower limbs (53.8%), followed by upper limbs (29.0%). The type of injuries found was strains (33.7%), sprains (27.1%) and fractures (23.1%). Mainly, the occurrences took place in practice (74.0%) and the most frequent causes were direct trauma (51.9%), indirect trauma (29.5%) and overuse (12.7%). A high percentage was relapses and chronic injuries (40.9%). Boys were found to experience significantly more sports injuries than girls for the decimal ages 12-13 years ($\chi^2 = 6.608, p = .014$) and for the bone ages 14-15 years ($\chi^2 = 6.76, p = .010$). The OR for age group was 2.26 suggesting that those ≥ 16 years were 2.26 times more likely to have an injury than the younger subjects and concerning the PA level, the school sports and federated sports subjects were 4.21 and 4.44 times more likely to have an injury than non sports subjects. **BR>** **CONCLUSIONS:** Sports injuries in school age children were predominantly minor conditions where sprains and strains were the major injuries encountered. They result mostly of trauma situations that occur in practice and lower and upper limbs were the most affected areas. Injury occurrence increases with age and is higher in school and federated athletes. Sex was only differentiator at the decimal age of 12-13 years and at the bone age of 14-15 years and it was deeply related to the PA category.

3066 Board #131 June 3, 3:30 PM - 5:00 PM
Injury Profile Of Time-loss Injuries In Non-elite/ community U.S. Rugby-7s Tournament Players

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Reported Relationships: R. Ma: Contracted Research - Including Principle Investigator; Sponsored by the Empire and New England Rugby Football Unions.

PURPOSE: Rugby-7s is a future Olympic collision sport that is played globally with a high incidence of injury. The sport is growing exponentially in the U.S., but there is a lack of injury data on community Rugby-7s. To determine the incidence (per 1000 playing hours), severity (days absence) and mechanisms of injuries. **METHODS:** A prospective epidemiology study of non-elite/community males (566) and females (222) in USA Rugby sanctioned tournaments, 2010-2013; compliant with the international consensus statement for studies in rugby union. **RESULTS:** Time-loss injuries were encountered at 49.1/1000ph (n=378) (men: 23.5±5.3 years old; women: 24.6±6.0 years old). Among player positions, backs were injured more often (men, 52.6/1000ph; women 51.7/1000ph) than forwards

(men 36.1/1000ph; women 38.0/1000ph) (RR: 1.1; P=0.009). The injury burden was greater in women than men (42 mean days versus 30 mean days absent; P=0.024). Most injuries were acutely (96%) encountered in the tackle (71%). Main injuries were ligament injuries (42%) to ankles (32%). Amongst men, backs were more likely to suffer a ligament injury than forwards (P=0.003). A high incidence of head/neck injuries (including concussions) in the U.S. population (overall: 10.7/1000ph, CI: 8.5-13.2; men: 11.2/1000ph; women: 9.4/1000ph) was encountered. Knee injuries had the highest injury burden out of all body parts injured (63 mean days absent, CI: 34.4-91.6).

CONCLUSION: There is a high risk of sustaining an injury while playing U.S. community-level Rugby-7s. This study has identified a profile of incidence and risk factors of injury in the sport. Further research is needed to identify the risk factors and mechanisms of injury amongst the strata of playing levels. Once obtained, this data would guide age and level focused injury prevention measures and reduce injury for this large community playing population, with global ramifications.

3067 Board #132 June 3, 3:30 PM - 5:00 PM
Epidemiology Of Injury In Race-day Jockey Falls In Flat Horse Racing In Ireland, 2011-2014

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Horse racing is a high risk physically demanding sport with a high incidence of falls and injury previously reported. In recent years in Ireland, a number of health and safety interventions have been implemented, including the raising of the stipulated minimum competition weights, implementation of improved helmet safety standards and the introduction of a new concussion assessment protocol. Despite this, the impact of the implementation of these measures on the incidence of falls and injuries in horse racing remain unknown. **PURPOSE:** To provide an up to date analysis of the falls and injury incidence in flat horse racing jockeys in Ireland by evaluating and reporting injury data from 2011-2014. Also to evaluate the impact of the introduction of the new health and safety measures on the frequency of the falls and nature of injuries both in terms of incidence and type. **METHODS:** In a four year prospective epidemiological study, the total number of falls and injuries that occurred during all official flat horse race meetings were recorded. A standardised injury report form was utilised to record all falls and injury data from each race meeting. All data were collated by a trained medical practitioner on duty at the particular race course and stored using a centralised database coordinated by the Turf Club Senior Medical Officer. **RESULTS:** The falls rate per 1,000 rides was 4.0 [95% CI: 4.01-4.02]. Injury incidence per 1,000 falls was noted to be 347.8 [95% CI: 346.9-348.6] and per 1,000 race meetings was 96.2 [95% CI: 96.0-96.4]. Soft tissue injuries were predominant (60.94%), with fractures and concussions accounting for 18.75% and 12.5% of injuries respectively. While lower limb injuries (37.50%) were the most common region of injury noted, the head and face (21.88%) were the most frequent location of injury. **CONCLUSION:** Compared to previous studies reporting falls and injury incidence in flat horse racing, there has been an increase in fall rate, but a reduction in injury rate during 2011-2014, which in part may possibly reflect the impact and effectiveness of the health and safety interventions implemented. Further research on the design, implementation and feasibility of injury prevention intervention strategies and their impact on the incidence of falls and injury risk are required.

3068 Board #133 June 3, 3:30 PM - 5:00 PM
Sport And Recreation Related Injury Episodes In The U.S. Population: 2011-2014

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With more people participating in sports and recreation (SR) activities, SR related injury is a growing public health concern. Much of the research on SR related injury focuses on a specific population, activity, or type of injury. National estimates of the total burden of SR related injury are limited. Purpose: To provide national estimates of SR related injury episodes and examine their distribution across age groups, activity, types of injury and body part injured. Methods: Information on medically-attended injury episodes for individuals aged 5 and above were obtained from the 2011-2014 National Health Interview Survey. SR related injuries were categorized by the associated SR activity using a classification scheme based on the International Classification of External Causes of Injury. ICD-9-CM diagnosis codes were used to identify the body part injured and the type of injury. Results: An average annual

estimate of 8.8 million SR related injury episodes were reported, with an age-adjusted rate of 29.2 per 1,000 population. Males, and persons aged 5 to 24, accounted for 61.2% and 64.7% of the SR related injury episodes, respectively. Exercising (16.3%) was the most frequently reported activity followed by basketball (9.9%), football (8.2%), pedal cycling (8.0%), soccer (6.2%), and gymnastics and cheerleading (5.6%). An annual estimate of 4.3 million SR related injury diagnoses involved sprains and strains, followed by fractures (2.1 million), contusions and superficial injuries (2.0 million) and open wounds (1.0 million). More than 70% of the injury diagnoses involved lower (4.4 million) and upper (3.2 million) extremities, while 16.4% and 10.3% of the total body parts injured involved head and neck (1.7 million) and spine and back (1.1 million), respectively. Sprains and strains and lower extremities were the leading diagnosis and body part injured for exercising, basketball, football and soccer, while contusions and superficial injuries and injuries to upper extremities were more common for pedal cycling. Conclusion: A significant proportion of SR related injuries involved males, children and young adults. The types of injury diagnoses and body parts injured varied across different SR activities, with the majority of the injuries involving sprains and strains, or injuries to the extremities.

3069 Board #134 June 3, 3:30 PM - 5:00 PM
Soccer Injury Rates When Ramadan Occurs At The Season-start In Conjunction With A Competitive Tournament

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The religious practice of Ramadan has shown little to no effect on injury rates in elite football players. However for the past years, Ramadan has occurred during the competitive calendar. **PURPOSE:** To assess the injury incidence of elite football players when Ramadan occurs at the start of the competitive calendar in conjunction with a competitive tournament. **METHODS:** Fifteen Qatari professional soccer teams were assessed for injury incidence during the 2013-2014 season. Pre-season training started 01 July 2013, whilst Ramadan occurred from 09 of July to 07 of August 2013. A competitive tournament involving all 15 teams occurred during Ramadan (20 July - 05 of August). A total of 32 matches were played during the tournament, with matches starting ≥ 3 hours after Iftar (fasting-break at sunset). Injury data were considered when a player was unable to take full part in future soccer training sessions or matches owing to physical complaints. Injury severity was defined with regard to the number of days of absence from training/matches. **RESULTS:** Overall 589 injuries occurred during the season, of which 50 (8.5%) occurred during Ramadan. There was no significant difference ($p > 0.05$) in distribution of injuries between Muslim and non-Muslim players during either Ramadan or for the rest of the season. Muslim players sustained 41 (8.4%) and 445 (91.6%) injuries, whilst non-Muslims sustained 9 (8.7%) and 94 (91.3%) injuries during Ramadan and non-Ramadan periods, respectively. There was no significant difference ($p > 0.05$) in injury severity between Ramadan and the rest of the season, or between Muslim and non-Muslim players. The distribution of injuries when expressed as a ratio of matches/training was as follows: 14/36 for Ramadan and 258/281 for non-Ramadan. Ramadan in conjunction with a soccer tournament corresponded with an injury rate of 13.9 injuries/1000 hrs of match exposure. **CONCLUSIONS:** Ramadan in conjunction with a football tournament at the start of the competitive calendar did not impact upon injury rates in Muslim and non-Muslim professional soccer players from Qatar followed during both the Ramadan and non-Ramadan segments of the 2013-2014 competitive season.

3070 Board #135 June 3, 3:30 PM - 5:00 PM
Time Trends in Incidence and Severity of Injury among NCAA Soccer Players, 1990-1996 and 2004-2009

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People under age 25 years comprise the largest cohort of soccer players in the U.S.; yet, the descriptive epidemiology of injury in this age group is limited. Moreover, there have been few analyses of injury occurrence across time that would allow investigators to monitor trends in response to changing practices and policies. **PURPOSE:** To identify trends in injury incidence and severity between two time periods (1990-1996 and 2004-2009) in NCAA soccer players. **METHODS:** Data were analyzed from the National Collegiate Athletic Association Injury Surveillance System (NCAA-ISS). As per data collection guidelines, injury incidence was defined as: 1) any injury event that occurred during participation in an intercollegiate game or practice;

2) that required medical attention; and 3) restricted participation or performance for >1 day beyond the event. To account for varying levels of playing exposure among the athletes we calculated Athlete-Exposure (AE), defined as a single athlete participating in a single practice or competition with any probability of injury. Incidence density then was calculated as the number of events per 1000 AE within each time period. The rate ratio (RR), along with the 95% confidence interval (CI), compared incidence density and severity in 2004-2009 relative to 1990-1996. RESULTS: Overall injury rates were significantly lower in the 2004-2009 cohort compared with the 1990-1996 cohort [RR=0.88 (95%CI=0.86, 0.91)] and this was true for almost every category of injury studied. The lower rates were especially noticeable for recurrent injuries [RR=0.62 (95%CI=0.57, 0.68)], short-term injuries [RR=0.69 (95%CI=0.67, 0.72)] and for injuries requiring surgery [RR=0.35 (95%CI=0.29, 0.41)]. There was also a significant reduction in injuries occurring during games, particularly during the second half [RR=0.69 (95%CI: 0.66, 0.73)]. In contrast, we observed a significant increase in rates of long-term (>7 days of lost time) injuries between the two time periods [RR=1.33 (95%CI=1.27, 1.40)]. CONCLUSIONS: Given the prominence of soccer play in the United States, public health efforts should promote the use of this surveillance system to better inform and evaluate injury prevention practices and policies directed toward player safety.

3071 Board #136 June 3, 3:30 PM - 5:00 PM
Incidence and Severity of Upper Extremity High School Football Trauma on Artificial versus Natural Grass
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Although newer generations of artificial turf have been developed to duplicate the playing characteristics of natural grass, no long-term studies have specifically compared articular and muscle trauma of the upper extremity between the two surfaces. **PURPOSE:** To quantify incidence, mechanisms, and severity of game-related upper extremity high school football injuries on artificial turf versus natural grass. **METHODS:** 19 high schools were evaluated over 9 competitive seasons for injury incidence, injury category, time loss, player position, injury mechanism and situation, type of injury, grade and anatomical location of injury, elective imaging/surgical procedures, and environmental factors. **RESULTS:** Of the 433 high school games documented, 239 team games (55.2%) were played on artificial turf versus 194 team games (44.8%) played on natural grass. A total of 239 upper extremity injuries were documented with 123 (51.5%) occurring on artificial turf, and 116 (48.5%) on natural grass. Univariate analyses per 10 team games indicated no significant injury incidence effect ($p > 0.05$), between surfaces by severity level, either in minor injury incidence rates (IIRs), 4.1 (95% CI, 3.5-4.7) versus 4.3 (95% CI, 3.6-5.0), in substantial IIRs, 0.7 (95% CI, 0.4-1.1) versus 1.2 (95% CI, 0.8-1.8), or in severe IIRs, 0.4 (95% CI, 0.2-0.7) versus 0.5 (95% CI, 0.2-0.9) documented on artificial turf when compared to natural grass, respectively. Analyses indicated a significant playing surface effect ($p > 0.05$) by position played at the time of injury (special teams); [0.5 (95% CI, 0.3-0.9) vs 0.0 (0.0-0.0)], and primary type of injury (contusions; [0.9 (95% CI, 0.7-1.4) vs 2.6 (2.1-3.3)], while competing on artificial turf versus natural grass, respectively. No significant surface effects on upper extremity trauma were observed in injury category, grade, player position, injury mechanism and situation, time loss, elective imaging/surgical procedures, environmental factors, or specific joint and muscle. **CONCLUSION:** Since minimal differences existed between artificial turf and natural grass during game-related play over a 9-year period of competitive play, artificial turf is a practical alternative when comparing upper extremity injuries in high school football.

3072 Board #137 June 3, 3:30 PM - 5:00 PM
Prevalence Of Cheerleading Related Injuries And Rehabilitation Of Korean Young Cheerleaders
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PURPOSE: Cheerleading is introduced to Korea in recent years and the popularity is growing fast. No study has reported the prevalence of cheerleading related injuries in Korea. This study describes the rate and types of injury and aftercare related to cheerleading of Korean teenagers. **METHODS:** Data are collected from the registered cheerleaders using a cheerleading injury surveillance questionnaire. A total of 345 teenage athletes of 42 teams who participated in Korea Cheerleading Club Festival sponsored by Korea Cheerleading Association responded to the questionnaire. From the questionnaire, their demographic information, the training history, injury incidence and types (multiple choice), and recovery process were reported.

RESULTS: Injury experienced teenager was 189 (IG; 54.8%, 14.9±2.9 yrs, 158.6±10.5 cm, 48.9±11.4 kg), and their physical characteristics were not different from injury non-experienced teenager (n=156, 45.2%). In IG, training period of less than 6, 6-12, 13-24, and 25-36 months was 21.8, 45.8, 24.6, and 7.8%, respectively. The most frequent injury site was in the order of wrist (38.6%), knee (34.1%), ankle (32.3%), shoulder (30.2%), waist (24.6%), face (13.9%), and neck (12.2%). Frequently reported injury type was contusion (44.7%), muscular pain (42.4%), ligament (20.2%), sprain (19.0%), abrasion (12.3%), and back pain (11.1%). Movements causing injury were Cradle (16.8%), Elevator (15.1%), Pyramid (11.8%), Extension (10.1%), Basket toss (9.0%), Practice (8.5%), and Handspring (6.8%). When experienced injuries, they went hospital with coaches (41.9%), visited clinic without a coach (25.7%), treated privately (19.0%), and did not care (6.7%). For treatment of injury, they were rehabilitated at a hospital (26.3%). Many of the injured cheerleaders (41.9%) did not practice rehabilitation or took care of themselves (19.0%). When returning to training after injury, they were fully (49.7%) or partially recovered (44.7%). **CONCLUSIONS:** More than half of the teenage cheerleaders experienced injuries and more than half of them did not practice proper rehabilitation. More than half of injured cheerleaders returned to training without a complete recovery. Safety and injury prevention measures and education for rehabilitation should be introduced to Korean teenage cheerleaders.

3073 Board #138 June 3, 3:30 PM - 5:00 PM
Epidemiology Of Severe Injuries Within Ncaa Football, Wrestling, And Men's Ice Hockey, 2009/10-2014/15 Academic Years.
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Severe injuries are a challenge that many student-athletes endure throughout their collegiate participation in athletics. Current research focuses on severe injuries sustained during football. However, little research examines the epidemiology of severe injuries in other collision sports. **PURPOSE:** To describe the epidemiology of severe injuries sustained within collision sports (football, wrestling, men's ice hockey) in the National Collegiate Athletic Association (NCAA) during the 2009/10-2014/15 academic years. **METHODS:** Severe injury data from the NCAA Injury Surveillance Program during the 2009/10-2014/15 academic years were analyzed. A severe injury was defined as: (1) occurring during a sanctioned competition or practice, (2) requiring medical attention by an athletic trainer or physician, and (3) resulting in time loss over 21 days or not returning for that sport season. Injury rates per 10000 athlete-exposures (AE) with 95% confidence intervals and distributions by body part, injury type, and injury mechanism were calculated. **RESULTS:** Overall, 1647 severe injuries occurred within collision sports. Severe injuries comprised 14.2% (n=173) of all injuries in wrestling, 10.3% (n=380) of all injuries in men's ice hockey, and 10.2% (n=1094) of all injuries in football. The highest severe injury rate was in wrestling (1.65/10000AE), followed by football (0.97/10000AE), and men's ice hockey (0.93/10000AE). Among severe injuries, the most common injured body part was the knee in football (40.6%, n=444) and wrestling (32.4%, n=56), and the head & neck in ice hockey (21.1%, n=80). The most common severe injury was ACL tear in football (14.0%, n=153), and concussion in wrestling (17.3%, n=30) and men's ice hockey (18.4%, n=70). Concussions made up 10.6% of all severe injuries sustained within these sports. The most common injury mechanism was player contact in football (57.5%, n=629), wrestling (56.6%, n=98), and men's ice hockey (49.7%, n=189). **CONCLUSION:** Severe injuries sustained in collision sports are often due to player contact and most often occur to the knee or head & neck. Additional research needs to help develop and evaluate injury prevention interventions to reduce injury incidence and severity in these sports.

3074 Board #139 June 3, 3:30 PM - 5:00 PM
Epidemiology of College Baseball Injuries Throughout a Season and the Relationship to Physical Fitness Characteristics.
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Baseball has a relatively low injury rate compared to other sports; however, it continues to gain popularity in DII and DIII athletics. **PURPOSE:** To describe the epidemiology of injuries in DII and DIII baseball players over a season, characterizing injury patterns by position, and determining relationships between injury and fitness level. **METHODS:** Field assessments analyzed agility, muscular strength

and endurance, anaerobic power, flexibility, speed, and aerobic endurance. Injuries sustained were recorded by an ATC on a baseball specific injury reporting form with the injury definition being “damage to the body that occurs as a result of competing, practicing and / or participating in an athletic activity”. Logistic regression determined independent factors associated with injury status, and ANOVAs determined differences between fitness variables across testing sessions and between positional groups. RESULTS: 82 injuries were sustained with 59% occurring in practice. There were 4.62 injuries per 1000 athlete-exposures, and the upper extremity was the most commonly injured region (44%). Strains were the most common injury (43%), followed by sprains (21%) and fractures (14%). Injuries to pitchers accounted for 32% of all injuries, followed by outfielders (24%), and corner infielders (19%). Significant associations were seen between position and body region injured ($p \leq 0.001$), with pitchers experiencing a greater proportion of injuries to the upper extremity compared to catchers and fielders ($p \leq 0.001$), and fielders experiencing a greater proportion of injuries to the lower extremity compared to catchers and pitchers ($p \leq 0.005$). Although 71% of injuries resulted in < 7 days of time lost, 8.7% were season ending, and 9.4% required surgery. Overall, a greater proportion of time lost was experienced by pitchers compared with fielders and catchers ($p \leq 0.001$). February showed the highest number of running injuries, yet the majority of injuries occurred in March (55%). CONCLUSION: Fitness performance differences were evident between positions and explained many of the injury trends. Further, proper pre-season conditioning is imperative to reduce the number and severity of injuries in DII and DIII baseball players; however, training programs need to be tailored to specific positions for optimal benefits.

3075 Board #140 June 3, 3:30 PM - 5:00 PM

Anterior Cruciate Ligament And Achilles Tendon Injuries In The Nfl From 2009-10 To 2014-15 Seasons

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Anterior cruciate ligament (ACL) or Achilles tendon (AT) injuries require significant recovery time and may decrease athletic performance. Studies demonstrate that the activity and position with the highest rate of ACL and AT injuries are games and skill players, respectively. However, to properly mitigate injury risk, the effect of activity and position on the number of ACL and AT injuries should be further explored. PURPOSE: Quantify the incidence of AT and ACL injuries by activity and position in the NFL from the 2009-10 to 2014-15 seasons. METHODS: Lower extremity injuries were documented from the 2009-10 to 2014-15 seasons. To confirm ACL and AT injuries, an internet search of the following key terms was used: player, team, season, and type of injury (ACL or AT rupture). Injuries were categorized by activity (game, practice, and non-team activity) and position (skill, lineman, special teams, and other). Descriptive statistics were calculated for all categories. RESULTS: Games accounted for the greatest number of ACL ruptures (Table 1), but the greatest variability in number of ACL injuries occurred during practice. The incidence of AT injuries was greater in practices than games (Table 1), which was not observed in previous studies that examined injuries between 1997 and 2002. By position, Skill > Lineman > Other > Special teams for total ACL injuries, and Skill > Other > Lineman > Special teams for total AT injuries (Table 1). The magnitude of ACL and AT ruptures increased between the 2009-10 and 2014-15 seasons (Table 1). CONCLUSIONS: Changes in practice patterns appear to have the greatest potential to reduce ACL and AT injuries in the NFL. Future studies should examine the effects of practice regulations on rate and number of injuries.

Table 1. Injuries 2009-10 to 2014-15

	2009	2010	2011	2012	2013	2014	Mean ± Std Dev
ACL	35	37	35	41	37	36	36.83±2.23
Game	9	11	8	13	23	14	13±5.4
Practice	20	26	23	19	31	18	22.83±4.96
Skill	12	10	7	18	18	21	14.33±5.47
Lineman	11	10	10	16	13	12	12±2.28
Other	45	49	43	54	62	51	50.67±6.83
AT							
Game	2	6	6	5	9	8	6±2.45
Practice	6	5	7	5	7	12	7±2.61
Skill	3	4	7	3	8	9	5.67±2.66
Lineman	3	6	1	3	5	6	4±2
Other	3	4	5	6	3	6	4.5±1.38
Total	9	14	15	12	17	21	14.67±4.13

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Yoga-Related Injuries Presented in United States Emergency Departments

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Reported Relationships: A. Esquivel: Contracted Research - Including Principle Investigator; Detroit Medical Center.

Purpose: The purpose of this study was to investigate the epidemiology of yoga-related injuries presenting to emergency departments in the US and to determine the rate of injury of adult yoga practitioners.

Methods: This is a retrospective analysis of the US Consumer Product Safety Commission’s National Electronic Injury Surveillance System (NEISS) database for years 2004, 2008, and 2012 for yoga-related injuries. Body part injured and injury diagnosis were compared with gender and age categories using chi square tests of Independence or Fisher’s Exact test, based on expected cell counts ($P < 0.05$).

Results: Overall, there were an estimated 6,443 yoga-related injuries in the three years sampled. Rates in yoga-related injuries have increased from 2004 to 2012. For females, these rates have changed significantly ($r^2=0.998$, $p=0.031$). Overall, females were more likely to be diagnosed with a strain or sprain ($p < 0.001$, $OR=2.01$, $CI 1.75-2.31$), and fracture ($p=0.009$, $OR=1.98$, $CI=1.18-3.33$) and also more likely to injure their upper extremity and head/neck region (Table 1). Overall, males were more likely to be diagnosed with a dislocation ($p=0.001$, $OR=1.67$, $C=1.24-2.26$) and more likely to injure their lower extremity and trunk region (Table 1). Overall participants less than 40 years old more likely to injure their head/neck region ($p < 0.001$, $OR=1.40$, $CI=1.23-1.58$) but less likely to injure their trunk region.

Conclusion: The number of yoga-related injuries reported in the emergency department is low; however, the rate of yoga-related injuries is increasing. As yoga practice continues to increase in popularity, continued surveillance of yoga-related injuries is necessary to assess potential risk factors.

Body Region Injured by Sex (M vs. F)**

Body Part Injured	2004 Chi Square p-values	2004 Odds Ratio	2008 Chi Square p-values	2008 Odds Ratio	2012 Chi Square p-values	2012 Odds Ratio	Overall Chi Square p-values	Overall Odds Ratio
Lower Extremity	<0.001	1.82 (M)	<0.001	2.61 (F)	<0.001	1.7 (M)	<0.001	1.48 (M)
Upper Extremity	<0.001	no male injuries reported	<0.001	3.57 (F)	<0.001	no male injuries reported	<0.001	16.32 (F)
Head/Neck	<0.001	no male injuries reported	<0.001	4.45 (F)	<0.001	1.67 (M)	0.011	1.36 (F)
Trunk	<0.001	4.65 (M)	0.164	1.26 (M)	0.009	1.26 (M)	<0.001	1.33 (M)

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The Tragedies Continue: US Weight Training Deaths & Injuries from 2010-2014.

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PURPOSE & METHODS: We have examined US Consumer Product Safety Commission (US CPSC) records since 1982 and documented as many as one dozen deaths per yr associated with bench presses and barbell neck or chest compression causing asphyxia or anoxia in males in the home without a spotter. To reduce or prevent these needless deaths, we petitioned US CPSC in 2003 to require warning labels on the uprights of all bench presses. Reviewers denied our petition indicating that the need for labelling was unsupported by data and that only one death per yr was clearly due to the cited mechanism. Here we present data from 2009-2014 to support the claims in our original petition. RESULTS: There were 15 documented deaths between February 2010 and May 2014, all males (age: 6-78 yr), 9 of 15 with neck/ chest compression and mechanical asphyxia with ≥ 5 in the home. We predict this is a significant underestimation due to a delay of up to 556 d from the time of death to data entry. For the 1st time since US CPSC was created in 1972, there were over 1/2 million injuries (501,570) associated with weight training in a 5-yr span, with the peak of 110,188 in 2013. For 2010-2014, males sustained 80,085 ± 4256 injuries per

yr (~80%), while females had 20,229 ± 2683 per yr (~20%). Of the 100,904 injuries in 2014, 25-44 yr olds accounted for 39,037 (~39%), while 15-24 yr olds accounted for 33,046 (~33%) injuries. The vast majority of patients were treated and released (96%) while a small % were hospitalized (~2%). The most common injury sites were the lower trunk (19,964, ~20%), shoulder (15,024, ~15%) and upper trunk (14,565, ~14%). However, sites of injury varied based on age, for example, 0-4 yr olds injured primarily the head and face (~42%), toe (~31%) and finger (~12%). Muscle strains and ligament sprains accounted for 38%, while contusions/abrasions (11%) and fractures (8%) were less frequent. **CONCLUSIONS:** Our examination of US CPSC data over the most recent 5 yr supports our original petition that every yr multiple deaths occur in males using bench presses with the common mechanism of asphyxia/anoxia due to neck/chest compression. We maintain that mandatory bench press warning labels would help to reduce death rates and plan to re-petition the US CPSC. Additionally, widespread education directed to specific age groups and genders would help to minimize weight training injuries.

3078 Board #143 June 3, 3:30 PM - 5:00 PM
The Epidemiology Of Non-time Loss Injuries Predating Subsequent Time-loss Injuries In Collegiate Athletes.

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Previous injury surveillance studies have failed to describe the association of initial or existing injuries with subsequent, more severe injuries.

PURPOSE: This study describes the relationship between injury events within individual athletes where a non-time loss (NLT) injury directly predates a subsequent time loss (TL) injury. **METHODS:** De-identified data from the National Collegiate Athletic Association Injury Surveillance Program from 2009-2015 were linked by unique student-athlete identifiers. An NTL injury was defined as resulting in time loss <24 hours; TL was defined as time loss ≥24 hours. Multiple injuries in an individual athlete were considered a matched event if each injury had the same values for body part and side, and if the NTL injury preceded the TL injury. Each matched event was then assessed by two athletic trainers to determine if the body structure and diagnosis of the injuries within that matched event indicated that the NTL injury likely contributed to the TL injury. Matched events were categorized as: 1) Direct - the NTL injury directly contributed to the TL injury, 2) Not direct - the NTL injury did not directly contribute to the TL injury, 3) Predisposition - the NTL injury likely made the athlete susceptible to the TL injury, but did not directly contribute to it, 4) Other - the NTL and/or TL diagnosis was reported as "other" and a determination was not possible, and 5) Excluded - events which were either mislabeled or mismatched. Descriptive statistics include counts and percentages. **RESULTS:** Of 33,203 injuries reported in 15,673 student-athletes, there were 425 matched events which involved 1,117 individual injuries in 387 athletes. Of these 425 matched events, 156 (36.7%) were Direct, 196 (46.1%) were Not direct, 32 (7.5%) were Predisposition, 32 (7.5%) were Other, and 9 (2.1%) were Excluded. Of the Direct events, 52 (33.3%) involved more than two separate injuries to the same body part. **CONCLUSION:** NTL injuries may potentially contribute to subsequent TL injuries. However, the incidence of such events may be rare, and management of NTL injuries by athletic trainers may mitigate subsequent injury risk. Further research is needed to better estimate the incidence of NTL injuries progressing to TL injuries.

3079 Board #144 June 3, 3:30 PM - 5:00 PM
Injuries in Elite U.S. Rugby 7s Tournament Players over 4 years: Time Loss and Medical Attention

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Reported Relationships: V. Lopez Jr: Contracted Research - Including Principle Investigator; Sponsored by the Empire and New England Rugby Football Unions.

PURPOSE: There is a lack of injury data on U.S. rugby and the new Olympic sport Rugby-7s. To determine the incidence (per 1000 playing hours (ph)), severity (days absence), and mechanisms of injuries.
METHODS: A prospective epidemiology study of Elite/national candidate males (348) and females (336) in USA Rugby sanctioned tournaments, 2010-2013; compliant with the international consensus statement for studies in rugby union.

RESULTS: Incidence of injury for medical attention and time-loss injuries combined were 89.7/1000ph (n=88) (men 23.9±3.6 years old; women 25.0± 4.6 years old). Time-loss injuries were encountered at 41.8/1000ph (n=41, 95% CI: 30.0-56.7) as compared to medical attention at 47.9/1000ph (n=47, 95% CI: 35.2-63.7). Male competitors (backs 134.3/1000ph, n=40; forwards, 71.6/1000ph, n=16; RR: 1.28; P=0.03) were injured more often than women (backs 83.7/1000ph, n=22; forwards, 45.6/1000ph, n=9; RR:1.2, P=0.134) (RR: 1.3, P=0.005). More days absence from play were encountered by women than men (1123 versus 548 days missed; P=0.017). Most injuries were acutely (98%) encountered in the tackle (68%). Main injuries were ligament sprains (34%) to lower extremities (53%). Knee injuries were more frequent in men than women (P=0.005). There was a high incidence of head/neck injuries (including concussions) among both sex (overall 22%; men 25%; women 16%) (P<0.044).

CONCLUSION: U.S. Elite tournament players were injured at lower rates than their international Rugby-7s counterparts. Given the high rate of injury in head and neck; and repetitive injury incidence, injury prevention initiatives should focus on proper tackling techniques, diagnosis of injury post tournament and a standardized return to play protocol. Understanding incidence of injury rates in U.S. national candidates would guide injury prevention protocols for the national program.

3080 Board #145 June 3, 3:30 PM - 5:00 PM
Timing Of Injuries And Type Of Exposure In Division I College Football: A 3-year Review

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 (No relationships reported)

Multiple factors related to injury such as rates, playing surfaces, mechanisms, and frequency of specific injuries have been evaluated in football. However, these factors are often examined in isolation. To optimize injury prevention, player position and time in the season must be considered when evaluating factors related to positional injuries. **Purpose:** To examine the injury relationships between position groups, period of the season and exposure activity (game or practice). **Methods:** All players, 323 athlete seasons, were evaluated by a team physician for musculoskeletal injuries and concussions using the NCAA Injury Surveillance System (ISS) reportable injury definition during games and practice for the 2012-2014 seasons. Injury details were divided into three position groups: *skill* (running back, wide receiver, defensive back), *line* (offensive and defensive line) and *other* (linebacker, tight end, special teams, quarterback). Injury incidence by position group was compared by time in the season (pre, 1st half, 2nd half) and exposure activity (game or practice). Descriptive statistics were calculated for all variables. **Results:** 141 injuries documented from 2012-2014. Most injuries occurred in the pre-season (55 injuries, 39%) and 1st half of the regular season (54, 38.3%) in contrast to the 2nd half of the season (32, 22.7%). *Skill* players were most often injured in all periods of the season (p<0.05) but accounted for the majority of total team injuries only in the pre-season (29, 52.7% pre-season injuries). *Line* players suffered the largest percentage of their injuries in the 1st half of the season (17, 40.5% of all *line* injuries) with similar totals in the pre and 2nd half of the season (13-pre, 12-2nd). *Skill* and *other* players suffered the largest proportions in the pre-season (*Skill* 29, 43.3% of *skill* injuries; *Other* 13, 40.6% of *other* injuries), decreasing as the season progressed (*Skill*: 29-pre, 25-1st half, 13-2nd half; *Other* 13-pre, 12-1st, 7-2nd). *Skill* (p<0.05) and *other* (p=0.033) players experience significantly more injuries during practice than games (*Skill*- 47 practice, 20 game; *Other*- 22 practice, 10 game). **Conclusion:** Future work should examine effectiveness of new practice techniques plus rules and regulation changes to optimize and improve injury prevention.

3081 Board #146 June 3, 3:30 PM - 5:00 PM
Comparison Of Risk Factors For Females Sustaining Acl Injuries Versus Ankle Sprains

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 (No relationships reported)

BACKGROUND: Ankle sprain and anterior cruciate ligament (ACL) injury are common lower extremity injuries among athletes. Ankle sprain is the most common athletic injury and accounts for approximately half of all injuries. ACL injury, although more rare, may occur due to similar mechanisms and often incurs longer rehabilitation and abstinence from sport. Although females experience greater rates of ACL injury than do males, they experience the same amount of ankle sprains. Little is known as to why this difference exists or what risk factors may be unique to each.

PURPOSE: To assess risk factors among females sustaining ankle sprain versus ACL injuries.

METHODS: All cases of ACL reconstruction and ankle sprain in females ages 15-39 years from 2002-2012 were gathered from Clinformatics Data Mart database and matched to non-injured controls at a 1:3 ratio by age, region, and index date. Conditional logistic regression was used to calculate the adjusted odds ratios (aORs) and 95% CIs for the risk of each outcome with a range of sociodemographic and

clinical predictor variables. Association of risk factors were examined and compared between the two models. Variables of interest included history of lower extremity injury, oral contraceptive use, antibiotic use, corticosteroid use, and aggregate comorbidity (Elixhauser).

RESULTS: 12,819 cases of ACL reconstruction and 134,299 cases of ankle sprain were included in this study. Those sustaining ankle sprains were more likely to have sustained previous lower extremity injury compared to those receiving ACL reconstruction, aOR of 4.08 vs. 2.76, respectively. Those sustaining ankle sprains also had higher odds of comorbidity than the ACL cohort. Among ACL injuries, injectable corticosteroid use was more common, aOR of 2.08 vs 1.41.

CONCLUSIONS: Ankle sprain and ACL injury appear to have different risk factors. In general, we found that those with ACL injuries were more likely to have received corticosteroid injections and less likely to have had a previous lower extremity injury or comorbid condition compared to those with ankle sprains. Monitoring of higher risk individuals by coaches and athletic trainers may be beneficial in preventing these injuries. Further, these risk factors may help identify injured individuals requiring extended rehabilitation and/or rest from sport.

3082 Board #147 June 3, 3:30 PM - 5:00 PM
Common Injuries Among Adult Figure Skaters

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Over the past 20 years, figure skating has transitioned to a lifetime sport. Like youth skaters, adult figure skaters are competitive and may experience similar injuries. However, there is limited information about the frequency and types of these injuries.

Purpose: To observe the most common sites of injuries experienced by adult figure skaters, when during training the injuries occurred, the onset of the injury, and the most common mechanisms of injury.

Methods: An electronic injury survey was distributed via email to adult figure skaters affiliated with U.S. figure skating clubs and posted on the USFS Adult Skating Facebook page. Skaters reported the body parts they have injured since beginning private lessons. They also reported the cause of injury and body part(s) involved for up to four injury events. We calculated the following proportions: skaters who experienced an injury, injuries at each body part, acute and overuse injuries, mechanism, and time of injury. We then determined the frequency of injuries at each body part for the specific injury events.

Results: A total of 168 skaters (age=42.4 ± 11.4 years, years of experience=26.9 ± 15.6) completed the survey. The majority of the sample was female (93.2%). Skating related injuries were reported by 68.5% of survey respondents. Among the 115 skaters with injuries, the most commonly reported sites of injury were the knee (52.2%), ankle (40.9%), low back (35.7%), wrist (35.7%), and head (30.4%). Of the 208 specific injuries reported, the sites most frequently involved in an injury were the knee (22.1%), ankle (17.3%), head (13.9%), low back (13.9%), and wrist (12.6%). The majority of injuries (89.5%) occurred during practice. Tripping (not involving another skater) resulted in 38.2% of injuries, while other (28.3%) and a fall from a jump (19.1%) also contributed to injuries. Most injuries (74.4%) were acute, rather than overuse.

Conclusion: Anecdotally, we know that many adult figure skaters experience injuries as a result of their training. Previous research has shown that elite singles skaters suffer from more overuse injuries, which is in contrast to our findings that adult skaters experience more acute injuries. Adult skaters in our sample were injured most frequently as the result of tripping, which may explain the high frequency of head and other acute injuries.

3083 Board #148 June 3, 3:30 PM - 5:00 PM
Prevalence And Characteristics Of Archery-related Injuries In Archers

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(No relationships reported)

Purpose: Public perception of the sport of archery is that risk for injury is relatively low compared to contact sports or other vigorous aerobic or strength activities. Clinical and training observations of archers in this geographic region suggest that archery-related injuries may be more pervasive than perceived. This study determined the prevalence and type of archery-related injuries among archers in the north central Florida region.

Methods: This was a cross-sectional study of archers (N=239; 31.67±13.28 yr; 65.2% male). Surveys were administered in-person at competitions and electronically to local club teams. The following data were captured: bow type, draw weight, archery experience, current training practice and volume and history of archery-related injuries.

Results: Archery-related injuries were reported by 43.5% of the archers (57.6% of women, 35.3% of men). Injuries had occurred in 53.9% and 35.3% of recurve and

compound bow users, respectively. The highest injury prevalence occurred in women who used recurve bows (70.7% vs 30.4%-45.5% in female and male compound bow users). The most common body parts injured were shoulder (70.3%), back (31.7%), elbow (18.8%), wrist (15.8%), fingers (12.9%), and forearm (11.9%). Seven cases were acute injuries (bruising, cut, forearm burns, broken thumb) and the remaining cases were overuse injuries (such as impingement, bursitis, labral tear, rotator cuff pain). Presence of injury was only weakly correlated with training days per week and months per year (r=.148-.167; p<.05) and bow type (r=.186; p=.004).

Conclusion: The prevalence of archery-related chronic injuries is comparable to that of other vigorous or contact sports. The mechanisms of archery injuries are predominantly overuse. Areas for targeted injury prevention could include increasing awareness to coaching staffs of injury risk, and improved core and upper body strength stabilization and position technique in archers, particularly in women who use recurve bows.

3084 Board #149 June 3, 3:30 PM - 5:00 PM
Boys Lacrosse Tournament Game Injuries

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Purpose: To describe the frequency, mechanisms and event characteristics associated with injuries during boys' lacrosse (LAX) tournament games.

Methods: Youth LAX tournament providers participated in a US Lacrosse-sponsored injury data collection project. Certified athletic trainers (ATs) at 11 tournaments in 7 states during the summers of 2014 and 2015 completed a LAX-specific injury reporting form for each injury that required medical attention during the tournaments. The form included player demographics, activity at time of injury, type and mechanism of injury (MOI), and injury event characteristics.

Results: ATs reported 203 injuries among players (M=13.5, range= 8 to 17 years, SD=2.0). 90% of injuries were contact related. The most common injuries were concussions (n=67, 33%), contusions (n=41, 20%), minor ligament injuries (n=24, 12%) and 17 possible/suspected fractures (8%). 42% of injuries occurred to the head, face or neck, followed by lower extremity (24%, n=52) and arm (22%, n=48). The most frequent MOI was bodily collisions (n=58, 29%), followed by stick contact (n=55, 27%). The most common MOIs for concussions were contact from another player's body or head (n=22, 33%), contact with two or more mechanisms, i.e. body and ground, (n=16, 24%) and another player's stick (n=12, 18%). A penalty was called in 22% injury incidents. 35% percent of the injuries involved midfielders (n=70), followed by attack (n=48, 24%) and defenders (n=46, 23%). 30% of injuries occurred during loose ball situations (n=60), transition accounted for 16% (n=33) and shooting on goal was associated with 10% (n=20). Close to 60% of injuries occurred in the second half of the game.

Conclusions: Collegiate and high school LAX are contact sports that allow body and stick checking. Modified rules for youth play restrict physical contact at the younger age groups and progress to more contact in older age groups. The majority of injuries in a tournament setting were associated with physical contact. Understanding common injuries, MOI and precipitating events can inform development of safety policies. Youth LAX tournament providers should ensure licensed health professionals, like ATs who are trained in concussion evaluation, are onsite to provide medical care and guidance to parents and coaches.

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3085 Board #150 June 3, 3:30 PM - 5:00 PM
Continued Sex-differences In The Rate And Severity Of Knee Injuries Among Collegiate Soccer Players

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Studies continue to report a greater risk of knee injury in female, compared with male athletes; however, there are no comparable data on injury severity.

PURPOSE: To examine sex-differences in the rate and the severity (lost days of participation, need for surgery) of knee injuries among collegiate soccer players between 2004 and 2009, while controlling for several covariables previously linked to injury occurrence. **METHODS:** Data from the National Collegiate Athletic Association Injury Surveillance System (NCAA-ISS) were used to calculate injury incidence density (ID) per 1000 athletic exposures (AE). As per the data collection guidelines of the surveillance system, injury incidence was defined as: 1) any injury event involving the knee that occurred during participation in an intercollegiate game or practice; 2) that required medical attention and/or surgery; and 3) restricted participation or performance for > 1 day beyond the event. The rate ratio (RR), along with the 95% confidence interval (CI), compared ID among female, relative to male soccer players.

Multivariable logistic regression and multivariable negative binomial regression modeling then tested the relation between sex and knee injury incidence and severity while controlling for contact, setting, and competition level. **RESULTS:** Between 2004 and 2009, the sex-specific rate of soccer-related knee injuries was 1.20 per 1000 AEs in women and 0.90 per 1000 AEs in men (RR = 1.45, 95% CI = [1.27, 1.64]). In the multivariable modeling, women continued to experience significantly higher odds of knee injury compared with men (aOR = 1.44, 95% CI = [1.27, 1.63]). Also, the adjusted odds of a knee injury that resulted in surgery remained higher in women compared with men (aOR = 1.61 (1.00, 2.58), but this was marginally so. From the negative binomial regression modeling, we observed that women also experienced significantly more time lost from participation, independent of contact, competition level and surgery ($p < 0.05$). **CONCLUSION:** Given the prominence of soccer play in the United States, continued efforts to evaluate and improve knee injury prevention practices and policies may be especially important for female players.

3086 Board #151 June 3, 3:30 PM - 5:00 PM

Epidemiological Analysis Of Injuries Occurring In Marine Corps Forces Special Operations Personnel

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Special Operation Forces have been shown to sustain greater rates of musculoskeletal injuries than conventional forces. These injuries result in loss in deployable operators, which negatively impacts force readiness. In addition to Operators (OPs), Marine Corps Forces Special Operations Command (MARSOC) also utilizes Combat Support Personnel (CSP) to support OP missions. These CSP may also be at risk for sustaining similar injuries and mechanisms as OPs.

PURPOSE: Describe injury epidemiology in MARSOC personnel and compare injury patterns between OPs and CSP.

METHODS: A total of 141 MARSOC personnel (85 OPs, 56 CSP) completed an injury history questionnaire and described musculoskeletal injuries that occurred in the previous 12 months. Injury proportions were calculated for OPs and CSP. Proportions of injured subjects were compared between OPs and CSP using Fisher's exact tests.

RESULTS: A total of 43 injuries were reported within the previous 12 months, 25 of which were classified as preventable (15 in OPs, 10 in CSP). There were no statistically significant differences in the proportion of injured subjects between OPs and CSP. Preventable injuries were sustained by 14% of OPs and 16% of CSP. Both OPs and CSP sustained the majority of preventable injuries while performing lifting and running activities (27% and 40% for OPs and 40% and 50% for CSP, respectively). Also, the knee and lumbopelvic region were the most commonly reported location of preventable injuries for OPs (20% each) and CSP (30% each). The top three most common injury types were muscle strain, tendinopathy, and pain/spasm.

CONCLUSIONS:

Approximately 15% of MARSOC personnel experienced preventable injuries within 12 months prior to the questionnaire. Therefore, the force would significantly benefit from performance and injury prevention programs to mitigate preventable injuries and optimize force readiness. Because the majority of injuries were sustained during physical training there is a need to monitor training readiness to avoid overtraining and fatigue. Additionally, OPs and CSP seem to sustain similar injury patterns with similar mechanisms, suggesting CSP should also be included in injury prevention initiatives to optimize force readiness.

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3087 Board #152 June 3, 3:30 PM - 5:00 PM

Descriptive Epidemiology of Injuries Among Masters Alpine Ski Racers

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There have been an increasing number of publications on recreational and elite alpine skiing injury epidemiology. To our knowledge, however, there are no previously published data on injuries in Masters alpine ski racers.

PURPOSE:

The aim of this study was to describe injury patterns among Masters alpine ski racers incurred during competition and training.

METHODS:

In this cross sectional study, data were collected from competitors at a single United States Ski and Snowboard Association Masters ski racing national championship during the 2012-2013 winter season via an online injury survey (N = 124; survey response rate 61.7%).

RESULTS:

The age of the respondents ranged from 22 to 84 years with a mean age of 53.4 years (SD = 12.8 years). In general, this group of Masters skiers was very experienced, with 83.1% of respondents reporting that they had participated in more than 15 Masters ski races. A total of 158 training or competition-related injury cases were reported from 65 competitors (52.4%), with an injury rate of 1.3 injuries per athlete and 2.4 injuries per injured athlete. Among the 158 injury cases reported, there were 289 separate injuries that occurred at nine different body regions, with the knee/leg region being the most commonly injured anatomic location (52 cases, 18.0%), followed by back (12.8%) and shoulder (12.1%). Among the knee injuries, meniscal injury was most common (22.3%). Median and anterior cruciate ligaments were the most common ligamentous knee injuries (17.9% of all knee injuries, each). Fractures accounted for 22% of all injuries. There were a total of 25 concussions reported. Hitting a gate was the most common event related to injury cases (52.3%) and equipment failure played a role in only 3.1% of injury cases. Masters skiers had substantial time-loss caused by injuries, with 41.5% of all injured athletes requiring more than 28 days off from training and competition. Injury rates were not associated with athletes' ages ($p = 0.724$).

CONCLUSIONS:

In conclusion, the results of this survey suggest that the risk of injury in Masters alpine ski racing is high. Further research in this area will better characterize injury risk in this athlete population and inform injury prevention measures.

3088 Board #153 June 3, 3:30 PM - 5:00 PM

Risk Factors for Running-Related Injuries in Trailrunners: A Prospective Cohort Study

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Trailrunning is becoming a popular mode of running in a broad population. However, the risk factors for running-related injuries (RRI) in trailrunning are not well established.

PURPOSE: To investigate in trailrunners the risk factors for RRIs.

METHODS: This was a prospective cohort study with biweekly repeated measurements, conducted between October 2013 and December 2014. Trailrunners aged 18 years or older participating in trailrunning events in the Netherlands were invited to participate. After a baseline survey, a follow-up questionnaire was administered biweekly to collect data about running exposure and RRI. RRI was defined as a disorder of the musculoskeletal system experienced or sustained during participation in running. A multivariate model using generalized estimating equations (GEE) was performed. The results were expressed as odds ratio (OR) and 95% confidence interval (95% CI).

RESULTS: The explanatory variables included in the model were: running exposure (hours, km, frequency and participation in events), practice of other sports, gender, age, body mass index, running experience, RRI at baseline and previous RRI. Previous RRI was the most significant predictor of reporting new RRIs during the follow-up (OR 1.89, 95% CI 1.18 to 3.02). An additional hour of running practice in a 2-week period was found to increase the odds of reporting new RRIs (OR 1.12, 95% CI 1.03 to 1.22). An additional km in a 2-week period was found to decrease the odds of reporting new RRIs (OR 0.98, 95% CI 0.97 to 1.00).

CONCLUSIONS: Trailrunners who increase their running exposure in hours may be more likely to report new RRIs, while increasing mileage may be a marker of running adaptation, thereby reducing the odds of reporting new RRIs. Changing specific running exposure parameters may influence the risk of RRIs.

Luiz C. Hespanhol Junior is supported by Capes, process number 0763/12-8, Ministry of Education of Brazil.

3089 Board #154 June 3, 3:30 PM - 5:00 PM

Epidemiology Of Knee Sprains In Youth, High School, And Collegiate American Football

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Variations in knee injury rates and distributions among competition levels are unclear, but may help inform strategies to prevent knee injuries during American football.

Purpose: Describe the epidemiology of knee sprains in youth, high school (HS), and collegiate American football.

Methods: Injury and athlete-exposure (AE) data were collected from three injury surveillance programs: (1) the Youth Football Safety Study (YFSS); (2) the National Athletic Treatment, Injury and Outcomes Network (NATION); and (3) the National Collegiate Athletic Association (NCAA) Injury Surveillance Program (ISP). During the 2012-2014 seasons, the YFSS, NATION, and NCAA ISP included 310, 184, and 71 football team-seasons, respectively. Knee sprain rates were calculated. Rate ratios (RR) compared rates across competition levels. Injury proportion ratios (IPR) compared distributions of knee sprains by injury activity and surgery need across competition levels. Analyses were then restricted to anterior cruciate ligament (ACL) injuries. RRs and IPRs with 95% confidence intervals (CI) not including 1.00 were considered statistically significant

Results: A total of 33, 313, and 374 knee sprains were reported in youth, HS, and college football, respectively. This led to respective rates of 0.16, 0.25, and 0.69/1000AE. The knee sprain rate in college was larger than that of HS (RR=4.38, 95%CI: 3.07-6.26) and youth (RR=2.73; 95%CI: 2.35-3.18). College football had the lowest proportion of knee sprains that occurred while being tackled (college vs youth: IPR=0.44, 95%CI: 0.26-0.76; college vs high school: IPR=0.71, 95%CI: 0.51-0.98). A total of 2, 98, and 83 ACL injuries were reported in youth, HS, and college football, respectively. This led to respective rates of 0.01, 0.08, and 0.15/1000AE. The ACL injury rate in college was larger than that of HS (RR=1.94, 95%CI: 1.45-2.60) and youth (RR=16.05, 95%CI: 3.95-65.26). The proportion of ACL injuries requiring surgery was higher in college than in HS (85.5% vs. 33.7%, IPR=2.54, 95%CI: 1.90-3.40).

Conclusion: Both knee sprain and ACL injury rates were highest in college. However, level-specific variations in the distributions of knee sprains by injury activity and surgery needs may highlight the need to develop policy and prevention that ensures safe sports play and injury management.

3090 Board #155 June 3, 3:30 PM - 5:00 PM
Disparities In Medical Staffing In Secondary School Sport: Implications For Concussion Identification
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 (No relationships reported)

Purpose: Despite the importance of secondary schools as a context for the prevention and management of concussion and other potentially severe injuries from sport, as well as the possibility of variation in school-based care, a health disparities perspective has not yet been extended to this area of health services research. The present study assessed whether variability in whether US high schools employ a certified athletic trainer (AT) is patterned by school socioeconomic and demographic characteristics, as well as whether more concussions are diagnosed on teams that have an AT or other medical personnel present at games.

Methods: A stratified random sample of football, girls' soccer and boys' soccer coaches at Washington state public high schools were surveyed about medical staffing at games as well as the number of concussions diagnosed on their team during the previous athletic season (n=144 schools, 287 coaches). School-level socioeconomic and demographic information was also obtained. **Results:** A one standard deviation increase in the percentage of students qualifying for free or reduced price lunch was associated with a school having significantly lower odds of employing an AT (OR=0.42, p<0.001). Schools located in a rural region and with lower enrollment had similarly lower odds of employing an AT. Independent of sport, teams with an AT present most of the time (OR=3.68, p<0.001) or all of the time (OR=7.45, p<0.001) had significantly greater odds of having more concussions diagnosed than teams without an AT present. The presence of medical personnel other than an AT was not significantly associated with the number of concussions diagnosed, and when added to the model did not change the strength of significance of the association between AT presence and number of concussions diagnosed. **Conclusion:** This study provides empirical support for the benefit of ATs in concussion identification in high school sport, and underscores the challenges to staffing medical personnel in lower resource settings. These findings challenge us to critically reflect on the point at which medical oversight of contact and collision sport is necessary from the perspective of risk prevention, and the extent to which we consider disparities in this medical oversight to be socially and ethically defensible.

3091 Board #156 June 3, 3:30 PM - 5:00 PM
Head and Neck Circumference Not Risk Factors For Game Concussions Among Youth American Football Players
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Neck to head circumference ratio (NHR) has been reported as a potential risk factor for concussion (CONC) among high school athletes. Research examining anthropometrics and neck (NC) and head (HC) circumferences and NHR in youth football is limited.

PURPOSE: To examine the relationship between player anthropometrics and CONC injury rates (IR) among youth football players.
METHODS: 1212 male youth football players (11.9±1.2 years) with 2.6±1.9 years experience participating in a large metropolitan youth football league were followed prospectively throughout 3 seasons (2012-2014). Height (HT, cm); weight (WT, kg); and NC and HC, cm; data were collected pre-season. CONC injury information, including mechanism of injury (MOI, for games was tracked each season by the leagues certified athletic trainer (AT) using an electronic medical record-keeping system. At each event, ATs collected injury and athlete-exposure (AE) data. CONC injury frequencies and rates with 95% confidence intervals (CI) were calculated based on 1000 AE. Descriptive statistics characterized anthropometrics and CONC. Binary logistic regression with forward step-wise elimination examined relationships between anthropometric characteristics (HT, WT, BMI, HC, NC, NHR) and the incidence of CONC (p≤0.05).

RESULTS: Participants (n=1068) mean anthropometrics: 157.4cm, 49.8kg, and 21.8.kg/m². The mean NC, HC and HNR ratio (n=951): 32.2cm, 52.07cm, and 0.53, respectively. 71 of 1212 participants (5.9%) were diagnosed with a CONC. CONC IR for games for all 3 seasons was 5.65 /1000 AE (95%CI: 4.34 -6.97). Majority CONC occurred during the 2nd half of play (n=52, 73.3%) as a result of helmet-to-helmet (31, 43.7%), and head-to-ground (n=15, 21.1%) collisions. Binary logistic regression identified no significant predictors of concussion 2(1, N=854)=94%, p = .92.

CONCLUSIONS: Incidence of CONC was similar to those previously reported in same age group of youth football players. While anthropometrics, NC, HC and NHR and BMI did not predict CONC, future research should examine these factors as well as neck strength as potential predictors of CONC. Research should also examine if the high incidence of CONC during the 2nd half of game play is related with other modifiable risk factors. Supported by Potomac Health Foundation.

3092 Board #157 June 3, 3:30 PM - 5:00 PM
Effect of Concussion on Pro Ice Hockey Player Performance
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Concussions can impact gait, reaction time, and visuomotor performance. However, there is limited research on how concussion may influence athletic performance.

PURPOSE: The current study aimed to examine the effect of concussion on ice hockey player performance in the National Hockey League (NHL). It was hypothesized that a concussion would decrease player performance and that player performance prior to injury may contribute to concussion risk.

METHODS: Using publicly available player statistics from the NHL, retrospective concussive and orthopedic injuries and player statistics were compiled. Concussion (n =20) and orthopedic (n =20) cases were pulled from injury reports during the 2013-2014 season. Player statistics included points, hits, shots, time on ice, and plus-minus. Concussed players were matched to orthopedic injured players using five criteria: 1) player position, 2) duration removed from play, 3) pre-injury time on ice, and 4) team division. Ten games prior to injury were compared to two weeks once athlete returned to play post-injury. Paired t-tests compared groups and time while logistic regression assessed injury risk.

RESULTS: No differences between groups were seen for height, weight, average time on ice, or years played in the NHL (all p>0.05). Concussed (M=18.0 days) and orthopedic (M=17.8 days) injured players were removed for the same duration (p>0.05). There was a significant time by injury type by position interaction for plus-minus (p=0.001). Players with orthopedic injuries improved plus-minus pre (M= -0.22) to post injury (M=0.05), while players with concussive injuries had decrements pre (M=0.03) to post-injury (M= -0.05), indicating that concussive players were on the ice for more goals against during post-injury play compared to pre-injury play. In terms of predicting concussive vs. orthopedic injuries, pre-injury plus-minus was a significant predictor of concussive injury (p<0.05) when controlling for weight and average penalty minutes. For each increase in plus-minus there is a 662% increase in the odds of having a concussive injury.

CONCLUSIONS: Concussive injuries may have an effect on player performance that extends beyond typical concussion recovery period. Moreover, performance in the ten games prior to injury may influence concussive injury risk.

3093 Board #158 June 3, 3:30 PM - 5:00 PM
The Epidemiology of Boys' and Girls' Youth Lacrosse
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Participation in youth lacrosse has dramatically increased in recent years. Yet, research on the incidence of lacrosse injuries in youth is limited.

PURPOSE: Describe the epidemiology of injuries in boys' and girls' youth lacrosse in the 2015 season.

METHODS: Athletic trainers (ATs) attended games and practices for twelve youth lacrosse leagues in four states with 550 male and 225 female players. The ATs collected injury and athlete-exposure (AE) data. Injury frequencies and rates were calculated. Rate ratios (RR) compared rates in games and practices, and in boys and girls. RRs with 95% confidence intervals (CI) not including 1.00 were considered significant.

RESULTS: During the 2015 season, 155 and 32 injuries were reported in boys' and girls' youth lacrosse, respectively, for rates of 13.0/1000AE (95%CI: 10.9-15.0) and 8.3/1000AE (95%CI: 5.4-11.2). The rate in boys was higher than girls (RR=1.6; 95%CI: 1.1-2.3). Most injuries occurred during games (boys: 60.0%; girls: 53.1%). In boys, the injury rate was higher in games than practices (RR=2.9; 95%CI: 2.1-4.0). Findings were similar in girls, but not statistically significant (RR=1.7; 95%CI: 0.9-3.4). Small proportions of injuries resulted in time loss of at least 24 hours (boys: 14.8%; girls: 15.6%). Most injuries were to the lower extremity (boys: 45.2%; girls: 37.5%) and were diagnosed as contusions (boys: 51.9%; girls: 43.8%) and sprains (boys: 14.7%; girls: 15.6%). Ten concussions (6.5%) were reported, all of which were to boys. Most injuries were due to contact with equipment, particularly stick contact (boys: 35.7%; girls: 28.1%) and ball contact (boys: 14.0%; girls: 18.8%). In boys, player contact was also a common injury mechanism (18.5%).

CONCLUSIONS: Our youth lacrosse rates were higher than those previously reported (13.0 vs. 8.7/1000AE and 8.3 vs. 3.4/1000AE, in boys and girls, respectively), but are more precise given the larger sample. As in previous research, rates were higher in boys than girls. Differences related to youth lacrosse injuries in boys and girls may reflect fundamental differences in rules, contact, and protective equipment and highlight the need for sex-specific intervention strategies. Also, the large proportion of equipment contact injuries demonstrate the need to consider rule changes that could better protect youth players.

3094 Board #159 June 3, 3:30 PM - 5:00 PM
Risk Of Stress Fracture Varies By Race/Ethnicity In U.S. Army Soldiers
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Stress fractures (SF) are common and costly injuries in military personnel. Risk for SF has been shown to vary with race/ethnicity. Previous studies report increased SF risk in White and Asian soldiers compared to Black soldiers. However, these studies did not account for the large ethnic diversity in the U.S. Military. In particular, the number of Hispanic soldiers in the U.S. Military is growing rapidly, yet the risk of SF in this group is not well characterized. **PURPOSE:** We aimed to identify differences in SF risk among race/ethnic groups within the U.S. Army, with a particular focus on Hispanic subgroups. **METHODS:** A retrospective cohort study was conducted using data from the Total Army Injury and Health Outcomes Database from 2002 until 2011. SF diagnoses were identified from ICD-9 codes. We used multivariate logistic regression models to calculate risk of SF by race/ethnic group after adjusting for age, sex, and BMI. We also performed a sex-stratified analysis to determine whether the ethnic variation in SF risk depends on sex. **RESULTS:** Overall, we identified 13,102 SF cases in 827,212 soldiers (over 55,889,391 person-years of risk), revealing an overall incidence rate of 2.81 per 1,000 person-years (2.05 and 7.47 per 1,000 person years in men and women, respectively). Blacks had the lowest risk of SF and were used as the reference group. Asians had the highest risk of SF, with an 80% greater risk of SF than Blacks [1.80 (1.66-1.95); OR (95% CI)], followed by Whites [1.75 (1.66-84)], American Indians [1.57 (1.33-1.85)], and Hispanics [1.39 (1.29-1.49)]. Analysis within

Hispanic subgroups showed that, compared to Blacks, Latin Americans tended to have the highest risk of SF [1.61 (1.38-1.72)], followed by Cubans/Puerto Ricans [1.51 (1.33-1.72)], and Mexicans [1.38 (1.25-1.52)]. The sex-stratified analysis revealed similar patterns for risk of SF among different race/ethnicity groups. **CONCLUSION:** Using a large database from Army soldiers, we found substantial differences in the risk of stress fracture among race/ethnic groups, with Asian soldiers at greatest risk, Black soldiers at lowest risk, and Hispanic and White soldiers at an intermediate risk. Additional studies are needed to determine the factors underlying these race- and ethnic-related differences in stress fracture risk among soldiers.

3095 Board #160 June 3, 3:30 PM - 5:00 PM
Factors Associated With Helmet Use and Risk-Taking in Skiing and Snowboarding
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 (No relationships reported)

Introduction:

Over the past decade, helmet use in recreational skiing and snowboarding has increased dramatically, while injury rates have remained stable or increased. There has been ongoing discussion regarding the concept of risk compensation as an explanation for this trend. Risk compensation is the theory that people will adjust behavior based on a perceived level of risk, thus behaving less cautiously when they feel protected. Recent studies suggest that increased skier and snowboarder risk-taking is not associated with helmet use, but is associated with other factors, including age, skill, sex, and risk-taking proclivity.

Purpose:

This study sought to characterize factors associated with risk-taking behavior among recreational skiers and snowboarders.

Methods:

This study was a prospective cross sectional survey of skiers and snowboarders at a large western United States mountain resort. Individuals responded to survey questions regarding attitudes and practices surrounding helmet use, the Brief Sensation Seeking Scale (BSSS) as a measure of risk taking behavior, and self-reported risk compensation. Data were analyzed using multiple linear regression (MLR) and logistic regression (LR).

Results:

Of the respondents (N = 1,267), 17.7%, 13.1%, and 69.2% reported that they wore a helmet never, sometimes, and always, respectively. The MLR analysis showed that, after adjusting for common demographic variables, individuals reporting to sometimes wear a helmet had significantly higher BSSS scores than those reporting to never wear a helmet (p = 0.010). It was also found that male sex, younger age, snowboarding, and higher perceived sport ability level were significantly associated with higher BSSS scores (p < 0.05). The LR analysis indicated that the odds of taking more risks when wearing a helmet for inconsistent helmet users was 1.57 times higher than the odds for those who reported to always wear a helmet.

Conclusion:

Individuals who inconsistently wear a helmet have characteristics of risk taking behavior and risk compensation more than those who always wear a helmet or never wear a helmet. Male sex, younger age, snowboarding, and higher perceived sport ability are also important determinants in risk taking behavior. These results will inform future injury prevention research in these high risk sports.

3096 Board #161 June 3, 3:30 PM - 5:00 PM
Ethinyl Estradiol-Containing Hormonal Contraceptive Prescriptions are Associated with Reduced Stress Fracture Risk in Female Soldiers
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Stress fractures are common injuries among military personnel, and female recruits have an approximately three times greater risk for stress fracture than their male counterparts. Due to positive effects on bone metabolism in amenorrheic and energy deficient athletes, it has been suggested that hormonal contraceptive use may reduce the risk for stress fractures. However, benefits of hormonal contraceptives remain controversial. **PURPOSE:** We aimed to determine the stress fracture risk associated with hormonal contraceptive prescriptions in female U.S. Army soldiers. **METHODS:** We conducted a retrospective cohort study using data from the Total Army Injury and Health Outcomes Database from 2002 to 2011. We identified female soldiers who had stress fractures at the lower extremity and pelvis (n=18,531; mean age 22.93 ± 5.57

yrs). Soldiers with a stress fracture were matched with 4 controls (n=74,124; mean age 23.34 ± 5.78 yrs) by length of time in the military on the date of stress fracture. We recorded contraceptive prescriptions within 6 months of stress fracture diagnosis. Conditional logistic regression was used to calculate the odds ratios (OR) and 95% confidence intervals (CI) for stress fracture with adjustment for age, race, ethnicity, and education level. Risk of stress fracture was determined for soldiers prescribed oral combination (ethinyl estradiol and progestogen) contraceptives (n=10,898), non-oral combination (ethinyl estradiol and progestogen) contraceptives (n=775), and progestogen-only contraceptives (n=220). **RESULTS:** Stress fracture risk was 25%-29% lower in soldiers prescribed oral (OR=0.75, 95% CI [0.71, 0.80]) and non-oral (OR=0.71, 95% CI [0.58, 0.87]) combination contraceptives. Progestogen-only contraceptives prescriptions had no effect on stress fracture risk (OR=0.94, 95% CI [0.66, 1.33]). **CONCLUSION:** This large study, with over 90,000 women, suggests ethinyl estradiol-containing contraceptives may have a protective effect on developing stress fractures. Prospective studies are needed to verify these results and identify the underlying mechanisms of this protective effect. The views expressed in this abstract are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government.

3097 Board #162 June 3, 3:30 PM - 5:00 PM
Low Back Pain Incidence and Rate of Chronicity in U.S. Army Soldiers: an Epidemiologic Study

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 (No relationships reported)

Purpose: Determine the 10-year incidence rate (IR) of low back pain (LBP) in soldiers and the rate of chronic or recurrent LBP within 1 year of initial onset.

Methods: Medical encounter data for US Army soldiers was used to quantify the incidence of LBP from 2002-2011 and the rate of chronic/recurrent LBP based on medical care >3 months and ≤1 year after the initial encounter. Poisson regression was used to calculate incidence rate ratios (IRR) for demographic risk factors (age, race, education, marital status, sex) and medical conditions (psychological issues, sleep disorders, obesity, tobacco use, alcohol use) associated with LBP. Logistic regression was used to calculate odds ratios (OR) for risk factors of chronic/recurrent LBP.

Results: There were 381,952 incident cases of LBP, for a 10-year IR of 112.8 per 1,000 person-years. Chronic/recurrent symptoms occurred in 28% of cases. Women (IRR=1.77, 95%CI [1.73, 1.80]) and age > 40 years had the highest rates of LBP (ref. 20-29 years; IRR=1.37, 95%CI 1.32, 1.42). Demographic risk profiles for chronic/recurrent LBP showed similar trends as seen for incident cases (women OR=1.34, 95%CI [1.31, 1.36]); >40 years old OR=1.28, 95%CI [1.24, 1.32]). Soldiers seeking care for psychological (psych) issues (IRR=0.97, 95%CI 0.95, 0.98), sleep disorders (IRR=0.75, 95%CI [0.73, 0.76]), obesity (IRR=0.79, 95%CI [0.77, 0.81]), tobacco use (IRR=0.85, 95%CI [0.84, 0.87]), or alcohol use (IRR=0.84, 95%CI [0.81, 0.86]) were less likely to be seen for incident LBP, but were more likely to develop chronic/recurrent LBP (psych issues OR=1.59, 95%CI [1.57, 1.61], sleep disorders OR=1.83, 95%CI [1.79, 1.86], obesity OR=1.52, 95%CI [1.49, 1.55], tobacco use OR=1.54, 95%CI [1.52, 1.57], alcohol use OR=1.25, 95%CI [1.22, 1.28]). Soldiers with 2-5 comorbid conditions showed progressively higher odds (OR=1.94-3.66) of developing chronic/recurrent LBP.

Conclusions: Women and those over 40 years old were more likely to seek medical care for LBP. Patients with medical encounters for LBP and comorbid psych issues, sleep disorders, obesity, tobacco abuse, or alcohol abuse were more likely to develop chronic or recurrent LBP.

The views expressed in this abstract are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government.

3098 Board #163 June 3, 3:30 PM - 5:00 PM
Epidemiology Of Exertional Heat Illnesses In NCAA Athletes, 2009/10-2014/15

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The epidemiology of exertional heat illnesses (EHI) among football athletes has been widely researched. However, data examining all collegiate sports are limited. **Purpose:** Describe the epidemiology of EHI in 25 National Collegiate Athletic Association (NCAA) sports. **Methods:** A sample of athletic trainers reported EHI data to the

NCAA Injury Surveillance Program during the 2009/10-2014/15 academic years. Type of EHI and need for emergency transport were recorded. EHI injury rates and rate ratios (RRs) were reported with 95% confidence intervals (CI). **Results:** Overall, 232 EHI were reported, for an EHI injury rate was 0.47 per 10,000 athlete-exposures (AE) (95%CI: 0.41, 0.53). Football comprised 75% of all EHI reported and had the largest EHI rate (1.55/10,000AE; 95%CI: 1.32, 1.78). Additional sports with relatively higher EHI rates were women's outdoor track (0.59/10,000AE; 95%CI: 0.12, 1.07), men's basketball (0.41/10,000AEs; 95%CI: 0.18, 0.65), men's soccer (0.31/10,000AEs; 95%CI: 0.06, 0.56), and women's soccer (0.30/10,000AEs; 95%CI: 0.09, 0.50). Most EHI occurred during practice (72.8%). However, the EHI injury rate was higher in competition than practice (0.70 vs. 0.42/10,000AE; RR=1.65; 95%CI: 1.23, 2.20). This RR was highest in football (3.47 vs. 1.34/10,000AE; RR=2.59; 95%CI: 1.81, 3.71). Most EHI were reported in the preseason (64.7%). The EHI rate was higher in the preseason than the regular season (1.13 vs. 0.23/10,000AE; RR=4.99; 95%CI: 3.78, 6.59). This RR was slightly higher in football (3.65 vs. 0.66/10,000AE; RR=5.56; 95%CI: 3.99, 7.76). Heat cramps (39%), heat exhaustion (27%), and dehydration (29%) were the most common condition types reported. Nineteen EHI (8%) required emergency transport; of these, 9 were reported in football followed by 2 each in women's outdoor track and field and men's cross country. **Conclusion:** Appropriate hydration strategies need to be examined to address the most common forms of EHI. Football continues to experience the most EHI due to unique factors. Continued emphasis on preseason EHI prevention guidelines is needed in football. However, EHI can potentially occur in all NCAA sports. Sport-specific guidelines that address EHI incidence may be warranted.

3099 Board #164 June 3, 3:30 PM - 5:00 PM
The Incidence of Stress Fracture in Collegiate Athletes

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Stress fractures are common sports-related injuries; female and endurance athletes are known to be at a higher risk than the general athlete population. There are thousands of collegiate athletes in the United States competing in high-impact sports, but no large study has been conducted to determine the incidence of stress fractures in this population.

Purpose: To calculate the incidence of stress fractures in National Collegiate Athletic Association athletes and investigate epidemiological trends in specific subgroups of athletes.

Methods: Data were analyzed from the NCAA Injury Surveillance Program from 2009-2010 to 2014-2015 academic years.

Results: A total of 747 stress fractures resulting in time loss were reported during 14,000,300 athletic exposures (AE) for an overall rate of 0.53/10,000 AE (95% CI: 0.50, 0.57). The rate of fracture was higher overall among female athletes (RR=2.06; 95% CI: 1.71, 2.47). Female cross country runners had higher fracture rates than males runners (RR=1.77; 95%CI: 1.05, 2.98), but this was also noted in female versus male soccer (RR=1.69; 95%CI: 1.09, 2.63) and basketball (RR=1.69; 95%CI: 1.26, 2.28) players. The pre-season rate was larger than the regular-/post-season rate (RR=3.27; 95% CI: 2.83, 3.78). The most common stress fracture locations were the metatarsals (38.8%, N=290), tibia (20.7%, N=155), and the lower back/lumbar spine/pelvis (13.4%, N=100), 22.5% (N=165) of stress fractures were recurrent.

Conclusion: Females had higher rates of stress fracture than males. Future work needs to focus on improved screening tools for female athletes in all sports as our results found a gender disparity in additional sports beyond the well-known cross-country athletes. A fifth of fractures are recurrent, potentially highlighting the need to reassess post-injury return to play policies.

Key Words: epidemiology; stress fracture; overuse injury; college athlete

3100 Board #165 June 3, 3:30 PM - 5:00 PM
International Classification Of Disease Coding Of Exertional Heat Illnesses In US Army Soldiers

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The severity of exertional heat illnesses (EHI) ranges from relatively minor heat exhaustion to potentially life-threatening heat stroke. Epidemiological surveillance of the types of and trends in EHI incidence depends on application of the appropriate International Classification of Disease, 9th Revision (ICD-9) diagnostic code. However, data examining whether the appropriate EHI ICD-9 code is selected are lacking.

Purpose: To determine whether the appropriate ICD-9 code is selected in a cohort of EHI casualties.

Methods: Chart reviews of 290 EHI casualties that occurred in US Army soldiers from 2009-2012 were conducted. The ICD-9 diagnostic code was extracted, as were

the initial and peak values for AST, ALT, creatine kinase (CK) and creatinine (Cr). Diagnostic criteria for heat injury and heat stroke include evidence of organ and/or tissue damage; 2 out of 3 of the following must have been met to be considered heat injury (ICD-9 code 992.8) or heat stroke (ICD-9 code 992.0): AST/ALT fold increase >3, CK fold increase >5, and/or Cr ≥1.5mg/dL. By-year and all-years contingency tables were constructed from which sensitivity, specificity, and positive and negative predictive value were calculated.

Results: The 290 cases examined represent ~29% of all EHI at Ft Benning and ~6% of all EHI Army-wide during the study period. There were 80 cases that met the laboratory diagnostic criteria for heat injury/stroke, however of those, 28 cases were diagnosed as an EHI other than heat injury/stroke (sensitivity=0.65). 210 cases did not meet the laboratory diagnostic criteria but 66 of those were incorrectly diagnosed as heat injury or heat stroke (specificity=0.69). Positive and negative predictive values were 0.44 and 0.84, respectively. In total, the incorrect ICD-9 code was applied to 94 of 290 total cases. Comparison of by-year contingency tables indicated considerable variability but no discernable trends were evident.

Conclusions: Our data suggest that caution is warranted when examining epidemiological surveillance data on EHI severity, as there was disagreement between the laboratory data and the selected ICD-9 code in ~1/3 of all cases in this cohort.

3101 Board #166 June 3, 3:30 PM - 5:00 PM
The Epidemiology of Acromioclavicular (AC) Joint Sprain in 25 National Collegiate Athletic Association Sports
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No previous studies have described the incidence of acromioclavicular (AC) joint injury in a large-sample of National Collegiate Athletic Association (NCAA) student-athletes. Such research is needed to understand the injury prevalence, injury mechanisms, and recovery patterns in NCAA student-athletes.

Purpose: To describe the epidemiology of AC joint sprain injuries in 25 NCAA championship sports.

Methods: AC joint sprains from the NCAA Injury Surveillance Program were analyzed for the 2009/2010-2014/15 academic years. AC joint sprain injury rates, rate ratios (RR), and injury proportion ratios (IPR) were reported with 95% confidence intervals (CI). The RRs were also compared between sex-comparable sports (i.e., soccer, basketball, ice hockey, lacrosse, baseball/softball, indoor track, outdoor track, cross country, tennis, and swimming and diving).

Results: During the study period, a total of 844 AC joint sprains were reported, for a rate of 1.72/10000 athlete-exposures (AE). The highest rates of AC joint sprain occurred in Men's Ice Hockey (6.40/10000AE) and Football (3.79/10000AE) and Women's Ice Hockey (2.12/10000AE). The AC joint sprain rate was higher in competition than practice (6.15 vs. 0.72/10000AE; RR=8.58; 95%CI: 7.44, 9.89). Most AC joint sprains were due to player contact (54.7%, n=462), followed by surface contact (29.0%, n=245). Overall, 71.1% of AC joint sprains resulted in time loss of less than 1 week. In sex-comparable sports, the AC joint sprain rate was higher in men than women (1.85 vs. 0.40/10000AE; RR=4.67; 95%CI: 3.56, 6.14). In sex-comparable sports, males had a larger proportion of injuries due to player contact than females (54.1% vs. 36.1%; IPR=1.50; 95%CI: 1.06, 2.13); females had a larger proportion of injuries due to surface contact than males (31.1% vs. 20.1%; IPR=1.55; 95%CI: 1.01, 2.38).

Conclusions: Overall, most AC joint sprains were due to contact, particularly with other players. Differences in mechanisms in sex-comparable sports highlight rule differences between men's and women's sports and is an area of future exploration. Further research into the specific activities and exposures at the time of injury may lend a better understanding of the causation of these injuries and lead to appropriate interventions to decrease their incidence and severity.

3102 Board #167 June 3, 3:30 PM - 5:00 PM
Delayed Reconstruction for Symptomatic Anterior Cruciate Ligament Tears: A population-based study
 Andrew Bryan, Thomas Sanders, Hilal Maradit Kremers, Walter Kremers, Bruce Levy, Diane Dahm, Michael Stuart, Aaron Krych. *Mayo Clinic, Rochester, MN.*
 (No relationships reported)

Purpose: Little is known about the long-term need for surgical stabilization of the knee among patients initially treated without surgery for anterior cruciate ligament (ACL) disruption. The purpose of this study is to 1) define the rate of delayed ACL reconstruction (beyond 1 year of injury) in a population-based cohort of isolated ACL tears and to 2) evaluate predictive factors associated with delayed reconstruction.

Methods: The study included a population-based cohort of 1,841 patients with new-onset, isolated ACL tears between January 1, 1990 and December 31, 2010. The complete medical records were reviewed to confirm diagnosis, collect data on clinical characteristics, and details of subsequent ACL surgery. Landmark survival analysis was performed with a landmark set at 1 year. Early and late predictors of ACL reconstruction were analyzed using Cox proportional hazards regression.

Results: Over a mean 10.4 years of follow-up, 1,142 patients underwent ACL reconstruction (ACLR) within the first year of injury (1-year cumulative incidence 63%, 95% CI: 60, 65) and 154 underwent ACL reconstruction between 1-5 years following injury (5-year cumulative incidence 72%, 95% CI: 69, 74). In patients less than 25 years, 91% had ACL reconstruction at 10 years. Among patients treated conservatively for up to 1 year, young age (HR 0.55 per decade, 95% CI: 0.48, 0.62) and meniscus tear (HR 1.48, 95% CI: 1.12, 1.95) were significant predictors of delayed reconstruction and 47% of patients 35 years or younger underwent delayed ACLR. 39% of patients experienced a secondary meniscal tear prior to delayed ACL reconstruction.

Discussion: The high rate of delayed ACL reconstruction due to persistent knee instability is similar between men and women. Young age and meniscal tear are significant predictors of delayed reconstruction. In addition, delaying ACL reconstruction is often associated with secondary meniscal tears.

3103 Board #168 June 3, 3:30 PM - 5:00 PM
Rehabilitation Rates following Anterior Cruciate Ligament Reconstruction
 Neal Glaviano, Grant Norte, Michelle Kew, Joe Hart. *University of Virginia, Charlottesville, VA.* (Sponsor: Jay Hertel, FACSM)
 (No relationships reported)

br />Decreased strength, altered gait, and decreased patient reported outcomes are common long-term consequences following anterior cruciate ligament reconstruction (ACLR). Additional challenges are often seen when complications to the meniscus are also present. Rehabilitation has been shown to have positive influences on these impairments, but it is currently known what trends in rehabilitation interventions are occurring following isolated ACL reconstruction (ACLR), ACLR with meniscus repair (ACLRRep) or ACLR with meniscectomy (ACLRMen).

Purpose: To explore rehabilitation rates and treatments being provided following surgical interventions for ACLR with and without meniscal repair or removal.

Methods: Retrospective chart review from 30 million individuals in the United States between 2007-2011 was utilized to assess 1.1 billion patient charges. Current Procedural Terminology (CPT) codes were used to search for individuals with ACLR with or without meniscal repair or removal. 70,642 patients were found without any surgical complications as assessed by CPT codes: isolated ACLR (n=40,719), ACLRRep (n=6,949) and ACLRMen (n=22,974). Patients within these three groups were tracked for billed physical therapy evaluation CPT codes within 30 days of surgery. Therapeutic exercise, manual therapy, and application of modalities were also assessed to calculate percentages that received this care and average number of charges per person. **Result:** Approximately 65% of all ACLR with or without meniscal involvement were billed for physical therapy through their insurance within 30 days of surgery. When evaluating care provided; 95% of patients received strengthening or range of motion exercise, 52% received mobilization, 33% performed balance and proprioception training, 27% received electrical stimulation and 10% performed gait training. Home exercise programs following surgery were only billed in 4-9% of all patients. **Conclusion:** While this data set is only a sample of the United State population, it provides insight into care being provided to patients following ACLR. While the majority of patients performed therapeutic exercises during their rehabilitation process, fewer patients performed balance or gait training during their acute rehabilitation phase.

3104 Board #169 June 3, 3:30 PM - 5:00 PM
Efficacy Of Prophylactic Knee Bracing In Conservative Management Of Knee Pain In Recreational Athletes
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 (No relationships reported)

INTRODUCTION: Patellofemoral pain is extremely common in recreational athletes. Patellofemoral symptoms can severely restrict participation in athletic activities, and may also progress into osteoarthritis in later life.

PURPOSE: The aim of the current study was to determine the clinical benefits of prophylactic knee bracing in recreational athletes with knee pain.

METHODS: Twenty participants (11 male and 9 females) with knee pain volunteered to take part in the current investigation. Participants were assessed on two occasions, following the first assessment they were provided with a prophylactic knee brace. Volunteers were instructed to wear the brace for all of their physical activities for a period of 14 days, following which they returned to the laboratory. Knee pain symptoms were examined on both occasions (pre-post) using the KOOS knee survey.

Differences in knee pain symptoms were examined using 2 (pre-post) x 2 (gender) mixed ANOVA's.
RESULTS: Significant improvements in knee pain symptoms were observed for the symptoms ($p < 0.05$, $\eta^2 = 0.71$), pain, ($p < 0.05$, $\eta^2 = 0.59$), function/ daily living ($p < 0.05$, $\eta^2 = 0.29$), sport/ recreational activities ($p < 0.05$, $\eta^2 = 0.71$) and quality of life ($p < 0.05$, $\eta^2 = 0.72$) subscales.
CONCLUSIONS: The findings from the current investigation indicate that both male and female athletes who suffer from knee pain may improve their symptoms using prophylactic knee bracing.

F-29 Free Communication/Poster - Knee Mechanics

Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

3105 Board #170 June 3, 2:00 PM - 3:30 PM
The Effects of Squat Depth on Electromyography of Eight Lower Extremity Muscles
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The need to build muscular strength may play a crucial role in a person's life. This demand may be vital for increased sports performance or to help complete activities of daily living. A common exercise to improve lower extremity strength is the squat exercise. However, optimal squat depth to elicit maximal lower extremity muscle activations has yet to be determined.

PURPOSE: To examine the effects of squat depth on electromyography (EMG) of eight lower extremity muscles during three different weighted conditions.
METHODS: Eighteen healthy recreationally active individuals (10 males, 8 females, 23 ± 2 years, 70.24 ± 12.72 kg, 1.68 ± 0.06 m) completed the study over two days. The first day was used to collect participants' one repetition maximum (1RM). On the second day of testing, eight surface EMG electrodes were placed on the rectus femoris, vastus lateralis and medialis, biceps femoris, medial hamstring, and medial gastrocnemius. Once electrodes were placed, subjects warmed up and then were asked to perform five repetitions at body weight (BW), 50% 1RM, and 80% 1RM during a maximal knee flexion (Deep) squat and at 90° knee flexion (Normal) squat. Changes in integrated EMG due to squat depth and load were assessed via a 2x3 repeated measures ANOVA.
RESULTS: EMG increased as both weight and condition changed. Significant interaction was observed for the biceps femoris, gluteus maximus, medial gastrocnemius, rectus femoris, vastus lateralis, vastus medialis ($p < 0.001$) and the medial hamstring ($p = 0.041$). The tibialis anterior showed a main effect for weight ($p < 0.001$) and condition ($p < 0.001$). Time was also measured during each condition which showed a significant weight*condition interaction ($p = 0.001$).
CONCLUSION: Lower extremity muscle activation is significantly increased during deep squats compared to normal squats, which suggests that individuals could benefit from performing a higher knee flexion squat to increase muscle activation and potentially increase muscle strength. Furthermore, time under tension increased as weight increased and during deep squats. This increase in time under tension would keep fibers activated longer, which could increase strength over time. These results may have training implications for various populations that utilize the squat exercise to achieve health or athletic goals.

3106 Board #171 June 3, 2:00 PM - 3:30 PM
Differences in Limb Symmetry in Collegiate and Recreational Athletes
 Lindsay Slater, Joe Hart. University of Virginia, Charlottesville, VA. (Sponsor: Jay Hertel, FACSM)
 (No relationships reported)

Anterior cruciate ligament (ACL) injuries are common in sports requiring pivoting and sudden changes of direction, such as soccer and basketball, and are often treated through reconstruction. ACL reconstructions require lengthy rehabilitation and patients are often cleared to return to sport based on measures of symmetry, however patients may require different limb symmetry indices dependent on sport.
Purpose: To compare lower extremity limb symmetries in collegiate soccer, collegiate basketball, and healthy, recreationally active men.
Methods: 17 Division 1 collegiate male soccer players (20.2 ± 1.0 years, 181 ± 8.5 cm, 76.3 ± 9.9 kg), 7 Division 1 collegiate male basketball players (21.2 ± 0.6 years, 201 ± 7.7 cm, 102.2 ± 10.2 kg), and 28 recreationally active males (21 ± 1.6 years, 181.3 ± 8.8 cm, 78.2 ± 10.7 kg) volunteered. Knee flexion and extension isokinetic testing was

completed at 90°/sec and 180°/sec on both the dominant and nondominant limb. Knee flexion and extension maximal isometric contraction (MVIC) were completed at 90° of knee flexion on the dominant and nondominant limb. Isokinetic and isometric torques were mass and height normalized. Limb symmetry was calculated as the nondominant/dominant limb. Dominant limb was defined as the preferred kicking leg. A MANOVA and Tukey post hoc test were used to compare peak torques between groups.
Results: Soccer players had greater limb symmetry for peak knee extension torque at 90°/sec (1.06 ± 0.1) compared to basketball players (0.95 ± 0.1 , $p = 0.046$) and recreational athletes (0.97 ± 0.1 , $p = 0.014$). Soccer players had greater limb symmetry for peak knee extension torque at 180°/sec (1.08 ± 0.2) compared to recreational athletes (0.96 ± 0.1 , $p = 0.014$). Basketball players had greater limb symmetry for knee extension MVIC compared to recreational athletes (Basketball = 1.18 ± 0.3 ; Healthy = 0.96 ± 0.2 , $p = 0.038$).
Conclusion: Soccer players demonstrated different knee extensor limb symmetries compared to basketball players and recreational athletes. These differences should be considered for return to play decisions and guidelines.

3107 Board #172 June 3, 2:00 PM - 3:30 PM
A Comparison of Lower Extremity Joint Kinetics Between a Flexible Barbell and a Steel Barbell
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 (No relationships reported)

The flexible barbell is becoming a popular training device among major college football programs as a mode to enhance power. **PURPOSE:** The purpose of the study was to measure the joint angle, angular power, and joint moment in the ankle, knee, and hip, while comparing an equally weighted flexible barbell (FB) to a standard steel barbell (SB) in the back squat.

METHODS: Eleven college football players, who were experienced in using the both types of barbells, volunteered to participate in the study. Reflective markers were placed on all lower extremity segments and joint for inverse dynamic analysis. Subjects performed 12 repetitions of back squats in time with a metronome while being monitored by an 8-camera, infrared 3-D motion analysis system, using either a FB or SB. Following a 5 minute rest subjects performed a second trial using the bar not used in trial 1. All trials were randomly ordered. Data were statistically analyzed by paired t-tests.

RESULTS: There were no significant differences in all parameters tested in the ankle joint between the FB and SB. There were significant differences in the knee and hip joints presented in the table below.

CONCLUSIONS: The results demonstrate that the FB generates greater joint power in the knee and hip joint when compared to an equally weighted SB, but not in the ankle. Since power is a product of angular velocity and moment, the results suggest that the FB may generate greater power due to a greater angular velocity the knee joint when compared to the SB. However, based on the moment being significantly different in the hip joint, it would be possible to infer that the muscles contributing to the hip extension could be more active and thereby generate more force with the FB.

Joint Kinetics		
Joint Kinetic Parameter	Flexible Barbell	Steel Barbell
Knee Angle (degrees)	- 88.91 ± 9.97	- 90.91 ± 7.19
Knee Moment (Newton-meter)	147.00 ± 39.17	141.73 ± 37.24
Knee Power (Watts)	304.55 ± 107.82*	241.36 ± 63.01
Hip Angle (degrees)	92.36 ± 7.92	92.55 ± 8.29
Hip Moment (Newton-meter)	- 229.73 ± 54.29 #	- 209.55 ± 51.40
Hip Power (Watts)	494.55 ± 151.07**	382.27 ± 133.65
* P = 0.012 ** P = 0.003 # P = 0.029		

3108 Board #173 June 3, 2:00 PM - 3:30 PM
MRI-Based Assessment of Lower Extremity Muscle Volumes in Patients with Meniscal Pathology and Knee Osteoarthritis
 Grant Norte, Katie Knaus, Michelle Kew, Mark Feger, Lindsay Slater, Craig Meyer, Silvia Blemker, Joe Hart. University of Virginia, Charlottesville, VA. (Sponsor: Jay Hertel, FACSM)
 (No relationships reported)

Meniscal pathology has been identified as a predisposing source of joint degeneration and catalyst for disease progression. Muscle weakness and atrophy are hallmark clinical manifestations of joint injury; however, study of skeletal muscle function is largely limited to the thigh musculature in knee-injured populations. Volumetric measurements of skeletal muscle can provide information about individual muscle function that is challenging when using force-based or electromyographic techniques.

PURPOSE: To describe lower extremity muscle volumes in patients with a history of meniscal injury and radiographic evidence of knee osteoarthritis (RKOA).
METHODS: A lower extremity MRI was obtained for seven patients (6M/1F, 47.1 ± 9.2 years, 182.5 ± 4.7 cm, 99.1 ± 20.5 kg) with a history of meniscal injury and radiographic evidence (Kellgren-Lawrence ≥ 1) of unilateral knee joint osteoarthritis. Axial images were acquired from the ankle to the thoracic vertebrae, and thirty-four lower extremity muscles were manually segmented using a semi-automated program written in Matlab. Normalized muscle volumes (cm³/kg*m) were converted to Z-scores relative to a database of volumes collected from healthy volunteers. Z-scores were averaged, and means with 95% confidence intervals were calculated for each muscle. Z-scores were calculated for muscle groupings as a secondary analysis.
RESULTS: On average, the vastus lateralis was the only muscle to exceed 2 SD below the corresponding muscle volume means of the healthy cohort (Z = -3.4 [-6.0, -0.9]), whereas, the vastus intermedius exceeded 2 SD above healthy (Z = 2.6 [0.7, 4.6]). Muscle groupings revealed reduced muscle volumes of the anterior (Z = -1.1) and medial hip (Z = -1.1), and anterior (Z = -1.3), lateral (Z = -1.1), and deep posterior (Z = -1.1) compartments in patients with knee pathology.
CONCLUSION: Patterns of lower extremity muscle deficits were observed about the knee, hip, and ankle in patients with knee pathology. Muscle volumetric adaptations may occur in regions proximal and distal to the knee in patients with meniscal pathology and RKOA. Assessment of post-traumatic lower extremity muscles may provide a targeted rehabilitation approach for health care professionals.
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3109 Board #174 June 3, 2:00 PM - 3:30 PM
Relationships among Knee Moments during Weighted Gait and Influence of Strength Variables after ACL Reconstruction

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PURPOSE: Investigate: 1) relationships among reduced internal knee moment impulses (IKEMI) during unweighted and weighted gait tasks; 2) whether quadriceps and hamstring strength predict IKEMI during these gait tasks. Each sex was evaluated separately.
METHODS: 38 subjects (Table 1) completed 5 trials of 3 gait tasks: unweighted (WALK) and weighted (50% body weight) (VEST and SLED). IKEMI were calculated over the first 25% of stance. 3 maximum voluntary isometric quadriceps contractions at 90° knee flexion and 10 repetitions of concentric knee extension and flexion contractions at 60°/second were completed (Biodex S4). Correlations and linear regressions determined relationships among gait tasks and whether strength variables predict IKEMI, respectively.
RESULTS: Women: ACLR limb's IKEMI and IKEMI symmetry index (SI) were correlated among 3 gait tasks (p≤.006). ACLR limb time to peak extension torque (EXT TQ) predicted IKEMI SI during VEST (β: -.49; p=.015; r²=.24). ACLR limb time to peak EXT TQ predicted involved limb IKEMI (β: -.48; p=.018; r²=.23) and IKEMI SI during SLED (β: -.56; p=.004; r²=.31). Men: ACLR limb IKEMI during WALK was correlated to IKEMI during VEST (p=.023, r=.60). IKEMI SI during WALK correlated to IKEMI SI during VEST (p=.017, r=.62). ACLR limb time to peak EXT TQ predicted ACLR limb IKEMI during SLED (β: -.55; p=.043; r²=.30). ACLR limb time to peak flexion TQ (β: .49; p=.04; r²=.332) and peak EXT TQ/BW predicted IKEMI SI (β: .48; p=.041; r²=.55) during SLED.
CONCLUSION: Women use consistent knee moment profiles across tasks; yet men's aberrant IKEMI deficits do not persist across tasks. Improving rate of peak EXT TQ in the ACLR limb appears warranted in men and women to increase symmetrical IKEMI during weighted gait.

Table 1: Participant Demographics and Variables of Interest

Demo-graphics	Age (years) mean / SD	Contact / Non-contact Injury	WALK IKEMI [ACLR LIMB (Nms/kg) & SI (%) means]	VEST IKEMI [ACLR LIMB (Nms/kg) & SI (%) means]	SLED IKEMI [ACLR LIMB (Nms/kg) & SI (%) means]	ACLR Time to Peak EXT TQ (msec) mean	ACLR Peak EXT TQ/BW (ftlbs/lb) mean	ACLR Time to Peak Flexion TQ (msec) mean
Women (n=24)	24.96 (10.85)	7/17	.033 & 79.09	.054 & 79.85	.087 & 72.32	567.5	--	--
Men (n=14)	23.93 (12.09)	8/6	.042 & 92.84	.075 & 92.43	.082 & 83.3	510.0	75.6	678.6

3110 Board #175 June 3, 2:00 PM - 3:30 PM
Biomechanical Determinants of Reduced Knee Joint Loads in Patients with Osteoarthritis Following Intensive Weight Loss

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Knee osteoarthritis (OA) progression is driven by biomechanical factors that are exacerbated by obesity. We showed weight loss (WL) reduces knee joint loads (KJLs) in adults with knee OA during walking. KJLs are affected by several kinetic and kinematic factors; however, the mechanisms leading to reductions in KJLs with WL are complex and undocumented.
Purpose: To identify biomechanical determinants of reduced KJLs consequent to 18 months of intensive dietary intervention and WL, either with or without exercise, within an osteoarthritic population.
Methods: Overweight or obese older adults with grade II or III knee OA (n=304) participated in an 18 month diet or diet plus exercise intervention. Temporospatial, kinetic, and kinematic data were collected at baseline, 6, and 18 month visits. The primary endpoints (tibiofemoral compressive force, TFCF, and patellofemoral compressive force, PFCF) were analyzed against several biomechanical predictors using linear regression analyses.
Results: A mean WL of 9.1kg led to reduced TFCF (-266.8N, -10.0%) and PFCF (-62.2N, -14.4%). Each biomechanical predictor was positively associated with TFCF and PFCF, except for step length. Standardized coefficients indicate that thigh muscle forces and knee flexion angle were most strongly associated with KJLs.

Predictors	Δ Mean After 18 Months	ΔTFCF Non-standardized slopes	ΔPFCF Non-standardized slopes
Weight, kg	-9.1 (-9.9%)	31.6*	3.33
Gait Speed, m/s	0.11 (9.2%)	1579*	305*
Step Length, cm	-1.5 (-11.0%)	12.0	0.41
Knee Flexion Angle, deg.	-1.2 (-7.3%)	83.9*	37.5*
Knee Extensor Moment, Nm	1.7 (4.9%)	17.9*	12.2*
Vertical GRF, BW	0.04 (3.7%)	3139*	1480*
Hamstrings Force, N	-92.4 (-13.4%)	1.72*	0.38*
Quadriceps Force, N	-62.7 (-5.0%)	1.25*	0.59*
Gastrocnemius Force, N	-48.4 (-6.9%)	2.18*	0.65*

*p<0.008
Conclusion: Intensive WL resulted in reduced knee flexion, vGRF, and knee-spanning muscle forces, contributing to decreased KJLs. Positive associations between predictors and KJLs further support this relationship. WL may have attenuated the effect of gait speed, showing that KJLs can be decreased through WL and not at the expense of important clinical outcomes.

3111 Board #176 June 3, 2:00 PM - 3:30 PM
Local Dynamic Stability of the Knee is Maximal for Walking Overground at the Preferred Speed

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While humans can walk at a range of speeds, they reveal a tendency to adopt a particular individual preferred gait speed. Given the preference for this speed, we may expect the movement trajectory to be more dynamically stable than faster or slower speeds. However, research on treadmill walking has found that local dynamic stability (quantified inversely as the maximum Lyapunov exponent, λMAX) increases with decreasing speed. Recent research on the stride frequency of overground walking suggests that use of a treadmill may have influenced these findings. Knowledge of the local dynamic stability of overground walking at different speeds promises to contribute to our understanding of the preferred gait speed of not only healthy individuals, but also those with movement disorders through aging or disease.
PURPOSE: To determine the impact of gait speed on local dynamic stability of knee motion when walking overground.
METHODS: The preferred gait speed of 12 young healthy adults was determined from each individual's average speed of three walking trials across a GAITrite© instrumented

mat. The task required walking 65 m overground in a straight line at 5 different target speeds of: 50, 75, 100, 125 and 150% of the preferred gait speed. Only trials performed within $\pm 10\%$ of each target gait speed were considered valid, and participants were required to complete 3 valid walking trials at each speed. Sagittal plane knee motion of both knees was measured using electrogoniometers. λ MAX was quantified from each electrogoniometer time series. The relationship between λ MAX and gait speed was statistically assessed using hierarchical linear modeling.

RESULTS:

Walking speed (s) had a large significant quadratic effect on λ MAX for both knees, with minima at the preferred speed (right: λ MAX = $0.00016s^2 - 0.033s + 2.75$, $p = .000$, $r^2 = .39$; left: λ MAX = $0.00013s^2 - 0.026s + 2.39$, $p = .000$, $r^2 = .48$).

CONCLUSIONS:

Walking overground at the preferred speed maximizes local dynamic stability (minimizes λ MAX) of knee motion in gait. Walking at faster or slower speeds reduces local dynamic stability of the knee motion, which has been correlated with increased risk of falling.

3112 Board #177 June 3, 2:00 PM - 3:30 PM

The Correlation Between Pelvic Obliquity And Dynamic Alignment Of Knee During Gait.

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Tsuji et al. reported that a patellofemoral joint pain was related to a sacral inclination that caused by changing of lumbar alignment, and they called this pathological concept "the knee-spine syndrome". Tauchi et al. reported that influence of spinal imbalance on knee osteoarthritis. However, few studies reported the dynamic alignment on the frontal plane on the frontal plane to elucidate knee - spine syndrome.

PURPOSE: To investigate association of the dynamic alignment of the pelvic and the knee during gait.

METHODS: This study included 100 patients (58 male; 31.7 \pm 17.45ys, 168.0 \pm 6.74cm, 63.1 \pm 11.33kg and 42 female; 38.5 \pm 20.42ys, 156.5 \pm 8.71cm, 52.0 \pm 10.93kg) with pain in the lower limbs and/or low back pain. The dynamic alignment of pelvic and knee during gait was measured at our clinic using a motion analysis system which consisted of six cameras, two force plates, and 39 retro-reflective markers. The relationship between the frontal plane motion of pelvic (i.e. pelvic obliquity) and knee (i.e. knee varus-valgus) were analyzed using linear regression. Then the patients were classified into three groups by pelvic obliquity imbalance and the dynamic alignment of knee was compared among four groups.

RESULTS: At the initial contact of left foot, the pelvic right obliquity angle was 3.7 \pm 1.92 (degrees; d) and the angular velocity of left knee varus was 28.3 \pm 38.26 (degree/sec; d/s), and the coefficients of correlation of them (r) was -.091 (ns). On the other hand at the initial contact of right foot, the pelvic left obliquity angle was 5.8 \pm 2.15 (d) and the angular velocity of right knee varus was 37.9 \pm 34.43 (d/s), and r was .379 ($p >$ right obliquity) group was 40.7 \pm 7.63 (d/s), and was larger than normal balance group (24.4 \pm 4.29 (d/s), $p <$.05).

CONCLUSIONS: In the landing movement, the correlation between the dynamic alignment of trunk and knee was reported. The same as the previous study, this study suggested that the correlation between pelvic obliquity and knee varus during gait. We hypothesize that the increases in pelvic obliquity motion from initial contact to foot flat was increased of frontal-plane knee movement and torques because of to transfer lateral-down forces from the trunk through the lower extremity. The findings of this study will provide clinicians with useful information for prevention overuse injuries.

3113 Board #178 June 3, 2:00 PM - 3:30 PM

The Biomechanical Research Of Lower Extremity During Stance Phase Of Walking In Knee Osteoarthritis Patients

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PURPOSE:

The purpose of the current study was to find biomechanics sensitive index of evaluating knee osteoarthritis gait and supply biomechanics theoretical basis for the prevention and rehabilitation of knee osteoarthritis.

METHODS:

In a gait laboratory, Each subject walked at a self-selected, comfortable pace on a 10-m walkway. A 16-camera motion analysis system and two Kistler force platforms were used to measure kinematic and kinetic data of 13 OA patients (65.9 \pm 4.1 years, 58.1 \pm 8.6kg) and 13 controls (63.4 \pm 2.3 years, 55.4 \pm 5.8kg) during walking. Intersegmental model of lower extremity joints was built on the basis of

conventional kinematic and kinetic analysis. The relationship between active muscle torque and passive torques of hip, knee and ankle joints in two different groups were explored thoroughly. All variables characterizing sagittal-plane joint function were compared between the two groups using Independent-Samples T test. The level of significance for the T test was set at $\alpha = 0.05$.

RESULTS:

1. Significant reductions were observed for the OA group compared to the control group in terms of the stride length (1.23 \pm 0.09m vs. 1.39 \pm 0.09m; $P = 0.0001$) and gait speed (1.28 \pm 0.12m/s vs. 1.39 \pm 0.13m/s; $P = 0.03$).
2. During the heel-strike portion(hs), midstance portion(ms) and terminal portion(ts) of the stance phase, Significant differences were obtained in the peak angle of left knee between OA and control groups (-6.9 \pm 1.9 $^\circ$ vs. -2.2 \pm 1.6 $^\circ$; $P_{hs} = 0.001$; -16.6 \pm 2.5 $^\circ$ vs. -18.0 \pm 2.6 $^\circ$; $P_{ms} = 0.03$; -9.2 \pm 2.3 $^\circ$ vs. -5.5 \pm 1.9 $^\circ$; $P_{ts} = 0.001$). Besides, knee extensor muscle torque of heel-strike(KFMhs) in OA group are less than that in control group (-16.38 \pm 5.55Nm/kg vs. -23.88 \pm 9.27Nm/kg; $P = 0.019$).
3. Interactive torque(INT) of ankle in OA group was lower than that in control group during the whole stance phase (INT_{OA} = 0.0055 \pm 0.0061, INT_C = 0.0134 \pm 0.0078; $P <$ 0.01).

CONCLUSION:

The change of extensor and flexor muscles' activity in lower extremity induced by knee osteoarthritis will alter the peak angle and muscle torque of knee in different portions of stance phase. So these variables could be considered to be non-invasive diagnostic index in biomechanics of knee osteoarthritis.

3114 Board #179 June 3, 2:00 PM - 3:30 PM

Knee Biomechanics of Replaced and Non-replaced Limbs during Level Walking Following Total Knee Arthroplasty

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Previously we showed that total knee arthroplasty (TKA) patients still showed deficiencies in replaced limbs in a stair ascent test compared to healthy subjects. These differences were mainly reflected in the reduced peak frontal plane ankle moments but elevated peak frontal plane hip moments at a similar preferred ascent speed. However, peak knee sagittal- and frontal-plane moments were similar.

PURPOSE: To compare knee biomechanics of replaced and non-replaced limbs of TKA participants and control limbs of age and body mass index (BMI) matched healthy controls in level walking.

METHODS: A total of 13 TKA (65.6 yrs, 28.3 BMI & 24.5 months from TKA surgery) and 15 healthy (62.3 yrs & 27.1 BMI) participants performed functional tests and five level walking trials at a preferred speed. A one-way ANOVA was used to detect difference between replaced, non-replaced limbs and healthy controls ($p <$ 0.05).

RESULTS: TKA participants had a slower level walking speed (1.18m/s) than healthy controls (1.40m/s, $p <$ 0.001); they also had slower stair ascent and descent times on an 11-step staircase but similar timed-up-and-go times compared to healthy controls. The push-off peak vertical ground reaction force (GRF) was reduced in replaced limbs [1.04 \pm 0.05 body weight (BW)] compared to control limbs (1.10 \pm 0.05 BW). The peak knee extension moment during loading response was decreased in both replaced (0.54 \pm 0.23 Nm/kg) and non-replaced (0.54 \pm 0.35 Nm/kg) limbs compared to control limbs (0.83 \pm 0.27 Nm/kg). The loading response peak internal abduction moment was also reduced in replaced limbs (-0.35 \pm 0.13 Nm/kg) compared to control limbs (-0.54 \pm 0.18 Nm/kg).

CONCLUSIONS: After rehabilitation and recovery, the TKA patients still demonstrated slower walking speeds. The reduced speeds were accompanied by decreased peak GRF, peak sagittal-, and frontal-plane knee moments in replaced limbs, and reduced peak sagittal-plane moment in non-replaced limbs of TKA patients. The results are in contrast to the stair ascent results showing similar peak knee moments between the replaced, non-replaced and control limbs. The differences may be related to different roles or strategies played by knee, hip and ankle muscles in level walking and stair ascent, suggesting that both tests are necessary in order to detect deficits of TKA patients.

3115 Board #180 June 3, 2:00 PM - 3:30 PM
Associations Between Indices of Quadriceps Strength and Self-Reported Function in Individuals After Knee Meniscal Surgery
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Persistent quadriceps weakness is common following surgical knee meniscectomy or meniscal repair procedures. Quadriceps strength normalized to body mass (QSBM) is known to associate with self-reported function in patients with a history of knee injury. Quadriceps strength limb symmetry index (QLSI) has emerged as a predictor of lab-based biomechanical measures and physical function in similar populations. However, it is unclear how these measures associate with self-reported function following meniscal surgery. This information is critical for determining the best clinical indicators of function in this population. **PURPOSE:** Determine the associations of QSBM and QLSI with self-reported function in patients with a history of meniscal surgery. **METHODS:** Sixteen patients with a history of meniscal surgery participated (11F, 5M, 29.75±11.79yrs, 174.23±11.22cm, 95.06±28.38kg). QSBM and QLSI were measured during maximal voluntary isometric contractions collected with an isokinetic dynamometer at 90° of knee flexion. The mean torque of three trials was recorded and normalized to body mass (Nm/kg) for use in our QSBM analyses. QLSI was calculated as the ratio of the surgical to non-surgical limb multiplied by 100, recorded as percent for our analyses. Self-reported function was determined via the International Knee Documentation Committee (IKDC) subjective form, and the disease-specific Western Ontario Meniscal Evaluation Tool (WOMET) aggregate score. Both questionnaires were recorded as percentages, with larger percentages representing a greater level of function. Spearman's rank correlations were used to determine associations between QSBM and QLSI with IKDC and WOMET scores. Alpha level was set a-priori P ≤ 0.05. **RESULTS:** QSBM (2.13±0.91) was strongly associated with IKDC (74.47±21.08; p=0.753, P=0.001) and WOMET (75.44±23.34; p=0.868, P<0.001), whereas QLSI (91.81±20.44) moderately associated with IKDC (p=0.515, P=0.041) scores. **CONCLUSION:** QSBM strongly associated with self-reported function and may be developed into a clinical indicator of high function following meniscal surgery. The strong association between QSBM, WOMET and IKDC suggests that maximizing strength in an effort to allow individual patients to support body mass is important for improving self-reported function.

3116 Board #181 June 3, 2:00 PM - 3:30 PM
Knee Extension Torque Deficits Exist Bilaterally in Patients Following Unilateral Anterior Cruciate Ligament Reconstruction
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Quadriceps weakness is known to limit lower extremity function, but it has also been linked to the development of knee osteoarthritis. Furthermore, evidence suggests that quadriceps function can be affected in the uninjured limb after ACLR. While peak knee extension torque (PKET) is a valuable measure of quadriceps strength, it does not assess rapid force production, which is often required in sports. Rate of torque development (RTD) determines the force generated in the early phase of muscle contraction in patients after ACLR. **PURPOSE:** To assess bilateral changes in PKET and RTD in patients before and after ACLR, and to compare these changes between limbs. **METHODS:** PKET and RTD were measured bilaterally in 15 patients (19.4±4.5 yrs) before and 6 months post-ACLR. PKET (Nm) was assessed via max voluntary isometric contraction (MVIC), and RTD (Nm/s) was calculated within the first 200ms of MVIC. Both measures were normalized to body weight (kg). The RTD curve was further divided into the first (RTD1) and last (RTD2) 100ms to examine differences in contractile and neural components of force production, respectively. Pre vs. post-ACLR, and between-limb comparisons were made using paired t-tests (α=0.05). **RESULTS:** PKET was significantly lower in the involved versus uninjured limbs of patients before (2.7±0.8 vs. 3.2±0.5 Nm/kg) and after ACLR (1.8±0.7 vs. 2.8±0.5 Nm/kg). PKET significantly decreased over time in both the involved and uninjured limbs. RTD was significantly lower in the involved limb versus uninjured limbs before (5.1±2.8 vs. 6.8±2.7 Nm*s-1/kg) and after ACLR (4.5±1.8 vs. 5.6±2.2 Nm*s-1/kg). RTD1 was no different between limbs before or after ACLR. RTD2 was significantly lower in the involved limb versus uninjured limb before (4.8±2.6

vs. 6.8±2.4 Nm*s-1/kg and after ACLR (5.0±1.4 vs. 3.6±1.1 Nm*s-1/kg. Neither RTD, RTD1, nor RTD2 changed from pre- to post-ACLR in the involved limb. These results were similar for the uninjured limb, except RTD2 was significantly decreased over time (p=0.02). **CONCLUSION:** Although PKET and RTD are lower in the involved limbs of patients after ACLR, both limbs exhibit deficits in quadriceps force production. Quadriceps strengthening should be performed on both limbs after ACLR to restore function and prevent subsequent injury.
 Supported by NCATS/NIH grant UL1000117.

3117 Board #182 June 3, 2:00 PM - 3:30 PM
Effects Of Knee Varus Alignment On Knee Frontal Plane Biomechanics During Stationary Cycling
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PURPOSE: Despite the importance of the knee alignment, no studies have explored its effects on knee frontal plane biomechanics during cycling. The purpose of this study was to examine the effects of varus knee alignment on knee frontal plane biomechanics during stationary cycling. **METHODS:** Eleven subjects in each of varus and neutral groups participated in the study. Anteroposterior full limb radiographs were obtained to measure the knee mechanical axis angle, of which varus group had 174.3±1.4 degree and neutral group 179.2±1.0 degree. The subjects pedaled in six cycling conditions: 80 rpm with 0.5 kg, 1.0 kg, and 1.5 kg with and without toe cage. A nine-camera motion analysis system and an instrumented force bike pedal were utilized to collect data. A 2×2×3 (Group × Toe cage × Workload) mixed design ANOVA was used for statistical comparisons (p < 0.05). **RESULTS:** The peak knee abduction moment did not differ between the varus group (-7.9±1.1 Nm) and the neutral group (-6.7±1.2 Nm). The peak knee abduction angle was greater in the neutral group (-5.5±1.6°) compared to the varus group (0.02±1.6°). **CONCLUSIONS:** A varus knee alignment did not result in a greater peak knee abduction moment, suggesting stationary cycling may be a safe exercise prescription for people with varus knee alignment such as medial knee osteoarthritis patients.

3118 Board #183 June 3, 2:00 PM - 3:30 PM
Body-Borne Load Increases Peak Knee Extensor Muscle Force During a Reactive Run-to-Stop Task
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A sudden stop while running with body-borne load (i.e. run-to-stop (RTS)) reportedly causes abnormally high knee joint loads, increasing risk of injury. Performing a reactive RTS may exacerbate these joint loads, requiring greater lower limb muscle force to successfully complete the maneuver, further increasing injury risk. Currently it is not understood whether knee muscle forces increase with the addition of load during a RTS, and whether they are further exaggerated during reactive tasks. **PURPOSE:** The purpose of this study was to determine if peak knee extensor and flexor muscle forces increase with the addition of load during pre-planned and reactive RTS tasks. **METHODS:** Seven males had lower limb biomechanics recorded during a RTS task with three military-relevant load conditions: unloaded (UL; 6.2 kg), fighting load (FL; 20.0 kg) and approach load (AL; 40.0 kg). During the RTS, participants ran down a walkway and stopped their dominant limb on a force platform. Participants performed three planned and three reactive RTS maneuvers with each load configuration. OpenSim was used to estimate peak knee extensor and flexor muscle force during the stopping phase of each RTS. Subject-based means of peak muscle force were quantified and submitted to a two-way repeated measures ANOVA with alpha level 0.05. Significant interaction effects were submitted to a one-way ANOVA stratified by condition (pre-planned or reactive). **RESULTS:** During the reactive RTS, significantly greater peak vastus medialis (p=0.041 and p=0.013), intermedialis (p=0.032 and p=0.012) and lateralis (p=0.039 and p=0.009) muscle force was evident with the FL (306.4, 355.8, 637.9 N) and AL (324.5, 382.6, 699.5 N) as compared to UL (234.2, 266.0, 485.0 N) configuration, but similar differences (p>0.05) in peak muscle force were not evident during pre-planned RTS. No significant increase (p>0.05) in peak knee flexor muscle force was evident with the addition of load, or between the pre-planned and reactive RTS. **CONCLUSION:** Peak knee extensor muscle force increased with the addition of load during reactive, but not pre-planned RTS. Performing a reactive RTS may require larger muscle forces to successfully complete the maneuver, resulting in greater injury risk compared to pre-planned maneuvers.

- 3119 Board #184 June 3, 2:00 PM - 3:30 PM
Relationship between Vertical Ground Reaction Force during Isometric Squat at Various Knee Angles and 1 RM Weight Lifted During Dynamic Back Squat
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PURPOSE: The purpose of this investigation was to systematically examine the relationship between a dynamic one repetition maximum (1 RM) squat exercise and 4 different knee angles (thighs are parallel to the floor (IsoPara), 90° (Iso90), 100° (Iso100), and 110° (Iso110)) of maximum isometric squat exercises in recreationally trained college-aged individuals. **METHODS:** Seven recreationally weight-trained healthy college-aged male subjects (mean age = 21.71 ± 1.58 years) were recruited from the University of Nebraska-Lincoln campus community for this study. Prior to the experimental sessions, the subjects' anthropometric and body composition data were collected. A force plate was used to analyze the vertical ground reaction forces (GRFs) during the experimental sessions. An elastic rubber band was positioned behind the subjects to identify the depth of the squats during the dynamic 1 RM squat trials. The height of the rubber band was set so that the subjects' thighs were parallel to the floor when their buttocks contacted the rubber band. As soon as the subjects contacted the band they pushed the weights as fast and forcefully as they could. Distances between their toes and heels were measured and used for their maximum isometric squat trials. For a maximum isometric squat, an order of the 4 angles was randomly assigned and the subjects performed two trials for each angle. The subjects were instructed to push an immovable bar fixed on a squat rack as fast and forcefully as possible for 5 seconds. The subjects were given a 3-5 minute break between experimental trials. **RESULTS:** Person product-moment correlation coefficients revealed that the correlations between the 1RM mean score and mean maximum isometric squat GRFs during the IsoPara, Iso90, and Iso100 were significantly correlated ($r(5) = 0.76, p \leq 0.05$ for 1RM and IsoPara, $r(5) = 0.78, p \leq 0.05$ for 1RM and Iso90, and $r(5) = 0.78, p \leq 0.05$ for 1RM and Iso100). Linear regression analyses were performed to generate regression equations to predict 1RM dynamic back squat weight based on the ground reaction force during maximum isometric squats ($\hat{y} = 0.011 + 0.715$ (IsoPara), $\hat{y} = 0.111 + 0.655$ (Iso90), and $\hat{y} = 0.233 + 0.522$ (Iso100)). **CONCLUSION:** Vertical GRFs obtained from a force plate during maximum isometric squats may be used to predict healthy college-aged males' dynamic 1 RM weights.

- 3120 Board #185 June 3, 2:00 PM - 3:30 PM
Hip Joint Muscle Forces during Stair Ascent Following Total Knee Replacement
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The number of total knee replacement (TKR) surgeries have increased steadily in recent years. Research has shown that TKR patients have to compensate during stair walking following surgery, especially at the hip joint. Muscle modeling techniques have been utilized to simulate muscle force during specific movements. An understanding of the hip muscle forces during stair ascent following TKR would provide a greater understanding of the compensation necessary by TKR patients. Thus helping direct physical therapy interventions both prior to and after a TKR. **Purpose:** To compare hip joint muscle forces between health and TKR patients during stair ascent. **Methods:** Five TKR (age: 63.6) and five healthy (age: 57.8) participants performed stair ascent using a 5-step staircase with 3 instrumented steps at a self-selected pace. A generic model of 12 segments, 19-degrees of freedom and 92 muscle (Gait 2392 Model, OpenSim 3.0.1, SimTK, Stanford, CA, USA) was used to simulate muscle forces of the major muscles surrounding the hip joint during the stance phase of the second step during stair ascent. **Results:** During the loading phase, TKR patients had greater peak muscle force of the sartorius (0.68 N/kg vs. 0.34 N/kg), tensor fascia late (0.88 N/kg vs. 0.54 N/kg), iliocacus (5.49 N/kg vs. 1.77 N/kg), and psoas major (5.91 N/kg vs. 2.95 N/kg) when compared with healthy individuals ($p < 0.05$). During the push-off phase, the peak sartorius (0.68 N/kg vs. 0.42 N/kg) and adductor magnus (1.12 N/kg vs. 0.63 N/kg) muscle forces were greater in TKR patients compared to controls, while the adductor longus muscle force was greater in controls (1.09 N/kg vs. 0.65 N/kg). **Conclusion:** TKR patients in this study showed greater force in muscles responsible for hip flexion, abduction and lateral rotation during the loading phase of gait. During push-off the results were not as consistent. The adductor magnus force was greater, while the adductor longus force was reduced in TKR participants compared to controls. This study suggests that there are muscle force compensations at the hip joint during stair ascent following a TKR. The findings of this study suggest a number of muscles that have greater force demands during stair ascent following a TKR. Strengthening these muscles in post-TKR therapy may be one way to improve the recovery following surgery.

- 3121 Board #186 June 3, 2:00 PM - 3:30 PM
Minimal Fixation Suffices For Supine Isokinetic Knee Extension: A Kinetic And 3D Kinematic Analysis
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Muscular capacities acting on the knee joint play an important role in many sports regarding performance improvement and injury prevention. They are often assessed by isokinetic tests assuming that the rotation centre of the knee joint remains fixed. However, sagittal knee joint movement does not occur perfectly aligned to a stable frontal axis. Nonetheless, a proper axis alignment is necessary to obtain reliable and valid results. Another important feature of highly standardised isokinetic test procedures is the subjects' fixation. There is a controversial discussion about how subjects' fixation affects isokinetic test findings. Most studies revealed fixation to increase force output, whereas others did not detect any differences.

PURPOSE: The aim was to investigate the effects of fixation (minimal vs. maximal), contraction mode (concentric vs. eccentric) and angular velocity (30 vs. 150°/s) on the kinetics and 3D kinematics of supine knee extensions.

METHODS: 18 healthy male participants (22.1y, 1.83m, 76.0kg) performed maximal unilateral isokinetic knee extensions (IsoMed 2000, D&R Ferstl GmbH, Hemau, Germany) with minimal (hand grips only) and maximal (grips, knee, hip and trunk straps) fixation. They laid in a supine position with a 20° flexed hip. At 100 Hz, two high speed cameras (Basler A602fc-2, Basler AG, Ahrensburg, Germany) recorded the motion of the transepicondylar axis represented by two retro-reflective spheres (Ø 8 mm).

RESULTS: Peak moments (+5%) and contractional work (+4%) significantly rose at minimal fixation. Maximal fixation improved sagittal axis alignment concerning the trajectory length of the lateral femoral epicondylus (-34%) and the mean distance to trajectory centre (-19%). Both kinematic parameters showed highly significant interactions of fixation, contraction mode and angular velocity ($p < 0.01$). Initial axis alignment in relaxed muscular state caused an antero-cranial shift (0.8 and 2.4 cm) of the lateral femoral epicondylus as well as mean roll and yaw angle tilts of each 2.3°.

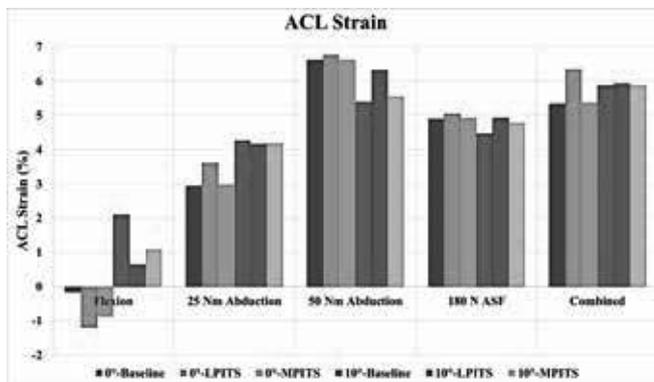
CONCLUSIONS: For supine isokinetic knee extensions, hand grips suffice as fixation to obtain accurate kinematic and kinetic results. If fixation is severe, force output will decrease. To minimise misalignment, lining up should be executed when muscles are contracting isometrically.

- 3122 Board #187 June 3, 2:00 PM - 3:30 PM
Finite Element Evaluation of the Effect of Medial and Lateral Tibial Slope on Anterior Cruciate Ligament Strain
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PURPOSE: To evaluate the effect of changes in medial (MPITS) and lateral (LPITS) posterior inferior tibial slope on ACL strain during simulated flexion with a patient-specific validated finite element (FE) knee model.

METHODS: MR images were obtained from one healthy 21yo male. Slopes were calculated in ImageJ (NIH). MR images were segmented in Mimics (Materialise). Tissues were converted to meshes of C3D4 elements and imported into ABAQUS (SIMULIA) where muscles, tendons, and other ligaments were simulated with truss elements. Hypermesh (Altair) was used to alter tibial slopes by 5° (consistent with sex-based differences in tibial slope). Simulations consisted of 0° and 10° flexion with nominal slope (baseline), 5° increase in LPITS, and 5° increase in MPITS. FE models were loaded with 25 Nm abduction, 50 Nm abduction, 180 N anterior shear, or combined 180 N anterior shear and 25 Nm abduction, all with 500 N compression (baseline) prior to loading.

RESULTS: Altered MPITS and LPITS resulted in increased ACL strain compared to baseline (Fig. 1). Steeper LPITS increased internal tibial rotation, knee abduction, and anterior tibial translation (ATT) for all scenarios. Increased MPITS resulted in negligible changes in ATT and peak ACL strain, with the exception of pure anterior shear. ACL strain was most sensitive to increased LPITS during combined loading (18% above baseline).



CONCLUSIONS: Results provide insight into sex-based differences in arthrokinematics known to produce non-contact ACL injury. Elucidation of the role that variability in proximal tibial geometry plays in ligament strain may aid clinicians in development of enhanced preventative interventions. Support by NIH (AR056259-06) and allocation by Ohio Supercomputer Ctr.

3123 Board #188 June 3, 2:00 PM - 3:30 PM
Quadriceps And Hamstring Strength: A Relationship To Number Of Competitive Years On The Cross-country Team

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Strength imbalances between the quadriceps and hamstring muscle groups, commonly measured with the hamstring to quadriceps ratio (HQR), are associated with performance decrements and injury risk. Many years of high intensity training completed by collegiate runners may contribute to such imbalances. Early identification of these imbalances may be useful for improving performance and reducing injury risk. **PURPOSE:** The purpose of this study was to determine if the number of years participating on an intercollegiate cross-country team influences hamstring strength, quadriceps strength, or HQR.

METHODS: 10 female intercollegiate cross country runners with varying years of Division-1 experience (3-years, n=4; 2-years, n=3; 1-year, n=3) granted written consent and performed isokinetic testing of the dominant limb to determine maximal concentric strength of the quadriceps and hamstring muscle groups (3 reps; 120%/s; Biodex, Shirley, NY). The maximum torque value of all trials was selected and HQR was calculated for each participant. A linear regression was used to assess how collegiate experience influenced HQR, quadriceps strength and hamstring strength.

RESULTS: Strength measures are reported in Table 1. A negative trend (R2=0.998) was observed in HQR. A positive trend (R2=0.747) was observed in quadriceps strength. No trend (R2=0.074) was observed in hamstring strength

CONCLUSIONS: The findings suggest that athletes with more years of collegiate cross-country participation have a lower HQR. As there was no trend in hamstring strength, the difference in HQR may be attributed to the trend of greater quadriceps strength in athletes with more years on the team.

Table 1 – Group Strength Measures (mean ± SD)

Years on Team	QUAD	HAM	HQR
	(Nm/kg)		(ratio)
1	1.40 ± 0.41	0.86 ± 0.09	0.64 ± 0.15
2	1.92 ± 0.06	1.10 ± 0.19	0.57 ± 0.09
3	1.91 ± 0.37	0.93 ± 0.16	0.49 ± 0.06

3124 Board #189 June 3, 2:00 PM - 3:30 PM
Effect of Menisci Presence on Anterior Cruciate Ligament Stress and Strain in a Finite Element Model

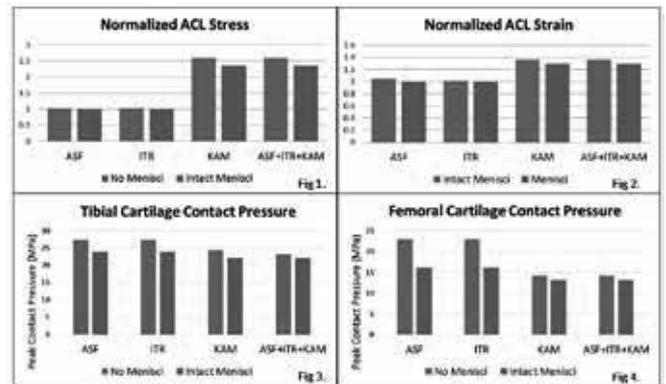
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PURPOSE: To evaluate anterior cruciate ligament (ACL) loading with and without modeled menisci to investigate the contribution of the menisci to ACL forces and cartilage contact pressures.

METHODS: MR images from one healthy 21 year old male were converted to 3D models of bone and soft tissues using Mimics (Materialise, Leuven, Belgium). Meshes of C3D4 elements were constructed in Hypermesh (Altair, MI, USA) before being imported into ABAQUS (SIMULIA, Providence, RI, USA). Cruciate and collateral ligaments were modeled as HGO hyperelastic materials, with bone, cartilage, and menisci as linear elastic, and with remaining ligaments as uniaxial, incompressible truss elements. Simulations were conducted at 25° of knee flexion and loaded with one 400N load at the quadriceps insertion and 100N loads at both the medial and lateral hamstring insertions. After flexion and muscle loading, four loading scenarios were simulated: 184N anterior shear force (ASF), 20Nm internal tibial rotation (ITR) moment, 50Nm abduction moment (KAM), and combined loading (ASF+ITR+KAM). ACL stress and strain values were normalized relative to passive flexion.

RESULTS: Normalized ACL stress and strain were reduced slightly for intact meniscal scenarios. Intact meniscal cases realized large reductions in tibial and femoral contact pressures across loading conditions.



CONCLUSIONS: Results indicated a small reduction in ACL stress and strain during KAM and combined loading occurred with the menisci present and support the convention that menisci may reduce contact pressures on tibial and femoral cartilage which may provide insight into meniscal injuries.

Support in part by NIH (R01 AR056259-06 TEH) and by an allocation from the Ohio Supercomputer Center.

3125 Board #190 June 3, 2:00 PM - 3:30 PM
Movement Mechanics Within A Single Patellofemoral Pain Cohort Significantly Vary

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Patellofemoral pain (PFP) is often studied by researchers who define PFP patients using only data that are self-reported by PFP subjects. Quantitative objective neuromuscular activation characteristics influence PFP, yet are not likely to be self-reported. The central activation ratio (CAR) is one objective description of neuromuscular activation.

PURPOSE: Compare movement mechanics between 2 subdivisions of PFP patients who scored differently on quadriceps CAR and similarly on 3 common PFP classification tools: Visual Analog Scale (VAS), Tampa Scale for Kinesiophobia (TSK) and Kujala Anterior Knee Pain (KAKP). **METHODS:** 30 PFP patients (M = 16, F = 14) participated: 15 Quadriceps Deficit (QD: CAR < 0.95; CAR = 0.91 ± 0.03; VAS = 3.87 ± 1.3; TSK = 37.9 ± 4.7; KAKP = 82.9 ± 6.6) and 15 Quadriceps Functional (QF: CAR > 0.95; CAR = 0.97 ± 0.01; VAS = 3.93 ± 0.70; TSK = 36.9 ± 5.2; KAKP = 79.3 ± 7.9). Subjects performed 5 forward jumps, landing on a force plate and then immediately jumping laterally, while movement mechanics (high-speed video and ground reaction forces) were measured. Functional linear models detected mean differences in movement mechanics; if 95% confidence intervals did not overlap zero, significant between-group differences existed. **RESULTS:** QD and QF subjects exhibited numerous significant mechanical differences (p < .05) during the ground contact phase (i.e., time of contact with the force plate) of the movement task; some of these differences are shown in Figure 1. **CONCLUSION:** When studying PFP movement mechanics, and other PFP characteristics, it is important to consider how objective neuromuscular activation characteristics that are not likely to be self-reported by PFP patients can be used to group research subjects.

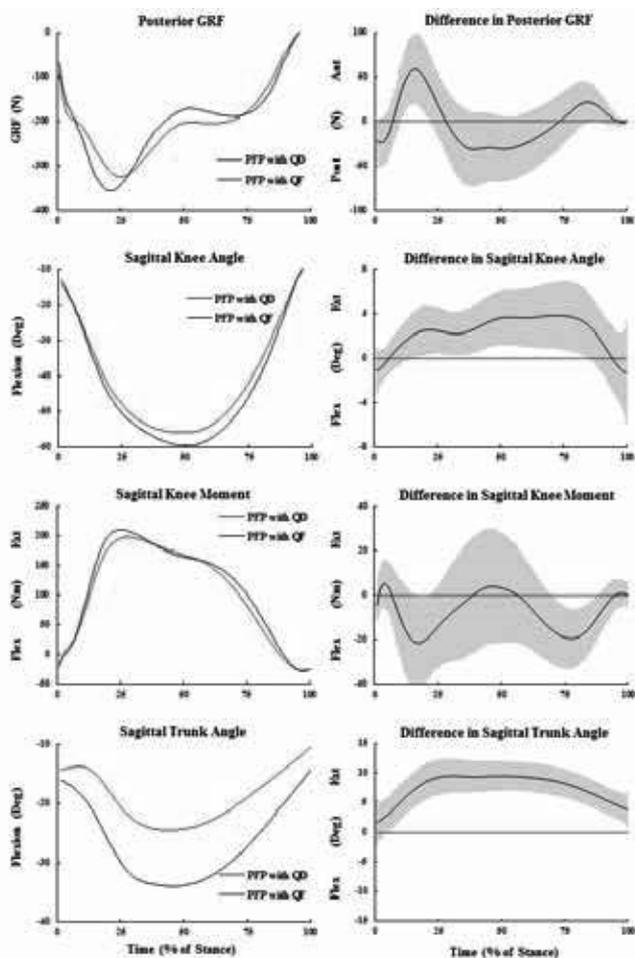


Figure 1. Grand ensembles for movement mechanics during a movement task in PFP patients (quads deficit vs quads functional). Pairwise comparison functions and associated 95% confidence intervals were plotted to detect mean between-group differences. If 95% confidence intervals (shaded gray area) did not overlap zero (horizontal red line), significant between-group differences existed ($p < 0.05$). 0-50% of stance indicates the landing phase, 51-100% of stance indicates the push-off phase, and 50% of stance indicates peak knee flexion angle.

3126 Board #191 June 3, 2:00 PM - 3:30 PM
Effect Of Acl Graft Type On Side-step Cutting In Young Athletes

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Reported Relationships: J. Pace: Consulting Fee; Arthex, Ceterix.

PURPOSE: Due to a slightly higher re-tear rate for ACL reconstruction (ACL) with hamstring (HT) versus patellar tendon (PT), differences in movement strategies were assessed during side-step cutting in young athletes with recent ACLR to determine if graft type affected post-operative motion.
METHODS: Dominant limbs from 21 athletes without lower extremity injury or previous surgery (age 14.9 ± 2.0 years) and 26 limbs in athletes who underwent unilateral ACLR (5.1-8.0 months post-operative) were included. 18 patients had HT ACLR (age 16.6 ± 3.7 years) and 8 had PT ACLR (age 16.7 ± 1.2 years). Lower extremity 3D data was recorded during the deceleration phase of a 45° cut. Group differences were assessed using analysis of variance with Bonferroni post-hoc tests.
RESULTS: The HT group had a slower approach velocity than controls (2.9 vs. 3.5 m/s; $p=0.006$) with intermediate velocity in the PT group (3.2 m/s). Both the HT and PT groups had lower peak ground reaction force (GRF) compared to controls (HT: 2.0 body weights (BW), PT: 2.2 BW, Control: 2.8 BW; $p \leq 0.02$), along with lower peak knee flexion moments (HT: 1.4 Nm/kg, PT: 1.3 Nm/kg, Control: 2.2 Nm/kg; $p=0.002$). The PT group had less power absorption at the knee than controls (0.3 vs. 0.7 Nm/kg; $p=0.07$), while the HT group had more at the hip (0.4 vs. 0.1 Nm/kg; $p=0.04$). The HT

group also had higher peak hip flexion (HT: 65.8° , PT: 53.9° , Control: 55.1° ; $p \leq 0.06$) and hip sagittal plane excursion (HT: 9.4° , PT: 3.6° , Control: 2.8° ; $p \leq 0.05$) than the PT and control groups.
 The HT group had lower peak knee valgus moments than controls (0.05 vs. 1.2 Nm/kg; $p=0.01$) and a greater range of frontal plane pelvic (8.2 vs. 3.4° ; $p=0.03$) and hip (7.6 vs. 3.0° ; $p=0.05$) motion. The PT group had intermediate values for valgus moment (0.8 Nm/kg) and pelvic (4.9°) and hip (3.3°) excursion.
CONCLUSIONS: While both ACLR groups showed reduced GRFs and knee flexion moments compared to controls, the HT group demonstrated greater adaptations proximally with increased hip flexion and frontal plane pelvic and hip excursion. The lower frontal and sagittal plane hip motion in the PT group may be due to anterior knee pain associated with PT grafts. Since the HT group exhibited movement adaptations, but no observable pathologic movement patterns, other factors likely account for the observed higher re-tear rate in HT vs. PT ACLR.

3127 Board #192 June 3, 2:00 PM - 3:30 PM
Altered Knee Neuromechanics during a Jump Task in AI Subjects Compared to Copers and Normals

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Ankle sprains often lead to ankle instability (AI). Copers are individuals who have sprained their ankles but have no residual symptoms. A comparison between copers and AI subjects can help clarify problematic movement neuromechanics in AI.
PURPOSE: To examine sagittal and frontal knee angles, moments, and vastus lateralis (VL) activation during a max jump task.
METHODS: 66 subjects (M=42, F=24; 22.2 ± 2 yrs, 173.8 ± 8 cm, 71.4 ± 11 kg) consisted of 22 AI ($77.1 \pm 15.3\%$ FAAM ADL, $62.5 \pm 20.4\%$ FAAM Sports, 4.1 ± 2.8 sprains), 22 Copers (100% FAAM ADL & Sports, 2.0 ± 1.1 sprains), and 22 healthy controls. Subjects performed 5 jumps, consisting of a max vertical jump, landing on a force plate, and transitioning immediately to a side jump, while dependent variables were collected during stance. Functional linear models ($\alpha=0.05$) were used to detect mean difference between groups. If functions and associated effects sizes (95% confidence intervals) did not cross the zero, significant differences existed ($p < 0.05$).
RESULTS: Figure 1 shows that copers exhibited similar neuromechanics to AI in frontal knee angles and moments, but AI showed 5° more knee flexion, which could be related to 0.6 Nm/kg more knee extension moment and 23% more VL activation during 0-25% of stance ($p < 0.05$). Copers exhibited similar neuromechanics to normals in sagittal knee angles and VL activation ($p < 0.05$).
CONCLUSIONS: Copers demonstrate unique neuromechanics similar to normals at times (sagittal-plane variables), and similar to AI at others (frontal-plane variables). AI subjects utilize a knee flexion dominant strategy with more VL activation and knee extension moments in a potential attempt to land safely, but ankle and hip motion may play a major role in altered knee neuromechanics.

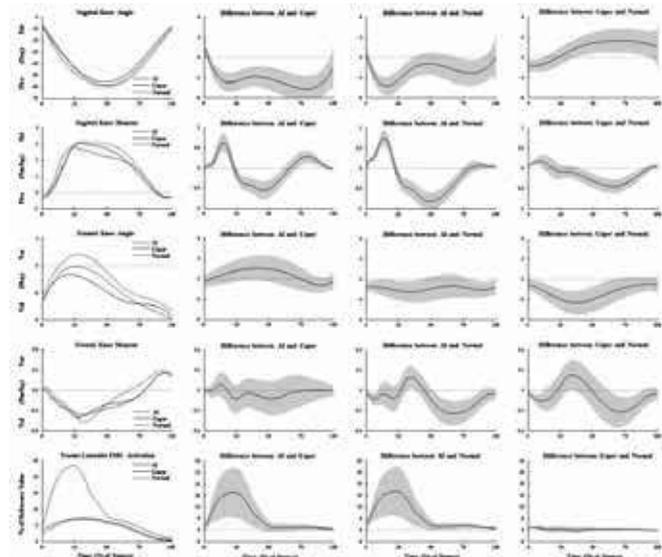


Figure 3. Grand ensembles for sagittal and frontal knee angles, moments, and vastus lateralis EMG activation. Pairwise comparison functions with its associated 95% confidence intervals were plotted to detect mean difference between groups (AI vs Copers, AI vs Normals, Copers vs Normals) during a max vertical forward side jump task ($p < 0.05$). This analysis compares variables as polynomial functions (curves) rather than discrete time points. If functions (black solid line) and associated 95% confidence intervals (gray shaded area) did not cross the zero (horizontal dotted line), then significant differences existed ($p < 0.05$). 0-50% of stance indicates the landing phase, 51-100% of stance indicates the push-off phase, and 50% of stance indicates peak knee flexion angle.

3128 Board #193 June 3, 2:00 PM - 3:30 PM
Impact Quadriceps Strengthening on Quadriceps Function and Patient Reported Outcomes after ACL Reconstruction.

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Quadriceps function is a key indicator of knee function and readiness for physical activity following ACL reconstruction (ACLR). **Purpose:** To assess the impact of a 2 week quadriceps strengthening program on quadriceps activation, knee extension MVIC torque, and self-reported function in participants with a history of ACLR. **Methods:** 18 participants with a history of ACLR (Sex = 14F/4M, Height = 166.1±6.5cm, Weight = 67.0±7.7kg, Time since surgery = 30.5±26.6mo) and 10 healthy participants (Sex = 8F/2M, Height = 171.9±2.2cm, Weight = 70.3±4.3kg) participated. Normalized knee extension MVIC torque (Nm/kg) and quadriceps central activation ratio (CAR, %) were assessed for the involved limb of ACLR participants and the dominant limb of healthy participants. Knee related function was assessed using the International Knee Documentation Committee 2000 form (IKDC). ACLR participants completed a 2 week quadriceps strengthening program after which pre-intervention measures were repeated. Pre-intervention CAR, knee extension MVIC torque, and knee related function were compared between groups using independent samples t-tests. Pre-intervention to post-intervention change in all variables were assessed using paired samples t-tests. The relationships between pre-intervention CAR, knee extension MVIC torque, and IKDC score as well as the pre-to-post intervention change in all variables were established using Pearson's product moment correlation coefficients. **Results:** Pre-intervention, ACLR participants experienced decreased CAR (ACLR = 82.13±9.72%, Healthy = 89.33±7.06%; $P = 0.01$), knee extension MVIC torque (ACLR = 1.75±0.57Nm/kg, 2.32±0.48Nm/kg, $P = 0.05$), and IKDC score (ACLR = 83.59±12.12, Healthy = 100.00±0.00, $P < 0.001$) compared to healthy participants. CAR (Post-intervention = 90.83±6.41; $P < 0.001$) and knee extension MVIC torque (Post-intervention = 2.15±0.68Nm/kg; $P = 0.001$) significantly improved after intervention. Pre-intervention and change in CAR or knee extension MVIC torque were not related to pre-intervention or change in IKDC score respectively ($P > 0.05$). **Conclusion:** Progressive quadriceps exercise may improve quadriceps strength and activation; however, this change in quadriceps function may not predict change in patient reported knee related function.

3129 Board #194 June 3, 2:00 PM - 3:30 PM
Alterations in Quadriceps Voluntary Force Control Following Anterior Cruciate Ligament Injury

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Although quadriceps strength is important following ACL injury, maximal activation of the quadriceps is rare during sporting situations and activities of daily living. Furthermore, functional stability of the knee joint depends on both adequate strength and the ability to produce force accurately. Previous studies assessing quadriceps force control following ACL injury have utilized constant sub-maximal isometric target forces. However, during most functional activities the quadriceps muscles are required to produce fluctuating force levels. Thus, the use of a testing protocol involving a cyclical or varying target force may better approximate quadriceps forces during functional activities.

Purpose: To examine submaximal quadriceps force control in individuals with an ACL injury using a cyclical force target.

Methods: Eighteen (18) individuals (12M/6F; 29.8 ± 8.7years) within 8 months of unilateral isolated ACL injury (69.5 ± 42.5 days post-injury) and 18 healthy controls (12M/6F; 29.2 ± 6.8years) participated in the study. Participants performed an isometric quadriceps contraction to match an increasing force ramp from 5% to 25% body weight (BW), after which the ramp gradually reduced from 25% to 5% BW (0.10Hz). Four trials of 60s with 60s rest in between were performed. The root mean square error (RMSE) of quadriceps torque relative to target torque was determined, and compared between groups and limbs using a 2x2 ANOVA with repeated measures on limb. Sub-regional analysis assessed accuracy of force control over an increasing (ascending RMSE) and decreasing (descending RMSE) force ramp.

Results: There was significantly greater overall RMSE in both limbs of the ACL group compared to healthy controls (3.36 ± 1.8 %BW INV limb; 3.28 ± 1.2 %BW UNINV limb; 2.40 ± 0.61 %BW CONT; 2.40 ± 0.58 %BW UNINV CONT $P=0.032$). The ACL group had significantly higher descending RMSE in both limbs compared to healthy

controls (3.92 ± 2.8 INV limb; 3.39 ± 1.6 UNINV limb; 2.43 ± 0.61 CONT; 2.36 ± 0.52 UNINV CONT $P=0.035$). Ascending RMSE did not differ between the ACL and control group limbs ($P>0.05$)

Conclusions: There are significant bilateral deficits in submaximal quadriceps force control after ACL injury, compared to healthy controls, potentially contributing to altered knee function after ACL injury.

3130 Board #195 June 3, 2:00 PM - 3:30 PM
Evidence Supporting Biphasic Action Of Rectus Femoris During Gait Using Ultrasound Imaging

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 (No relationships reported)

Current evidence suggests that the eccentric action of the quadriceps during load acceptance is essential for shock attenuation. Using Ultrasound imaging (US), rectus femoris (RF) muscle thickness can be successfully quantified in real time during a gait task.

PURPOSE: To characterize the RF thickness changes during the loading and terminal phase of gait.

METHODS: Eighteen healthy participants (23±2yrs; 1.7±0.1m; 65.9±9.4kg) completed 3 gait trials at a self-selected pace (1.06±0.17 m/s). Lower extremity kinematics and RF thickness values were assessed concurrently during the stance phase of gait. High-speed motion analysis cameras sampling at 200 Hz were used to track marker trajectory for kinematic data. US was collected at 87 Hz with a 16-mm 5-14 MHz linear array transducer placed 60% of the distance between the anterior superior iliac spine and base of the patella. US measures were collected in a longitudinal view. The ultrasound cart traveled alongside the participant over a custom-built track system. USI images were processed on MATLAB using custom software. Time of peak knee flexion from kinematic data was used to split stance into loading phase and terminal stance. Paired t-tests were used to compare peak and average values of RF thickness during loading phase and terminal stance. Alpha level was set a priori at $p<0.05$.

RESULTS: RF had a significantly greater ($p<0.05$) peak muscle thickness during terminal stance (4.8±1.98mm) than loading phase (3.9±2.23mm). However, no significant difference ($p>0.05$) was noted in average RF muscle thickness between terminal stance (2.8±1.10mm) and loading phase (3.2±2.10mm).

CONCLUSIONS: Peak architectural changes of the RF muscle during the loading phase of stance were significantly different from the values present during the terminal stance. This finding suggests that an early and most likely stronger contraction of the RF muscle is associated with load acceptance. Our findings are the first to our knowledge to characterize RF thickness changes during stance in a healthy population. Some traumatic injuries may impair RF muscle function specifically during the loading phase, and consequently lead to joint damage. Future studies should characterize muscle properties and function in individuals with pathological conditions (e.g. post-traumatic osteoarthritis).

3131 Board #196 June 3, 2:00 PM - 3:30 PM
Effects Of Rest Period Duration On Muscle Echogenicity And Cross Sectional Area

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 (No relationships reported)

Numerous studies have shown that resistance training can improve muscle size and quality over time; yet, it remains unknown how these muscle variables are influenced by the manipulation of training variables, such as rest period duration (i.e. time interval allotted between sets). **PURPOSE:** To determine the effects of rest period duration on muscle echogenicity and muscle cross-sectional area (CSA) following an 8 week (3 session/wk) resistance training program. **METHODS:** Twenty-one, college-aged males volunteered for, and completed, this IRB-approved research study. The participants were randomly assigned to 1 of 2 groups [SHORT ($n=11$); LONG ($n=10$)], before participating in 8 weeks of supervised, full-body, dynamic resistance training. All training variables were identical between groups (7 exercises, 3 sets, 10 reps, 10 RM load) with the only exception being rest period duration (SHORT = 1 min; LONG = 3 min). Before, and following, the resistance training program, ultrasound images were obtained from each participant's dominant rectus femoris (RF) and vastus lateralis (VL) muscles. Using NIH Image-J software, CSA (cm²) and echogenicity (mean gray-scale value; 0 - 255) were calculated by carefully selecting as much of the muscle as possible, while avoiding any outer fascia. **RESULTS:** Following training, no significant differences were observed between groups ($p>.05$). However, with both groups collapsed ($n=21$), significant improvements were seen for 3 of the 4 variables: CSA of the RF (+6.62%; $p<.05$), CSA of the VL (+13.61%; $p<.05$), and echogenicity of the VL (-7.73%; $p<.05$). Echogenicity of the RF, however, was not significantly affected following training (-3.23%; $p>.05$). **CONCLUSION:** Resistance training can increase muscle size and may positively affect echogenicity of the quadriceps muscles in college-aged males. However, our findings indicate that these adaptations were

not specific to the rest period duration utilized. Therefore, it was concluded that the resistance training program described in this investigation can elicit positive muscular adaptations (size and quality) using either 1 or 3 minute rest periods.

3132 Board #197 June 3, 2:00 PM - 3:30 PM
Y-Balance Limb Asymmetry In ACL Reconstructed Patients Cleared For Return-to-Play
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 (No relationships reported)

PURPOSE: The purpose of this study was to compare the lower extremity Y-balance results of the operative and uninjured limbs in ACLR patients cleared to return to sports.

METHODS: In this IRB-approved study, we analyzed prospectively collected data on patients undergoing primary ACL reconstruction at our academic medical center. Patients who were cleared by their orthopaedic surgeon and/or rehabilitation specialist for return to sports were eligible for inclusion in this study. At a minimum of six months postoperatively, we performed Y-balance testing per published protocols on the operative and nonoperative legs. Absolute measurements of Y-balance reach in the anterior (ANT), posteromedial (PM), and posterolateral (PL) directions were recorded, and a composite score was calculated from the average of all three values and normalized for limb length (anterior superior iliac spine to distal medial malleolus). The stance leg was considered the tested leg. Mean Y-balance scores between groups were compared with a two-tailed t-test, and statistical significance was set at p<0.05.

RESULTS: Testing was performed on 17 consecutive subjects who met inclusion criteria. The mean age was 23.18 years (range 15-45), and 10 were female (59%), while seven were male (41%). Mean time from surgery was 8.38 months (range 6-14). There were no significant limb length differences between limbs. Subjects demonstrated significantly lower scores (p=0.008) in the anterior direction (ANT) for the ACLR limb (60.48, SD=5.36) compared to the contralateral limb (63.25, SD=4.05). The PM, PL, and composite scores did not differ significantly between limbs, although there was a trend toward lower composite scores (p=0.088) in the ACLR limb (93.31, SD=4.57) compared to the contralateral limb (94.81, SD=6.127).

CONCLUSIONS: ACLR patients who had been deemed ready for return to play demonstrated statistically significant lower Y-balance anterior reach scores in the ACLR limb as compared to the contralateral limb, and trended toward lower composite scores in the ACLR limb. The 2.77 cm anterior reach difference between limbs approached the 4 cm difference associated with increased initial injury risk in previously published studies. ACLR patients may continue to have lower extremity deficits in the injured limb even after returning to sports.

3133 Board #198 June 3, 2:00 PM - 3:30 PM
Sex Differences in Static Lower Extremity Alignment in Korean Collegiate Student
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 (No relationships reported)

Lower extremity alignment (LEA) characteristics have been reported as potential risk factor that can cause ACL injuries during a variety of sports events. Even though there seems to be different relationship among LEA between male and female, gender difference in alignment however, has not been widely investigated in Korea.

PURPOSE: To compare gender differences of static LEA in the Korean collegiate student.

METHODS: A total of 66 subjects (34M: age = 21.1 ± 3.1 years, height = 176.0 ± 6.7 cm, mass = 71.5 ± 8.4 kg; 32F: age = 21.0 ± 1.7 years, height = 163.6 ± 5.0 cm, mass = 56.8 ± 5.4 kg) participated in this study. Seven static LEA [hip anteversion, quadriceps angle (Q-angle), rearfoot angle, tibial varum, tibial torsion, pelvic angle, navicular drop] were measured by a single investigator. All alignments were measured only on the dominant. Cohen's effect size was calculated in order to identify the magnitude of differences. A confidence interval of 95% was calculated to find any significant differences.

RESULTS: Females have a significantly greater Q-angle [M = 13.21° ± 3.76°, F = 18.95° ± 4.14°, ES = -1.46 (CI: -2.41 to -0.5)]. Even though the results were not significantly different (moderate high effect size), females have greater hip anteversion [M = 6.35° ± 6.88°, F = 10.38° ± 6.06°, ES = -0.62 (-2.19 to 0.95)] than males, while males have a greater external rotational tibial torsion [M = 21.03° ± 7.09°, F = 16.59° ± 6.76°, ES = 0.64 (-1.03 to 2.31)].

CONCLUSIONS: In the case of Koreans, there was no anecdotal difference of ACL injury between the sexes. Based upon this study, the sex differences of static LEAs were only indicated in the Q-angles of the two sexes. In previous studies not only Q-angle but multiple LEA such as Tibiofemoral angle, WB Q-angle, anterior pelvic tilt, femoral anteversion, genu recurvatum were significantly different between male

and female. Thus, further study is necessary to identify ethnic difference in LEA as well as any differences in dynamic alignment among different sexes. Sponsored by IOC Medical and Scientific Commission Research Center for Prevention of Injury and Promotion of Athletic Health Grant

3134 Board #199 June 3, 2:00 PM - 3:30 PM
Knee Joint Loads and Surrounding Muscle Forces of Selected Movement Elements in 42-form Tai Ji
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 (No relationships reported)

Knee joint loads for Tai Ji are unknown and such information is needed for designing Tai Ji intervention for people with knee pathologies.

PURPOSE: To estimate joint loads to knee medial and lateral compartments and related muscle forces of selected Tai Ji movement elements compared to slow walking. **METHODS:** Five healthy subjects (age: 24.2 ± 3.6 years, height: 1.74 ± 0.06 m, mass: 70.5 ± 14.9 kg) with two weeks of Tai Ji experience performed level walking at 0.8 m/s and seven Tai Ji movement elements: high- (35 ± 5°) and low-pose (80 ± 5°) lunges and pushdowns, high-pose (hip height) and low-pose (knee height) kicks, and pseudo step. The motion capture data of experimental trials were exported from Visual3D into the OpenSim. A musculoskeletal model with 18 segments, 23 degrees of freedom and 92 muscle-actuated was scaled to the height and weight of each subject to generate subject-specific models. Muscle forces were estimated using static optimization minimizing the sum of squared of muscle activations. The compressive forces (CF) of the medial and lateral knee compartments were computed using the joint reaction analysis tool. Paired-sample t-tests were used to compare differences among the high-pose lunge, pushdown and kick and the low-pose lunge, pushdown and kick with pseudo-step and walking, respectively.

RESULTS: Peak medial CF was greater for high- (4.16 BW) and low-pose (5.09 BW) lunges than walking (2.63BW, all p<0.05). Peak lateral CF was greater for low-pose lunge (2.98BW) and pushdown (3.79BW) than walking (0.64 BW, all p<0.01). Peak overall CFs were greater for the low-pose lunge (7.85 BW) and pushdown (8.23BW) than low-pose kick (3.63BW) and walking (3.09BW), respectively (all p<0.03). The peak muscle forces of vastus medialis, vastus lateralis and vastus intermedius, and quadriceps femoris were greater for low-pose lunge (1.54BW, 1.51BW, 2.92BW, and 6.3BW) and pushdown (1.67BW, 1.60BW, 3.19BW, and 6.97BW) compared to walking (0.1BW, 0.12BW, 0.21BW and 0.73BW, all p<0.05).

CONCLUSIONS: Knee loads in pseudo-step, high-pose pushdown and high- and low-pose kick were similar to that in slow walking. Thus, these movements may be suitable for Tai Ji participants with knee pathologies. The lunge and low-pose pushdown should be modified to minimize overall and medial knee joint loads if to be used for these participants.

F-30 Free Communication/Poster - Mental Health and Athletes

Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

3135 Board #200 June 3, 2:00 PM - 3:30 PM
Persistent Psycho-affective Alterations In Elite Adolescent Hockey Players With A History Of Concussion
 William Archambault, Julien Lépine, Robert D. Moore, Milan Barande, Dave Ellemberg. *Université de Montréal, Montréal, QC, Canada.*
 Email: will_a11@hotmail.com
 (No relationships reported)

Title: Persistent Psycho-Affective Alterations in Elite Adolescent Hockey Players with a History of Concussion

Authors: William Archambault, Julien Lépine, Robert Davis Moore, Milan Barande & Dave Ellemberg

Institution: Université de Montréal

BACKGROUND: Concussive injuries are an increasing public health concern; however, the majority of research focuses on neuropsychological outcomes in adults, with less attention given to developing populations and psycho-affective outcomes. Furthermore, symptoms of anxiety and depression are too often neglected when it comes to the return-to-play decision. **PURPOSE:** To determine the influence of concussive injuries on psycho-affective health in elite adolescent hockey players.

METHODS: Results from forty-nine elite hockey players (28 concussed, 21 non-

concussed) from the Québec Midget AAA hockey league (age 14-17) were analyzed in the current study. Athletes completed a psychoaffective assessment consisting of the Depression (BDI) and Anxiety Inventories (BAI) of the Beck Youth Inventory (BYI). Independent *t*-tests were used to analyze the raw data and *t*-scores for both the BAI and BDI. Bivariate correlations were carried out to measure the relations between injury variables and metrics of psycho-affective health. **RESULTS:** Both the raw and *t*-scores for the BAI were significantly greater in concussed hockey players versus their non-concussed peers (Raw score: mean = 9.50 vs. 6.24; *p* = .04 / *t*-score: mean = 47.86 vs. 44.19; *p* = .03). In addition, analysis revealed a group trend for the BDI raw scores and *t*-score (Raw score: mean = 5.68 vs. 3.38; *p* = .09 / *t*-score: mean = 46.68 vs. 44.10; *p* = .06). However, bivariate correlations failed to reveal any significant relations between injury variables and metrics of psycho-affective health relationship (*ps* ≥ .39 for all). **CONCLUSION:** Elite level adolescent hockey players who report to be symptom free on concussion checklists and are actively engaged in their sport still exhibit increased depression and anxiety relative to their non-injured teammates.

3136 Board #201 June 3, 2:00 PM - 3:30 PM
Transition into Adulthood: The Effects of Team Sport Participation on Mental Health
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 (No relationships reported)

Evidence clearly shows that sport participation improves mental health across the lifespan. However, there is a lack of epidemiological evidence that investigates the differences in retention and drop out patterns between youth and adulthood. **PURPOSE:** To examine the transition impact of team sport participation on the selected mental health from youth to adolescents. **METHODS:** Data CDS-2002 and TA-2011 from the Panel Study of Income Dynamics (PSID) were analyzed. Using a listwise deletion method, total 1,346 responses with four groups were identified: (1) continuous group, (2) discontinuous group, (3) late entry group and (4) no participation group. Team sport participation (IV) was measured by asking participants if they belong to sport teams (yes, no) at two different time points (youth, adult). Five mental health variables (DVs) were worry, anxiety, flourishing, non-psychological distress, and risky behaviors in which each variable includes 3-5 sub-items. This study used one-way MANOVA to analyze if there was a difference in mental health by sport participation patterns. **RESULTS:** Preliminary assumptions test results showed that there were no serious violations. MANOVA results showed that there was a statistically significant difference in mental health based on team sport participation patterns, $F(15, 3694.03) = 5.01, p < .05$; Wilk's $\Lambda = .95$, partial $\eta^2 = .02$. Univariate ANOVA results revealed that Team sport participation patterns has a statistically significant effect on worry ($F(3, 1342) = 11.60; p < .05$; partial $\eta^2 = .01$), flourishing ($F(3, 1342) = 47.90; p < .05$; partial $\eta^2 = .02$), non-psychological distress ($F(3, 1342) = 97.83; p < .05$; partial $\eta^2 = .02$), and risky behaviors ($F(3, 1342) = 2.30; p < .05$; partial $\eta^2 = .02$) but not on anxiety. Post Hoc tests results provide interesting findings that the mean scores of the continuous group were highest among the groups and statistically significant comparisons to other groups while the mean scores recruitment group were not. **CONCLUSIONS:** There are clear differences in mental health by the patterns of team sport participation in which individuals with continuous participation in team sports showed the highest level of mental health. The results also suggest that team sport participation in youth is a significant indicator for understanding mental health in adulthood.

3137 Board #202 June 3, 2:00 PM - 3:30 PM
Muscle Dysmorphia Symptoms In Bodybuilders And Non-bodybuilder Resistance Trainers, And Associated Psychological Characteristics: A Systematic Review And Meta-analysis
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Associated with a self-perceived lack of size and muscularity, muscle dysmorphia (MD) is characterized by a preoccupation with and pursuit of a hyper-mesomorphic body. MD symptoms may hypothetically be more prevalent in bodybuilders (BB) than non-bodybuilder resistance trainers (NBRT). **Purpose:** Compare the propensity towards MD symptoms in BB to NBRT, and identify psychological and other characteristics associated with MD in these groups. **Methods:** Relevant databases were searched from earliest record to February 2015 for studies examining MD symptoms in BB and/or NBRT. Included studies needed to assess MD using a diagnostic tool. Between-group standardized mean difference

[effect sizes (ES)] and 95% confidence intervals (CI) for each MD subscale were calculated. Meta-analysis was performed when five or more studies used the same MD tool. Data describing psychological or other characteristics associated with MD were also extracted. Study quality was evaluated using an adapted version of a validated tool.

Results: Of the 2135 studies identified from the initial search, 31, describing 5990 participants (BB: *n*=2614, NBRT: *n*=3376) were eligible for inclusion. Most participants were male (90%). Eight different MD assessment tools were used. Meta-analysis for five studies all using the Muscle Dysmorphia Inventory (MDI) revealed there was a medium-large pooled ES for a greater propensity towards MD symptoms in BB than NBRT on all MDI subscales (ES: 0.594-1.041; *p*<0.001). Competitive BB scored higher than non-competitive BB (ES=1.212, 95% CI: 0.824-1.599; *p*<0.001). MD symptoms were associated with anxiety (*r*: 0.320-0.424; *p*≤0.01), social physique anxiety (*r*: 0.26-0.75; *p*<0.01), depression (*r*: 0.232-0.529; *p*≤0.01), neuroticism (*r*: 0.381; *p*<0.001) and perfectionism (*r*: 0.35; *p*<0.05) and inversely associated with self-concept (*r*: 0.323-0.356; <0.01) and self-esteem (*r*: 0.42-0.466; *p*<0.01). Study quality was poor-moderate (range 9-16/22). **Conclusions:** There was a greater propensity towards MD symptoms in BB than NBRT. Anxiety and social physique anxiety, depression, neuroticism, perfectionism, self-concept and self-esteem were associated with MD. It is unclear whether these characteristics are exacerbated by bodybuilding or if individuals with these characteristics are attracted to the sport

3138 Board #203 June 3, 2:00 PM - 3:30 PM
The Prevalence of Depression and Concussions in Semi-professional and Professional North American Football Players
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 (No relationships reported)

Concussive events frequently occur in high impact sports such as North American football. The long term effects of concussive events on physical and psychological well being are the focus of ongoing research. **PURPOSE:** To determine if multiple concussive events increase the incidence and severity of depression in semi-professional and professional North American football players. **METHODS:** An anonymous online survey was sent to 200 players to collect the following self-reported data: position played, years played, number of concussions sustained and subsequent depressive symptoms using the Center for Epidemiologic Studies Depression (CESD-R) scale. An independent T-test was used to determine differences in the number of concussive events in those with CESD-R scores <16 vs. ≥16, where scores ≥16 are indicative of a depressed state. Likewise, an independent T-test was used to compare CESD-R scores between players with ≥3 concussions vs. ≤2. **RESULTS:** Twenty-seven respondents reported previous concussive events and answered all survey and CESD-R questions. Individuals with a CESD-R score ≥16 (*n*= 16), sustained a significantly greater number of concussions (3.8 vs. 1.6) than those who scored <16 (*n* = 11) (*p*= 0.0004). Further analysis also revealed significantly higher CESD-R scores in players who had sustained ≥ 3 (*n* = 11) concussions (24.0 vs. 15.6) than those with ≤ 2 (*n* = 16) (*p*=0.03). **CONCLUSIONS:** Within the parameters of this study, players that were classified as “depressed” using the CESD-R scoring criteria had sustained significantly more concussions compared to those who were not classified. Further, multiple concussive events (≥ 3) appears to increase symptoms of depression.

F-31 Free Communication/Poster - Muscle Atrophy, Hypertrophy, Fatigue and Function
 Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

3139 Board #204 June 3, 3:30 PM - 5:00 PM
Effect Of Divergent Contraction Mode Under Equivalent Exercise Volume On Muscle Proteolytic Signaling
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PURPOSE: An acute bout of resistance exercise stimulates not only muscle protein synthesis but also protein breakdown, although protein net balance stays positive during post-exercise period. Previous studies have reported that divergence of muscle contraction mode (i.e. eccentric or concentric contraction) influences proteolytic

responses under similar contraction time. While different contraction mode gives different exercise volume (i.e. force-time integral) even under the same contraction time. However, the effect of different contraction mode on muscle proteolytic response under the same exercise volume had not been investigated. The purpose of this study was to investigate the effect of divergent contraction mode on acute proteolytic responses under equivalent exercise volume.

METHODS: The male SD rats were randomly assigned to three groups designated as eccentric (ECC), concentric (CCN), or isometric contraction (ISO) groups. Muscle contraction was performed on right gastrocnemius muscle by percutaneous electrical stimulation (100Hz, 3 sec stimulation × 10 contractions per set, with 3 min rest intervals) by changing ankle joint angle (ISO: at 90°, ECC: 60°-105°, CCN: 105°-60°, with joint angular velocity at 15°/sec for ECC and CCN). In order to apply equivalent exercise volume between different contraction mode, the number of sets were modified between groups (i.e. ECC: 3sets, CCN: 4sets, ISO: 5sets). Left gastrocnemius muscle served as the control. Animals were sacrificed and muscle samples were taken 3 hours after exercise. Western blotting analysis was used to measure expression of molecules involved in proteolysis.

RESULTS: Phosphorylation of FoxO3a did not change with exercise in any groups. ULK1Ser757 phosphorylation increased significantly after exercise in all groups, although no significant difference was observed between groups. By contrast, phosphorylation of ULK1Ser317 was unchanged after exercise in all groups. LC3B-II/I ratio increased significantly after exercise in all groups, while the level of the ratio was not different between groups.

CONCLUSIONS: Under the conditions of equivalent exercise volume during maximal electrical stimulation, divergence of muscle contraction mode may not influence the magnitude of proteolytic response in rat skeletal muscle.

3140 Board #205 June 3, 3:30 PM - 5:00 PM

Skeletal Muscle Phenotype and Performance of an Elite Mixed Martial Artist

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PURPOSE: Mixed martial arts (MMA) requires a unique combination of muscular strength, power, and endurance. However, little is known regarding elite MMA athletes muscle characteristics at the cellular level. The purpose of this study was to determine the myocellular phenotype [fiber type, size, and myonuclear domain (MND) size] and whole muscle performance of an elite MMA fighter.

METHODS: One male MMA athlete [Record: 8 wins, 2 losses; Ranked: top 10 in the Ultimate Fighting Championship (UFC) Light Heavyweight Division] volunteered to participate in this study [Age: 33 y, Height: 1.89 m, Mass: 102.1 kg (competes at 93.0 kg)]. The participant underwent a vastus lateralis muscle biopsy to analyze myocellular characteristics, which included myosin heavy chain (MHC) fiber type distribution (via SDS-PAGE), fiber size (cross-sectional area; CSA), and MND size (via immunofluorescent labeling and confocal microscopy). Whole muscle performance measures included hand grip dynamometry, peak isometric mid-thigh pulls, vertical jump (measured with no counter-movement), and 5 repeat Wingate Anaerobic Tests (WAnT).

RESULTS: Muscle fiber type composition was 29% MHC I (pure slow-twitch fibers), 66% MHC IIa (pure fast-twitch fibers) and 5% hybrid fibers (containing multiple MHC types). Mean ± SE fiber CSA and MND size were 3,183 ± 225 m² and 11,008 ± 1,331 m², respectively. His grip strength was 78.4 kg, isometric mid-thigh pull peak force was 37.7 N/kg, and vertical jump was 57.2 cm. Additionally, the WAnT determined his peak power (PP): 1,075.89 W, relative PP: 10.45 W/kg, average power (AP): 838.87 W, fatigue index: 43.39%, and PP decrease over 5 rounds: 12.1%.

CONCLUSIONS: This elite MMA athlete exhibited a homogeneous muscle fiber type (i.e. predominantly fast-twitch with few hybrids) with relatively small MND sizes compared to untrained men in the literature (using similar measures). These cellular characteristics may help partially explain the athletes elevated whole muscle strength, power, and endurance performance. This case study provides initial insight into the muscle physiology of high-level MMA fighters; future research should continue investigating the myocellular structure/function relationship among these unique athletes to further our knowledge regarding elite human muscle physiology.

3141 Board #206 June 3, 3:30 PM - 5:00 PM

The Etiology Of Muscle Fatigue Differs Between Two Electrical Stimulation Protocols

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PURPOSE: This study aimed at analyzing from combined electrophysiological and metabolic measurements, the mechanisms involved in force decrease throughout two electrical stimulation (ES) protocols for which the motor units (MUs) recruitment by efferent and/or afferent pathways differs.

METHODS: The triceps surae of eleven healthy subjects was activated by ES applied over the tibial nerve. Two ES protocols (CONV: 20 Hz - 0.05 ms vs. WPHF: 80 Hz - 1 ms) were used consisting of 40 trains (6 s on- 6 s off) delivered at an intensity (IES) evoking 20% of maximal voluntary contraction. To assess the contractile properties of the solicited MUs, force-frequency relation was evoked at IES before and after each protocol. For both protocols, a single twitch was delivered at IES after each train, and the force and the electrophysiological responses (ΣEMG) were recorded to analyze the behavior of the MUs. Phosphocreatine (PCr) depletion was assessed using 31P-MR spectroscopy.

RESULTS: MUs were predominantly recruited through efferent pathways for CONV protocol, whereas afferent pathways were more involved in the MUs recruitment during WPHF. Despite this different MU recruitment, both the force reduction (≈26%) and PCr depletion (≈8%) were similar between the two protocols. The CONV protocol induced a rightward shift of the force-frequency relationship, whereas a significant reduction of the ΣEMG evoked at IES was observed only for the WPHF.

CONCLUSIONS: These results suggest that a decreased number of active MUs mainly contributed to WPHF-induced force decrease while intracellular processes were most likely involved in force decrease during CONV stimulation.

3142 Board #207 June 3, 3:30 PM - 5:00 PM

The Influence Of Percent Body Fat On Skeletal Muscle Quality In Firefighter Personnel

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(No relationships reported)

Firefighters are a critical part of public safety and perform various physically demanding jobs in dangerous situations. Recent studies suggest firefighters have a greater prevalence of overweight and obesity than the general public. Excess body fat has been associated with an increased risk of musculoskeletal injury and poor performance. Skeletal muscle quality (i.e. degree of intramuscular fat) can be examined using ultrasonography (US) and has recently been shown to be an important contributor to lower extremity performance. However, contrasting findings exist for the relationship between US derived muscle quality and a marker of body composition. Purpose: The aim of this study was to examine the relationship between skeletal muscle quality and percent body fat (%BF) and in career firefighters.

Methods: Body composition was assessed in twenty-eight male firefighters (mean ± SD: age, 34.6±3.2; stature, 179.9±5.4cm; body mass 103.7±22.2kg) using a four-compartment (4-C) model that utilizes body volume (BV) from air displacement plethysmography, total body water (TBW) from bioelectrical impedance spectroscopy, and bone mineral content (BMC) from dual-energy x-ray absorptiometry. Muscle quality was assessed using panoramic brightness-mode US of the vastus lateralis (VL). Ultrasound images were collected on the right thigh with subjects lying in the supine position and the leg propped at 50 degrees of knee flexion. The US probe was positioned perpendicular to the skin, moving lateral to medial in the traverse plane of the VL. Transmission gel was applied to the US probe in order to enhance acoustic coupling. Image-J software was used to determine echo intensity (EI) or the mean gray scale value of the selected muscle region of interest. The EI values were corrected for subcutaneous fat depth. The relationship between %BF and EI was assessed using Pearson's correlation coefficient (r) with an alpha level set a priori at P≤0.05. Results: There was a significant positive relationship between %BF and VL EI (r=.517, P<0.01).

Conclusion: These findings indicated that greater total %BF is associated with decreased muscle quality. The high rates of obesity in the fire service continues to be a public health concern which may also influence skeletal muscle performance. Grant Funding: Supported by NIOSH Grant T42OH008673

3143 Board #208 June 3, 3:30 PM - 5:00 PM

Anthropometric Prediction of Skeletal Muscle Cross-sectional Area in Persons with Spinal Cord Injury

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Skeletal muscle is a viable metabolic organ representing more than 40% of the whole body mass. Skeletal muscle atrophy following spinal cord injury (SCI) triggers a spectrum of health related metabolic consequences. Magnetic resonance imaging is considered the gold-standard technique in measuring muscle size in response to disuse and training. However, we are lacking a field method to accurately evaluate muscle size after SCI.

PURPOSE: To establish and validate a prediction equation using mid-thigh circumference and skinfold measurements to estimate muscle cross-sectional area (CSA) in persons with chronic SCI.

METHODS: Fifteen men (35 ± 10 years old; 80 ± 14 kg; 1.79 ± 0.5 m and BMI of 25 ± 4 kg/m²) with motor complete SCI (C5-T11) participated in the current study. Magnetic resonance imaging was captured to measure whole thigh CSA (Whole thigh _{MRI-CSA}), whole skeletal muscle CSA (Muscle _{MRI-CSA}) and subcutaneous adipose tissue thickness (SAT_T). This was followed by a circumferential measurement of the mid-thigh (Thigh _{circum. = 2πr}) using a standard inflexible measuring tape and a Harpenden skinfold caliper to measure subcutaneous fat thickness (SF_T). The thigh _{circum.} and SF_T were used to predict the whole thigh _{MRI-CSA} and thigh muscle _{MRI-CSA} that yielded whole thigh _{predicted-CSA} and muscle _{predicted-CSA} using the following mathematical equations [circumference = 2π*radius & area = π*(radius)²].

RESULTS: Whole thigh _{MRI-CSA}, Muscle _{MRI-CSA}, Thigh _{circum.} and SF_T were 189 ± 48 cm², 104 ± 27 cm², 51 ± 7 cm, 4.15 ± 1.5 cm, respectively. Predicted thigh _{predicted-CSA} and muscle _{predicted-CSA} were 211 ± 58 cm² and 96 ± 29 cm², respectively. Predicted thigh _{predicted-CSA} and muscle _{predicted-CSA} explained 88% (r² = 0.88, P < 0.0001) and 69% (r² = 0.69, P < 0.0001; (n = 14)) in thigh _{MRI-CSA} and muscle _{MRI-CSA}, respectively. The following field equation can be used to predict muscle _{predicted-CSA}: muscle _{predicted-CSA} = thigh circumference/2π - [(0.27(skin fold thickness) + 0.1153) + 0.142], where 0.142 cm represents the radius of the mid femur.

CONCLUSION: The present study demonstrated that thigh circumference and skinfold thickness can be used to predict whole thigh and skeletal muscle CSA in persons with chronic motor complete SCI.

3144 Board #209 June 3, 3:30 PM - 5:00 PM

Application Of The Neuromuscular Fatigue Threshold To Muscles Of The Thigh During Incremental Treadmill Running

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PURPOSE: The purposes of the present study were twofold: (1) to determine if the physical working capacity at the fatigue threshold (PWCFT) model that has been used for estimating the onset of neuromuscular fatigue in the vastus lateralis (VL) during incremental treadmill running could also be applied to the vastus medialis (VM), biceps femoris (BF), and semitendinosus (ST) muscles, and (2) to compare the running velocities associated with the PWCFT of each muscle with those of the ventilatory threshold (VT) and respiratory compensation point (RCP).

METHODS: Eleven aerobically-trained individuals (mean age ± SD = 21.7 ± 1.8 yrs) volunteered to perform an incremental treadmill test that began at 9.0 km-h⁻¹ (1% grade) and increased 1.6 km-h⁻¹ every two minutes until volitional fatigue. During each 2-min stage of the test, six, 10-second electromyographic (EMG) samples were recorded from the VL, VM, BF, and ST muscles. The EMG amplitude (μVrms) values were calculated for each 10-second epoch and separately plotted across time for each stage of the test. The PWCFT values were then determined by averaging the highest running velocity that resulted in a non-significant (P > 0.05) slope coefficient for the EMG amplitude versus time relationship, with the lowest running velocity that resulted in a significant (P < 0.05) positive slope coefficient. Expired gas samples were collected for the determination of VT and RCP.

RESULTS: The one-way repeated-measures ANOVA and post hoc analyses indicated that the VT (11.9 ± 1.4 km-h⁻¹) was associated with a significantly (P < 0.05) lower running velocity than the PWCFT for the VL (14.4 ± 2.0 km-h⁻¹), VM (14.3 ± 1.9 km-h⁻¹), BF (13.8 ± 1.8 km-h⁻¹), ST (14.7 ± 2.3 km-h⁻¹), and RCP (14.5 ± 1.7 km-h⁻¹). There were no significant differences, however, among the running velocities associated with the PWCFT for the VL, VM, BF, and ST, as well as the RCP.

CONCLUSIONS: The findings of the present study indicated that the PWCFT model resulted in the identification of neuromuscular fatigue at the same running velocity for muscles of the quadriceps and hamstrings as well as the RCP. These findings provide physiological validation that the PWCFT treadmill test estimates the maximal running velocity that can be sustained for an extended period of time without fatigue-induced increases in muscle activation.

3145 Board #210 June 3, 3:30 PM - 5:00 PM

The Effect of Muscle Length on Transcranial Magnetic Stimulation-induced Muscle Relaxation Rate

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(No relationships reported)

Muscle relaxation rate is an important intrinsic contractile property that influences the neural drive necessary to achieve a desired force. Most relaxation data are obtained at rest through evoked contractions; however, the application of transcranial magnetic stimulation (TMS) during a maximal voluntary contraction (MVC) allows for an *in vivo* (i.e., a more functionally-relevant) measurement of muscle relaxation.

PURPOSE: The purpose of this study was to determine if TMS-induced relaxation is sufficiently sensitive to detect changes in plantar flexor muscle length when all synergists are actively engaged and the ankle joint angle is varied. **METHODS:** Seven males (24.3 ± 7.3 years; mean ± SD) performed a total of 21 brief (~3s) isometric plantar flexor MVCs in a prone position at full knee extension, randomized between 20° dorsiflexion (DF), a neutral ankle position (0°), and 30° plantar flexion (PF). During each MVC, high-intensity TMS (80% of stimulator output) was delivered to the motor cortex with a double-cone coil attached to two magnets via a BiStim unit. Peak relaxation rate was calculated to be the steepest slope of the TMS-induced drop in torque. **RESULTS:** MVC torque was significantly greater in the dorsiflexed (178.6 ± 35.5 Nm) compared to neutral position (144.2 ± 19.6 Nm) and in the neutral compared to plantar flexed position (59.0 ± 10.0 Nm). Peak relaxation rate was equivalent at 20° DF (-2060.3 ± 626.7 Nm/s) and 0° (-1944.8 ± 259.9 Nm/s) and both rates were significantly faster compared to the rate at 30° PF (-794.1 ± 203.9 Nm/s). **CONCLUSION:** Absolute relaxation rate was markedly slower when the plantar flexor muscles were placed in a shortened position, which indicates that TMS is sufficiently sensitive to detect changes in muscle length. These results support published data which demonstrate an ability of TMS to detect changes in muscle relaxation rate due to temperature, fatigue, stimulus intensity, and synergist contribution.

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3146 Board #211 June 3, 3:30 PM - 5:00 PM

Biomechanical Properties of the Cervical Muscles Depending on Degree of Smartphone Addiction.

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Overuse of Smartphone leads the extensive forward tilt of head causing occurrence of musculoskeletal disorder such as scoliosis and turtle neck syndrome which is closely related with biomechanical properties of cervical muscles. Myoton has been used as a portable device for evaluating biomechanical properties of muscles which has high reliability and repeatability. However, it is uncertain that direct relationship between Myoton indices reflecting biomechanical properties of cervical muscles and usage of Smartphone. **PURPOSE:** The purpose of study was to investigate the relationships between biomechanical properties of cervical muscles using Myoton and degree of Smartphone addiction. **METHODS:** Fifty healthy young males without any orthopedic disorders participated in this study. All subjects used Smartphone more than 60 minutes daily basis. Major cervical muscles; splenius cervical, sternocleidomastoid, and upper trapezius were measured twice with Myoton assessing mechanical properties; frequency (F), decrement (D), stiffness (S), creep (C), and relaxation (R). The degree of Smartphone addiction was evaluated by Smartphone Addiction Proneness Scale (SAPS). **RESULTS:** All parameters reflecting the mechanical properties of splenius cervicis, sternocleidomastoid, and upper trapezius had less than 2% of coefficient of variation (CV) between measurement intervals. As result of intra-class correlation coefficient (ICC), each parameters had high reliability (ICC > 0.9, p < 0.01). On the correlation analysis between Myoton indices and addiction score; moreover, F (r = 0.353, p < 0.05) and S (r = 0.346, p < 0.05) from upper trapezius were negatively correlated with degree of Smartphone addiction. Furthermore, D (r = -0.284, p < 0.05) and R (r = 0.288, p < 0.05) from sternocleidomastoid were positively associated whereas F (r = -0.368, p < 0.01), D (r = -0.405, p < 0.01), and S (r = -0.424, p < 0.01) from splenius cervicis were negatively correlated with Smartphone addiction score. **CONCLUSION:** Myoton would be a suitable device to evaluate the biomechanical properties of muscles in accordance with the close relationship between Myoton indices obtained from cervical muscles and degree of Smartphone addiction.

3147 Board #212 June 3, 3:30 PM - 5:00 PM

Reexamining Skeletal Muscle Fatigability and Fiber Type in Resistance Trained Med: 40 Years After Thorstenson

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(No relationships reported)

Nearly 40 years ago Thorstenson and Karlsson developed an equation (THOR) allowing a fatigue test to estimate the percentage of fast-twitch muscle fibers (%FT) in an individual's vastus lateralis (VL). Fiber-typing methodologies have advanced considerably since this time. Moreover, THOR was developed from a heterogeneous group of habitually active men. **PURPOSE:** Reexamine THOR using modern muscle fiber-typing techniques and in resistance-trained men. **METHODS:** Fifteen resistance-trained males (strength/power-trained $\geq 3d/wk$ for ≥ 6 months; age=24.8 \pm 1.3y, height=1.79 \pm 0.05m, mass=82.2 \pm 8.0kg) performed 60 maximal knee extensions at 180°/s on an isokinetic dynamometer, returning on a separate day for a VL muscle biopsy. Approximately 200 individual fibers (per participant) were isolated and analyzed for fiber type using sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE). Individual muscle fibers were identified as either expressing myosin heavy chain (MHC) I, I/IIa, IIa, IIa/IIx, IIx, or I/IIa/IIx. %FT was determined as a combination of MHC IIa, IIa/IIx, and IIx. **RESULTS:** The original correlation between FT% and percent decline in peak torque ($r=0.86$, $p<0.05$). Moreover, a Bland-Altman plot suggested THOR overestimated %FT by an average of 6.91%, with a range of -27.62% to +41.44% (limits of agreement, 95% Confidence Interval) in our participants. Also, the data were heteroskedastic (correlation coefficient, $R^2 = 0.53$, $P = <0.01$), indicating THOR underestimated FT% in participants with less fast-twitch fibers, and overestimated FT% in participants with more fast-twitch fibers. **CONCLUSIONS:** This collectively suggests fiber phenotype alone does not predict performance during a fatigue test in strength-trained men. These findings likely differ from Thorstenson and Karlsson because we utilized the highly precise single fiber-typing method that allowed differentiation of fibers into 6 isoform categories (as opposed to only 2 in THOR). However, THOR may still be valid when examining across heterogeneous exercise backgrounds or "habitually active" participants.

3148 Board #213 June 3, 3:30 PM - 5:00 PM

Temporal Expression Of PDGFs In PPTJ In Vivo Cyclical Loading Model

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(No relationships reported)

Patella-Patella Tendon Junction (PPTJ) overuse injury is common athletic and occupational problems, but it's early pathophysiological processes remains unexplored. Previous study shows that platelet-derived growth factors(PDGFs) is effective in enhancing tendon healing in vivo tendinopathy model.

Purpose

Based on our previous established PPTJ overuse injury model, this study aimed to evaluate expression of PDGF-A and PDGF-B in PPTJ during the early stage of PPTJ overuse injury.

Method

45 female New Zealand rabbits(2.37 \pm 0.14 kg) were randomly divided into 5 groups according to cyclical loading times. The left rectus femoris muscles were electrically stimulated to contract repetitively for 60 repetitions/min at 30% peak tetanic force for 2h, 4h, 6h, 12h and 24h cumulative loading respectively. We randomly choosed 9 contralateral limbs served as controls. The PPTJ were harvested, and sections were immunostained PDGF-A and PDGF-B. 5 regions of interest in PPTJ were digitally photographed at 400 \times for immunostained sections. Positive staining cells were manually counted in each region and we calculated mean positive stained cell densities of each sample. One way ANOVA with Tukey adjusted post hoc pairwise comparisons were used to compare mean positive staining cell density of PDGF-A and PDGF-B in six groups.

Result

There was no significant change of mean positive stained cell densities of PDGF-A between the groups(68.1 \pm 22.9 cells/mm², 166.9 \pm 18.8 cells/mm², 136 \pm 20.1 cells/mm², 137.9 \pm 22.1 cells/mm², 117.3 \pm 21.7 cells/mm², 141 \pm 17.7 cells/mm² for C, 2h, 4h, 6h, 12h and 24h groups, respectively). Compared with 2h group(67.2 \pm 53.8 cells/mm²), the mean positive stained cell densities of PDGF-B were significantly lower in C(421.7 \pm 66.4 cells/mm², $p<0.01$), 6h(489.9 \pm 67.3 cells/mm², $p<0.05$), 12h(398.2 \pm 61.9 cells/mm², $p<0.01$) and 24h(442.2 \pm 57.4 cells/mm², $p<0.01$).

ACSM May 31 – June 4, 2016

Conclusion

With increasing of cyclical loading, the decreasing expression of PDGF-B in PPTJ may play a role in the early progression of PPTJ overuse injury.

3149 Board #214 June 3, 3:30 PM - 5:00 PM

Increased Body temperature During Exercise Enhances Glucose Metabolism-related Signaling Transduction In OLETF Rat Skeletal Muscle

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(No relationships reported)

Our previous study indicated that increased body temperature during exercise effectively improves insulin resistance and lipid metabolism; however, the underlying mechanisms remain unknown.

PURPOSE: To examine the effects of increased body temperature during acute exercise on glucose metabolism-related signaling transduction in skeletal muscle of type 2 diabetic rats.

METHODS: Otsuka Long-Evans Tokushima Fatty rats, a rodent model of type 2 diabetes, were divided randomly into three weight-matched groups at 25 weeks of age; control (Con, n = 9), exercised in warm temperature (WEx, n = 16), and exercised in cold temperature (CEX, n = 16). The WEx and CEx animals were subjected to running on a treadmill at 20 m/min for 30 min under warm (25°C) or cold (4°C) conditions, respectively. Rectal temperature was measured before and after exercise. The gastrocnemius muscle was sampled under anesthesia immediately after exercise. Phosphorylation of signal transducers related to glucose uptake was analyzed by Western blot.

RESULTS: Rectal temperature increased significantly in the WEx group after exercise, but not in CEx animals. Akt (Ser473) and AS160 (Thr642) phosphorylation levels were significantly higher in the WEx group than those in the Con group ($p < 0.05$). In contrast, phosphorylation of AMP-activated protein kinase (Thr172) increased significantly in the WEx and CEx group compared with that in the Con group ($p < 0.05$), but no significant difference was observed between the WEx and CEx groups. **CONCLUSIONS:** Our data suggest that increased body temperature during exercise is essential for activating the insulin signaling pathway in skeletal muscle of type 2 diabetic rats.

3150 Board #215 June 3, 3:30 PM - 5:00 PM

Intermittent Running at Lactate Threshold Evokes a Comparable Insulin-like Growth Factor-1 Response to Its Continuous Counterpart

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(No relationships reported)

Insulin-like growth factor-1 (IGF-1) is a trophic factor that promotes growth and survival in various types of cells, such as muscle cells and neurons. Acute moderate-intensity exercise is known to increase the circulating level of IGF-1, but it is unclear if the exercise format affects this transient effect.

PURPOSE: To compare changes in the circulating level of IGF-1 during continuous and intermittent running at lactate threshold over the same distance.

METHODS: Six male subjects (age: 20.0 \pm 1.2 years, maximal oxygen consumption: 49.3 \pm 4.4 ml/kg/min) randomly performed two formats of running at lactate threshold speed (159.3 \pm 7.8 m/min) on two separate days: 40-min continuous running (CR) and intermittent running (IR) consisting of 40 repetitions of 1-min bouts separated by 30-sec rests. During each session, blood samples were drawn via peripheral cannulation at rest, at 10, 20, 60 and 100% of running time, and 30 min after running. A blood concentration of IGF-1 and those of several stress markers including lactate, cortisol, and catecholamines were measured at each time point. Heart rate was also measured during CR and IR. Two-way analyses of variance for repeated measures with post-hoc tests, if appropriate, were performed to compare changes between CR and IR.

RESULTS: There was a significant main effect of time on IGF-1 concentration ($p<0.01$) but no main effect of format or interaction ($p\geq 0.05$). The IGF-1 concentration at 100% of running was significantly higher than that at rest when CR and IR were collapsed (205.6 \pm 34.1 vs. 189.8 \pm 32.2 ng/ml, $p<0.001$). In contrast, significant interactions were found in all the stress markers and heart rate ($p<0.05$ to <0.001). Specifically, lactate concentration significantly increased in CR but decreased in IR, cortisol concentration significantly decreased only in IR, and concentrations of catecholamines and heart rate significantly increased in both running formats but the effect was greater for CR ($p<0.05$ to <0.001).

CONCLUSIONS: Intermittent running at lactate threshold evoked an IGF-1 response comparable to its continuous counterpart, whereas the two running formats induced

Boston, Massachusetts

quite different stress responses. These results suggest that moderate intermittent running has the potential to stimulate the IGF-1 pathway without considerable stress. Supported by JSPS 25242065.

3151 Board #216 June 3, 3:30 PM - 5:00 PM

Beetroot Juice Increases Skeletal Muscle Force Production in Recreationally Active Subjects.

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(No relationships reported)

Supplementation with dietary inorganic nitrate (NO₃⁻) in the form of beetroot juice (BRJ) reduces whole-body oxygen consumption during submaximal exercise. There are currently two proposed mechanisms to explain this decrease; 1) improved mitochondrial function and 2) improved mechanical efficiency. Previous research has shown that mitochondrial bioenergetics are not improved following 7-d of BRJ supplementation, however there was an increase in H₂O₂ emission. As reactive oxygen species (ROS) have been shown to increase skeletal muscle (SkM) contractile force, this presents a possible mechanism for the ergogenic effects of BRJ. **PURPOSE:** To examine the effects of 7-d of BRJ supplementation on SkM contractile characteristics and function. **METHODS:** Young recreationally active males (n=8) underwent transcutaneous electrical muscle stimulation of the vastus lateralis for evaluation of SkM contractile characteristics pre and post 7-d of BRJ supplementation (280 ml/day, ~26 mmol NO₃⁻). Subjects performed 2 isometric maximal voluntary contractions (MVC), which were used for determination of a voltage that elicited ~40% MVC at 100 Hz. This was subsequently used for performance of a force frequency (FF) curve (10, 20, 30, 50, 100 Hz). Muscle twitches were evoked using a single supramaximal (~150 V, 50 μs duration) impulse twice prior to and twice following performing the FF curve. **RESULTS:** Following supplementation, there was no change in force produced during MVC (602.1 ± 50.4 vs. 596.6 ± 56.4 N), however peak twitch tension was increased (132.6 ± 3.3 vs. 153.5 ± 6.0 N, p<0.01). While there was no change in twitch half-relaxation time, the maximal rates of force development and relaxation were increased (3529 ± 251 vs. 2455 ± 135 and -2676 ± 283 vs. -2010 ± 168 N/s, respectively, p<0.05). Force was also increased during the FF curve at 10 Hz (41.1 ± 2.3 vs. 37.6 ± 2.4 % of peak force, p<0.05), but was not different at other frequencies. **CONCLUSION:** Following 7-d of BRJ supplementation, force production at low stimulation frequencies is increased in human SkM. In addition to the increased rates of force development and relaxation, these results suggest a possible mechanism of action for BRJ is via modification of calcium handling or calcium sensitivity of the contractile apparatus, possibly due to ROS. Supported by NSERC, Canada.

3152 Board #217 June 3, 3:30 PM - 5:00 PM

Are Voluntary Activation Determined By The Interpolated Twitch Technique And Mechanomyographic Amplitude Synonymous?

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Theoretically, voluntary activation (VA) and the amplitude of the mechanomyographic signal (MMG_{AMP}) are thought to reflect motor unit recruitment. **PURPOSE:** To compare the patterns of responses for the percent VA and MMG_{AMP} vs. torque relationships in healthy, college-aged males. **METHODS:** Sixteen men (mean ± SD, age = 22 ± 5 yrs; height = 177 ± 6 cm; weight = 80 ± 14 kg) completed a maximal voluntary isometric leg extension contraction (MVIC) followed by 9 randomly ordered isometric leg extension contractions at 10-90% of MVIC. During each muscle action, leg extension torque (Nm) and MMG_{AMP} from the vastus lateralis were calculated during a 500 ms stable torque plateau. In addition, supramaximal doublet stimuli were delivered to the femoral nerve during and after each muscle action to determine VA via the interpolated twitch technique. Polynomial models (linear, quadratic, cubic) were fit to the composite (i.e., mean) and individual VA vs. torque and MMG_{AMP} vs. torque relationships. **RESULTS:** The composite VA vs. torque relationship was best fit with a quadratic model (R² = 0.998; F = 1836.97; p < 0.001). For the individual subjects, however, the %VA vs. torque relationship was best fit by a linear, quadratic, or cubic model for 3, 9, and 4 subjects, respectively. In contrast, the composite MMG_{AMP} vs. torque relationship was best fit with a cubic model (R² = 0.970; F = 65.02; p < 0.001). However, the MMG_{AMP} vs. torque relationship was best fit by a linear, quadratic, or cubic model for 8, 5, and 3 subjects, respectively. Only 5 of 16 subjects exhibited the same VA vs. torque and MMG_{AMP} vs. torque patterns of responses. **CONCLUSION:** Not only were the composite patterns of responses different for VA and MMG_{AMP}

versus torque, but only 31% of subjects exhibited the same patterns of response for both the VA and MMG_{AMP} vs. torque relationships. While VA and MMG_{AMP} are both thought to reflect motor unit recruitment, our results suggest that these two variables contain unique information. For example, MMG_{AMP} is thought to be influenced by muscle stiffness, cross-bridge cycling rate, and/or intra- or extra-cellular fluid mediums. Therefore, VA and MMG_{AMP} may not be interchangeable.

3153 Board #218 June 3, 3:30 PM - 5:00 PM

The Influence of Circadian Rhythms on Upper Body Isometric Strength, Muscle Thickness and Body Temperature

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(No relationships reported)

Diurnal variations in muscle function have shown mixed results, with differences in protocols and time points reported in the literature. Most studies wake the individual in order to take measurements and it is unknown if this has an impact on the rhythm. It is thought that cell volume also follows a rhythm, which may influence changes in muscle size, though this remains untested.

PURPOSE: To examine rhythms of strength, body temperature and muscle thickness without interrupting an individual's natural sleep/wake cycle. A second aim was to determine if these potential rhythms are reproducible.

METHODS: Approximately 2 hours after their normal wake time, 7 strength trained participants had their oral temperature, muscle size of the upper and lower body, and elbow flexor isometric strength (MVIC) measured. Measurements were repeated every 2 hours for 12 hours. To examine the repeatability, participants returned and completed the same procedures as before within 14 days of their first testing visit. Dietary intake was recorded during the first visit and food choices and intake patterns repeated on Day 2. A repeated measures ANOVA was used to determine if differences existed for body temperature, MVIC, and muscle thickness. Significance was set at p ≤ 0.05. Data are presented as mean ± SD. Cosinor analysis was used to determine rhythm patterns for each variable.

RESULTS: There was no interaction (p=0.29), time main effect (p=0.15), or day main effect (p=0.74) for body temperature (range: 37.0-37.2 degrees). For strength, there was no interaction (p=0.93), or day main effect (p=0.50), however, there was a main effect for time (p=0.14), with strength at time point 1 (84.4 ± 6.4 nm) and 2 (87.1 ± 6.2 Nm) being greater than time point 4 (84.2 ± 6.6 Nm) and 6 (83.4 ± 6.8 Nm, p0.05).

CONCLUSIONS: When accounting for an individual's natural sleep/wake cycle, rhythms of oral temperature, muscle strength, and size were not detected. As this was observed twice, it suggests that these rhythms may be masked by different zeitgebers or, perhaps, less pronounced when not disturbing sleep.

3154 Board #219 June 3, 3:30 PM - 5:00 PM

Regional Difference In Gastrocnemius Tension During Passive Stretching As Assessed With Shear Wave Elastography

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(No relationships reported)

Muscle strain injuries occur when the muscle is either stretched passively or activated during stretch. Calf strain injuries are most commonly found in the medial gastrocnemius (MG), especially at the distal musculotendinous junction. One of the reasons for the susceptibility of musculotendinous junction for strain injuries may be that the distal region of MG is stretched more than the medial belly region. Muscle tension during passive stretching can be estimated from shear elastic modulus measured by shear wave elastography.

PURPOSE: To investigate the regional difference in MG tension during passive stretching, shear elastic modulus at the distal and medial belly regions of the MG was assessed by shear-wave elastography.

METHODS: Twenty-two healthy men and 25 healthy women participated in this study. Shear elastic moduli at the distal and medial belly regions of the MG were measured with the ankle joint positions at 30° plantarflexion (PF), a neutral anatomical position (NE), and 20° dorsiflexion (DF). The regional differences in the shear elastic modulus were tested with a two-way analysis of variance (region of the MG × ankle joint position), followed by t-tests with Bonferroni correction, with the significance set at P < 0.05.

RESULTS: Shear elastic modulus was not significantly different between the distal and medial belly regions at PF (distal region: 5.7 ± 2.0 kPa; medial belly region: 5.0 ± 1.4 kPa) and NE (distal region: 9.8 ± 1.6 kPa; medial belly region: 9.9 ± 1.8 kPa), but it was significantly higher at the distal region (40.7 ± 10.1 kPa) compared with the medial belly region (35.9 ± 9.1 kPa) at DF.

CONCLUSIONS: Regional difference in MG tension during passive stretching was observed in the ankle joint position where the MG is sufficiently lengthened, which could lead to muscle strain injuries at the distal musculotendinous junction of the MG. The study was supported by JSPS KAKENHI (Grant Number 15K16500).

3155 Board #220 June 3, 3:30 PM - 5:00 PM
The Effectiveness of Dry Needling and Stretching on Hamstring Flexibility: A Randomized Controlled Trial.

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Flexibility and mobility have long been an integral part of rehabilitation and fitness programs. Recently, dry needling (DN) has emerged as a popular treatment for muscular pain and tension. While there are several studies detailing the benefits of this intervention for pain, few studies exist examining the effects on soft tissue mobility. **PURPOSE:** To determine if the addition of hamstring (HS) DN to a standard stretching program results in greater improvements in HS flexibility assessed with active knee extension (AKE) and active straight leg raise (ASLR), squat range of motion (ROM), knee pain, and the Lower Extremity Functional Scale (LEFS) compared to sham DN and stretching in subjects with atraumatic knee pain. **METHODS:** Thirty-nine subjects were randomized to DN group, n=20 (age 20.3 ± 1.08) and sham DN group, n=19 (age 20.16 ± 2.12). All subjects performed 1 HS stretch for 30 seconds, 3 times daily. All dependent variables were measured at baseline, post intervention, and at follow ups 1, 3, and 7 days after initial treatment. One additional treatment was performed on day 3. Mixed model analyses of variance (ANOVA) were used to measure within subject and between group differences for each variable. **RESULTS:** The 2x5 ANOVAs demonstrated statistically significant main effects for time suggesting similar improvements regardless of group in LEFS (F = 12.79, p<0.001), AKE (F = 3.94, p<0.01), ASLR (F = 4.04, p<0.01), squat ROM (F = 10.34, p<0.001), pain with squat (F = 11.44, p<0.001), and pain with step down (F = 8.78, p<0.001). Post hoc comparisons demonstrated statistically significant improvements (p<.05) for all variables at final follow up compared to baseline. While a main effect for time was observed for all variables, the 2x5 ANOVA failed to show a significant time by group interaction for LEFS (F = 1.73, p = .17), AKE (F = .83, p = .51), ASLR (F = .29, p = .89), squat ROM (F = .69, p = .60), pain with squat (F = .58, p = .67) and pain with step down (F = 2.30, p = .47). **CONCLUSION:** The results of the current randomized controlled trial suggest that 2 sessions of DN and daily stretching produce similar short term outcomes in hamstring ROM, knee pain, and LEFS compared to daily stretching and sham DN in a young active population with atraumatic knee pain.

F-32 Free Communication/Poster - Muscle Damage/Musculoskeletal Injury

Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

3156 Board #221 June 3, 2:00 PM - 3:30 PM
Effect of Rest Interval Between Pitches on Throwing Performance and Muscle Damage Markers in Pitchers

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PURPOSE: To determine influence of recovery time between pitches on fatigue, muscle damage and inflammatory markers at an equal throwing load. **METHODS:** All pitchers (N=7) had thrown 20 pitches with rest interval of 8, 12, and 20 seconds in a randomized counter-balanced design. Seven simulated inning pitches were completed with a 5-min rest interval for each pitcher. At least one-week cessation of training was allowed between trials. Performance indicators including accuracy (strike rate), pitching speed, and rated perceived exertion (RPE) were measured immediately at the end of 20th pitch for each inning. Muscle damage and inflammatory markers were measured 24, 48, and 72 hours after the seven-inning challenge.

RESULTS: Pitching speed and strike rate dropped significantly from the 1st to 7th inning with rest interval of 8 and 12 seconds, but well-preserved with rest interval of 20 seconds. Blood levels of lactate dehydrogenase increased significantly post-exercise and fallen after 24 h later. Post-exercise rise in blood levels of creatine kinase (CK) was similar but relatively delayed. The magnitude of these rises was linearly associated with decreased rest interval between pitches. Transient increases in IL-6 and sustained increases in IL-10 after challenge were observed but no change with those of 20 seconds.

CONCLUSIONS: Our result suggests that the changing rule from 20-second to 12-second rest interval between pitches poses additional cost on throwing performance and subsequent inflammatory curing cost of pitchers.

3157 Board #222 June 3, 2:00 PM - 3:30 PM
Efficacy of Radial Extracorporeal Shockwave Therapy on Lateral Epicondylitis and Common Extensor Tendon Stiffness

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 (No relationships reported)

Purpose: To investigate the effects of radial extracorporeal shock wave therapy (rESWT) and determine the post-treatment common extensor tendon stiffness among lateral epicondylitis patients. **Methods:** Thirty lateral epicondylitis patients were randomly divided into the experimental and control groups. Participants in the experimental and control groups received rESWT plus physical therapy and sham shockwave plus physical therapy for 3 weeks, respectively. Assessments were performed at baseline (T0), and after 6 (T1), 12 (T2), and 24 (T3) weeks using the Visual Analogue Scale (VAS), grip strength dynamometer, Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, and ultrasonography in real-time sonoelastography (RTS). **Results:** The experimental group had more significant pain reduction at T1 (3.53 ± 1.81 vs. 5.73 ± 1.62 points, p<0.001), T2 (3.20 ± 1.27 vs. 5.73 ± 1.62 points, p<0.001), and T3 (2.00 ± 1.36 vs. 5.73 ± 1.62 points, p<0.001) than at baseline and at T3 (2.00 ± 1.36 vs. 3.77 ± 1.79 points, p=0.004) than the control group. Compared with the baseline and the control group, the experimental group had significantly higher maximal grip strength at T2 (30.20 ± 9.91 vs. 25.20 ± 9.37 kg, p=0.026 and 30.20 ± 9.91 vs. 22.46 ± 6.58 kg, p=0.029, respectively) and T3 (31.20 ± 10.35 vs. 25.20 ± 9.37 kg, p=0.004 and 31.20 ± 10.35 vs. 23.69 ± 8.68 kg, p=0.042, respectively), with significant increases (5.00 ± 5.69 vs. 0.46 ± 3.71 kg, p=0.033 and 6.00 ± 5.41 vs. 1.69 ± 5.45 kg, p=0.047, respectively). Compared to baseline, the experimental and control groups had significantly lower DASH disability/symptom scores at T1 (16.49 ± 12.70 vs. 28.72 ± 14.28 scores, p=0.001), T2 (12.33 ± 9.59 vs. 28.72 ± 14.28 scores, p=0.001), T3 (7.44 ± 6.68 vs. 28.72 ± 14.28 scores, p<0.001), and at T3 (19.87 ± 12.57 vs. 31.99 ± 15.44 scores, p=0.007), respectively. The inter-rater reliabilities of RTS were poor to fair (-0.117 for modified RTS score, and 0.264, 0.103 for red and blue pixel intensity in color histogram analysis, respectively). **Conclusion:** Patients with lateral epicondylitis who received rESWT in addition to physical therapy had better and faster pain reduction, grip strength increase, and functional improvement. However, RTS had poor to fair inter-rater reliabilities for measuring stiffness of the common extensor tendon.

3158 Board #223 June 3, 2:00 PM - 3:30 PM
Increased Extracellular Matrix Degradation Following Eccentric Versus Concentric Muscle Actions in Humans

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 (No relationships reported)

It is unclear at this time if there is a difference in the extracellular matrix (ECM) remodeling response, specifically metalloproteinase-9 (MMP-9), to a single bout of isolated eccentric versus concentric muscle actions. **PURPOSE:** To determine if contraction type differentially alters the ECM in physically inactive humans. **METHODS:** Subjects (n=21) were randomly assigned to 3 exercise groups: concentric-only (CON, n=7), eccentric-only on a free weight machine (ECC1, n=7), and eccentric-only on an isokinetic dynamometer (ECC2, n=7). Contraction type was isolated for each group, but the task was generally the same: 6 sets of 10 maximal contractions of the non-dominant leg extensors. Functional (range of motion, leg circumference, soreness, strength) and blood (plasma creatine kinase, MMP-9, tissue inhibitor of metalloproteinase-1 (TIMP-1)) parameters were measured prior to, immediately after, and 3-days after the exercise (PRE, POST, 3DAY). At 3DAY, a biopsy was collected from the *Vastus lateralis* of each leg with the unexercised leg serving as each subject's control. Muscle was sectioned and stained for morphology,

collagen type IV (COL4) and MMP-9 content, and homogenized to determine relative quantity of mRNA for 3 genes of interest: MMP-9, TIMP-1, and COL4.

RESULTS: Plasma MMP-9 was increased (PRE: 48.4 ± 30.6 ng/ml to 127.4 ± 67.6 ng/ml) and TIMP-1 was decreased (PRE: 90.0 ± 20.2 ng/ml to POST: 65.4 ± 13.6 ng/ml) after exercise in ECC2. Muscle MMP-9 was increased ($41.5 \pm 26.2\%$), and muscle COL4 content and TIMP-1 mRNA were decreased at 3DAY in ECC2 only (COL4: $-9.3 \pm 3.2\%$; TIMP-1: 0.60 ± 0.07 NRQ). These indications of an ECM environment favoring degradation occurred in the absence of overt histological or functional signs of damage.

CONCLUSIONS: Adaptations to the ECM are more apparent following eccentric than concentric muscle actions. Histological and functional signs of damage may not be required to produce changes to the ECM environment surrounding skeletal muscle.

3159 Board #224 June 3, 2:00 PM - 3:30 PM

Improved Glucose Tolerance By An Acute Bout Of Muscle Damaging Exercise

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(No relationships reported)

PURPOSE: To determine the magnitude of muscle damage and glucose responses in an oral glucose tolerance test (OGTT) after eccentric training.

METHODS: Participants (N=21) were challenged by 5 times of 100-meter downhill sprinting and 20 times of squats training at 30 pounds weight load for 3 days.

RESULTS: This challenge produced a wide spectrum of increased levels of muscle creatine kinase (CK) in blood, 48 h after the last bout of training. Participants were then divided into two groups according to the magnitude of CK increases (low CK: $+48\% \pm 0.3$; high CK: $+137\% \pm 0.5$, $P < 0.05$). Both groups show comparable decreases in blood glucose levels in OGTT, suggesting that muscle-damaging exercise does not appear to decrease but rather improve glycemic control in men.

CONCLUSIONS: The result of the study rejects the hypothesis that muscle-damaging exercise will decrease glucose tolerance in men.

3160 Board #225 June 3, 2:00 PM - 3:30 PM

Intermittent Hypoxia Increases Mitochondrial Dynamics and Biogenesis After Eccentric Exercise-Induced Muscle Damage in Trained Rats

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(No relationships reported)

Mitochondria play a key role in (and are modulated by) exercise physiology, response to hypoxia and to cellular damage. Consequently, hypobaric hypoxia and exercise could play an important role in muscle damage and recovery through mitochondrial regulation.

PURPOSE: To analyze the mitochondrial biogenesis and dynamics in eccentric-exercise induced muscle damage (EIMD) and its recovery with intermittent hypobaric hypoxia (IHH), alone or combined with light exercise.

METHODS: Muscle injury was induced by downhill running to forty-eight Sprague-Dawley trained rats. They were divided into three groups: (1) Ctrl (passive recovery); (2) HYP (exposed to IHH: 4-hour session per day, at 4,000 m); and (3) EHYP (IHH + light aerobic exercise). Each group was analyzed 1, 3, 7 and 14 days after the muscle damage. The following proteins were determined by Western Blotting: PGC-1 α , TFAM, TOM20 (proteins related to biogenesis), Mfn1, OPA-1 and DRP-1 (proteins related to mitochondrial fusion and fission) and Sirt3 (protein related to biogenesis and oxidative stress). All results were normalized to the Ctrl group.

RESULTS: 7 days after the damage induction, both HYP and EHYP groups showed significant increased levels of biogenesis markers PGC-1 α (161 and 159%, respectively) and TOM20 (156 and 147%) compared with the Ctrl group, while only EHYP had a significant increase of TFAM. At t14 only EHYP rats had increased levels of PGC-1 α (128%), but both HYP and EHYP groups showed increased TFAM (153 and 155%) and TOM20 (145 and 144%). Sirt3 was significantly increased in HYP t03 (200%) and in the EHYP group at t07 (127%). Regarding to the mitochondrial fusion proteins, HYP and EHYP rats had increased levels of OPA-1 at t07 (171% both) and t14 (136 and 128%), while Mfn1 was only increased at t14 in EHYP (158%). On the other hand, DRP-1 appeared elevated in HYP t07 (133%) and EHYP t14 (162%) groups. These differences had a p-value < 0.05 .

CONCLUSIONS: after an EIMD protocol, IHH exposure increased mitochondrial biogenesis and dynamics, as well as Sirt3 protein. When combined with light aerobic

exercise, these increments were more consistent and took place in a later stage of the recovery. Taking into account the important role of the mitochondria in the muscle cell, the results suggest that these protocols can improve the muscle damage recovery.

3161 Board #226 June 3, 2:00 PM - 3:30 PM

Effects of Tart Cherry Extract and L-Arginine on Regeneration of Myotube Cultures after Mechanical Strain

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(No relationships reported)

Eccentrically-biased muscle loading produces temporary damage to muscles leading to repair and adaptation. The muscle adaptation process after exercise induced muscle damage results in temporary de-habilitation and compromised resiliency of the muscle. Both tart cherry extract (TCE) and L-arginine (L-Arg) have been shown to reduce strength loss due to muscle loading, but the mechanisms by which they operate are currently unknown. **PURPOSE:** To determine: a) the activation threshold of mechanical loading that induces muscle cell damage and regeneration, and b) to determine the influence of TCE and L-Arg on markers of damage, regeneration, and metabolism in cultured muscle cells. **METHODS:** A FlexCell™ FX5000 system was used to apply mechanical strain to C2C12 myotube cultures. The strain protocol consisted of a fixed magnitude of strain for 0, 2, 4, 6, 12, 18, or 24h. Cultures were then assayed at all time points for lactate dehydrogenase (LDH) release (damage), satellite cell proliferation (regeneration) using a Click-iT® EdU Imaging Kit and mitochondrial metabolism via XTT assay, in the presence or absence of TCE (5 ng/ml) or L-Arg (150 μ m). **RESULTS:** Mechanical strain induced significant ($p < 0.05$) LDH release from myotube cultures after 12h ($64.4 \pm 31.5\%$), and 24h ($60.5 \pm 20.3\%$) of strain, relative to controls. Satellite cell proliferation increased by ($39.5 \pm 5.4\%$) at 6h, ($87.5 \pm 6.1\%$) at 12, peaked at 18h ($135 \pm 7.6\%$), and remained elevated at 24h ($99.5 \pm 11\%$) post-strain, relative to controls ($p < 0.05$). Mitochondrial metabolism was elevated in strained myotube cultures (vs. controls) at 18h ($25.1 \pm 4.3\%$) and 24h ($24 \pm 10.8\%$) post-injury ($p < 0.05$). Changes in satellite cell activation ($r = 0.77$, $p = 0.01$) and metabolism ($r = 0.78$, $p = 0.01$) were highly correlated to LDH release. TCE (5 ng/ml) and L-Arg (150 μ m); however, had no effect on damage, satellite cell activation, or metabolism, compared to untreated cultures. **CONCLUSION:** These findings demonstrate in vitro that the magnitude of the regenerative response to muscle damage is associated with the degree of the initial mechanical insult. Moreover, TCE and L-Arg do not lessen the initial mechanical insult or accelerate regeneration in this model of strain-induced muscle injury.

Funding source: Combat Feeding Research & Engineering Program

3162 Board #227 June 3, 2:00 PM - 3:30 PM

Muscle Damage Over A Resistance-training Period: Repeated Bout Effect Analysed Through Direct And Indirect Markers

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(No relationships reported)

Resistance training (RT) bout promotes exercise-induced muscle damage (EIMD), but repetition of exercise stimulus lead to attenuation of EIMD termed the repeated bout effect. However, EIMD can be measured directly or estimated using indirect markers, and their responses have never been followed nor compared throughout an RT period. **PURPOSE:** Analyze EIMD directly (Z-band streaming) and indirectly (maximal isometric voluntary contraction (MVC), muscle soreness (SOR) and creatine kinase (CK) activity) throughout a RT program. **METHODS:** 10 healthy untrained young men (27 ± 1 years; body mass index 23.6 ± 1.0 kg \cdot m⁻²) performed isoenergetic RT twice a week, for 10 weeks and were evaluated for: a) Z-band streaming magnitude from muscle biopsies at pre- and 48h post-RT bout at the first (T1), third (T2) and last (T3) RT week; and b) MVC in an isokinetic dynamometer, SOR using a visual analog scale and CK activity on plasma were assessed at pre-, 24h (except CK) and 48h post-RT bout at T1, T2 and T3. **RESULTS:** Z-band streaming area increased at 48h at T1 ($10.3 \pm 3.6\%$) and at T2 ($10.8 \pm 2.5\%$) compared with pre at the respective week (T1: $0.1 \pm 0.1\%$; T2: $4.9 \pm 1.0\%$). Z-band streaming was lower at 48h at T3 ($2.4 \pm 0.9\%$) when compared to 48h values at T1 and T2. MVC decreased and SOR increased significantly at 24h (MVC: $78 \pm 5\%$, SOR: 40 ± 6 mm) and 48h (MVC: $78 \pm 5\%$, SOR: 61 ± 8 cm) at T1. In addition, CK increased at 48h (416 ± 81 U \cdot l⁻¹) at T1. There were no significant changes from baseline for the indirect markers at T2 and T3. **CONCLUSION:** The repeated bout effect induced by 4 previous RT bouts (at T2) measured directly by Z-band streaming was small or even negligible, as compared

with attenuations of MVC, SOR or CK. Therefore, the early attenuation of EIMD extensively reported in the literature is seen only when examining indirect markers than by direct measurement of muscle remodelling (Z-band streaming) at least when using a continuous isoinertial RT. Clearly indirect markers of EIMD do not reflect the direct measures of EIMD and protein remodelling seen as Z-band streaming. Indirect markers are poor reflections of actual damage to the muscle per se and should be used with caution.

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3163 Board #228 June 3, 2:00 PM - 3:30 PM
The Effects Of Traditional Chinese Massage On Muscle Damage Status And Blood Leukocyte Subpopulations After An Acute Repeated Jump Exercise

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(No relationships reported)

PURPOSE: Traditional Chinese massage has been used to treat muscle soreness and tightness for centuries in oriental countries. Therefore, the purpose of the present study was to investigate the effect of traditional Chinese massage on muscle damage and the changes of blood leukocyte subpopulation after an acute bout of repeated deep-squat jump exercise.

METHODS: Traditional Chinese massage has been used to treat muscle soreness and tightness for centuries in oriental countries. Therefore, the purpose of the present study was to investigate the effect of traditional Chinese massage on muscle damage and the changes of blood leukocyte subpopulation after an acute bout of repeated deep-squat jump exercise.

RESULTS: An acute jumping exercise significantly increased blood creatine kinase at 24- and 48-hours after exercise in both groups ($p < .05$), whereas there were no difference between two groups. Total white blood cell (WBC) numbers significantly increased at 24- and 48-hours after acute jumping exercise ($p < .05$), but the magnitude of WBC increase was lower in CMSG ($p < .05$). The level of neutrophil (Neu) significantly increased but lymphocyte (Lym) markedly decreased at 24-hours after this muscle-damaging exercise ($p < .05$). However, no difference in leukocyte subpopulation were observed between two groups.

CONCLUSIONS: The CMSG has no effects on attenuating muscle damage status after an acute muscle jumping exercise. Although CMSG suppressed an increase in total WBC after exercise in compared with AR, there were no effects of CMSG on the changes of leukocyte subpopulation in response to acute muscle damaging exercise.

3164 Board #229 June 3, 2:00 PM - 3:30 PM
Changes In Motor-unit Recruitment Strategy And The Repeated-bout Effect

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(No relationships reported)

Eccentric exercise results in an adaptation which attenuates muscle damage from subsequent exercise—termed the “repeated-bout effect (RBE).” This study used decomposition of surface EMG signals (dEMG) to examine if motor-unit recruitment strategy changed concomitant to the RBE. **PURPOSE:** The primary aim of this study was to examine changes in motor-unit activation (mean firing rate, recruitment threshold, and their inter-relationship) of the biceps brachii 3 weeks following a bout of eccentric exercise. **METHODS:** Nine participants performed 5 sub-maximal isometric trapezoid (ramp-up, hold, ramp-down) contractions at force levels corresponding to 50%, 80%, and 100% maximal isometric strength (MVC). Surface EMG signals of the biceps brachii were decomposed into individual motor-unit action potential trains. The relationship between mean firing rate (MFR) of each motor-unit and its recruitment threshold (RT) was examined using linear regression. Eccentric exercise was then performed until biceps brachii MVC had decreased by ~40%. MVC, range-of-motion (ROM), and delayed onset muscle soreness (DOMS) were measured 24-hours, 72-hours, and 1-week following eccentric exercise. Three weeks later all procedures were repeated. **RESULTS:** A RBE was observed with a second bout of eccentric exercise resulting in smaller reductions in MVC ($-32 \pm 14\%$ vs $-25 \pm 10\%$; $p = 0.034$) and ROM (-11% vs 6% ; $p = 0.01$), and reduced soreness ($31.0 \pm 19\text{mm}$ vs $19 \pm 12\text{mm}$; $p = 0.015$) compared to the initial bout of eccentric exercise. When compared to the initial assessment, a decrease in the slope (-0.60 ± 0.13 vs -0.70 ± 0.18 ; $p = 0.029$) and increase in the y -intercept (46.5 ± 8.3 vs 53.3 ± 8.8 ; $p = 0.020$) of the MFR vs. RT relationship during contractions at was observed during contractions at 80% of MVC prior to the second bout of eccentric exercise. No changes were observed at 50% or 100% of MVC. **CONCLUSION:** These findings indicate a long lasting shift in the relationship between MFR and RT of motor-units occurred following muscle damage. The observed shift is consistent with preferential activation of slow-twitch motor-

units which have been shown to be less susceptible to muscle damage than fast-twitch fibers. These findings support the hypothesis that neural adaptations, at least partially, underlie the RBE.

3165 Board #230 June 3, 2:00 PM - 3:30 PM
A Combination Of Exercise And Resveratrol Produces Additive Effects In Reducing Muscle Pathology In Mdx Mouse

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(No relationships reported)

Duchenne

Muscular Dystrophy (DMD) is the most common lethal genetic disease in boys. There is no cure and few treatments. A gene mutation (dystrophin) causes the disease and the pathology is exacerbated by chronic inflammation. Our previous studies have shown that

anti-inflammatory compounds and exercise, each independently, alleviate the pathology. In the current study we sought to examine an additive or synergistic effects by combining treatments.

PURPOSE: The

goal of our study is to determine the ability of a combination treatment, exercise and anti-inflammatory drug, to reduce muscle pathology of the mdx mouse model of DMD. **METHODS:** 24

male mdx mice and 7 control (healthy) mice, approximately 5 weeks of age were randomized to four groups: exercise, exercise and resveratrol, resveratrol, or water for 8 weeks. At study conclusion, skeletal muscle tissue was extracted and preserved for analysis. All

dependent variables were analyzed with a one-way ANOVA to examine differences between treatment groups. A p -value of

< 0.05 was considered significant. **RESULTS:** All

mice completed the study. There were no differences in distance run over the course of 8 weeks ($p > 0.05$). Inflammation was quantified in TA and

Gastrocnemius muscle by immunohistochemistry for CD45. Exercise decreased inflammation ($22 + 6\%$, $p =$

0.04), while resveratrol produced a trend ($p = 0.09$) of decreased inflammation. A standard histologic analysis of the

gastrocnemius revealed a decrease in fiber necrosis due to the combination treatment of exercise and resveratrol ($p < 0.05$). A preliminary analysis of and utrophin by western blot showed difference between treatment groups. Exercise and nutraceutical treatment have a positive additive effect on some variables of muscle health in the mdx mouse. **CONCLUSIONS:** Combining exercise with pharmaceutical treatments is likely

to produce a greater positive impact on muscle health than pharmaceutical treatments alone.

3166 Board #231 June 3, 2:00 PM - 3:30 PM
Establishing a Functional Model of Mouse Muscle Injury and Recovery

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(No relationships reported)

Purpose: To establish an in vivo mouse model of muscle injury and recovery.

Methods: Sixteen genetically identical female mice were randomized to two 8-mouse injury cohorts (either Phosphate Buffered Saline (PBS) (control) or cardiotoxin (injured)). Injections were performed unilaterally to the right tibialis anterior. One protocol (nocturnal wheel running) was evaluated longitudinally throughout the 17 day study period, while the remaining 5 protocols (dynamic weight bearing, treadmill gait analysis, Rota-Rod performance, open field testing, and grip strength) were evaluated as one-time assays over post-injury days 5-6. All experiments were conducted at Jackson Laboratory, Bar Harbor, Maine.

Results: Of the six protocols examined, only the Rota-Rod assay demonstrated a statistically significant difference between injured and control mice ($p < 0.0018$). The Rota-Rod is a rotating rod that increases velocity until the mouse is no longer able to stay on and falls to a soft surface for a maximum trial duration of 300 seconds. The mean latency (seconds until falling) was 298 seconds for control mice and 186 seconds for cardiotoxin-injured mice, with a significant difference of 111 seconds (95% CI 17.0-205.5). There was no significant difference in the two groups in terms of wheel running, weight bearing, gait, open field, or grip strength.

Conclusion: The Rota-Rod consistently and significantly delineated between cardiotoxin-injured mice and placebo mice at day 5 post-injury. It is likely that even

greater statistical significance would result from Rota-Rod trials lasting greater than 300 seconds. It is unknown how Rota-Rod would perform at other time points. Unilateral cardiotoxin injection to the tibialis anterior and subsequent Rota-Rod trial provides a low cost easy to perform in vivo murine model of muscle injury functional assessment within which novel therapies can be assessed.

3167 Board #232 June 3, 2:00 PM - 3:30 PM
The Efficacy of Cooling with Phase Change Material for the Treatment of Exercise-Induced Muscle Damage
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(No relationships reported)

PURPOSE: The limited efficacy of cold-water immersion in diminishing muscle damage may be due to inadequate treatment duration. Phase Change Material (PCM) can provide prolonged cooling. The purpose of this study was to examine the efficacy of post-exercise PCM cooling on strength loss and pain after eccentric exercise. **METHODS:** Four men and 2 women (39±13 yo) performed isometric quadriceps strength tests at 30°, 50° and 70° knee flexion, then performed 120 eccentric quadriceps contractions (Biodes System 2, Shirley NY) at 90% MVC. The protocol was repeated on the contralateral leg. PCM packs were then placed inside compression shorts over the quadriceps. PCM at 15°C were applied to the first leg, and PCM at room temperature were applied to the second leg. The 15°C packs were replaced after 3 hr (6 hr total). Quadriceps skin temperature was recorded continually. Strength and pain (VAS 0-10 scale) were assessed for 4 days. The protocol was repeated 5 mo later (room temperature PCM on both legs). Since cooling one leg might have a systemic effect on the contralateral leg, the effect of cooling was assessed by Treatment by Time ANOVA with treatments defined as Direct Cooling (leg with 15°C packs), Systemic Cooling (leg with room temperature packs contralateral to the 15°C packs), and Control (legs tested 5 mo later). **RESULTS:** Skin temperature averaged 21±1° C for Direct Cooling versus 31±2° C for Systemic Cooling and Control (P<0.01). Strength (% of baseline) across 4 days post-exercise was 101±9% for Direct Cooling, 94±16% for Systemic Cooling, and 91±7% for Control (Linear Treatment effect P<0.05). Peak strength loss occurred 1 day post exercise: Direct Cooling, 93±13%, Systemic Cooling, 92±16%, Control 83±10% (Linear Treatment effect P<0.01). Pain across 4 days post exercise was 0.9±1.0 for Direct Cooling, 1.6±1.4 for Systemic Cooling, and 2.5±2.4 for Control (Linear Treatment effect P<0.05). Peak pain occurred 2 days post exercise: Direct Cooling, 1.7±1.9, Systemic Cooling, 2.7±2.3, Control 4.0±0.7 (Linear Treatment effect P<0.05). **CONCLUSIONS:** Prolonged post-exercise muscle cooling using PCM resulted in minimal strength loss and pain compared to control (with a possible systemic effect also evident). This study demonstrates the potential utility of a cooling garment for accelerating recovery from damaging exercise.

3168 Board #233 June 3, 2:00 PM - 3:30 PM
Does Repetitive Stress Damage Judo Practitioners' Elbows? A Stress Ultrasound Imaging Study
 Yasushi Fukuda¹, Osamu Yuzuki¹, Mitushi Hirokawa², Hidemasa Tokuyasu¹, Koji Koyama¹. ¹*Tokyo Ariake University of Medical and Health Sciences, Tokyo, Japan.* ²*Toin University of Yokohama, Yokohama, Japan.*
(No relationships reported)

Ultrasound imaging is a new technique being used in the field of sports medicine. Recent studies reported that stress ultrasound identified that the ulnar collateral ligament (UCL) in the dominant elbow of asymptomatic baseball pitchers is thicker, and has increased laxity with valgus stress. Judo practitioners often experience elbow injuries due to repetitive valgus stress to their lifting hand (tsurite) during Seoi-Nage (shoulder throw). However, there have been no reports documenting the elbow condition of judo practitioners on stress ultrasound. We hypothesized that judo practitioners would develop morphological changes in the lifting hand, such as thickening of the UCL and increased ulnohumeral joint space. **PURPOSE:** The purpose of the study was to compare the condition of the UCL and of the ulnohumeral joint space between the lifting hand and the pulling hand (hikite) in Japanese collegiate judo practitioners through stress ultrasound. **METHODS:** The subjects were 36 Japanese male collegiate judo practitioners (age, 19.9 ± 1.2 years; years of experience, 12.9 ± 2.4), recruited from the Japanese Judo College Student Federation. Stress ultrasound examinations were performed with 60° of flexion, at rest and under 40N of valgus stress. The UCL thickness and ulnohumeral joint space width were measured in the lifting hand and the pulling hand. UCL thickness at rest and joint space at rest and under stress were compared bilaterally with Mann-Whitney U test at alpha level = 0.05. **RESULTS:** UCL thickness was found to be similar in both elbows (lifting hand 4.7 ± 0.8 vs. pulling hand 4.5 ± 0.7 mm; P = 0.20). The ulnohumeral joint space was similar between elbows under stressed and unstressed condition. (stressed: lifting hand 2.8 ± 0.9 vs. pulling hand 2.5 ± 0.8 mm; P = 0.22; unstressed: lifting hand 4.1 ± 1.4 vs. pulling hand 3.6 ± 1.3 mm; P = 0.17). The mean change in joint space from rest to the

stressed condition was 1.3 mm in the lifting hand and 1.1 mm in the pulling hand (P = 0.30). **CONCLUSIONS:** Japanese collegiate judo practitioners had not developed the UCL thickness and increased ulnohumeral joint space reported previously with US baseball pitchers.

3169 Board #234 June 3, 2:00 PM - 3:30 PM
Muscle Cramp Susceptibility Increases Following a Prior Muscle Cramp
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Many athletes develop multiple muscle cramps in the same muscle during exercise. This phenomenon may be due to cramp-induced increases in nervous system excitability. The effect of prior cramps on future cramp risk or how long prior cramps affect cramp risk is unknown. **PURPOSE:** We tested 2 hypotheses: (1) volitionally-induced muscle cramps will decrease cramp threshold frequency (TF) thereby indicating greater cramp risk and (2) cramp TF would be lower 5 minutes post-cramp but return to baseline after 30 minutes. **METHODS:** A cross-over, counterbalanced, repeated measure experimental design guided the study. Fifteen subjects capable of volitionally inducing a flexor hallucis brevis (FHB) cramp completed the study (11 males, 4 females: age=25±5 y, height=180.8±12.1 cm, mass=85.0±11.8 kg). On 4 days, we measured cramp TF (the lowest electrical stimulation frequency necessary to induce cramp). On day 1, baseline cramp TF was determined by electrically stimulating the tibial nerve (two square-wave bursts, burst duration=1 s, pulse width=1 ms, pulse delay=1 ms, stimulus intensity=80V). Initial burst frequency was 4 Hz. If cramp was not induced, subjects rested 1 min and frequency was increased by 2 Hz. This process continued until a cramp occurred. Subjects rested 10 minutes, volitionally induced a FHB cramp, and rated the volitionally-induced cramp's intensity (0=weakest cramp, 100=strongest cramp). On testing days 2-4, subjects first voluntarily induced a FHB cramp and then waited either 5 minutes, 30 minutes, or 60 minutes before cramp TF was reassessed. Volitionally-induced cramp amplitude, cramp duration, and perceived intensity were measured each day to ensure consistency of volitionally-induced cramps. **RESULTS:** Volitionally-induced cramp amplitude (F3,42=1.1, P=0.37), cramp duration (F3,42=0.7, P=0.54), and perceived cramp intensity (F3,42=1.2, P=0.33) were similar each day. Volitionally-induced muscle cramps significantly decreased cramp TF (F2,25=4.5, P=0.02). Baseline cramp TF (18±6 Hz) was higher than the 5 minute (14±6 Hz), 30 minute (14±5 Hz), or 60 minute TF (14±5 Hz, P<0.05). **CONCLUSIONS:** Prior muscle cramps increase cramp risk for at least 60 minutes. Clinicians should continue treatment interventions to prevent cramps for >60 minutes to decrease the probability of recurrence.

3170 Board #235 June 3, 2:00 PM - 3:30 PM
Effects Of Kinesio-Taping On Recovery After Exercise-Induced Muscle Damage: A Randomized, Placebo-Controlled Trial
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Exercise-induced muscle damage is a well-known phenomenon that happens after performing lengthening contractions or unaccustomed exercise. Studies have not yet confirmed the best way to alleviate symptoms of this phenomenon. **PURPOSE:** To examine the effects of Kinesio-Taping (KT) on recovery after exercise-induced muscle damage. **METHODS:** Fifty-four non-athletic volunteers were assigned randomly in KT and placebo KT groups. The damaging exercise consisted of 100 consecutive drop-jumps from a 0.60 m high platform. Kinesio-tape was applied with the fan technique on the quadriceps muscle in the KT group. Placebo KT group received the kinesio-tape with no technique and tension. Muscle soreness, maximal isometric quadriceps muscle strength, vertical jump height, and blood analyses (creatine kinase, lactate dehydrogenase, myoglobin and C-reactive protein) were measured pre-, immediately post-, 48 h post-, and 72 h post-exercise. **RESULTS:** Significant time effects were observed for all of the dependent variables (p<0.05), except serum C-reactive protein level (p>0.05). The decrease in muscle soreness in the KT group was higher compared to the placebo KT group between 72h post- and immediately post-exercise (p=0.012). The serum creatine kinase level was found higher in the KT group at 48h post-exercise when compared with the placebo KT group (p=0.022). No significant differences were identified between the groups for the other outcome measures. **CONCLUSION:** The findings of this study revealed that KT reduces muscle soreness but it has no effects on maximal quadriceps isometric strength

and vertical jump height, as well as the serum LDH, myoglobin, and CRP levels. In addition, it may negatively affect the muscle damage with increasing CK level, and delays the recovery.

F-33 Free Communication/Poster - Neuroscience and Sport

Friday, June 3, 2016, 1:00 PM - 6:00 PM
Room: Exhibit Hall A/B

3171 Board #236 June 3, 2:00 PM - 3:30 PM The Effects of Perceptual Learning on Visual Processing Functions in Professional Baseball Players

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Reported Relationships: D.N. Cunningham: Contracted Research - Including Principle Investigator; Glasses off.

Perceptual learning (PL) has been shown to induce neuroplasticity in adults with poor vision due to abnormal development (amblyopia) or blurred input from the eyes (presbyopia, myopia), resulting in improved visual functions, including vision sharpness. Recent studies have shown that PL can have a positive impact on the vision performance in young subjects with normal or superior vision. **Purpose To determine if PL can enhance vision performance of professional athletes with already superior visual processing functions, including visual acuity, contrast sensitivity, reaction time, and processing speed./B>:**

Methods Twelve (12) professional baseball players had clinical baseline assessments of ocular health and of their visual functions using standard ETDRS, Stereo Randot, Ishihara color test and dynamic evaluation on PC from a distance of 150 cm of their visual functions. Players engaged in daily app-based PL training exercises at a personally convenient location. The PL exercises were conducted at ~40cm distance, lasting ~12-15 minutes per session, using the GlassesOff app on an iPhone. Eleven (11) players completed an average of 29 sessions over a 40-day time period. Ten (10) players completed final exit evaluations. Baseline and exit comparisons were made using a 2-way ANOVA analysis with repeated measures./B>:

Results Before training, players started with monocular supervision VA of -0.1 which improved by 0.055±0.013 (mean±SEM) achieving mean of -0.16 logMAR (p=0.015). Binocular distance VA improved by 0.032±0.013 (logMAR, p=0.01) achieving mean of -0.2 logMAR. Crowded visual acuity was improved by ~32% from an excellent level of young participants after training, from baseline VA 0±0.02 to -0.12 ±0.02 after completing training (p<0.0001). Reaction time was improved by ~19% (p:

Conclusion PL can induce improved neural vision processing speed in professional athletes, thereby not only overcoming the limitations posed by crowding and sequential presentations, but resulting in enhanced visual acuity, dynamic visual acuity, contrast sensitivity, and reaction time./B>:

3172 Board #237 June 3, 2:00 PM - 3:30 PM Heart Rate Variability in Adolescents Following a Sport-Related Concussion

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Heart Rate Variability in Adolescents Following a Sport-Related Concussion
Sport-related concussion (SRC) or mild traumatic brain injury symptoms are usually resolved within 2 weeks after the injury, but a growing body of evidence suggests persistent deficits of the central nervous system months and years after the injury. A concussion could also alter the autonomic nervous system (ANS), which regulates heartbeat, blood pressure, respiration, thermoregulation and circadian rhythm. A simple and non-invasive way to evaluate ANS function is to measure heart rate variability (HRV). HRV, the variation of the beat-to-beat interval, is one of the physiological manifestations of the ANS. HRV was showed as a reliable marker of SNA dysfunction in patients who suffered from a traumatic brain injury. However, very few studies evaluated the effects of sport-related concussion on HRV and all of them only involved adults. Together, these studies suggest ANS alteration days to months after the injury. Nonetheless, the outcomes of concussion in youth regarding HRV and ANS remain unexplored and unknown. **PURPOSE:** Therefore, we sought to evaluate the influence

of concussion on HRV in adolescents aged from 11 to 17 years. **METHOD:** To do so, we tested 30 hockey players with a history of concussion (HC) and 22 controls without a history of concussion (NHC). Time since injury was on average 25 months (±24,5). For each participant, we recorded the R-R interval with a chest strap heart rate monitor during all the session. After 5 minutes of sitting rest, the participants exercised on a cycle ergometer during 20 minutes between 60 and 70% of their theoretical maximal heart, following a gradual load increase. Then, there was a cool down for 2 minutes on the ergocycle and a rest period in sitting position for 10 minutes. We compared the HRV of the HC and the NHC during 4 minutes of the pre-exercise rest and 4 minutes of the post-exercise rest. **RESULTS:** We found no significant difference in any HRV measure of the temporal or frequency domains, neither did we find any difference in the non-parametric measures of HRV (p > 0.05). **CONCLUSION:** Our results suggest that, if there are ANS deficits in adolescents following a concussion, they do not manifest themselves under the conditions that we tested.

3173 Board #238 June 3, 2:00 PM - 3:30 PM

Oorbitofrontal Connectivity and Impulsivity Characteristics in Collegiate Football Players

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Competitive football players may vary in impulsive traits and neurobiologic status. Previous models of impulsivity have hypothesized that frontal regions may play a role in impulsive behavior; however, the limited sensitivity of standard clinical imaging approaches for detecting neurobiologic changes associated with brain functions has made it difficult to identify brain regions related to this behavior.

PURPOSE:

The aim of the study was to assess the relationship between self-report ratings of impulsivity and magnetic resonance functional connectivity (FC) of the orbitofrontal cortex (OFC).

METHODS:

Thirty-two members of an NCAA Division 1 football team completed the ImpACT (Iverson, 2005) and imaging with a resting state protocol (Fox, 2007) during preseason camp. Impulse Control scores from the ImpACT were utilized to examine impulsive behavior. BOLD echo planar images were obtained during the 8-minute resting-state using a 3T Siemens Trio scanner. fMRI images were analyzed using SPM8 and Matlab. Functional connectivity maps were computed by using a standard seed-based whole brain correlation method. One-sample t-tests were done to determine brain regions showing significant functional connectivity to the left and right OFC (p 20 voxels). Regression analyses between OFC connectivity and ImpACT Impulse Control were performed

RESULTS:

Football players demonstrated strong (hyper)connectivity between the left and right OFC and frontal and temporal brain regions. However, only the left OFC showed significant connectivity between the amygdala, the temporal lobe region, and the inferior parietal lobe, which was negatively correlated (p<.0001) with ImpACT Impulse Control ratings.

CONCLUSIONS:

These results suggest that OFC connectivity in college football players is strongly correlated, which reflects highly synchronized brain circuitry at rest. Furthermore, players with lower connectivity showed higher impulsivity scores. These results are consistent with previous reports implicating frontal brain circuitry in inhibitory control and suggest that damage to these circuits may alter or increase impulsive behavior.

F-34 Free Communication/Poster - Nutrition and Aging

Friday, June 3, 2016, 1:00 PM - 6:00 PM
Room: Exhibit Hall A/B

**3174 Board #239 June 3, 3:30 PM - 5:00 PM
Increased Capacity of Work Production following a 16-Week Treadmill Walking Protocol in Sedentary Older Women**

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Aging is associated with reduced ability to perform activities of daily living. Aerobic exercise is known to improve cardiorespiratory fitness, but little is known regarding changes brought about by exercise training in the capacity of producing work at submaximal and maximal levels. **PURPOSE:** To quantify changes in cardiorespiratory fitness, energy expenditure, and work produced at submaximal and maximal levels following an aerobic training program in sedentary older women. **METHODS:** Sedentary females participated in a 16-week moderate-intensity treadmill walking protocol (n = 72, age = 65 ± 4 years). At baseline and end-intervention, indirect calorimetry was used to determine resting metabolic rate and oxygen consumption during graded maximal exercise tests on a motor-driven treadmill. Peak oxygen consumption ($\dot{V}O_{2Peak}$) was measured and used to calculate 50% and 75% $\dot{V}O_{2Reserve}$ ($\dot{V}O_{2R}$). Work was calculated at each level (50% and 75% $\dot{V}O_{2R}$, and $\dot{V}O_{2Peak}$) by multiplying Weight x Speed x Angle of Treadmill Inclination x Time. Metabolic Equivalents (METs) were calculated using oxygen consumption ÷ resting metabolic rate for each individual. Energy Expenditure was calculated by multiplying Absolute $\dot{V}O_{2}$ x Respiratory Quotient Coefficient. **RESULTS:**

	Variable	Baseline	End-Intervention
50% $\dot{V}O_{2R}$	METs	5.37 ± 0.91	5.6 ± 1.01
	Energy Expenditure, Kcal·min ⁻¹	4.67 ± 0.96	4.77 ± 0.96
	Work, kg·m·2min ⁻¹	360.63 ± 229.75	355.52 ± 227.18
75% $\dot{V}O_{2R}$	METs	7.55 ± 1.36	7.9 ± 1.52
	Energy Expenditure, Kcal·min ⁻¹	6.67 ± 1.44	6.9 ± 1.43
	Work, kg·m·2min ⁻¹	838.98 ± 289.59	967.56 ± 369.14*
$\dot{V}O_{2Peak}$	METs	9.74 ± 1.81	10.2 ± 2.03
	Energy Expenditure, Kcal·min ⁻¹	8.98 ± 1.98	8.93 ± 1.85
	Work, kg·m·2min ⁻¹	980.6 ± 278.78	1144.53 ± 401.59**

As shown in the above Table, there was ~14% increase in work at 75% $\dot{V}O_{2R}$ (p < 0.05) and ~15.5% increase in work at $\dot{V}O_{2Peak}$ (p < 0.001) despite similar MET levels and metabolic costs (p > 0.05). **CONCLUSION:** Aerobic training can lead to improved capacity to produce more work at submaximal and maximal efforts. These findings suggest an improved ability to perform activities of daily living which is important for the older sedentary population.
Supported by NIH/NIA R00AG031297

**3175 Board #240 June 3, 3:30 PM - 5:00 PM
Elderly Rowers Have Favorable Metabolic Profiles Regardless Of Genetic Predisposition**

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(No relationships reported)

Rowing exercise with boats on water or ergometers at sports gyms has been widely performed by elderly people worldwide. Our previous studies have demonstrated that elderly rowing-trained men had higher cardiorespiratory fitness and lower risk for coronary heart diseases than untrained men. However, elderly rowers had high levels of abdominal fat comparable to that of untrained men, despite favorable metabolic profiles. This suggests that elderly rowers have favorable genetic profiles against metabolic diseases.

PURPOSE: To determine whether or not a favorable metabolic profile in elderly rowing-trained men was due to genetic predisposition.

METHODS: The study participants were elderly rowing-trained men (ROW: n = 33; 70.1 ± 4.2 years) and age-matched controls. We measured maximal oxygen uptake ($\dot{V}O_{2max}$) and divided the control group members into low-fitness (LF-CON: n = 25; 71.3 ± 4.3 years) and high-fitness groups (HF-CON: n = 26; 68.7 ± 2.6 years), according to the median value of $\dot{V}O_{2max}$. Waist circumference and visceral fat area assessed with magnetic resonance imaging were used as the indices of abdominal obesity. Genetic risk of obesity, type 2 diabetes, and dyslipidemia were evaluated by constructing a genetic risk score (GRS). We genotyped 5-11 single nucleotide polymorphisms (SNPs) associated with each trait, and GRS was calculated by summing the number of risk allele of each SNP.

RESULTS: ROW and HF-CON had higher $\dot{V}O_{2max}$ (ROW: 32.8 ± 4.0 mL/kg/min, LF-CON: 22.7 ± 2.7 mL/kg/min, HF-CON: 30.2 ± 2.7 mL/kg/min, p < 0.001) and lower glycated hemoglobin level (ROW: 4.95 ± 0.18 %, LF-CON: 5.18 ± 0.36 %, HF-CON: 4.96 ± 0.25 %, p = 0.008) than LF-CON. Serum HDL cholesterol level was higher in ROW than in LF-CON and was not significantly different between ROW and HF-CON (ROW: 65.4 ± 14.0 mg/dL, LF-CON: 56.5 ± 13.2 mg/dL, HF-CON: 64.1 ± 17.1 mg/dL, p = 0.023). ROW had higher waist circumference than HF-CON (ROW: 86.4 ± 6.7 cm², LF-CON: 86.7 ± 7.4 cm², HF-CON: 81.9 ± 6.2 cm², p = 0.020), although $\dot{V}O_{2max}$ and metabolic variables were not significantly different between these groups. GRS for obesity, type 2 diabetes, and dyslipidemia were not different among the 3 groups.

CONCLUSIONS: The present study indicates that the favorable metabolic profile of elderly rowing-trained men was not due to their genetic predisposition.

**3176 Board #241 June 3, 3:30 PM - 5:00 PM
How Do Different Drinks Affect Body Fluid Balance: Does Age Make a Difference?**

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(No relationships reported)

Aging is associated with a reduced ability to maintain homeostatic control over a variety of body functions, including maintenance of body fluid balance. **PURPOSE:** To compare fluid balance responses to the ingestion of commonly consumed drinks in young and older men. **METHODS:** 16 healthy male participants: 8 young (mean (SD) 25.1(5.2) y and 8 older 60.1(5.8) y were recruited. A venous cannula was inserted and a baseline blood sample was obtained. Initial near nude body mass was recorded after emptying their bladder to provide a urine sample. Participants then consumed a fixed volume (1L, 250ml every 15 min) of water (W, control), fruit juice (F, 0 mmol/L Na⁺; 23 mmol/L K⁺; 21 kcal/100 ml), sports drink (S, 29 mmol/L Na⁺; 2.7 mmol/L K⁺; 28 kcal/100ml) or skimmed milk (M, 19mmol/L Na⁺, 40mmol/L K⁺; 35 kcal/100ml). Participants urinated at the end of the 60-minute drinking period and every hour for the next 3 hours. Urine mass was recorded and a sample obtained for analysis of urine osmolality and electrolytes (Na⁺ and K⁺). Blood samples were drawn immediately after the drinking period and every hour for the next 3 hours, for serum osmolality and electrolytes. **RESULTS:** Initial serum osmolality demonstrated that both groups began euhydrated (young, 298(3); old, 297(4) mOsm/kg). Mean(SD) total urine mass loss over 3 hours for W (1256(222) g) was significantly different (p<0.01) to M (876(358) g) but not to F (1139(354) g) or S (1216(262) g) in the young group. No difference in total urine mass loss was observed between drinks in the older group (W, 1217(507) g; F, 1124(160) g; S, 1100(228) g; and M, 974(137) g). There was no difference in Na⁺ net balance with M in the older group (-0.30(0.16) g compared to young (-0.44(0.38) g). Net K⁺ balance in both young and old, respectively, was different following M ingestion (+0.09(0.62) and +0.46(0.35) g) compared to W (-1.10(0.52) and -1.22(0.97) g) and S (-1.11(0.61) and -0.71(0.57) g) but was not different between groups. **CONCLUSIONS:** In young adults M helps to maintain positive net fluid balance for longer than other drinks. In older adults this effect of M is not observed despite similar net electrolyte balance responses. Future work should more fully explore these potential differences in fluid balance responses to drink ingestion between young and older adults.

**3177 Board #242 June 3, 3:30 PM - 5:00 PM
Adiposity Indexes Comparisons And Cut-off Values In The Prediction Of Disability In Older Women**

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(No relationships reported)

PURPOSE: To compare adiposity indexes and propose its cut-off values in the prediction of disability in older women.

METHODS: 87 volunteers (67.27 ± 6.45 years) took part in this cross-sectional study, who underwent functional tests, body composition assessment using DXA, and had 5 anthropometric indexes measured (Waist Circumference - WC, Waist-to-Height Ratio -

WHtR, Body Mass Index - BMI, Body Adiposity Index - BAI, and Conicity Index - C index). Senior fitness test battery was performed to evaluate functionality, consisting of 30-s chair stand, 8-foot up-and-go, and 6-minute walk. Disability was determined as at least two from three performance scores below reference values. Pearson's correlation was conducted to identify relationship between variables. Cut-off values to predict disability were obtained from Receiver's Operating Characteristic (ROC) curves considering its sensibility and specificity. Area under the ROC curve and confidence intervals were used to compare the predictive ability of each adiposity index. Moreover, odds ratio for each adiposity index were calculated for disability outcome. **RESULTS:** Disability prevalence was 36.8%. Senior fitness test battery scores showed stronger associations with WC ($r=-0.345$; $p<0.01$), WHtR ($r=-0.417$; $p<0.01$), and BAI ($r=-0.296$; $p<0.01$). The cut-off values for each adiposity index were 89.5cm, 39.2%, 26.93kg/m², 34.6%, 0.51cm, and 1.23, for WC, DXA-derived body fat percentage, BMI, BAI, WHtR, and C index, respectively. Significant greater risks for disability outcome were found for volunteers who had WHtR (7.75; CI: 1.0 - 63.2; $p=0.05$) or WC (3.16; 1.3 - 7.8; $p<0.01$) measurements above cut-off values. None of the remaining adiposity measurements predicted disability risks. **CONCLUSIONS:** Adiposity indexes considering abdominal fat (WC and WHtR) had stronger relationship with functional performance and its cut-off values exhibited predicative skill for disability in older women, in spite of gold standard body composition evaluation using DXA. Easy and low cost implementation of these measurements suggests potential practical applications.

3178 Board #243 June 3, 3:30 PM - 5:00 PM

Chronic Exercise Reduces The Sirt1 S-nitrosation In The Liver Of Old Mice

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(No relationships reported)

The SIRT1 deacetylase protein plays a crucial role in cellular metabolism. It is known that during aging decreases in SIRT1 activity can contribute to development of metabolic disorders. **PURPOSE:** Determine if the reduction in iNOS genetically (knockout) or by exercise is related to increased activity of SIRT1 by S-nitrosation and/or the post-translational mechanisms responsible for this phenomenon. **METHOD:** "Young" (Y) (2 months), "sedentary-old" (O) (30 mo) "trained old" (TO) (30 mo) and "iNOS KO old" (iNOSKO) (30 mo) groups were submitted to a treadmill training for 4 weeks (5 days/week) at the intensity of 60% of maximum power ($n=5$). During the last experimental week, we performed a pyruvate tolerance test (PTT) and glucose samples were collected at rest, 30 and 60 minutes after pyruvate administration. 24 hours after the last exercise bout the animals were euthanized and the liver extracted for western blotting analysis. The database 'genenetwork.org' was used to perform bioinformatics analysis from data containing mRNA values from liver samples of bxd mice and humans, using mitochondrial biogenesis markers that were strongly correlated with the iNOS gene. Results were analyzed by One-Way ANOVA and Bonferroni post hoc test when necessary. **RESULTS:** "Y" and "TO" animal had reduced glucose production compared to "O" at minute 30 ($Y=72.8\pm 4.6$ vs $TO=124.9\pm 1.5$ vs $O=261.9\pm 32.2$ mg/dl, $p<0.05$) during the PTT and area under glucose curve during PTT was increased in "O" animals compared to "Y" ($Y=5352.8\pm 786.6$ vs $O=9738.7\pm 1390.0$ mg/dl.60min, $p<0.05$). Liver analysis showed reduced levels of gluconeogenesis enzymes G6Pase and PEPCK in "Y", "TO" and "iNOSKO" compared to "O" animals. We found reduced iNOS expression, SIRT1 S-nitrosation and improved mitochondrial complexes responsible for ATP synthesis and fatty acid oxidation (MTCO1 and Uqcrc1) in both "TO" and "iNOSKO" groups compared to "Y" and "O" groups. Bioinformatics analysis shows that bxd iNOS mRNA is negatively correlated to mitochondrial biogenesis markers. Such finding corroborates human analysis. **CONCLUSION:** The chronic physical exercise promotes attenuated expression of iNOS and S-nitrosation of SIRT1 contributing to increased activity of SIRT1 protein, improving liver function in aging mice. Supported by CNPq, Capes and FAPESP (2013/20293-2).

3179 Board #244 June 3, 3:30 PM - 5:00 PM

Regular Exercise And Resveratrol Attenuates Oxidative Damage And Ameliorates In Aging Mouse Heart: Apoptosis And Fibrosis Signal Pathway

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(No relationships reported)

Regular exercise is known to exhibit various health benefits in reducing risks of age-related diseases such as cardiovascular diseases, type 2 diabetes and cancer. Resveratrol (Res) which is a polyphenolic compound has various biological properties. In the present study, we investigated whether the aging associated changes in the heart can be reversed by exercise or resveratrol, and the mechanisms of aging related heart failure in senescence-accelerated mouse (SAM). **PURPOSE:** The purpose of this study was to investigate whether a 10 week exercise training can suppress senescence-oxidative stress markers of heart tissues. **METHODS:** Thirty-two male senescence-accelerated mice were administered with Res (100 mg·kg⁻¹·d⁻¹) for 12 weeks. SAM were divided into the following four groups: (1) CONTROL(C), (2) Res, (3) EXERCISE, and (4) Res+EXERCISE. Expressions of Cytochrome C, Bax, Bcl-2, Caspase 9, cleaved Caspase 3, cleaved PARP, MMP2 and MMP9 in heart apoptosis and fibrosis pathway are detected. **RESULTS:** The results show that apoptosis index cleaved Caspase 3 and cleaved PARP were significantly lower in Res and Res+EXERCISE than in C group ($P<0.05$); apoptosis protective protein Bcl-2 is significantly higher than C group ($P<0.05$). In Res+EXERCISE group through increasing PI3K-Akt signaling activities and inhibiting apoptosis and fibrosis pathway activities compared with C group **CONCLUSION:** These results suggest that the intake of resveratrol together with habitual exercise is beneficial for suppressing the aging-related decline in physical performance that may suppress apoptosis and fibrosis markers in the heart tissues in senescence-accelerated mouse. This study was supported by a research grant from (MOST103-2410-H-029-037)

3180 Board #245 June 3, 3:30 PM - 5:00 PM

The Relationship between Fat Intake, Physical Activity, and Muscle Lipid in Aged Individuals

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(No relationships reported)

Dietary fat intake, physical activity (PA), and BMI play a role in affecting age-associated intramyocellular (IMCL) and extramyocellular lipid (EMCL) content. Animal studies suggest that higher intakes of saturated fatty acids (SFA) are associated with more IMCL and lower lipid turnover. Conversely, high intake of polyunsaturated fatty acids (PUFA) and monounsaturated fatty acids (MUFA) are associated with increased lipid turnover and improved metabolic health. However human data on IMCL pool size remains inconclusive and the relationship between dietary fat intake, PA, and **PURPOSE:** The purpose of this 13-wk trial was to examine how dietary fat intake and PA contribute to IMCL and EMCL in healthy, aged individuals. **METHODS:** At baseline (BL), midpoint (MP), and endpoint (EP), three 24-hour dietary recalls and accelerometry were used to measure dietary variables and PA. Gastrocnemius IMCL and EMCL were measured with magnetic resonance spectroscopy and fat segmentation at BL and EP. Pearson correlations examined the relationship between dietary intake, PA, and muscle lipids. Factors known to contribute to IMCL and EMCL were analyzed in a linear regression model. **RESULTS:** Eleven participants completed all study measures. Mean age and BMI were 68.6 ± 7 YO and 25.5 ± 4 kg/m², respectively. BMI ($p<0.006$) was a better predictor of EMCL than age ($p=0.98$), PA ($p=0.83$), and percent calories from fat ($p=0.67$). PA was not associated with EMCL or IMCL ($p>0.05$). Dietary energy intake from fat was $34.6\pm 5\%$ and was positively associated with IMCL ($p=0.01$). The unsaturated to saturated fatty acid ratio, [(PUFA + MUFA)/SFA] was negatively correlated with IMCL ($p=0.008$) and was a better predictor of IMCL ($p=0.096$) than age ($p=0.66$), BMI ($p=0.69$), and PA ($p=0.77$). **CONCLUSION:** Although preliminary, these data suggest that a higher unsaturated to saturated fatty acid intake ratio is inversely associated with IMCL and was the best predictor of IMCL content, while PA was not associated with either muscle lipid depot. Along with exercise and maintaining a healthy weight, increased consumption of MUFA and PUFA may have a favorable effect on muscle lipid profiles and contribute to enhanced metabolic health. Supported by NIH grants R21AG046762-01A1 and T32DK007778-14.

F-35 Free Communication/Poster - Nutrition and Chronic Disease

Friday, June 3, 2016, 1:00 PM - 6:00 PM

Room: Exhibit Hall A/B

**3181 Board #246 June 3, 2:00 PM - 3:30 PM
Effect of a Single Bout of Aerobic Exercise on NF-κB in Peripheral Blood Mononuclear Cells**Kelly N. Z. Fuller, Corey M. Summers, Rudy J. Valentine. *Iowa State University, Ames, IA.**(No relationships reported)*

Lipemia and systemic inflammation are involved in the development of metabolic disorders including atherosclerosis, Type 2 diabetes, and metabolic syndrome. Nuclear factor-κB (NF-κB), elevated by circulating lipids, has long been recognized as a key pro-inflammatory transcription factor involved in the pathogenesis of these and other diseases. Despite the known anti-inflammatory and lipid lowering effects of exercise, its effect on NF-κB remains unclear.

PURPOSE: The aim of this study was to determine the effect of a single bout of aerobic exercise on fasting NF-κB phosphorylation in circulating peripheral blood mononuclear cells (PBMCs).

METHODS: Healthy male subjects (n=9, age=24±6, BMI=23±4, %Fat=19±8) reported to the laboratory following an overnight fast (12-14h) on two separate occasions for blood draws. The afternoon prior (16-18h) to one of the morning visits participants completed an acute bout of aerobic exercise (45-min of cycling at 70-75% of VO₂ peak). Physical activity was monitored throughout the study and, with the exception of the prescribed exercise, participants were instructed to remain sedentary for the 24h prior to each visit. Fasting triglycerides (TG) were quantified using an *in vitro* assay and PBMCs were isolated using the Ficoll Paque Plus method. Cells were lysed and equal protein was separated by SDS-PAGE. Phosphorylated NF-κB p65 (Ser536) protein, as an indicator of activation, was determined via Western blot and analyzed with Image J software. Statistical analysis was performed between the control and exercise sessions using a paired T-test and linear regression was used to identify significant correlations.

RESULTS: A single bout of acute aerobic exercise, performed 16-18h prior, significantly decreased fasting expression of phosphorylated NF-κB (p-NF-κB) in PBMCs (27% decrease, p=0.01). The exercise bout also tended to reduce fasting plasma TG levels (13% decrease, p=0.07). Age was significantly associated with the exercise-induced reduction in p-NF-κB (r=0.70, p=0.04).

CONCLUSION: An acute bout of aerobic exercise decreased fasting NF-κB phosphorylation in circulating PBMCs, which may be related to reductions in triglycerides. Ongoing analyses will further describe molecular changes involved in the regulation of NF-κB signaling.

**3182 Board #247 June 3, 2:00 PM - 3:30 PM
Relationships between Physical Inactivity and Insulin Secretory Capacity in Non-obese Subjects with Type2 Diabetes Mellitus**

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*(No relationships reported)***PURPOSE:**

In western countries, obesity is a major risk factor for developing insulin resistance and the onset of type 2 diabetes mellitus (DMII). Conversely, Japanese adults with DMII are often not obese, but have a genetically low insulin secretory capacity. Current Japanese guidelines for treatment of DMII are mainly based on evidence from studies done with obese subject with DMII. Although exercise plays an important role in improving insulin resistance and reducing the risk of DMII, the effects of exercise in non-obese patients with DMII have not been well-studied. We investigated the association between insulin secretory capacity and daily physical activity and sedentary time in non-obese Japanese adults with DMII.

METHODS:

Subjects were non-obese adult men with DMII (DM; n=12, age; 54.5±7.2 yr, BMI; 24.0±1.8 kg/m²) and a control group of non-obese healthy adult men (C; n=10, age;

53.9±6.6 yr, and BMI; 24.0±1.7 kg/m²). Daily physical activity and sedentary time were measured using a triaxial accelerometer (HJA-350IT OMRON Corporation). Insulin and glucose were measured prior to and two hours after standard meal ingestion. Fasting C-peptide concentrations and the homeostatic model assessment beta cell function (HOMA-β) were used as indices of insulin secretory capacity.

RESULTS:

Daily step counts and time spent sedentary and in low, moderate, and vigorous physical were not different between two groups (P > 0.05). HOMA-β in DM was significantly lower than in C (DM; 21.1±9.3 %, C; 48.4±23.2 %). The correlation between HOMA-β and moderate to vigorous intensity physical activity time was not significant in either C (r=-0.20, P=0.61) or DM (r=0.13, P=0.68). However, in DM, there was a significant inverse correlation between sedentary and HOMA-β (r=-0.62, P < 0.03) and C-peptide (r=-0.81, P<0.01).

CONCLUSIONS:

In non-obese Japanese men with DMII, time spent in sedentary behaviors, but not time spent in physical activity, is associated with reduced insulin secretion. These results suggest that reducing inactivity time may be an appropriate strategy to increase insulin secretion capacity in non-obese patients with DMII.

**3183 Board #248 June 3, 2:00 PM - 3:30 PM
Effects of a Single 75-Minute Yoga Session on Post Exercise Cardiovascular and Blood Metabolic Parameters**

Jennifer M. Shin¹, Gretchen A. Casazza², Brandy L. Garcia¹, Brandon S. Trafton¹, Shannon L. Wilson¹, Daryl L. Parker¹, Roberto Quintana¹. ¹California State University, Sacramento, Sacramento, CA. ²University of California, Davis, Davis, CA. Email: jenshin428@gmail.com

(No relationships reported)

PURPOSE: To determine the acute effects of yoga on CV and blood metabolism parameters in a young, healthy population.

METHODS: A total of 9 subjects (8 females and 1 male) participated in yoga (YA) and placebo (PL) interventions followed by blood work and an oral glucose tolerance test (OGTT). For each intervention baseline heart rate (HR), fasting blood glucose (FBG), blood lactate (BL), and blood pressure (BP) were measured. Day 1 subjects participated in the yoga intervention followed by HR, blood glucose (BG), BP, BL and an OGTT. Day 2 subjects participated in the placebo intervention followed by HR, BG, BP, BL and an OGTT. Statistical analysis utilized repeated measures ANOVA and Tukey Post Hoc analysis (p < 0.05).

RESULTS: There was no significant difference between PL vs YA groups in OGTT (150 min). However, there were trends towards a greater decrease in post yoga recovery FBG levels and OGTT levels (time 90), p=0.099 and p=0.08, respectively. BL levels post yoga intervention decreased significantly, 0.89±0.40 vs 0.64±0.19, PL and YA respectively (p=0.02). Yoga did not alter cardiovascular responses (HR, BP) during recovery.

CONCLUSIONS: This pilot study indicates that the acute effects of yoga can decrease BL and possibly lower post exercise BG values in a young, healthy population. This indicates that yoga may have a beneficial impact on health.

**3184 Board #249 June 3, 2:00 PM - 3:30 PM
The Synergy Effect of Low-Intensity Exercise Training and Caloric Restriction on BDNF in Rat Hippocampus**

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(No relationships reported)

PURPOSE: Recent studies have suggested that exercise training and caloric restriction have beneficial effects on brain function, including the improvements of cognitive function by the promotion of brain-derived neurotrophic factor (BDNF) expression in the hippocampus. In addition, the level of oxidative stress might be involved in the mechanism to explain these effects. The purpose of this study was to investigate the synergy effects between 12-week low-intensity exercise training and caloric restriction on BDNF expression and the level of oxidative stress in rat hippocampus.

METHODS: Twenty-six, 7 week-old male Wistar rats were randomly divided into the following 4 groups: 1) sedentary control (Con, n=7); 2) exercise (Ex, n=6); 3) caloric restriction (CR, n=7); and 4) exercise training and caloric restriction (ExCR, n=6). Ex and ExCR underwent treadmill running at 10 m/min, 5° slope, 30 min/day, 5 days/week. Although Con and Ex were fed ad libitum over time, CR and ExCR consumed 40 % less food compared with Con. Forty-eight hours after the termination of the 12-week intervention, rats were sacrificed and the hippocampus was quickly dissected for measurement of BDNF and 4-hydroxy-2-nonenal (4-HNE) contents, and serum total antioxidant capacity (TAC) were also assessed.

RESULTS: 4-HNE contents in Ex and CR were significantly increased compared with Con (p<0.05, respectively). However, these elevation was not observed in ExCR.

On the other hand, no changes were observed in the alteration of serum TAC among 4 groups. Hippocampal BDNF contents was significantly increased in Ex compared with Con ($p<0.05$), whereas the exercise-induced elevation in BDNF was completely suppressed by a combination with caloric restriction. Furthermore, we found a significant relationship between hippocampal BDNF and 4-HNE contents ($p<0.05$), suggesting the hypothesis that oxidative stress is essential for the expression of BDNF in the hippocampus.

CONCLUSION: Our findings indicate that optimal stimulus of oxidative stress induced by low-intensity exercise training contributes to BDNF expression in hippocampus. However, it is conceivable that exercise training combined with caloric restriction might not have a synergy effect on hippocampal BDNF expression.

3185 Board #250 June 3, 2:00 PM - 3:30 PM
The Effects of Physical Activity on Markers of Hepatic Lipid Metabolism During Weight Cycling

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(No relationships reported)

Non-alcoholic fatty liver disease (NAFLD) has emerged as the leading cause of liver disease and develops when the rate of hepatic triglyceride formation exceeds the rate of disposal. Weight loss is often prescribed to treat NAFLD; however, only one in six obese or overweight individuals who lose weight through diet are successful at maintaining weight loss resulting in weight regain (i.e., weight cycling).

Purpose: To determine the effect of physical activity on the prevention of hepatic steatosis and expression of lipogenic genes during weight cycling.

Methods: To induce obesity, male C57BL/6 mice were fed a 60% fat diet for 10-weeks. Following weight gain, mice were randomly assigned to a 10% fat diet either with (Diet+PA) or without (Diet) physical activity to induce weight loss for 8 weeks. Physical activity consisted of unrestricted access to running wheels. Following weight loss, the Diet and Diet+PA groups were switched back to a 60% fat diet for 10 weeks to cause weight regain. The Diet+PA had continued access to physical activity during weight regain. Age-matched lean and obese control mice were fed a 10% fat diet (LF) and 60% fat diet (HF), respectively for the entire 28-week study. Significant differences ($P<0.05$) between groups were identified by one-way ANOVA.

Results: Following weight regain, body mass of the Diet+PA was significantly lower than the HF (47.8 vs. 55.3 g) and Diet (47.8 vs. 53.9 g). No significant difference in body mass was observed between Diet and HF. The Diet+PA had significantly lower plasma cholesterol levels compared to HF (230.5 vs. 254.5 mg/dL) and Diet (230.5 vs. 271.9 mg/dL). In addition, the Diet+PA group had significantly lower total hepatic lipid (23.2 vs. 26.5%) when compared with Diet, which was associated with 60%, 50%, and 40% lower expression of lipogenic genes *Fasn*, *Srebp1c*, and *Lxra*, respectively. No difference was noted between Diet and Diet+PA for the expression of lipogenic genes *Scd1* and *Acc1*.

Conclusions: These data suggests that continued physical activity during weight cycling resulted in lower weight regain and reduced accumulation of hepatic lipid by way of decreased *de novo* lipogenesis. Overall, the reduced expression of lipogenic related genes might point to a potential protective mechanism that physical activity has on the development of NAFLD during weight cycling.

3186 Board #251 June 3, 2:00 PM - 3:30 PM
Treadmill Running Combined With Caloric Restriction Induces Greater Benefits Against Non-alcoholic Fatty Liver Disease

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Current guidelines for non-alcoholic fatty liver disease (NAFLD) treatment recommend a restricted diet plus physical activity. However, the underlying mechanisms are not clear.

Purpose: To investigate the effect of exercise training (EX) plus hypocaloric diet on NAFLD in a high fat diet (HFD)-induced obese mice. **Method:** Fifty mice (C57BL/6) were assigned to standard chow (SC, n=10) or HFD (n=40) for 23 weeks. During the last 8 weeks of the 23-week dietary course, the HFD mice were further assigned to HFD (n=10) or HFD plus exercise training (HFD+EX) (n=10) or HFD+SC (n=10) or HFD+EX+SC (n=10). The HFD+EX and HFD+SC+EX mice were subjected to treadmill running at a moderate intensity for 50 minutes per session with a frequency of 5 days per week. **Result:** Compared to the HFD mice, the HFD+EX, HFD+SC, and HFD+EX+SC mice had significantly lower values in areas under the curves of glucose (HFD: 49230±11353; HFD+EX: 45401±3357; HFD+SC: 25320±4321; HFD+EX+SC: 24466±2335) and insulin (HFD: 6225±1629; HFD+EX: 5871±1070;

HFD+SC: 4466±570; HFD+EX+SC: 3784±254) tolerance tests and histological progression of hepatic steatosis (HFD: 3.8±0.4; HFD+EX: 2.5±0.5; HFD+SC: 2.3±0.5; HFD+EX+SC: 0.8±0.4) in conjunction with significantly higher levels of serum adiponectin (HFD: 23.0±1.8; HFD+EX: 29.5±4.4; HFD+SC: 31.6±3.4; HFD+EX+SC: 36.8±7.0) and hepatic adiponectin receptor 1 and 2 mRNAs. Attenuation of whole body insulin resistance ($P=0.001$ and $P=0.001$, respectively) hepatic steatosis ($P=0.001$, respectively), and hypo-adiponectinemia ($P=0.001$, respectively) was significantly higher in the HFD+SC+EX mice than in the HFD+EX or HFD+SC mice. Compared to the HFD mice, the HFD+SC and HFD+EX+SC mice had significantly higher levels of hepatic genes (i.e., Tfam, NRF, COX4I1, SIRT1, CPT-1a, and CYP4a10 mRNAs) involved in mitochondrial function. Compared to the HFD mice, the HFD+EX, HFD+SC, and HFD+EX+SC mice had significantly lower levels of hepatic genes involved in inflammation (i.e., Ly6d and Lgals3 mRNAs) and fibrosis (i.e., Timp1 and Col1a1 mRNAs). **Conclusion:** The current findings suggest that CR+EX has greater effects against NAFLD and its metabolic complications in HFD-induced obese mice.

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3187 Board #252 June 3, 2:00 PM - 3:30 PM
Single Bout Of Aerobic Exercise Reduces Intrahepatic And Intramyocellular Triglyceride In Obese Individuals With Nafld

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High amounts of intrahepatic triglyceride (IHTG) and intramyocellular triglyceride (IMTG) are common metabolic complications associated in obese individuals with Non-alcoholic fatty liver disease (NAFLD). Caloric restriction is often prescribed to treat NAFLD, however, the effects of aerobic exercise in reducing IHTG and IMTG is unknown. **PURPOSE:** The aim of this study was to evaluate the effect of a single bout of the American College of Sports Medicine physical activity guidelines for adults on IHTG and IMTG content obese individuals with NAFLD. **METHODS:** Ten obese people (Mean \pm SD, Age 45.2 \pm 5.2 years, BMI=38.1 \pm 4.6 kg/m²) with NAFLD performed a single bout of aerobic exercise (30 minutes at 50% of V02max) on a motor driven treadmill. Magnetic resonance spectroscopy was used to evaluate IHTG and IMTG content before and immediately after the exercise bout. IMTG was evaluated from the soleus muscle. Dual Energy X-ray Absorptiometry (DXA) was used to measure body weight and percent body fat. **RESULTS:** A single bout of aerobic exercise resulted in a significant ($p<0.05$) decrease in IHTG from before (16.0 \pm 2.8%) to after (14.2 \pm 2.2%) the exercise bout. IMTG significantly ($p<0.05$) decreased from before (2.2 \pm 0.9%) to after (1.3 \pm 0.7%) the single exercise bout. As expected there was no significant change in body weight (103.1 \pm 4.2 kg and 102.9 \pm 4.2 kg) or percent body fat (38.9 \pm 2.1% and 39.2 \pm 2.1%) before and after the exercise bout. **CONCLUSION:** Performing even a single bout of physical activity as recommended by the ACSM reduces IHTG and IMTG obese persons with NAFLD.

3188 Board #253 June 3, 2:00 PM - 3:30 PM
Prevalence of Metabolic Syndrome in Colombian Children and Adolescents Aged 9-17 Years Using Three Different Pediatric Definitions

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PURPOSE: Currently, there is no gold standard definition for Metabolic syndrome (MetS) in children and adolescents; however, the description of prevalence of MetS according to few proposed pediatric definitions is necessary in Latin American populations. The objective of this study was to assess the prevalence of MetS in children and adolescents aged 9-17 years from Bogotá, Colombia using three different definitions for this age group. **METHODS:** The sample (n=1,939) consisted of 879 male and 1,060 female children and adolescents aged 9-17 years from a cross-sectional population survey, the FUPRECOL Study. Study information sheets were provided to participants and informed written consent was obtained from both the parent and the child. MetS was estimated according to the definitions by Cook et al., de Ferranti et al. and IDF, which use age-adjusted cut-off points. Blood was collected via capillary sample following

an overnight fast. Fasting glucose, high-density lipoprotein cholesterol (HDL-C) and triglycerides (TAG) were determined using commercial kits in an automatic analyzer (Cardiocheck Inc., USA). Waist circumference (WC), Body mass index (BMI) and blood pressure measurements were made by trained investigators using standard techniques and instruments.

RESULTS: On comparing our prevalence of MetS according to the definitions by Cook et al. and de Ferranti et al. with that in the original studies, our prevalence was lower than that reported in the study by Cook et al. (3.2% vs. 4.2%), and almost comparable with that presented in the study by de Ferranti et al. (13.2% vs. 9.2%). The most frequent combination of the MetS components was low HDL-C, abdominal obesity and elevated blood pressure, followed by low HDL-C, high serum TAG and elevated blood pressure.

CONCLUSIONS: Primordial prevention of CVD should start in the pediatric years. Further research is required for the evaluation of the current definitions (multicentric studies), addition or design of new and useful criteria, and, importantly, analysis of the predictive capabilities of the pediatric MetS definitions for cardiometabolic diseases during adult life periods.

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3189 Board #254 June 3, 2:00 PM - 3:30 PM
Moderate and High Intensity Exercise Training Matched for Energy Expenditure Reduces Intrahepatic Lipid in Obese Individuals with Hepatic Steatosis

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Exercise training is commonly prescribed for individuals diagnosed with nonalcoholic fatty liver disease (NAFLD); however, consensus is lacking regarding the volume and intensity of exercise for optimal benefits. Purpose: Here, we sought to determine if high intensity interval exercise (HIIE) differentially impacted intrahepatic lipid (IHL) content and hepatic inflammatory biomarkers compared with continuous moderate exercise (CME) in obese adults with hepatic steatosis. Methods: Sixteen obese adults (BMI, 37.0±1.4 kg/m²; age, 43.7±3.0 yr; IHL, 16.9±2.3%) were randomized to either 4 wk x 4x/wk of HIIE (4 min 80% VO₂peak/3 min 50% VO₂peak) or CME (55% VO₂peak, 50-75 min), matched for energy expenditure (~400 kcal/session). Baseline and post-training IHL were measured by 1H-MRS and frequent blood samples were analyzed for glucose, insulin, c-peptide, fetuin A, cytokeratin 18 (CK18), and NEFA levels during a meal test (180 min) as incremental area under curve (iAUC). Results: Baseline IHL and fasting glucose concentrations were greater in CME and HIIE compared to controls (P<0.05). Body weight, body mass index, fat mass and fasting insulin concentrations were greater in CME vs HIIE (P<0.05); whereas, HIIE had greater VO₂peak and insulin sensitivity (P<0.05). Both HIIE and CME lowered IHL [HIIE, -37.0±12.4%; CME, -20.1±6.6%, P<0.05], with no differences noted between exercise intensities (P=0.40). Fetuin A and CK18 levels were not different between CME and HIIE, however, CK18 tended to decrease in the HIIE group (P=0.09). Exercise training decreased postprandial insulin, c-peptide levels, and insulin secretion rate (iAUC, P<0.05), yet no between group differences in CME vs HIIE were observed. Baseline postprandial insulin clearance and c-peptide iAUC were predictors of the ΔIHL after controlling for body mass, fat mass, percent body fat, and fasting/postprandial glucose, insulin, and NEFA levels. Conclusions: Four weeks of both high intensity interval and moderate intensity continuous exercise training effectively lowered IHL content in sedentary obese individuals with hepatic steatosis. Larger cohort studies examining different exercise intensities and durations are warranted.

3190 Board #255 June 3, 2:00 PM - 3:30 PM
Effects of Chronic Stress on Pancreatic Beta Cell Density in Obese and Lean Zucker Rats

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Chronic stress has been implicated as a possible contributing factor to the onset of Type 2 Diabetes Mellitus. PURPOSE: To evaluate beta cell density in a rat model of chronic stress and the metabolic syndrome.

METHODS: Obese (OZR) and lean Zucker rats (LZR) were randomly divided into stress (OZR-S, n=4; LZR-S, n=4) and non-stress (OZR-NS, n=4; LZR-NS, n=4) groups. Stress included bath, damp bedding, no bedding, cage tilt, altered light cycles, and cage-switching for 7 hours/day, 5 days/week for 8 weeks, after which animals were euthanized. Pancreases were harvested and flash frozen. 7µm thick sections were cut, mounted on glass slides, incubated with an insulin antibody labeled with Alexa-Fluor 546 to identify the beta cells. DAPI was used to label the cell nuclei. Digital

images of the pancreas cells were obtained by a Zeiss LSM 510 Confocal microscope using Zenn 2009 software. The insulin positive area was measured using Image J. The images of stained cells and islets were merged and the number of beta cells per islet recorded. A two-way ANOVA was used to compare dependent variables among groups with significance set at P<0.05.

RESULTS: There were significant main effects of obesity and stress for all three dependent variables (Table 1). OZR animals had a reduced beta cell density within insulin positive area; however, this was greater in stressed animals. No interactions were observed among groups.

CONCLUSIONS: Results indicate that although obesity and metabolic syndrome reduces beta cell density, 8 weeks of chronic stress can overcome this and lead to an increased insulin positive area and greater total beta cell number. The effect of exercise training on these responses are currently under investigation.

Group (n=4)	Mean Insulin Positive Area (µm ² , ± SE)	Total Beta Cells (±SE)	Beta cell/µm ² insulin positive area
OZR-S	6961 ± 453	94 ± 5	.013800 ± .0006
LZR-S	9227 ± 644	130 ± 11	.014675 ± .0009
OZR-NS	5998 ± 966	61 ± 10	.010550 ± .0003
LZR-NS	7367 ± 379	103 ± 4	.014100 ± .0006

3191 Board #256 June 3, 2:00 PM - 3:30 PM
Relationships Among Intramuscular Adipose Tissue Content, Intramyocellular Lipid Or Extramyocellular Lipids In Humans

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Increase in amount of fat infiltrated within given muscles, known as intramuscular adipose tissue (IntraMAT), is induced by aging or disuse. IntraMAT has an inappropriate effect on insulin sensitivity and muscle function, thus increase of IntraMAT has a potential to induce diabetes and/or metabolic syndrome. IntraMAT has been evaluated by medical imaging techniques such as magnetic resonance imaging (MRI) and ultrasound (US). These techniques have a benefit to detect IntraMAT; however, it is unclear where fat signal comes from in muscle cells. 1H-magnetic resonance spectroscopy (1H-MRS) is an ideal technique to detect intra- and extramyocellular lipids (IMCL and EMCL, respectively) non-invasively. **PURPOSE:** The purpose of this study was to assess relationship between IntraMAT by MRI or echo intensity by US and IMCL or EMCL by 1H-MRS.

METHODS: Thirty young and elderly men and women were participated in this study. T1-weighted MR image was taken from the right mid-thigh to measure IntraMAT content of the vastus lateralis (VL) and biceps femoris (BF) using a histogram shape-based thresholding technique. Ultrasonographic images were taken from the VL and BF of the right mid-thigh to measure echo intensity based on grey-scale level for quantitative analysis. IMCL and EMCL were measured from the VL and BF at the right mid-thigh using 1H-MRS.

RESULTS: There was a significant correlation between IntraMAT content by MRI and EMCL of the VL and BF (VL, r = 0.506, P < 0.01; BF, r = 0.591, P < 0.001) and between echo intensity and EMCL of the VL and BF (VL, r = 0.485, P < 0.05; BF, r = 0.648, P < 0.01). IntraMAT content was also significantly correlated with echo intensity of the VL and BF (VL, r = 0.404, P < 0.05; BF, r = 0.493, P < 0.01).

CONCLUSIONS: These results suggest that IntraMAT and echo intensity reflects EMCL, not IMCL, in human skeletal muscles.

3192 Board #257 June 3, 2:00 PM - 3:30 PM
Differences in Abdominal and Liver Fat Accumulation Between Obesity-Matched Diabetic and Non-Diabetic Adults

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Purpose: To determine whether type 2 diabetic (T2D) have greater levels of visceral adipose tissue (VAT) and liver fat by comparison to age and obesity-matched non-diabetics (NT2Ds) in White and Asian adults.

Methods: Four thousand, five hundred and four participants were initially recruited from 29 countries in a multicenter, international observational, cross-sectional analysis. From this sample, 2383 White and Asian adults were selected for the focus of this analysis. T2D and NT2D men and women were matched for age, body mass index (BMI) and waist circumference (WC). T2D and NT2D men and women were also compared to participants with either impaired fasting glucose (IFG) and/or impaired

glucose tolerance (IGT; (IFG/IGT group)). A secondary analysis determined whether differences exist between NT2Ds and T2Ds in VAT and liver fat accumulation within selected BMI categories for Whites and Asians. Abdominal adipose tissue was measured by computed tomography; liver fat was estimated using the computed tomography-derived mean attenuation.

Results: T2Ds and IFG/IGT had elevated levels of VAT and liver fat compared to NT2Ds across gender and ethnicity (p<0.05). However, liver fat accumulation was greater in T2Ds compared to IFG/IGT in both White and Asian participants (p<0.05). Within each BMI category, T2Ds had elevated VAT and liver fat compared to age and anthropometrically matched NT2Ds in both Whites and Asians (p<0.05). With few exceptions, abdominal subcutaneous adipose tissue levels were not different in T2Ds or IFG/IGT compared to NT2Ds independent of gender or ethnicity.

Conclusion: Compared to age and obesity-matched men and women, White and Asian T2Ds, and those with IFG/IGT, present with greater levels of both VAT and liver fat.

3193 Board #258 June 3, 2:00 PM - 3:30 PM
Serum FGF 21 in Individuals with and Without a Family History of Type 2 Diabetes

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Determining predictive markers for the development of type 2 diabetes, particularly in young individuals, offers immense potential benefits in preventative medicine. Previous research examining serum fibroblast growth factor 21 (FGF 21) in humans has revealed equivocal relationships with clinical markers of metabolic dysfunction. However, it is unknown to what extent, if any, first degree family history of type 2 diabetes (mother or father of the participant diagnosed with type 2 diabetes) or resting metabolic rate (RMR) have in the expression of serum FGF 21 in humans. **PURPOSE:** The aim of the study was to determine if there was a relationship between serum FGF21 and RMR as well as clinical risk factors associated with metabolic disease in individuals with (FH+) and without (FH-) a family history of type 2 diabetes. **METHODS:** Healthy male and female participants between the ages of 18-35 were recruited. Thirty five participants completed the cross-sectional study, FH+ n = 18, FH- n = 17. Female participants had to report to the lab within seven days of starting the follicular phase of the menstrual cycle. Body composition was measured via air displacement plethysmography RMR was determined via indirect calorimetry. Additional baseline characteristics including gender, age, BMI, waist circumference, and blood pressure were collected. Serum FGF 21 was determined from 10 ml of cubital vein blood for each sample via a commercially available immunoassay kit. The assay microplate was read on a microplate absorbance reader and all samples were analyzed in duplicate. **RESULTS:** A one-way ANOVA revealed that differences between groups for FGF21 (FH+ = 266 pg/ml ± 51.4, FH- = 180 pg/ml ± 29) were not significant (F = 2.04, p = 0.16). RMR values between groups (FH+ = 1812 kcal/day ± 71, FH- = 1864 kcal/day ± 95), were not significant (F = 0.19, p = 0.66). Nominal logistic regression revealed gender, age, BMI, waist circumference, blood pressure, and body composition were not predictive of serum FGF 21 in FH+ or FH-. **CONCLUSION:** Serum FGF21 is not significantly different between FH+ and FH-, nor is it related to other clinical markers in young, healthy individuals. Thus FGF21 is unlikely to be an effective predictor for the development of type 2 diabetes for this population.

3194 Board #259 June 3, 2:00 PM - 3:30 PM
Associations Between Strength Fitness, Body Composition and the Determinants of Glycemic Control in Overweight/Obese Individuals

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Purpose: Multiple methods have been proposed to assess insulin sensitivity using an oral glucose tolerance test (OGTT), yet the relationship between strength fitness, body composition and the underlying determinants of glycemic control is unclear. We evaluated the associations between muscle strength, body composition and OGTT-derived indices of insulin sensitivity and secretion in young overweight/obese individuals.

Methods: 53 young overweight/obese participants (age 24 ± 5; BMI = 34.5 ± 5.2 kg/m²) underwent a standard 2-hr 75-g OGTT, 1-repetition maximum testing (bench press, leg press, and back row) and body composition by dual-energy X-ray absorptiometry

for estimation of total and trunk fat mass and lean body mass (LBM). Fasting glucose (Glu_{T0}) and insulin (Ins_{T0}), and OGTT-derived indices, including area under the curve for glucose and insulin (AUC_{Glu} and AUC_{Ins} respectively), insulinogetic index (IGI; a surrogate measure of first-phase insulin response to a glucose challenge), Matsuda insulin sensitivity index (ISI; a composite of both hepatic and peripheral tissue sensitivity to insulin) and oral disposition index (oral DI; a marker of pancreatic β-cell function) were calculated, and associations between these determinants of glycemic control with muscle strength and body composition were examined.

Results: Relative muscle strength, trunk and total fat mass were significantly associated with Ins_{T0} (-0.35, 0.65 and 0.57, respectively), AUC_{Ins} (-0.36, 0.63 and 0.56, respectively), IGI (-0.45, -0.61, and 0.64, respectively) and ISI (0.42, -0.54, -0.52, respectively) (all p<0.05), but not with Glu_{T0}, AUC_{Glu} or oral DI. There were no significant associations observed between LBM and OGTT-derived indices.

Conclusion: Strength fitness and fat mass was associated with fasting insulin, AUC_{Ins}, early-phase insulin secretion and insulin sensitivity, but not with glucose indices or pancreatic β-cell function in young overweight/obese adults. These findings highlight the potential importance of strength fitness, as opposed to LBM, in protection against the development of type 2 diabetes in overweight/obese population.

3195 Board #260 June 3, 2:00 PM - 3:30 PM
Inflammation and Cardio-Metabolic Risks In African American Women

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Individual of African origin in Europe and the Caribbean have a lower prevalence of coronary heart disease (CHD) than Europeans and European Americans, but African Americans (AA) do not possess the same low CHD prevalence as Africans. Are obesity, lifestyle and stress contributor to AA, especially women having more CHD morbidity and mortality? **PURPOSE:** This secondary analysis was designed to determine if highly sensitive C-reactive protein (hsCRP) is related to other cardio-metabolic risks (CMR) or is it unrelated to other CMR and therefore independently contributes to CHD in AA women (AAW). **METHODS:** Participants were 50 sedentary and overweight AAW between 20 and 58 yrs of age. Participants were measured for CMR (fasting glucose, triglyceride (Trig), HDL-C, blood pressure (BP), body adiposity, oxygen uptake VO₂max and hsCRP). The CMR of all participants and participants divided into groups based on hsCRP classifications (It equal 1 low risk-GP1 and 1-3 average risk -GP2) were evaluated for differences with an independent t-test. CMR of the participants were also evaluated for relationships with %fat, hsCRP and VO₂max using Pearson correlations. **RESULTS:** All Participants were obese (GP1 37.3 and GP2 43.4 %fat), but GP2 was fatter and older (age 29.9 vs 38.5 yrs - p 0.05). VO₂max was correlated with SBP and %fat in GP1. A number of relationships (p 0.05) were observed for GP2 (VO₂max was related to SBP, DBP, LDL-C and %fat; hsCRP was related to Trig, and %fat was related to DBP). **CONCLUSIONS:** These data indicate that the participants were obese, but metabolically healthy and that CMR is related to lifestyle as indicated by VO₂max when hsCRP values rise. Although further investigation of these findings are warranted, these data suggests that inflammation and obesity are relatively independent of other CMR and that they along with sedentary lifestyles may be partially responsible for the greater CHD morbidity and mortality observed in AA women.

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3196 Board #261 June 3, 2:00 PM - 3:30 PM
Abdominal Fat, Sedentary Behavior, And Insulin Resistance In Pregnancy

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 (No relationships reported)

Obesity, and particularly central adiposity, and inactivity are associated with diabetes in the general adult population. During pregnancy, insulin resistance is likely, however its relationships with inactivity and central fat accumulation are not fully understood. **PURPOSE:** To test the hypothesis that central adiposity and physical inactivity are strong predictors of gestational insulin resistance.

METHODS: Twenty-eight nulliparous pregnant women (68% Caucasian, mean age 27.2 ± 4.5 years) were recruited from a partner OB/GYN clinic. Between 16-23 weeks gestation, body composition assessments, including bioimpedance analysis (InBody 720) and intra-abdominal adipose tissue (IAAT via ultrasound), along with 7-day accelerometry (Actigraph GT3x) were conducted. Fasting glucose and insulin were assessed at 24-26 weeks and used to compute the homeostasis assessment model of insulin resistance (HOMA-IR). Average daily sedentary time was calculated from the four most compliant days of seven. Pearson correlation and linear regression analyses were used to determine relationships.

RESULTS: When controlling for age and race, HOMA-IR was strongly associated with IAAT (r=0.637, p=0.026) and percent body fat (r=0.569, p=0.027), but not with

sedentary time ($r=-0.091$, $p=0.748$). Moreover, linear regression revealed that IAAT ($\beta=0.580$, $p=0.037$), but not sedentary time ($\beta=-0.067$, $p=.785$), was a significant predictor of HOMA-IR in a model including maternal age. However, the overall model was unable to achieve significance ($R^2=0.371$, $p=0.15$).

CONCLUSIONS: Abdominal fat distribution, but not sedentary behavior, is an independent predictor of insulin resistance during pregnancy. Supported by internal grants from the Office of the Vice President of Research and Center for Excellence in Teaching and Leadership, Kennesaw State University.

3197 Board #262 June 3, 2:00 PM - 3:30 PM

Combinations of Physical Activity, Sedentary Behaviour and Sleep: Relationships With Health in Children and Youth

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Reported Relationships: T.J. Saunders: Contracted Research - Including Principle Investigator; Stepscount.

PURPOSE: To determine how combinations of physical activity (PA), sedentary behaviour (SB) and sleep are associated with important health indicators in children and youth aged 5-17 years.

METHODS: MEDLINE, EMBASE, SPORTdiscus, CINAHL and PsycINFO were searched for studies examining the relationship between time spent engaging in different combinations of PA, SB and sleep with adiposity, cardiometabolic biomarkers, and physical fitness. Meta-analyses were planned for all outcomes; however, this was precluded due to the high levels of heterogeneity across studies. Therefore, narrative syntheses were employed for all health indicators. The quality of evidence was assessed using the GRADE framework.

RESULTS: 13 cross-sectional studies and 1 longitudinal study reporting data from 36,560 participants met the inclusion criteria. Children and youth with a combination of High PA/High Sleep/Low SB had more desirable measures of adiposity (e.g. a 2.39 kg/m² lower fat mass index, and an 8-fold reduction in the odds of obesity, $p<0.05$) and cardiometabolic health (e.g. a 3.31 unit lower metabolic syndrome score, $p<0.05$), compared to those with a combination of Low PA/Low Sleep/High SB. Health benefits were also observed for those with a combination of High PA/High Sleep (cardiometabolic health and adiposity) or High PA/Low SB (cardiometabolic health, adiposity and fitness), compared to Low PA/Low Sleep or Low PA/High SB. Of the 3 movement behaviours, PA (especially moderate-to-vigorous PA) was most consistently associated with desirable health indicators. Given the lack of randomized trials, the overall quality of the available evidence was low.

CONCLUSIONS: School-aged children and youth characterized by High PA/High Sleep/Low SB have more desirable measures of adiposity and cardiometabolic health, compared to those with a combination of Low PA/Low Sleep/High SB. Further, those with High PA/High Sleep, and High PA/Low SB are also likely to experience health benefits, when compared to Low PA/Low Sleep, or Low PA/High SB.

FUNDING: This project was made possible through funding from the Canadian Society for Exercise Physiology, Conference Board of Canada, Healthy Active Living and Obesity Research Group at the CHEO Research Institute and the Public Health Agency of Canada.

3198 Board #263 June 3, 2:00 PM - 3:30 PM

Cardiopulmonary and Circulatory Responses in The Coexistence of Hypertension in Diabetes Type II Patients

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(No relationships reported)

The cardiac autonomic modulation and exercise capacity, which are strong predictors of cardiovascular and overall mortality, are reduced in type 2 diabetes (T2DM) and

hypertension. New indices from non-linear modeling have been recently proposed as a method to describe the complexity of heart rate (HR) dynamics. Variables from cardiopulmonary exercise test (CPET), as circulatory power (CP), ventilatory power (VP), and oxygen uptake efficiency slope (OUES) have been used as important markers of exercise limitation. However, whether a coexistence of T2DM and systemic arterial hypertension (SAH) impairs these new markers is not yet elucidated. **Purpose:** The purpose of the present study was to verify the impact of SAH in T2DM patients on autonomic nervous system at rest. **Methods:** We evaluated 60 participants (42 male and 18 female), diagnosed with T2DM; subjects were divided in two groups: T2DM patients ($n=30$; 51 ± 7 years old) and T2DM + SAH patients ($n=26$; 51.42 ± 7 years old). HR and RR interval were obtained in supine position at rest. Linear and nonlinear indices of heart rate variability (HRV) were calculated using Kubios HRV software. Pulmonary gas exchange was measured breath-by-breath, using a portable telemetric system during maximal incremental exercise testing on a cycle ergometer. Statistical analysis included Shapiro-Wilk test, followed by Pearson correlation and linear regression. **Results:** The OUES was influenced by SD1 (interaction effects: $R^2 = -0.28$, $p < 0.005$) and VP ($R^2 = -0.32$, $p < 0.03$) when both groups were considered together. When we considered the T2DM + SAH group, we also found an ApEn influence on OUES ($R^2 = -0.40$, $p < 0.05$) and VP ($R^2 = -0.48$, $p < 0.02$). Considering just the T2DM group we found that only ApEn predicted OUES ($R^2 = -0.40$, $p < 0.03$). **Conclusion:** These results can potentially indicate increased cardiovascular risk for adverse events, once the cardiac autonomic and exercise capacity are reduced. These data, together suggest that the coexistence of T2DM +SAH can lead to impaired cardiopulmonary and circulatory responses.

F-36 Free Communication/Poster - Nutritional Status of Athletes

Friday, June 3, 2016, 1:00 PM - 6:00 PM
Room: Exhibit Hall A/B

3199 Board #264 June 3, 3:30 PM - 5:00 PM

Changes in Body Composition Following Fat Source Exchange While on Isocaloric Diets: A Self-Study

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(No relationships reported)

Purpose:

To determine the effects of exchanging dietary fats for supplemental medium chain triglycerides (MCTs) on body composition while following isocaloric diets.

Methods:

The coauthor of this report initially recorded her body weight and used a 9-site skinfold caliper test to calculate fat mass, lean body mass, and percent body fat. She then followed a 1,550 calorie diet composed of 130 grams of protein, 100 grams of carbohydrates, and 70 grams of fat for a period 4 weeks. The dietary protein was derived primarily from chicken, tilapia, and turkey breast. The carbohydrates were derived primarily from rolled oats, brown rice, sweet potatoes, and non-starchy vegetables. Dietary fats were derived primarily from avocados, olive oil, and macadamia nuts. All foods were weighed and meals were recorded with the MyFitnessPal mobile device app in order to insure that daily macronutrient and caloric targets were reached. At the end of the initial 4-week period, body composition was reassessed and dietary fats were mostly replaced with supplemental MCT oil (99.2% caprylic triglyceride). Food sources of protein and carbohydrates remained the same, as did macronutrient and caloric totals. With the introduction of supplemental MCTs, the diet was resumed for an additional 4 weeks. Following the 4-week period, body composition was assessed for a final time and interval changes were calculated. Throughout the entirety of the study, the subject's activity level remained largely unchanged. She exercised 4 days/week, lifting weights for 40 minutes followed by running on a treadmill for 20 minutes during each exercise session.

Results:

During the initial 4-week diet period, the subject experienced a 0.6 lb loss of body weight, a 0.2 lb gain in lean body mass, a 0.5 lb loss of fat mass, and a 0.6% reduction in body fat.

Following the exchange of dietary fats for supplemental MCT oil, the subject experienced a 4.9 lb loss of body weight, a 3.3 lb gain in lean body mass, an 8.1 lb loss of fat mass, and a 5.9% reduction in body fat.

Conclusion:

Substitution of supplemental MCT oil in place of common sources of dietary fat leads to favorable changes in body composition.

3200 Board #265 June 3, 3:30 PM - 5:00 PM

Examination Of Recovery And Dietary Needs In Crossfit AthletesErik Bonn, Toni M. Torres-McGehee, Justin Goins. *University of South Carolina, Columbia, SC.**(No relationships reported)*

CrossFit is a popular strength and conditioning program that implements constant varied, high-intensity, functional movements. Due to the large amount of energy expended, it is critical to examine recovery and dietary needs for these athletes. Purpose: To examine recovery, muscle glycogen stores, and dietary needs in CrossFit athletes.

Methods: Local moderately trained CrossFit athletes (n=8; ages: 26 ± 1 year) participated in a consecutive 5 day study. Participants consisted of 4 males (height: 183.1 ± 5.5 cm; weight: 92.6 ± 20.2 kg) and 4 females (height: 163.9 ± 2.4 cm; weight: 63.8 ± 2.8 kg). Height, weight, body composition and resting metabolic rate (RMR) were measured. MuscleSound ultrasound measured muscle glycogen stores pre-post workout in the gastrocnemius (GS) and rectus femoris (RF). Perceived recovery scale (PRS), rating of perceived exertion (RPE), and 5 days of dietary logs assessed diet and daily recovery.

Results: Participants exercised 38.6 ± 7.7 mins/workout with exercise energy expenditure (EEE) estimated at 392.1 ± 102.4 kcal/workout. Energy needs for all participants included: energy intake (EI: 1665.1 ± 571.1 kcal/day; energy availability (EA: 27.4 ± 11.8 kcal/kg/d FFM), and total energy expenditure (TEE: 2586.21 ± 278.2 kcals/day). Overall, 100% of athletes reported under the recommendation for CHO intake (6-10 g/kg); 62.5% (n=5) reported under the recommendation for protein intake (1.2-1.7 g/kg), and 100% of athletes met the fat recommendations (20-35%) for athletes. Overall, there was no significance between PRS and RPE and daily workouts. When examining muscle glycogen across 5 days, 17.5% participants reported low muscle glycogen and 10% increased muscle glycogen in the GS. In addition, 27.5% participants reported low muscle glycogen and 10% increased muscle glycogen in the RF.

Conclusion: No differences were found in PRS and RPE, yet low muscle glycogen levels in some participants were revealed; thus leading to athletes poorly judging how adequately their muscles are recovering between workouts. Participants were also below the daily recommendations for CHOs set by American Dietetic Association. Greater CHO in a diet causes higher muscle glycogen availability; therefore education on dietary needs is recommended for these athletes.

3201 Board #266 June 3, 3:30 PM - 5:00 PM

Factors Related To Rapid Weight Loss Practices Among Taekwondo CompetitorsCosme F. Buzzachera¹, Andreo F. Aguiar¹, Natalia F. Silva¹, Stephanie L. S. Salmaso Leal¹, Elisangela V. P. Miyazawa¹, Juliano M. Gabardo¹, Fernando M. Mitamura¹, Andrea G. Bernardes¹, Renata S. B. Januário¹, Laura Guidetti, FACSM².¹North University Of Parana, Londrina, Brazil. ²University Of Rome, Rome, Italy.

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In official tournaments, Taekwondo competitors are allocated into weight classes to create equitable matches in terms of strength, agility, and leverage. However, weight classification systems lead a large proportion of competitors to reduce their body weight in a short amount of time before a tournament in an attempt to compete at the lowest weight class possible to gain an advantage against lighter, smaller, and weaker opponents. To be eligible in lighter weight classes, competitors use a combination of potentially harmful weight loss practices, which may adversely affect one's physical and mental health.

PURPOSE: The present study examined the rapid weight loss practices among Taekwondo competitors.

METHODS: Participants were 399 Taekwondo competitors (258 men; mean age ± SD 18.2 ± 5.9 yr) who completed a previously validated questionnaire developed to evaluate rapid weight loss in combat sports athletes, which provides a score. The higher the score obtained, the more aggressive the rapid weight loss practices. Data were analyzed using descriptive statistics and frequency analyses. Pearson r correlation coefficients were calculated to determine the association of age, current body mass, years of experience, and magnitude of rapid weight loss ($P < 0.05$).

RESULTS: Seventy-eight percent of Taekwondo competitors reported that have already lost weight to compete. Most athletes reported reductions of up to 5% of body weight (mean ± SD 2.4 ± 2.1%). The reductions usually occurred within 7 ± 4 d. Excessive running, using saunas, food and fluids restrictions, training with plastic or rubberized suits, were cited as the most common rapid weight loss methods. No significant correlation was found between age, body mass, years of experience, and magnitude of rapid weight loss ($P > 0.05$).

CONCLUSIONS: These results suggest that rapid weight loss is highly prevalent in Taekwondo competitors. The level of aggressiveness in weight management behaviors seems to not be influenced by the age, current body mass, or years of experience.

3202 Board #267 June 3, 3:30 PM - 5:00 PM

Performance Nutrition Program for Collegiate Student-Athletes Increases Utilization of Sports Dietitians for Nutrition InformationRachel B. Parks, Scott J. Hetzel, M. Alison Brooks. *University of Wisconsin, Madison, WI.**(No relationships reported)*

Purpose: To describe nutrition behaviors of NCAA Division-I student-athletes and evaluate the impact of their engagement in a sports nutrition education program.

Methods: A confidential, voluntary 35-item survey was made available online to all student-athletes (n = 738) at a single institution during the first 8 weeks of the spring semester in 2015. Statistical analysis to assess the relationship between program engagement and nutrition behaviors included chi-square tests and multivariate logistic regression controlling for gender, sport type and year of eligibility.

Results: Survey response rate was 94% (n = 697), with 72% of student-athletes indicating they had engaged in at least one aspect of the nutrition education program. Among all student-athletes, the most often cited source of nutrition information was parents/family (55%, n = 381). Females were more likely to rely on teammates/friends ($p < 0.001$) or popular media ($p = 0.012$), compared to males who were more apt to use their coaches as a nutrition resource ($p = 0.029$). The desire to lose or gain weight affected the daily food choices of 293 student-athletes (42%). Lunch was reported as the most frequently skipped meal, typically due to lack of time. When traveling for competitions, 150 student-athletes (22%) reported having difficulty following their preferred diet on the road. Attendance at the incoming athlete nutrition presentation increased student-athletes' likelihood of viewing the sports dietitians as a primary source of nutrition information by 79% and reduced their likelihood of relying on media sources by 47% ($p \leq 0.008$). Team-specific education was equally effective. Student-athletes who attended at least one team talk by a dietitian were 1.93 times more likely to later utilize nutrition personnel for nutrition information ($p \leq 0.001$). For each team cooking seminar attended the odds of utilizing nutrition personnel increased by 42% ($p < 0.001$).

Conclusion: Collegiate student-athletes face multiple nutritional challenges including body weight/composition pressures, limited time and frequent travel. Participation in a performance nutrition program increases the likelihood that student-athletes will obtain their nutrition information from a qualified sports dietitian instead of other sources such as family, friends or popular media.

3203 Board #268 June 3, 3:30 PM - 5:00 PM

The Diets Of Researchers In The Arctic: A Swiss Camp Case StudyNanna Meyer, FACSM¹, Rebecca Viner¹, Claire Siekaniec².¹University of Colorado, Colorado Springs, CO. ²University of Virginia, Charlottesville, VA.

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(No relationships reported)

INTRODUCTION: Arctic researchers are exposed to extreme environmental conditions with an often limited, irregular access to food and fluid. **PURPOSE:** To describe the quantity and quality of food intake, energy expenditure, and hydration status during a 10-day expedition to the Greenland icesheet and to capture qualitative data on the perceived food experience during such extreme expeditions. **METHODS:** An Arctic research team comprised of 6 individuals (n=6, 4 male, 2 female) were studied at a climate research station known as Swiss camp (latitude 69° 33' 53" N; longitude 49° 19' 51" W, altitude 1093 m). Before departure, subjects filled out a survey documenting previous Arctic experience, health and nutrition. Body mass (BM), urine specific gravity (USG), and energy intake (EI), using dietary records, were assessed daily. Total daily energy expenditure (TDEE) was measured in each subject during 2 days using the Actiheart device. Interviews were coded for common themes regarding food experiences. **RESULTS:** Data revealed BM maintenance (71.5 ± 11.0 kg vs 71.6 ± 10.3 kg, range -1.1 to +1.0 kg, $p > 0.05$) over 10 days, with temperatures ranging from -3.7 to -20.0°C (average temp: -10.6°C). TDEE was 2366 ± 583 kcal/d with range of 1679-3026 kcal/d and a PAL of 1.8 ± 0.2. Based on individual analysis (Actiheart), heavy physical exertion in Arctic fieldwork originated from shoveling and snowmobiling. Average EI was 3188 ± 856 kcal/d. Carbohydrate (49% of EI; 351 ± 101 g/d; 4.9 ± 1.1 g/kgBW/d), protein (15% of EI; 117 ± 32 g/d; 1.6 ± 0.3 g/kgBW/d) and fat (36% of EI, 127 ± 31 g/d; 1.8 ± 0.3 g/kgBW/d) fell within adequate macronutrient distribution ranges, although 38% of carbohydrates were consumed as sugar. Several micronutrient intakes were below the RDA. Average daily USG was 1.017 ± 0.003, indicating borderline dehydration (≥ 1.02), concomitant with low fluid intakes (2.0 ± 0.6 L/d). Interview themes included food quality, eating experience, food waste, and sustainability. **CONCLUSION:** Arctic researchers at Swiss Camp maintained weight despite high EI compared to TDEE. Methodological concerns to capture valid

energy balance data in the field are most likely responsible. Low fluid intake and dehydration with low micronutrient intakes are of concern but may be addressed by hydration, food, and dietary supplement strategies.

3204 Board #269 June 3, 3:30 PM - 5:00 PM
Dietary Practices and Anthropometric Profile of Mixed Martial Arts Athletes

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The mixed martial arts (MMA) is a combat sport in which athletes commonly perform pre-competitive weight loss. However, little is known about the nutritional status during the training camp. **PURPOSE:** To identify dietary practices together with anthropometric variables of a group of professional MMA fighters. **METHODS:** Five male MMA athletes (age: 25 ± 5.15 y, height 1.76 ± 0.11 cm, weight 78.98 ± 11.60 kg; BMI: 25.36 ± 2.55 kg / m², body fat percentage: 15.43 ± 5.08%) and six female MMA athletes (age: 22.67 ± 3.61 y; height: 1.63 ± 0.02 cm, weight: 60.63 ± 3.96 kg; BMI: 22.92 ± 1.47 kg / m², body fat percentage: 23.84 ± 3.39%) who compete at the regional, national, and international level were investigated. Dietary assessment was made with a quantitative food frequency questionnaire (FFQ) validated in a Brazilian population study. During the same day, anthropometric measurements (body mass, height, body circumferences and seven skinfold thicknesses) were made. Daily energy expenditure (EE) was calculated with the formula of the FAO / WHO (1985). **RESULTS:** Dietary and energy characteristics for male athletes were EE: 3963.53 ± 372.68 kcal; energy intake: 4581.82 ± 2642.03 kcal / day; carbohydrates: 7.61 ± 4.36 g / kg / day or 54.4%; protein: 1.87 ± 0.94 g / kg / day 13.1%; fat: 2.05 ± 1.01 g / kg / day or 32.2%; fiber: 18.19 ± 14.03 and for female athletes EE: 2511.03 ± 105.3 kcal; energy intake: 3373.78 ± 704.63 kcal / day; carbohydrates: 7.31 ± 1.14 g / kg / day or 52.4%; protein: 2.41 ± 1.08 g / kg / day or 17%; fat: 1.73 ± 0.8 g / kg / day or 27.3%; fiber: 31.64 ± 6.62. Micronutrients were adequate except for folate (both sexes) and vitamin D and calcium for females. Both sexes showed a high consumption of dietary supplements (63.6%) and foods rich in added sugar and fat. **CONCLUSION:** Excess energy intake may be due to high intake of foods rich in added sugar and fat. Inadequate folate may be due to low intake of vegetables. The use of FFQs for quantification of macro and micronutrients is not usual, but it is a practical tool. However more research needs to be done comparing this FFQ with traditional methods like 24-hour recalls and food records to check for possible inadequacies of the method. In addition, these data indicate that MMA athletes need nutrition support and education.

3205 Board #270 June 3, 3:30 PM - 5:00 PM
Prevalence, Magnitude, Methods, And Symptoms Related To Weight Loss In Athletes Of Brazilian Jiu-Jitsu

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In competitions of grappling combat sports such as judo and wrestling, athletes generally perform rapid weight loss procedures in an attempt to gain competitive advantage. In the case of Brazilian Jiu-Jitsu (BJJ), also a grappling combat sport, where competitors are divided into categories whose criteria are age, belt color, and body mass (weight), it is possible that this same condition occurs. **Purpose:** analyze the prevalence, magnitude, and weight loss methods and identify the symptoms related to this practice in athletes of BJJ who took part in a world-class competition held in Curitiba-Paraná-Brazil. **Methods:** the sample consisted of BJJ male athletes (n = 17; age: 23.12 ± 6.2) with 6:35 ± 3:10 years of experience in competitions who participated of the Jiu-Jitsu Curitiba Open, competing in the Lightweight (76kg) adult purple belt class. The Rapid Weight Loss Questionnaire adapted for BJJ was applied in order to evaluate the prevalence, magnitude, and weight loss methods. A symptoms-list question added to the questionnaire aimed identify the main symptoms experienced by the athletes. **Results:** All 17 athletes reduced their weight to take part in the competition and the weight loss magnitude was 2.68 ± 1.4 kg (3.5 ± 1.4%) in an average of 9 days. Using a gradual diet (100%), exercising more than usual (82.4%) and decreasing fluid intake (64.7%) were the most cited weight loss methods. Moreover, athletes also reported the use of laxatives (23.5%), and diuretics (23.5%) which are regarded as doping substances. Among the symptoms, athletes recorded have experienced during the weight loss process, dizziness (11.8%), moments of excessive heat (11.8%), and sickness (11.8%). **Conclusion:** weight loss was highly

prevalent in the sample. However, the athletes had a reasonable magnitude of weight loss when compared with another combat sports athletes, which can be related to the organization of the competition. Once the weigh-in takes place immediately before the fight and athletes do not have time to regain the weight they have lost, large reductions in body weight (>5%) could negatively influence their sport performance. Moreover, some of them have used methods that are illegal and can be harmful to health and competitive performance, and can be related to the symptoms that they reported having experienced during weight loss.

3206 Board #271 June 3, 3:30 PM - 5:00 PM
The Healthy Eating Score: A Five-item Measure Of Diet Quality

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PURPOSE: Measures to assess diet tend to be lengthy and time-consuming. The present study sought to validate a 5-item Healthy Eating Scale (HES-5) against a comprehensive food frequency questionnaire (FFQ), and key nutritional biomarkers. **METHODS:** 221 soldiers (77% male; 28±9 years old; 19% wounded warrior) from four Army installations completed the HES-5 (which comprises of the frequency of eating fruits, vegetables, dairy, whole grains, and fish), FFQ (based on 110 foods), and additional exercise questions. Blood assays included Omega-3 and lipoproteins. Percent body fat was estimated using bioelectrical impedance analysis. **RESULTS:** The HES-5 strongly correlated with HEI (r=.48, p<.001). Both the HES-5 and HEI correlated with Omega 3 levels, but the HEI's correlation was stronger (r=0.29, p<0.05) than HES-5's (r=0.18, p<0.05). Both scores also correlated with %BF, and neither correlated with lipoprotein profiles. Both scores moderately related to key health behaviors, including eating breakfast (rHES-5=0.34; rHEI=0.37) and eating recovery snacks after exercise (rHES-5=0.33; rHEI=.45). HES-5 also related to self-reported vigorous physical activity (r=0.20, p<0.05), but the HEI did not. With regard to individual HES-5 items, these relations were higher for fruits and vegetables than for other items. These relations were consistent across Wounded Warriors and non-Wounded Warriors. Among non-wounded soldiers, neither score correlated with reported Army Physical Fitness Test performance. **CONCLUSIONS:** The HES-5 score appears to be an adequate indicator of a healthy diet when compared with scores for the USDA's HEI in a group of active Soldiers. The HES-5 should be considered as a brief measure of diet quality when resources are not available to administer a full FFQ. This research was supported by a grant from Comprehensive Soldier and Family Fitness (CSF2; HT9404-12-1-0017; F191GJ).

F-37 Free Communication/Poster - Physical Activity Interventions in Youth

Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

3207 Board #272 June 3, 2:00 PM - 3:30 PM
Longitudinal Patterns of Physical Activity Using a Personalized Intervention for Adolescents with Diabetes or Obesity

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Increased physical activity is an important lifestyle modification for adolescents with diabetes or who have risks for diabetes, yet they often fail to meet recommended moderate to vigorous physical activity (MVPA) guidelines. We previously demonstrated that adolescents who reported to be sedentary and then engaged in a 16-wk personalized community-based intervention adhered to 30 versus 60 minutes of MVPA on average 70% and 38% of the time, respectively. **PURPOSE:** The aim of this investigation was to further examine the longitudinal physical activity patterns and moderating characteristics that contributed to adherence in the personalized community-based physical activity intervention. **METHODS:** Patterns of physical activity were evaluated throughout the intervention using accelerometers situated at the hip in 46 adolescents with either type 1 diabetes (N=22), type 2 diabetes (N=12), or obesity (N=12) (age, 14.4 ± 1.5, 56.5% female; 61% Hispanic). Of these, 39 completed the intervention (completers) and 7 did not (non-completers). **RESULTS:** Completers began above 1060 MET-min/week and stayed above 900 MET-min/

wk for at least 4 weeks on average and declined 39 MET-min/wk until end of study (14.5±3.1 wks). Non-completers began at 924 MET-min/wk yet dropped below 800 MET-min/wk by end of week 1 and declined at an average of 151 MET-min/wk until end of study (7.1±4 wks). Significant longitudinal patterns were observed for gender and metabolic control (HbA1c) ($p<.05$). No differences were observed by diagnosis. Gender ($p=.002$) and HbA1c ($p=.025$) significantly predicted changes over time: males had consistently higher volumes yet declined faster and youth with higher HbA1c began at lower volumes and declined faster than those with lower HbA1c levels. CONCLUSION: These findings highlight key time points for adherence interference and unique moderating subject characteristics as likely targets to improve physical activity adherence in adolescents with diabetes and obesity with risks for developing future diabetes.

Funding: NIH 7R21 NR009267 (Faulkner, PI)

3208 Board #273 June 3, 2:00 PM - 3:30 PM
Effects Of A School-Based Physical Activity Intervention On Cognitive Performance In Danish Adolescents

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Background:

Physical activity (PA) is associated not only with health-related parameters, but also with cognitive and academic performance. Studies on the effect of PA on cognitive performance have predominantly been conducted in controlled settings and little school-based research is available.

Purpose:

To describe the effects of a school-based PA intervention on cognitive performance in adolescents.

Methods:

Data was from the study; Learning, Cognition and Motion (LCoMotion). A 20 week cluster randomized controlled trial was conducted including 14 schools with 7 allocated to receive the intervention and 7 acting as controls. Baseline measurements were carried out in November/December 2013 with follow-up performed in May/June 2014. A total of 632 students (mean (SD) age: 12.9 (0.6) years) completed the trial with baseline and follow-up data on primary or secondary outcomes. The intervention was multi-faceted and consisted of teacher initiated PA during academic subjects, provision of opportunities to engage in organized activities during recess, encouragement to engage in active transportation to school and provision of leisure-time PA homework. Cognitive performance was assessed by an executive functions test (flanker task) with the primary outcome being task accuracy and reaction time. Secondary outcomes included mathematics skills and interference control. Intervention effects on PA levels were assessed by accelerometry.

Results:

No difference in change, comparing the intervention group to the control group, was observed on the primary outcomes (all $p\geq 0.16$) or mathematics skills ($p=0.73$). A significantly larger change in interference control was found in favor of the control group ($p=0.03$). Baseline to mid-intervention changes in PA levels did not differ between groups (all $p>0.25$).

Conclusion:

No evidence was found for effectiveness of a 20 week multi-faceted school-based PA intervention in enhancing executive functioning or mathematics skills compared to a control group. A negative result was found for interference control. The intervention was not successful in affecting any domains of PA.

Trial registration: www.clinicaltrials.gov (NCT02012881)

Financed by the Danish Ministry of Education.

3209 Board #274 June 3, 2:00 PM - 3:30 PM
The Effect Of Obesity Management Intervention Using Activity Tracker In Overweight And Obesity Adolescents.

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 (No relationships reported)

Background: Adolescents obesity is one of the challenging epidemics of recent decades. There is a need for evidence of an efficacy of obesity management intervention programs for overweight and obesity adolescents.

Purpose: This study examined the effect of school based obesity management intervention using an activity tracker (accelerometer) on physical activity level, body mass index, physical self-description, and physical activity characteristics.

Method: Sixty adolescents over 85% body mass index percentile (BMI%ile) of their age group were equally and randomly divided into three groups; control group (CG; 14.2 ± 0.7 yrs, 164.9 ± 6.0 cm, 82.2 ± 9.9 kg, 30.2 ± 2.8 kg/m²), obesity management intervention with activity tracker group (ATG; 14.1 ± 0.8 yrs, 167.5 ± 7.8 cm, 86.0 ± 15.8 kg, 30.5 ± 4.0 kg/m²), and obesity management intervention with activity tracker and personalized counseling group (APG; 86.0 ± 15.8 yrs, 163.2 ± 7.6 cm, 78.8 ± 9.6 kg, 29.5 ± 2.7 kg/m²). CG and ATG participated in an on-site education program once a month, and ATG also utilized a mobile application connected to the activity tracker. APG was identically intervened as ATG, but they were also personally counselled by a professional. Physical activity level (daily step frequency, energy expenditure, locomotive distance), age group BMI%ile, physical self-description (self-efficacy, self-esteem), and physical activity characteristics (activity intensity using a questionnaire) were measured before and after 10 weeks of intervention period.

Results: A total 56 adolescents analyzed in this study. After 10 weeks, no changes were noticed in CG while ATG showed reduced BMI (29.8 ± 4.0 kg/m²). APG reduced their BMI (28.9 ± 3.1 kg/m²) as well as BMI%ile from 96.6 ± 2.5% to 95.1 ± 4.8% ($p<0.05$). No significant changes were found in physical activity level, physical self-description, and physical activity characteristics in all groups.

Conclusion: The results suggest that school based obesity management intervention using activity tracker with personalized counseling is most effective strategy in reducing body mass index.

Funding: This research was supported by the R&D Program for Society of the National Research Foundation (NRF) funded by the Ministry of Science, ICT & Future Planning (NRF-2013M3C8A2A02078507).

3210 Board #275 June 3, 2:00 PM - 3:30 PM
WHO Recommended Structured Physical Activity Intervention Improves Psychomotor Speed And Neuro-cognitive Functions In Adolescent Students.

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Purpose: To study the effect of six months of structured and unstructured physical activity interventions on psychomotor speed and neuro-cognitive functions in adolescents.

Methods: In our randomized, single blinded, parallel group, active controlled trial (CTRI/2013/08/003897) the recruited healthy school student volunteers, aged 12 - 17 years (n = 439), were allocated into Structured Physical Activity (SPA) and Unstructured Physical Activity (USPA) intervention groups by age and gender stratified block randomization. SPA designed as per World Health Organization (WHO) Physical Activity Guidelines for children and youth, and USPA which included any indoor or outdoor recreational activity of the participant's choice, were administered by physical education instructors for two hours a day, six times a week, for six months. Auditory and visual reaction times (ART and VRT), Letter Cancellation test (LCT), Trail Making test A and B (TTA and TTb), Ruff Figural Fluency test (RFFT) were recorded pre and post intervention that was successfully completed by 347 participants. Data analysis was done by an investigator blinded to the allocation sequence using student 't' tests by following per-protocol analysis (SPA n = 172 and USPA n = 175).

Results: LCT and TTb times (seconds) were significantly reduced in structured physical activity group [(LCT - USPA: 105.33 ± 19.54 vs. 104.61 ± 15.22, $p = 0.528$; SPA: 107.08 ± 21.87 vs. 100.03 ± 18.12, $p < 0.001$) (TTb - USPA: 93.19 ± 21.88 vs. 88.50 ± 18.29, $p < 0.001$, SPA: 94.31 ± 26.61 vs. 87.44 ± 20.27, $p < 0.001$)]. TTA time was not significantly altered in both the groups. VRT and ART (milliseconds) were significantly reduced in both the groups however the improvement was better in structured physical activity group [(VRT - USPA: 212.54 ± 29.88 vs. 192.10 ± 25.26, $p < 0.001$, effect size = 0.76; SPA: 214.36 ± 31.09 vs. 187.23 ± 28.31, $p < 0.001$, effect size = 0.87) (ART - USPA: 187.65 ± 19.29 vs. 175.15 ± 19.31, $p < 0.001$, effect size = 0.65; SPA: 188.54 ± 23.71 vs. 169.61 ± 22.79, $p < 0.001$, effect size = 0.79)].

Conclusion: Structuring the physical training intervention (as per WHO guidelines) in a cognitively engaging manner leads to greater improvements in psychomotor speed and neuro-cognitive executive functions of adolescents, probably due to cognitive loading and contextual interference.

3211 Board #276 June 3, 2:00 PM - 3:30 PM
The Effects of a Randomized Control Trial Sedentary Behavior Intervention on Depression in Active, Young Adults

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Previous research has demonstrated associations between sedentary behavior and depression. However, much of the existing sedentary behavior research is cross-sectional in nature. Few studies have utilized an experimental design to examine the associations between sedentary behavior and mental health.

Purpose: To examine the effects of a one-week sedentary behavior intervention on depression in active, young adults.

Methods: Participants completed the IPAQ-SF and were asked to wear a GT9X accelerometer for one week to confirm their activity levels. Participants then completed the PHQ-9 and were randomly assigned to the intervention (N= 20; Mage = 22.1) or control group (N= 11; Mage = 22.8). The intervention group was instructed to eliminate exercise and minimize steps to < 5000/day (monitored with Digi Walk SW 200 pedometers) for seven days, after which they returned to complete the PHQ-9 again. The intervention group was asked to resume normal physical activity levels for one week, after which they returned for a third depression assessment.

Results: For the experimental group, the average accumulated steps/day during week 1 was 8358, decreased to 5572 in week 2, and increased to 9334 in week 3 (P= .0018 for week 1vs2; P= .0001 for week 2vs3; P= .2234 for week 1vs3). No changes in steps occurred for the control group (9107 to 11,164, P= .0629). In the control group, PHQ-9 scores did not change from week 1 to week 2 (4.91 vs. 3.67, P= .2283). However, in the experimental group, depression scores paralleled the changes in steps. In the experimental group, across weeks 1, 2, and 3, respectively, PHQ-9 scores were 3.8, 6.5, and 2.9 (P<0.05 for weeks 1vs2 and 2vs3; P= .2234 for weeks 1vs3).

Conclusion: A one-week sedentary behavior intervention significantly increased depression levels in active, young adults. These findings support a possible causal relationship between sedentary behavior and depression. Encouragingly, depression symptoms decreased once physical activity returned to normal levels.

3212 Board #277 June 3, 2:00 PM - 3:30 PM
Exercise Intervention In Overweight And Obese Adolescents: Meta-analysis And Implications For New Zealand

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Background: The global rise in the prevalence of childhood and adolescent obesity has been linked to modifiable lifestyle factors, including lack of physical activity. However, no known meta-analysis has been conducted on the effects of exercise intervention on weight loss and metabolic risk factors in overweight and obese adolescents.

Objectives: To investigate whether exercise intervention improves body composition and cardio-metabolic risk factors in overweight and obese adolescents.

Data Sources: PubMed, Web of Science, SPORTDiscus, Google Scholar.

Study Selection: randomized controlled trial; structured exercise intervention, alone or combined; control group received no other treatment designed to increase physical activity; participants were overweight or obese; and aged between 10 and 19 years.

Appraisal and Synthesis Methods: 1667 studies were identified. After evaluation of study characteristics and quality and validity, data from 13 studies (15 trials) involving 554 participants were extracted for meta-analysis.

Results: Following exercise intervention, there was a most likely moderate reduction in BMI (2.0, CI: 1.5, 2.5). There were also most likely small reductions in body weight (3.7 Kg, CI: 1.7, 5.8), body fat percentage (3.1 %, 95% CI: 2.2, 4.1), waist circumference (3.0 cm, CI: 1.3, 4.8), and a most likely trivial increase (improvement) in lean mass (1.6 Kg, 95% CI: 0.5, 2.6). Following an oral glucose tolerance test, there was a most likely large improvement in the area under the curve for insulin (162 µU/ul, 95% CI: 93, 231) and very likely moderate improvement in blood glucose (39 mg/dl, 95% CI: 9.4, 69). There were also most likely moderate improvements in the homeostatic model assessment (1.0, 95% CI: 0.7, 1.4) and systolic blood pressure (7.1 mm Hg, CI: 3.5, 10.7). The effects of exercise on total cholesterol, LDL cholesterol, HDL cholesterol, fasting insulin and fasting blood glucose were inconclusive.

Conclusions: The current evidence suggests that exercise intervention in overweight and obese adolescents improves body composition, including decreased body fat and increased lean muscle mass. The limited available evidence further indicates that exercise intervention improves cardio-metabolic risk factors.

3213 Board #278 June 3, 2:00 PM - 3:30 PM
Healthy U-phase 2: A School Based Intervention To Improve Health Behaviors

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PURPOSE: To assess health behaviors and physical activity in select 4th and 5th grade students in New Jersey over a three year period.

METHODS: Physical activity intervention was the Coordinated Approach to Child Health (CATCH) curriculum administered by school personnel. FITNESSGRAM assessment performed in Fall 2014 consisted of PACER for aerobic capacity, Back Saver sit and reach, curl-ups and push-ups. A total of 4311 students participated in the CATCH curriculum in Year 3 and 172 students formed an intact control group. Unequal variance estimates were used to compensate for the differences in group sizes. In addition, subjects in each group were assigned haphazardly rather than through randomization because of the necessity of using intact groups within specific participating schools. FITNESSGRAM scores between intervention (I) and control (C) groups were compared using t-tests for independent samples.

RESULTS: There were no statistically significant differences between (I) and (C) groups for aerobic capacity and sit and reach while curl-ups were significantly greater for (C) as compared to (I) with push-ups significantly greater for (I) than (C) p<.05. Mean data: aerobic capacity (VO2max) (C) = 44.66 ml.kg.min. (I) =43.87 ml.kg.min.; sit and reach/right (C) = 22.17 cm (I) = 21.1 cm; sit and reach/left (C) = 22.16 cm (I) =21.12 cm; curl-ups (C) = 45.49 (I) = 29.3 and push-ups (C) =8.8 (I) = 10.97.

CONCLUSION: Two tests showed no significant differences between (C) and (I) while two split significance between (C) and (I). Although physiologic differences were not profound between (I) and (C) a major outcome of this study was attitudinal. Even though anecdotal, program facilitators received many student and faculty positive comments that the CATCH intervention enhanced their interest in and daily practice of healthy lifestyle choices.

3214 Board #279 June 3, 2:00 PM - 3:30 PM
Effects of Physical Activity Interventions in a Rural School District

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>Childhood obesity is increasing at an alarming rate. The CDC states that in 2012, more than one third of children and adolescents were overweight or obese. Physical activity interventions in the school may be a way to combat childhood obesity.

PURPOSE: To determine if physical activity education and interventions ensure that students enrolled in a school district in a rural Midwestern school district meet the age-appropriate cardiovascular fitness level.

METHODS: Physical activity interventions included: new cardiovascular and strength training equipment by middle school and high school students, and strength training sessions were included in physical education classes, sessions in physical education classes where students trained at their target heart rate, physical activity and fitness goal setting, adaptive physical education purchased new equipment to expand their curriculum, the high school fitness room was used at least four days a week (where it was previously only used two days a week), fitness related technology, and education related to physical activity. A stratified random sample was used for kindergarten through twelfth grade over a two year period. The PACER (progressive aerobic cardiovascular endurance run) was used to determine age-appropriate cardiovascular fitness levels. The total numbers of completed laps were used to determine if the goal was met, based on age and gender. The 15 meter or 20 meter converted FITNESSGRAM standards were used.

RESULTS: There was an 85.21% (2403/2820) response rate for completed PACER tests. Results indicate that 78.15% (1878/2403) of subjects met the criteria. This is much higher than the 32.9% that met the criteria during baseline testing.

CONCLUSIONS: Physical activity interventions and education encouraged students to participate in activities that increased their cardiovascular fitness levels.

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3215 Board #280 June 3, 2:00 PM - 3:30 PM

The ‘Girls Active’ Physical Activity Intervention: Baseline Characteristics Of Objectively Measured Physical Activity

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Purpose: ‘Girls Active’ is a UK school-based intervention, designed by the Youth Sport Trust, to target the low levels of physical activity observed in adolescent girls. ‘Girls Active’ is being evaluated through a cluster randomised controlled trial. The purpose is to describe the baseline characteristics of the participants, specifically focusing on objectively measured physical activity.
Methods: Baseline data were collected from February-April 2015. Date of birth and ethnicity were self-reported and height and weight measured. Physical activity was assessed objectively (GENEAActiv wrist worn accelerometer) 24 hours/day for 7 days. Mean acceleration and time in MVPA were calculated for weekdays and weekends, the school day and after school period (end of school - 9pm). Percentage of girls meeting the recommended physical activity guidelines was also calculated. Baseline characteristics are described by means (±SD) and percentages. Pearson correlation examined associations between the physical activity variables and both age and BMI.
Results: In total, 1753 girls 11-14 years (mean age 12.9 ± 0.8yrs, mean BMI 19.9 ± 4.0 kg/m², 76% White European) consented to take part. Accelerometer wear compliance was excellent: 94% of girls provided valid accelerometer data (≥4 days of data). Mean acceleration was 38mg, 33mg, 24mg, 22mg for weekdays, weekends, during school and after school respectively. Time in MVPA was 47.6 ± 20.9, 40.1 ± 25.7, 18.2 ± 8.1 and 17.3 ± 9.5 mins/day for weekdays, weekends, during school and after school respectively. Only 22.2% of participants achieved the physical activity guidelines of 60minutes of MVPA/day. Acceleration and MVPA for all time periods were inversely associated with age (acceleration: r = -0.21 - r = -0.23, p<0.01; MVPA: r = -0.16 - r = -0.20, p<0.01) and acceleration and MVPA were inversely associated with BMI for weekdays (acceleration: r = -0.07, p<0.05; MVPA: r = -0.06, p<0.01), weekends (acceleration: r = -0.08, p=0.01; MVPA: r = -0.07, p<0.01) and after school MVPA (r = -0.05, p<0.05).
Conclusion: Girls were highly compliant with the wrist worn accelerometer. The majority of adolescent girls did not meet the recommended physical activity levels with very little time spent in MVPA during and after school. Younger age and lower BMI were associated with higher activity.

3216 Board #281 June 3, 2:00 PM - 3:30 PM

Effects of Nutrition Interventions in a Rural School District

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Childhood obesity is increasing at an alarming rate. The CDC states that childhood obesity has more than doubled in children and quadrupled in adolescents in the past 30 year. Nutrition interventions in the school may be a way to combat childhood obesity.
PURPOSE: To determine if nutrition education and interventions ensure that students enrolled in a school district in a rural Midwestern school district eat the recommended amount of fruits and vegetables. The goal was to have students eat three vegetables and two fruits every day during data collection.
METHODS: Nutrition interventions were implemented for the entire school district. Interventions include: appropriate food portion sizes, 1% milk replaced 2% milk, all candy bars and snack chips were removed, greater variety of fruits and vegetables added to the cafeteria menu, nutrition education implemented into courses and nutrition education information posted throughout schools. A stratified random sample was used for kindergarten through twelfth grade over a two year period. Subjects used a food recall form to collect this data. The elementary students (K-6th) used a four day form; the middle school and high school students (7th -12th) used a seven day form. In order to have met this goal, the students had to report eating at least two fruits and three vegetables each day.
RESULTS: There was a 69.74% (1392/1996) response rate for completed logs. Only 1.44% (20/1392) of subjects ate three vegetables and two fruit every day during the data collection period. When individual days were analyzed, 54.41% (2250/4135) of the students who responded ate two or more fruits a day and 13.69% (560/4092)

of students ate three or more vegetables a day. Furthermore, 92.74% (3835/4135) of the students reported eating fruit and 88.07% (3604/4092) of students reported eating vegetables on the individual days.
CONCLUSIONS: Nutrition interventions and education did not encourage students to eat the recommended amount of fruits and vegetables over a multiple day period. However, a majority of subjects ate at least one fruit and/or one vegetable a day.
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3217 Board #282 June 3, 2:00 PM - 3:30 PM

Effect Of 12-week Exercise Intervention On Daily Physical Activity of Elementary School Students

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PURPOSE: To investigate the effect of 12-week rope skipping exercise and regular physical education (PE) on daily physical activity (PA) levels of elementary school pupils.
METHODS: A total of 28 second grade students (age in yr.: 8.03±0.45; height in cm: 129.80±5.62; weight in kg: 30.69±8.12; BMI: 18.10±3.99) was divided into either the rope skipping intervention and conventional PE groups. The intervention group received a 35-minute rope skipping session, twice a week, for 12 weeks. Daily PA was measured before and after 12 weeks for both groups while wearing ActiGraph GT3X + on right hip for seven consecutive days. This study used the cut-points established by Evenson et al. (year2008) to estimate PA intensity levels (Sedentary: 0-100, Moderate and vigorous PA (MVPA) >2297, Vigorous PA (VPA) >4012 counts/min, cpm).
RESULTS: The intervention group spent more VPA and MVPA time and less sedentary time than the control group after the 12-week intervention (Table 1).
Table 1 Group differences in weekday and weekend PAlevels (min/d)

Group		Sedentary		VPA		MVPA	
		Weekday	Weekend	Week-day	Week-end	Week-day	Week-end
Inter-vention	Before	415.79 ± 71.68	494.06 ± 39.99	24.97 ± 4.89	17.00 ± 8.85	33.15 ± 12.23	22.19 ± 4.47
	After	409.13 ± 92.31	451.24 ± 83.76	27.13 ± 7.02	23.29 ± 8.45#	34.87 ± 31.76	39.16 ± 7.07#
Control	Before	418.39 ± 93.37	480.84 ± 82.49	22.18 ± 4.90	26.76 ± 8.73	28.31 ± 10.21	25.48 ± 6.28
	After	477.47 ± 73.97*#	546.07 ± 91.55*#	23.37 ± 4.16	29.43 ± 9.47	26.57 ± 9.10	28.00 ± 11.03

Note: Comparison of results before and after intervention between groups: * P < 0.05, **P < 0.01; comparison of results before and after intervention within group: # P<0.05).
CONCLUSION: Rope skipping exercise could help increase elementary school students’ high-intensity physical activity in their daily life, while reduced their sedentary time. Meanwhile, it was noticed that daily MVPA levels of most of these students were significantly below 60 min/d, especially among girls.
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3218 Board #283 June 3, 2:00 PM - 3:30 PM

Effects Of Community-based Intervention On Physical Activity In Overweight And Obese Children

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Childhood obesity is a major public health crisis. It is associated with multiple factors including a lack of adequate physical activity(PA). Purpose: To assess the effects of a community-based obesity prevention program on PA and fitness in children aged 6-10. Methods: The 16-week intervention program consisted of a weekly 75 minute sessions that included PA and nutritional education for both children and parents and supervised PA for children. The analytic sample included 64 children ages 6-10 years who attended one of six programs implemented between 2011-2015. Measurements were taken before and after program participation. Height and weight were measured using standard procedures and used to calculate Body Mass Index (BMI) and BMI z-scores. PA was measured for 7 days by accelerometer (GT3x) at baseline and at the

end of the program. The criteria for accelerometer wear time was a minimum 3 days with 6+ hours/day. Time spent in moderate and vigorous physical activity (MVPA) was calculated using standard cut-off limits (>500 cnts.min⁻¹). Physical fitness were measured using the FitnessGram including the curl up, push up, trunk lifts and shoulder stretch tests. Pre-post changes in the PA, BMI, BMI z-scores and FitnessGram outcomes were determined via paired T-test or wilcoxon signed rank test, or analysis of covariance. Results: Twenty-two children (8 boys and 14 girls, age=8.7±1.2 years, BMI= 24.8±4.96 kg/m²) met the required accelerometer wear time at both time points. BMI z-scores decreased from baseline to post (1.92±0.85 to 1.81±0.76, p=0.001). There was a pre-post increase in curl ups (7.25±10.63 to 12.05±6.39, p=0.003) and trunk lifts (5.70±2.98 to 8.75±3.84, p<0.001). There was no change in mean daily MVPA (113±36 vs. 104±45 min, p=0.293) and changes were similar in both boys and girls (-2.27±40.5 and -12.39±37.34 min, p=0.559). The correlation between absolute changes of MVPA and BMI z-scores was not significant (r=-0.13, p = 0.55). Conclusion: The community-based program was effective in reducing children's BMI z-scores and improving some aspects of physical fitness. However, there was no difference in MVPA, which may be to the limited number of children who met accelerometer wear time criteria. Methods to increase accelerometer compliance in community-based programs should be explored in future research.

3219 Board #284 June 3, 2:00 PM - 3:30 PM
Neuromuscular Training Programs For Acl Tear Prevention In Young Female Soccer Athletes: A Health Technology Assessment Of The Clinical Evidence And Cost-effectiveness

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PURPOSE: To determine if neuromuscular training programs (NTP), compared to routine care, prevent the occurrence of an ACL tear in young female soccer athletes. **METHODS:** A Health technology assessment of the clinical and cost-effectiveness of neuromuscular training programs in an outpatient clinic setting consisting of clinics, schools, and soccer clubs. The target population patients were young female soccer athletes between the ages of 10 and 18. The intervention was a neuromuscular training programs with the control group as routine care. The main outcome measure analyzed was a symptomatic, full thickness, complete ACL tear. The timeframe of analysis was 1 year, or 2 full seasons. **RESULTS:** Inclusion criteria were randomized controlled trials, systematic reviews, meta-analyses, and economic analyses. 7 systematic reviews, 6 prospective cohorts, and 5 randomized controlled trials were identified for full-text review to assess the methodological quality. Only 1 randomized controlled trial, 1 meta-analysis and 1 economic analysis focused specifically on neuromuscular training versus routine care in preventing ACL tears in the adolescent female subgroup. The optimal age window was before the age of 18 with a 72 % risk reduction rate. A universal neuromuscular training program can lead to decreased ACL tears with costs as low as 1.25\$ per player to as high as 25\$ per player in a season. NTP is effective with a decreased incidence of injury from 3% to 1.1 % per season and could save 275\$ per athlete in injury-related costs. **CONCLUSION:** Neuromuscular training programs are safe, efficacious in the real world, cost-effective, impact the quality of life of patients, and impact government budgets on a minimal basis.

3220 Board #285 June 3, 2:00 PM - 3:30 PM
The Effect of 16-week Aerobic Exercise Training on Circulating Adropin in Children

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Circulating adropin has been shown to be negatively associated with obesity, aging and metabolic diseases in adults. However, the effect of habitual aerobic exercise on such relationships in healthy children remains unclear. **PURPOSE:** To determine the effect of aerobic exercise training on the association between circulating adropin concentration and cardiovascular risk markers in preadolescent children. **METHODS:** Nine girls (9.7 ± 0.2 yrs, 142 ± 5 cm, 56.3 ± 6.5 kg, 25.3 ± 2.2 kg/m²) and three boys (9.7 ± 0.9 yrs, 142 ± 5 cm, 42.1 ± 13.1 kg, 20.4 ± 5.3 kg/m²) participated in a 16-week physical activity program. A fasting blood sample, VO₂peak, body composition and blood pressure were obtained before and after training. **RESULTS:** In response to training, plasma adropin concentration increased from 20.0 ± 4.0 to 22.7 ± 3.9 ng/mL in boys and decreased from 16.6 ± 1.8 to 14.6 ± 1.4 ng/mL in girls (p<0.05 for interaction). There were sex differences in adropin concentrations, but a limited number of boys were studied; therefore, additional correlational analyses were performed only in girls. Percent body fat was negatively correlated with adropin

both at baseline (r=-0.724, p<0.05) and after exercise training (r=-0.838, p<0.05). Similarly, body mass index (BMI) approached a significant negative correlation with adropin at baseline (r=-0.724, p=0.076) and was negatively correlated with adropin after exercise training (r=-0.693, p<0.05). The correlation between VO₂peak and adropin was nearly significant at baseline (r=0.658, p=0.054) and significant after exercise training (r=0.788, p<0.05). There was a training-induced decrease in adropin (-2.0 ± 1.1 ng/mL), which was correlated with the change in BMI (0.5 ± 0.4 kg/m², r=0.715, p<0.05), but not with changes in percent fat or cardiorespiratory fitness. In addition, there was no correlation between adropin and lipid profiles, blood pressure, plasma glucose or insulin levels at baseline or after training. **CONCLUSIONS:** Exercise training exerts differential effects on plasma adropin in boys and girls. Obesity status and cardiorespiratory fitness may play a role in mediating circulating adropin concentrations in girls. Furthermore, changes in adropin are correlated with changes in BMI over the course of 16-week aerobic exercise training. Supported by NIH RO1DK071081.

3221 Board #286 June 3, 2:00 PM - 3:30 PM
Kinanthropometric Responses To Callisthenic Strength Training In Children

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Childhood overweight and obesity is likely to challenge worldwide public health if they do not engage in recommended levels of physical activity as prescribed by public health organizations. **PURPOSE:** The study aimed to determine the effects of a six-week callisthenic training program on body composition in previously sedentary normal weight and overweight/obese children. **METHODS:** Fifteen previously sedentary obese and overweight children (OOC) and 15 previously sedentary normal weight children (NWC), aged between 9 and 11 were assigned to a six-week non-consecutive callisthenic strength training program of approximately 45 minutes consisting of six exercises, while an additional 15 previously sedentary normal weight children were assigned to a non-exercising control group (NON). **RESULTS:** Results indicated that the callisthenic training program significantly (p ≤ 0.05) decreased body mass (from 44.54 ± 10.53 to 43.77 ± 10.38 kg, p = 0.002), BMI (23.27 ± 5.05 to 22.85 ± 5.00 kg.m⁻² p = 0.002), percentage body fat (from 33.01 ± 5.15 to 31.94 ± 5.55%, p = 0.042), fat mass (from 15.01 ± 5.45 to 14.30 ± 5.33 kg, p = 0.000), and sum of skinfolds (from 46.46 ± 11.65 to 44.38 ± 11.61 mm, p = 0.032) in the OOC. The callisthenic training also decreased hip circumference (from 73.26 ± 5.84 to 72.76 ± 5.88 cm, p = 0.030), and sum of skinfolds (from 29.38 ± 10.18 to 25.84 ± 8.11 %, p = 0.034) in the NWC. Callisthenic training is a cost-effective and useful intervention strategy to decrease kinanthropometric variables, not only in overweight and obese, but also normal weight children.

3222 Board #287 June 3, 2:00 PM - 3:30 PM
High and Supra High Intensity Intermittent Training in Obese Prepubescent Boys

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 (No relationships reported)

PURPOSE: Our objective was to determine whether HIIT and supra-HIIT would improve vascular structure and function in obese prepubescent boys. **METHODS:** Thirty seven obese boys (BMI 25.49±0.42 kg/m²), aged 8-12 years, were randomly assigned into control (CON; n=11), HIIT (n=11) and Supra-HIIT (n=15) groups. Both exercise groups performed exercises on a cycle ergometer 3 times/week for 12 weeks. HIIT consisted of 8 x 2-minute cycling at 90% peak oxygen consumption (VO₂peak) and 1-minute recovery while Supra HIIT consisted of 8 x 20-second cycling at 170% VO₂peak and 10-second recovery. **RESULTS:** The supra-HIIT group had a higher enjoyment score and a lower dropout than the HIIT group (p<0.05). Both HIIT and Supra-HIIT did not affect body mass, body fat percentage, and waist circumference. VO₂peak and resting metabolic rate increased in both exercise groups (p<0.05). Leg muscle strength increased and systolic blood pressure and brachial-ankle pulse wave velocity decreased only in the supra HIIT group (p<0.05). Carotid artery intima-media thickness decreased after 12-week of HIIT and Supra-HIIT program (p<0.05). There were no changes in flow-mediated dilation in any of the groups studied. Blood lipid profile (i.e., total cholesterol, triglyceride, LDL-cholesterol, and triglyceride/HDL ratio) improved in both HIIT and supra-HIIT groups (all p<0.05).

CONCLUSIONS: Both HIIT and supra-HIIT have favorable effects on vascular structure and function and blood lipid profile in obese prepubescent boys. Supra-HIIT may be a feasible, time-efficient, and effective exercise for preventing future cardiovascular disease and enhancing fitness in obese children.

ACKNOWLEDGEMENTS: This study was supported by Ratchadaphiseksomphot Endowment Fund, Chulalongkorn University.

3223 Board #288 June 3, 2:00 PM - 3:30 PM
Aerobic Training Increased Cardiorespiratory Fitness but Did not Affect Habitual Physical Activity Pattern in Adolescents

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The health benefits of engaging in regular physical activity (PA) are well established; however, recent studies suggest that those who engage in high amounts of sedentary behavior are at increased risk of mortality and morbidity regardless of their level of cardiorespiratory fitness. The 2014 US Report Card on Physical Activity for Children and Youth indicates that the majority of the US youth spend more than half of the waking hours in sedentary behavior. While it is imperative to provide structured programs of PA for youth, the impact of such programs on more spontaneous PA and sedentary behavior is not known.

PURPOSE: The aim of this study was to determine whether a standard exercise program, designed to increase aerobic fitness, will also promote habitual PA pattern and decrease sedentary behavior in a group of adolescent boys and girls.

METHODS: 30 adolescents (14-17 y/o, 20 girls) completed 8-week supervised aerobic exercise program (three 1hr sessions/week). Activity monitors (Actigraph GT3x) were worn on the waist (24 hour/day) during the first and last week of the training program. Activity data was analyzed using Actilife software. Cardiorespiratory fitness was assessed in the laboratory to determine peak VO₂. A paired t-test was used to compare variables before and after training.

RESULTS: At the end of the exercise program 27 out of 30 participants had an increase in peak VO₂ (average of 15.7±2.3%, p<0.0001 paired t-test). However there was no effect on daily habitual PA, i.e., sedentary time or time spent in MVPA.

CONCLUSION: Our data suggest that a standard PA program is not sufficient to promote habitual PA and reduce sedentary time in adolescents. Health promotion policies and physical activity programs should be designed not only to improve cardiorespiratory fitness, but also to address the need of promoting habitual PA and reducing sedentary time.

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3224 Board #289 June 3, 2:00 PM - 3:30 PM
Effect of Soccer Training Program On Health Parameters In Prepubertal Obese Boys.

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PURPOSE: To verify body composition, cardiorespiratory fitness and thigh muscular strength answers of prepubertal obese boys to a 16-week soccer training program.

METHODS: Sixteen obese boys (age: 7-10 yrs, body mass index (BMI) > than CDC 95th percentile; 35.5±7.4 percent fat) were submitted to pre and post soccer training program evaluations. *Anthropometry:* weight, height, BMI, skinfold measurements to determine percent fat and fat-free mass. *Aerobic capacity:* ergospirometry treadmill test to determine relative VO₂max (mL.kg⁻¹.min⁻¹). *Isokinetic evaluation:* two knee extension-flexion (concentric-concentric) at 60°/sec. *Training design:* two 60-min sessions/week with average intensity >75-91% of the age-predicted (HRmax) corresponding to a mean average energy expenditure of 346.6 kcal/session. Individual portable HR monitor controlled training intensity. *Statistical analysis:* data are presented as mean (±SD); use of paired Student t-test for pre and post-training comparison with significance level at p ≤ 0.05. **RESULTS:** The table presents pre and post-training values as mean ± SD and Student t-test p-value. Significant increases in weight, height and FFM (8%) and significant 6%-decrease in percent fat were observed. BMI remained unchanged. Relative VO₂max significantly increased 11%. Total work flexion of the dominant member presented 14% increase. Adherence to the soccer sessions was of 80±12%. **CONCLUSION:** Controlled intensity and adherence

to this 16-week soccer training program were determinant and effective to successfully enhance body composition, cardiorespiratory fitness and muscular strength effects in this group of prepubertal obese boys.

Variable	Pre training	Post training	P
Weight (kg)	47.4± 10.9	49.7± 10.9	0.002
Height (cm)	139 ± 7.8	143 ± 7.5	0.001
BMI (kg/m ²)	24.6	24.4	NS
Fat (%)	35.5 ± 7.4	33.2 ± 8.0	0.017
Fat-free mass (%)	64.5± 7.4	66.7 ± 8.1	0.017
VO ₂ max (mL.kg ⁻¹ .min ⁻¹)	27.6 ± 4.6	30.6 ± 4.2	0.018
Total work flexion dominant member (J)	201.4 ± 47	229.9 ± 95.2	0.001

3225 Board #290 June 3, 2:00 PM - 3:30 PM
Physiological And Cognitive Adaptations To 8 Weeks Of Training On A Movement-based Video Game

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Cognitive and physical training are two approaches that successfully enhance deficient cognitive control abilities. A synergistic effect may be attainable through the combination of each training approach. **PURPOSE:** Assess physiological and cognitive adaptations from 8-weeks of training on a novel video game (Body-Brain Trainer "BBT") combining both cognitive and physical training in a proportional fashion. Positive adaptations in each domain were expected to be greater as compared to an expectancy-matched placebo control group.

METHODS: At the halfway mark of this study, ten lightly active young participants (24.2 +/- 1.62 yrs) completed 8 weeks of training (24 sessions total) on BBT, a video game comprised of nine 4-minute game play sessions. An age-matched (24.75 +/- 3.64 yrs) placebo group (n=16) trained on a non-physical video game. Physical task difficulty adapted during game play based on real-time heart rate measurements and titrated participants to 70-80% of VO₂ max. Cognitive task difficulty was adaptive, based on cognitive performance metrics. Physiological assessments performed at baseline and follow-up included BMI, resting blood pressure, body composition, vertical jump, Hexagon Agility Test, and VO₂ max. Cognitive assessments performed included behavioral and neural measures of working memory, sustained attention, and goal management.

RESULTS: Preliminary findings revealed a significant improvement in systolic blood pressure in the BBT group (108.33 + 8.17 mmHg, p=.001) compared to placebo (114.31 + 7.39 mmHg, p=.774). Vertical jump also showed a significant improvement in the BBT group (15.25 + 2.64 inches, p=.003). VO₂ max showed no improvement in either group, but BBT participants were in their prescribed heart rate zone for only 35% of training sessions. 80% of BBT participants showed an improvement in working memory abilities as compared to 62.5% in Placebo, although to date no significant group differences exist.

CONCLUSIONS: This novel video game proportionally integrating both exercise and cognitive challenges revealed potential improvements in both cognitive and physiological measures. Future endeavors include doubling the number of participants as well as the enrollment of control groups to assess training either on a "Brain-only" or "Body-only" version of BBT.

3226 Board #291 June 3, 2:00 PM - 3:30 PM
Relationships Between Depression And Sleepiness, Daily Physical Activity Level, Physical Fitness In Japanese University Student

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PURPOSE: Life style has been disturbed in recent Japan, particularly in young generation, which may deteriorate quality and quantity of sleep and decrease physical activity. In addition, depressive tendency has been becoming widespread in college age. Therefore, it is important to examine the relationships among those factors. In this study, we report significant correlations between depression and sleepiness, daily-physical-activity-level, physical fitness in Japanese university student.

METHODS: Eighty-five undergraduate students participated in this study (52 men and 33 women). We measured physical activity level using an accelerometer (LifeRecorder [Lc], Kenz, Nagoya, Japan) for 2 weeks. The Lc measured the daily number of steps (steps per day), 24-energy expenditure (kJ per day), and energy expenditure of

exercise (kJ per day). To evaluate the level of endurance fitness, Maximal oxygen uptake (VO₂max) was calculated by an indirect method using a cycle ergometer. The VO₂max was predicted by the nomogram of Åstrand and Ryhming, a modality that is generally used to predict the VO₂max. Depressive tendency and daytime sleepiness was evaluated with questionnaire, PHQ9 and JESS (Japanese version of the Epworth Sleepiness Scale), respectively.

RESULTS: The mean of PHQ9 score, sleepiness score, the number of steps, and VO₂max were 5.3 ± 3.3 , 10.7 ± 3.6 , 9513.3 ± 3283.2 steps, and 42.5 ± 6.5 ml/kg/min., respectively. There were significant positive correlations between PHQ9 score and sleepiness, PHQ9 score and physical activity variables ($N = 85$; $r = 0.35$ and $r = 0.39$, respectively; $p < 0.05$ for both). That was also true between PHQ9 score and VO₂max ($r = 0.25$; $p < 0.05$). The trends were more pronounced in male than in female.

CONCLUSIONS: Our important finding is that there are positive correlations between depression and variables of physical activity level. The mean values of daily physical activity level of participants with depression tendency were within normal range. Then we infer that sports facilities or sports-oriented club activities with fierce competition, especially in male students, may cause both high daily-physical-activity-level and depressive tendency in university students.

3227 Board #292 June 3, 2:00 PM - 3:30 PM
College Students' Situational Motivation, Energy Expenditure, and Blood Pressure in Exergaming and Treadmill Walking

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(No relationships reported)

Purpose: This study examined the impact of exergaming on college students' situational motivation (SM), energy expenditure (EE), step counts, and blood pressure (BP) as compared to traditional treadmill exercise, while also investigating the predictive strengths of SM on all outcomes.

Methods: Fifty-seven college students (28 males; Mage = 23.54, SD = 4.06) completed three separate 20-minute exercise sessions on Xbox 360 Kinect Reflex Ridge, Xbox 360 Kinect Just Dance, and moderate-intensity treadmill walking (4.0 mph). EE and step counts were measured by ActiGraph accelerometers; BP was assessed via an automatic blood pressure cuff; SM was assessed by Situational Motivation Scale (SIMS; intrinsic motivation [IM], identified regulation [IR], external regulation [ER], amotivation [AM]) following each exercise.

Results: Repeated-measures ANOVAs revealed significant differences among the three activities on all outcomes. Specifically, treadmill walking yielded significantly higher caloric expenditure ($p < .01$), steps ($p < .01$), and BP changes ($p < .01$) than the two exergaming sessions. Additionally, Reflex Ridge resulted in significantly higher caloric expenditure ($p < .01$) but lower steps ($p < .01$) than Just Dance. Notably, participants reported higher IM ($p < .01$) and less ER ($p < .01$) toward exergaming as compared to treadmill walking, indicating greater likelihood to engage in exergame play versus treadmill walking. Finally, regression analyses suggested IM ($\beta = .51$, $p < .01$) positively predicted steps while IR ($\beta = -.62$, $p < .01$) and AM ($\beta = -.38$, $p < .05$) negatively predicted steps in treadmill walking. No other significant relationships were identified.

Conclusion: The findings suggest that Kinect-based exergaming has the potential to stimulate physiological responses among college students, but has not yet reached the moderate-intensity physical activity level of fast treadmill walking. Regardless, exergaming is more likely to motivate and engage college students in physical activity versus treadmill walking. Lastly, findings indicate motivation may be a major determinant of steps in treadmill walking. Future research is warranted on investigation of individuals' actual skill levels and the corresponding physiological and psychological outcomes during exergaming.

3228 Board #293 June 3, 2:00 PM - 3:30 PM
Effects Of Physical Activity On Memory In Pre-adolescent Children

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Effects of Physical Activity on Memory in Pre-Adolescent Children

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PURPOSE: *Energizers* are short activities implemented in the classroom that allow children to get up and move during academic instruction (Mahar, Murphy, Rowe, Golden, Shields, & Raedeke, 2006). In the *Energizer* study, the researchers asked teachers to lead one 10-minute activity per day for 12 weeks. There was more than an 8% increase of average on-task behavior from pre- to post- *Energizer* activity. Furthermore, there was a 20% improvement in on-task behavior after the intervention

in low on-task students (defined as students who were on task less than half the time). There is considerable amount of research that supports the positive relationship between fitness and academic achievement including retention and on-task behavior. There is not much research demonstrating the acute significant results of physical activity on academic achievement in children.

To assess the impact of short bouts of physical activity, using the *Energizers* curriculum, on the level of working memory span in fourth grade students.

METHODS: Working memory span was tested using an electronic memory game in 20 fourth grade students (ages 9-10 years old). Students were tested once at the beginning of Physical Education class without any previous activity and once after participating in a 10-15 minute *Energizer* activity. **RESULTS:** The participants scored an average of 0.825 points higher after the *Energizers* activity when compared to any physical activity before the memory game test (6.363 and 5.537, respectively). The difference between the intervention (post-activity) and the control (pre-activity) was statistically significant ($p = 0.0093$) and the effect size of the mean difference was medium (Cohen's $d = 0.600$). **CONCLUSION:** The current study revealed that *Energizer* activities do significantly improve memory by increasing memory game scores when compared to not participating in any physical activity.

3229 Board #294 June 3, 2:00 PM - 3:30 PM
Health Related Fitness, Sedentary Time and Self-Esteem Among Hispanic Children in Puerto Rico

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Sedentary time (ST) and low fitness are important health risk factors. While adults show indirect correlations between ST and fitness, and direct correlation between fitness and self-esteem; these associations have not been well established in children.

PURPOSE: To evaluate the association between health related fitness (HRF), sedentary time, and self-esteem in elementary school Hispanic children in Puerto Rico.

METHODS: A group of 114 children (54 girls and 60 boys; mean age = 7 years), completed three FITNESSGRAM® tests (%fat, sit & reach, push-ups), wore accelerometers for 7 days=(ActiGraph GT3X+), and completed a self-esteem questionnaire. A HRF score was created based on the achievement of a healthy fitness zone in each test, for a maximal score of 3. A t-test was conducted to detect gender differences, and Spearman correlations to detect associations between HRF, sedentary time, self-esteem, grade, and age.

RESULTS: No gender differences were detected in HRF, sedentary time or self-esteem; and no correlation was observed between HRF, sedentary time, and self-esteem. However, HRF indirectly correlated with grade ($r = -0.22$, $P = 0.02$), and age ($r = -0.27$, $P = 0.003$). Also, sedentary time was directly correlated with grade ($r = 0.21$, $P = 0.03$), and age ($r = 0.27$, $P = 0.004$).

CONCLUSIONS: The decrease in HRF and increase in sedentary time with age in this group of young children raise concerns about their future health and wellbeing. Interventions must be implemented to help reduce this trend.

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3230 Board #295 June 3, 2:00 PM - 3:30 PM
Taekwondo Routines do not Improve Working Memory in Children

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There is scientific evidence supporting the beneficial effects of martial arts practice on cognitive variables; however, there is no evidence regarding the effects of practicing specific taekwondo routines on working memory (WM) in Costa Rican children.

PURPOSE: To examine the chronic effects of a taekwondo training program (poomsae) on WM in sedentary children.

METHODS: Twenty-six children (8 males and 18 females, mean age = 10.9 ± 1.0 years) were randomly allocated to either a) 60-min of the first taekwondo poomsae standardized routine, or b) no practice of poomsae. Children in the taekwondo poomsae group performed two sessions per week for four weeks. Exercise consisted of a defined pattern of defense-and-attack movements taught by a black-belt taekwondo expert. Executive control (EC) was measured as a WM variable using the Words Backward (WBT), Digits Forward (DFT) and Digits Backward Tests (DBT) at the beginning (pre-test) and at the end of the program (post-test).

RESULTS: Two-way analysis of variance with repeated measures on one factor (time) revealed no statistically significant between-group interactions on EC measured by DFT ($p = 0.23$), DBT ($p = 1.0$), and WBT ($p = 0.11$). Statistically significant main

effects were obtained for measures of EC obtained by WBT (pre-test = 25.6 ± 6.6 vs. post-test = 28.1 ± 5.9, $p = 0.01$) and DBT (pre-test = 2.6 ± 0.9 vs. post-test = 3.3 ± 1.1, $p = 0.006$).

CONCLUSIONS: Taekwondo standardized training (poomsae) does not improve working memory in sedentary Costa Rican children.

3231 Board #296 June 3, 2:00 PM - 3:30 PM
Changes in Physical Activity and Sedentary Time are Related to a Better Bone Profile in Youth
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 (No relationships reported)

The benefits of physical activity (PA) in a positive bone health are well known, and sedentary time (ST) has been independently associated with poor bone mass in adults. In children and adolescents, this relationship is unclear. Moreover, studies strongly support that fat accumulation is unfavorable to bone mass. **PURPOSE:** To explore whether changes in PA time in different intensities and ST are related to a better bone profile in obese/overweight children and adolescents involved in a school-based PA program. **METHODS:** 53 youth (28 girls, age=10.6±3.5) took part in an 8-month school-based PA intervention programme. PA by accelerometers, bone area (BA), bone mass (BM), bone mineral density (BMD), percentage of body fat (%BF) by DEXA, and vitamin D (VITD) were taken at the baseline and at the end of the intervention. Three Linear Regression models were done with deltas BA, BM and BMD as dependent variables, and deltas VITD, PA time, and ST as predictors, to analyze the longitudinal effect of PA time and ST changes in bone variables changes. Analyses were adjusted for age, sex and delta height. **RESULTS:** Descriptive statistics showed significant and positive paired differences for height (2.71%), body mass (1.11%), body lean mass (1.43%), bone area (0.41%), bone mass (0.06%), bone mineral density (0.02%), with $p < 0.001$, and moderate physical activity-MPA (7.39%; $p = 0.011$). There was a significant decrease in sedentary time (-39.09%; $p = 0.002$). Delta ST was negative and significantly associated with deltaBM ($\beta = -.526$) and deltaBMD ($\beta = -.019$), while deltaMPA was positively associated with deltaBM ($\beta = .673$), deltaBA ($\beta = .584$) and deltaBMD ($\beta = .014$). **CONCLUSION:** Positive changes in MPA and ST after an 8-months PA intervention program provided significant positive changes in BA, BM, and BMD in children and adolescents, highlighting the positive impact of this type of intervention on children and adolescents bone health.

3232 Board #297 June 3, 2:00 PM - 3:30 PM
Acute Exercise and Academic Achievement in Middle School Youth
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Research has established that when students are more physically active, their academic performance improves relative to their more sedentary peers. Aerobic exercise (AE) has consistently demonstrated positive effects on academic achievement (AA) in middle-school-aged students. Research in adult and elderly populations has shown that resistance exercise (RE) can positively influence cognition. However, there is a paucity of research examining the effects of RE on measures of academic achievement in youth.

PURPOSE: The purpose of this study was to compare the acute effects of AE, RE, and a non-exercise (NE) control on measures of AA and cognition in 8th grade boys and girls.

METHODS: This study utilized a randomized crossover design. Eighth grade boys and girls performed three separate exercise trials (AE, RE, NE) separated by seven days each. Immediately following exercise, participants completed a 10-question mathematics test, followed by the Stroop Test (Victoria version).

RESULTS: Repeated measures ANOVA revealed a significant difference in mean math test performance between RE and NE ($F_{1,62} = 4.50, p = .038, \eta^2 = .068$). AE also resulted in a mean math score increase of 0.44 points (out of 10), which may be considered practically significant ($\eta^2 = .04$). Results of separate repeated measures ANOVAs revealed significant differences between RE and NE in the Stroop Dot test ($F_{1,62} = 8.14, p = .006, \eta^2 = .116$), Stroop Word test ($F_{1,62} = 9.90, p = .003, \eta^2 = .138$), and Stroop Color test ($F_{1,62} = 7.57, p = .008, \eta^2 = .109$). Significant differences were also found between AE and NE in the Stroop Word test ($F_{1,62} = 91.63, p < .001, \eta^2 = .596$) and Stroop Color test ($F_{1,62} = 14.53, p < .001, \eta^2 = .19$). Finally, significant differences were found between RE and AE in the Stroop Dot test ($F_{1,61} = 9.18, p = .004, \eta^2 = .129$), Stroop Word test ($F_{1,62} = 14.73, p < .001, \eta^2 = .192$), and Stroop Color test ($F_{1,62} = 20.14, p < .001, \eta^2 = .245$).

CONCLUSION: RE and AE demonstrated improvement in mean math test performance as compared to NE. Additionally, RE significantly improved performance over AE and NE in the Stroop Dot, Word and Color tests. To the author's knowledge, this is the first example of acute RE being utilized to enhance AA and cognitive functions in a middle-school-aged sample.

3233 Board #298 June 3, 2:00 PM - 3:30 PM
Longitudinal Examination of the Impact of Daily Physical Education on the Fitness of Underserved Youth
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PURPOSE: The purpose of the study was to examine the impact of 45 minutes of daily physical education on fitness levels among elementary aged students attending Legacy Charter School. **METHODS:** An analysis of variance (ANOVA) mixed effect linear model was used to evaluate the effectiveness of 45 minutes of daily physical education and physical fitness levels among youth in grades 3rd-5th attending Legacy Charter, a Title I school in the southeastern US. Gain scores (final post-test assessment in May 2015 - original pre-test assessment in September 2013) were calculated and analyzed for significance. The interaction between school and time was estimated for each outcome. Each analysis was stratified by grade, gender and age to control for baseline differences by school. A Title I control school who provided physical education once per week was identified and utilized as a comparison. **RESULTS:** Legacy Charter students observed significant gain increase on: 3 of 3 ($p < .05$) FITNESSGRAMR assessments. Legacy Charter school females significantly improved on the number of PACER laps (Gain Score= 7.01; $F = 12.20, df = 1, 278, p = 0.001$), the number of curl-ups (Gain Score=14.8; $F = 17.79, df = 1, 274, p = 0.000$), and the number of push-ups (Gain Score=2.93; $F = 52.78, df = 1, 274, p = 0.000$) over time from 2013 to 2015. Legacy Charter 8-year old males significantly improved in PACER laps (Gain Score=10.55; $F = 9.11, df = 1, 42, p = 0.004$) and curl-ups completed (Gain Scores=21.82; $F = 5.11, df = 1, 42, p = 0.029$). 3rd graders at Legacy Charter improved in the number of PACER laps (Gain Score=8.66; $F = 739.27, df = 1, 116, p = 0.000$) and push-ups performed (Gain Score=4.47; $F = 35.00, df = 1, 116, p = 0.023$) over time. **CONCLUSION:** 45 minutes of daily physical education led to an increase in fitness levels among elementary aged students attending Legacy Charter School over time. Funded by Campbell Young Leaders Foundation.

3234 Board #299 June 3, 2:00 PM - 3:30 PM
The Effect Of Tdcs And 15minutes Running Upon Cognitive Performance And Blood Pressure Response In Young Adults
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 (No relationships reported)

Physical exercise and Transcranial Direct Current Stimulation (TDCS) have shown to improve both cardiovascular and cognitive benefits in children and adults.

PURPOSE: To verify the acute effects of 15min of running and TDCS on blood pressure and cognitive performance in young adults.

METHODS: eight male (20.5±1.3yr; 77.4±10.8kg; 1.79±5.5m; 9.6±3.4%body fat) participated on this study. Firstly, they were performed in two sessions: anthropometric evaluations, subject's familiarizations with cognitive tests, and determination of Anaerobic Threshold (AT) through running 1600m. Thereafter, four sessions lasting 15min were performed in randomized order: 1) Control - seated resting; 2) Running at 80%AT velocity; 3) Running at 100%AT velocity; 4) TDCS at 2mA. Subsequently, the cognitive tests were applied over the post-session recovery (rec); Flanker task and Go/no-go. Additionally heart rate (HR), Systolic, Diastolic and Mean Arterial Pressure (SBP, DBP, MAP) were recorded over 10 min before and for 60min after interventions. **RESULTS:** ANOVA revealed better performance of Flanker task in ETCC session (484.6±56.3ms), 100%AT (466.7±51.5ms) and 80% AT (476.4±37.8ms) ($p > 0.05$) in comparison with Control. They showed better results in ETCC and 100%AT in GO/No-go than session ($p > 0.01$). The SBP after 110%AT was decreased at 30 min (-5.3%), and 60 min (-11.2%) of recovery ($p < 0.05$ and $p < 0.01$ respectively); whereas MAP decreased at 60 min (-7.1%). There where no significant differences among 80%AT, TDCS and Control for blood pressure.

CONCLUSIONS: 15 min of running at 80%AT, 100%AT and TDCS in left prefrontal cortex showed positive effect in executive function in young adults. Additionally, only running at 100%TA promoted blood pressure decreases.

3235 Board #300 June 3, 2:00 PM - 3:30 PM
Cervical Strengthening in Adolescent Athletes: a Pilot Study

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PURPOSE: Recent research correlates neck strength and concussion risk. This pilot study evaluated a 6 week neck strengthening program in adolescent soccer athletes. **METHODS:** Local soccer teams were recruited for pre-season baseline anthropometric and cervical strength measurements. Cervical flexion (F), extension (E), and right (RF) and left lateral (LF) flexion strength was measured using a hand-held dynamometer (lbs). Teams were assigned to control (C) or intervention (I) groups. I group subjects were assigned a progressive 6 week cervical strengthening program, accessed electronically. C group subjects were asked to continue normal pre-season conditioning. Repeat cervical strength measurements were collected for both groups approximately 6 weeks after baseline measurements. Intra- and inter-group differences were examined by paired t-tests and multiple linear regression. **RESULTS:** There was no significant difference between I and C groups for gender, height, weight, head or neck circumference, or strength in cervical flexion. The I group had significantly lower values for baseline strength in E, RF and LF. There was a significant increase in cervical strength for F, E, RF and LF compared to baseline for I group athletes only (table 1). After adjusting for preseason values and gender, the I group had greater strength (lbs) for F, E, RF and LF at follow up testing, when compared to the C group, by an average of 3.6 (95% CI: 0.8, 6.4), 5.6 (95% CI: 2.9, 8.2), 2.8 (95% CI: 0.1, 5.5) and 3.8 (95% CI: 1.2, 6.4), respectively. **CONCLUSIONS:** A 6 week program is effective in increasing cervical strength in adolescent soccer athletes. This should be validated in larger populations to determine reproducibility and impact on concussion rates.

Comparison of Baseline and Follow Up Testing			
	Baseline (lbs)	Follow Up (lbs)	P value
Intervention	n = 50	n = 43	
Extension	34.9 (32.2, 37.6)	41.4 (39, 43.9)	<0.001
Flexion	28.9 (27, 30.9)	33.3 (31, 35.8)	<0.001
Right flexion	27.5 (25.5, 29.5)	31.8 (29.6, 33.9)	<0.001
Left flexion	28 (25.8, 30.2)	33.7 (31.3, 36.2)	<0.001
Control	n = 33	n = 32	
Extension	40.9 (37.5, 44.3)	39.9 (37.6, 42.3)	0.83
Flexion	31.5 (28.8, 34.5)	29.8 (27.2, 32.6)	0.19
Right flexion	30.3 (27.6, 33.4)	30.1 (27.5, 32.9)	0.93
Left flexion	32.8 (30, 35.6)	32.8 (30, 35.6)	0.66

3236 Board #301 June 3, 2:00 PM - 3:30 PM
Effect Of Exercise Intensity On Brain-derived Neurotrophic Factor (bdnf) And Memory In Adolescents

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Brain-derived neurotrophic factor (BDNF) is an important factor in the development and plasticity of neurons, and a key factor in both learning and memory. Research has demonstrated that aerobic exercise acutely increases BDNF levels and influences chronic resting serum BDNF levels. However the response of BDNF to both the intensity and duration of the aerobic exercise remains unclear and very few studies examine BDNF and exercise in adolescents. **PURPOSE:** To examine the effects of aerobic training intensity on serum BDNF, IGF-1, cortisol, and memory in adolescent participants. **METHODS:** Healthy Korean middle school students (N=40; Age=15.18±0.66 yrs) volunteered for the study and were equally (n=10) randomly assigned to a treadmill exercise group (LOW40%VO2R; MOD 55%VO2R; or, HIGH 70%VO2R intensity) or a control group (CON). Exercise expenditure was prescribed at 200 kcal/session. CON performed light stretching matched for session frequency. All groups exercised 4 sessions/week for 12-weeks. Body composition (Multipolar Bioelectric Impedance Analysis, InBody BIA, Korea), VO2max (GXT), BDNF, IGF-1, cortisol and memory (Korea Wechsler intelligence scale for children, subset questions for memory) were assessed pre- and post-intervention. Fasted (12h) venous blood samples were measured

for BDNF (ELISA), IGF-1 (radio-immunoassay), and cortisol (radio-immunoassay) concentration levels. **RESULTS:** HIGH demonstrated significant increases for BDNF (Pre=25239.90±3416 pg/ml; Post=30088.50±4800pg/ml; p<0.01), IGF-1 concentration (Pre=401.00±13.30 ng/ml; Post=432.60±39.40 ng/ml; p<0.05), and memory(Pre=21.20±1.31; Post=24.20±3.48; p<0.01), and significantly decreased cortisol (Pre=13.36±3.73µg/dL; Post=9.71±3.21 µg/dL; p<0.05). MOD had significant increase in BDNF (Pre=25900.00±2658pg/ml; Post=27708.50±2586/ml; p<0.05). For BDNF the HIGH group had a significant increase (p<0.05) compared to the LOW and CON; and, memory significantly increased (p<0.05) for the HIGH exercise group compared to the LOW, MOD and CON groups. **CONCLUSIONS:** High intensity aerobic exercise exhibited a positive effect on resting serum BDNF and memory in adolescents. As aerobic exercise increases from moderate to high intensity the benefits on resting BDNF levels and memory also increase.

3237 Board #302 June 3, 2:00 PM - 3:30 PM
The Effect Of Nine Months Of Martial Arts On Bone Mineral Density In Adolescents

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The biological and metabolic processes occurring in youth include the formation of bone tissue. There are certain factors that influence bone growth, among which is sports. Martial arts involve impact and are expected to contribute to increased bone mineral density (BMD). However few studies have investigated whether different martial arts such as judo (where the recommended techniques include holds and twists) and muay-thai (impact fighting utilizing punches and kicks) effect the BMD of adolescents. **Proposal:** To analyze the influence of training two modalities (judo and muay-thai) on adolescent BMD. **Methods:** Thirty-two adolescents (age= 10.8 ±1.4) composed the samples: judo (n = 17), muay-thai (n = 9) and the control (n = 6). The BMD of the arms, legs, trunk, and total body was measured by DEXA. The intervention with judo and muay-thai lasted nine months and training was held 2x per week for one and a half hours per session. The intervention consisted of a warmup, specific technical exercises for each modality and combat simulation. The difference between the pre- and post- was seen by Delta%. The Covariance analyses (ANCOVA) adjusted for gender, age, peak growth rate and fat-free mass verified the differences between the groups. **Results:** No significant difference in increments of BMD was noted for the arms: judo (Δ% = 4.43 ±4.2), muay-thai (Δ% = 2.70 ±4.5) and control (Δ% = 2.34 ±1.8) [p=0.447]; trunk: judo (Δ% = 5.28 ±4.2) muay-thai (Δ% = 6.67 ±4.1) and control (Δ% = 4.49 ±4.1) [p=0.708] and whole body: judo (Δ% = 4.43 ±4.2), muay-thai (Δ% = 6.17 ±4.1) and control (Δ% = 4.17 ±2.06) [p=0.641]. There was no significant difference in the leg BMD of the muay-thai group (Δ% = 11.22 ±9.4) compared to judo (Δ% = 5.6 ±2.9), but it was significantly higher than in the control group (Δ% = 3.06 ±2.5) [p=0.041]. **Conclusion:** All adolescents had increases in BMD over 9 months. However, practicing muay-thai caused significant increases in leg BMD.

3238 Board #303 June 3, 2:00 PM - 3:30 PM
Effects Of The Correcting Motions On The Rehabilitation Of Adolescent Idiopathic Scoliosis

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Effects of the Correcting Motions on the Rehabilitation of Adolescent Idiopathic Scoliosis
 The adolescent idiopathic scoliosis is a popular problem in many countries. The main reasons of adolescent idiopathic scoliosis are keeping the wrong posture for a long-time and lack of physical exercise, except the congenital spine malformation. **PURPOSE:** The research aimed to design a set of correcting motions for the rehabilitation of adolescent idiopathic scoliosis. **METHODS:** 4 volunteers with the adolescent idiopathic scoliosis were performed the motions, whose scoliosis angle were from 10° to 20°. We collected the electromyography (EMG) activity of muscles of 4 volunteers with scoliosis of thoracic segments in each motion. **RESULTS:** We designed 9 kinds of adymmetry actions to enhance strength of the muscles in the side of scoliosis concave: Dumbbell shoulder press with one side leg on a step; The Prone back on unilateral weight-bearing; Squat posture unilateral weight-bearing barbell row; Standing posture pull-down; Standing posture pull-up; Kneeling posture unilateral shoulder hyperextension with straight arm; A single leg weight straight knee brace jump practice; Kneeling posture pushing the ABS wheel; Side bridge. The EMG amplitude of scoliosis concave side of the paraspinal muscles were increased by the asymmetry standing and asymmetric load. For example the

myoelectric activity of spinal curvature concave side of paraspinal muscle was strengthened by the dumbbell shoulder press with one side leg on a step and unilateral weight-bearing (concave/convex: 2.03, 1.98, 1.67 and 1.39). The EMG amplitude of the concave side was significantly increased by the kneeling posture unilateral shoulder hyperextension with Straight arm (concave/convex: 19.25, 13.83, 15.05 and 14.55). The Cobb angle of one volunteer was decreased from 14° to 2.5° after 3 months' practicing. CONCLUSIONS: Our results showed the strength of scoliosis concave side of paraspinal muscle was enhanced by the correcting motions we designed. The adolescent idiopathic scoliosis can be effectively corrected by long-term practicing the set of correcting motions.

Key Words: Adolescent; Idiopathic Scoliosis; Correcting Motions

3239 Board #304 June 3, 2:00 PM - 3:30 PM
A Formative Evaluation of Freshman College Students' Preferences And Practices Regarding Technology-based Weight Control

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Men and women are vulnerable to weight gain during their freshman year of college. Technology is beginning to be examined as a tool for the delivery of behavioral weight control interventions in college students, but no studies have gauged the preferences and practices of college freshman with respect to technology and weight control to inform study design. **PURPOSE:** To conduct a formative assessment of freshman college students' use of electronic technologies, as well as their interest in and preferences related to technology-based healthy weight control programs. **METHODS:** A convenience sample of incoming college freshman (37 women and 18 men, 18.3 ± 0.6 y, body mass index = 21.7 ± 3.2 kg/m²) from a public university in the Southeastern United States was recruited at the start of the fall semester via fliers distributed around campus. Participants completed an online questionnaire, which addressed their demographic characteristics, technology use, social media preferences for receiving health information, health concerns, weight control intentions, and interest in receiving various technology-based health promotion programs. Descriptive statistics were calculated for all items. **RESULTS:** Most participants reported that they were trying to either maintain weight (66%) or lose weight (27%), but only 20% weighed themselves at least one time/week and most did not use a 'wearable' physical activity tracking device (91%) or a smartphone application to monitor their diet (89%) and physical activity (81%). Among electronic media platforms, e-mail was used by the highest proportion of participants (96.4%), followed by Snapchat (73%). E-mail was the preferred platform for receiving health information by most participants (87%), followed by Facebook (38%). Weight gain was a concern among 78% of the participants and 82% expressed interest in receiving technology-based healthy weight and physical activity promotion programs. **CONCLUSION:** The findings suggest that most college freshman are interested in technology-based healthy weight programs. Opportunities exist to both introduce college freshman to technology-based tactics for self-regulation of weight and determine how to best harness electronic media tools that are widely used by this population (e.g., e-mail; Snapchat) for healthy weight promotion.

3240 Board #305 June 3, 2:00 PM - 3:30 PM
Impact of Different Levels of Physical Activity on Physical Fitness in Chinese College Students
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PURPOSE: The continuous decline of physical fitness has reached a high level of concern. This study aimed to examine the impact of different levels of physical activity on physical fitness in Chinese college students by gender. **METHODS:** 4,710 undergraduates in one university (2298 females, 2412 males) voluntarily participated in this study. Students' weekly minutes spent in moderate and vigorous aerobic PA were assessed by completing International Physical Activity Questionnaire (IPAQ). The students' physical fitness was assessed by trained evaluators using the National Students Physical Fitness Assessment Kit during regular physical education classes. The assessment included body height, body weight, lung capacity, standing long jump, and sit-and-reach. Data were analyzed by means of descriptive statistics, ANOVA methods. **RESULTS:** Descriptive statistics indicated that 58.7% of students participated in ≤ 90 min weekly PA (low level of PA (LPA)), 35.3% of students spent > 90 min, < 150 min weekly PA (moderate level of PA (MPA)), and 6.4% of students spent ≥ 150 min weekly PA (vigorous level of PA (VPA)). The results of ANOVA revealed significant differences among three levels of PA in males' and females'

cardio-pulmonary function (F = 7.64, p < .01; F = 7.46, p < .01), flexibility (F = 4.71, p < .01; F = 7.2, p < .01), and lower limb strength (F = 16.95, p < .01; F = 13.5, p < .01). The BMI was significantly different among three levels of PA for female students (F = 16.72, p < .01), but not for male students. Furthermore, no significant difference was found between MPA and VPA in cardio-pulmonary function for males and females. Males showed no significant difference in flexibility between LPA and VPA, while females showed no significant difference in flexibility between MPA and VPA. Regarding lower limb strength, no significant difference was found for males between MPA and VPA and for females between LPA and VPA. **CONCLUSION:** Both male and female students who were in MPA and VPA groups significantly outperformed than their counterparts who were in LPA group in cardiovascular endurance, flexibility, and lower-limb strength, but in BMI. However, gender differences in specific fitness between specific levels of PA were found in this study.

3241 Board #306 June 3, 2:00 PM - 3:30 PM
A Comparison Of Oxidative Stress Markers In Active Vs. Sedentary College Age Students

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PURPOSE: To determine the effects of activity level, aerobic capacity and body mass index (BMI) on markers of oxidative stress in college age females. **METHODS:** 17 female collegiate cross-country athletes (19.1 ± 0.86 years old) and 17 female sedentary college students (21.5 ± 1.8 years old) were examined. Measures of oxidative stress (d-ROMs) and antioxidant capacity (PAT) were obtained using the FRAS-4 Evolve Analytical System. Height, weight and BMI were recorded for each subject. For the sedentary group, a subjects' maximum aerobic capacity (VO2 max) was estimated via a submaximal 1-mile walk/jog test. For the cross-country athletes, VO2 max was directly measured using a Parvo Medics TrueOne metabolic cart during an incremental treadmill test to volitional exhaustion. A t-test was used to compare differences between groups. A Pearson correlation was used to determine if a linear relationship existed between any of the test variables. **RESULTS:** Sedentary subjects demonstrated significantly (p < 0.01) higher d-ROMs values (547 ± 172) compared to athletes (385 ± 156). There was no difference in PAT values between the two groups (Sedentary 2287 ± 329, Athletes 2295 ± 518.) Cross-Country athletes had a significantly lower body mass index (20.68 ± 1.64, 26.11 ± 5.11) and a higher VO2 max (50.6 ± 4.70, 36.45 ± 3.29) compared to the sedentary group. There was a strong positive correlation between BMI and d-ROMs (r = 0.53, p < 0.001) and a strong negative correlation between d-ROMs and VO2max (r = -0.56, p < 0.001). **CONCLUSION:** Elevated BMI, reduced aerobic capacity and a sedentary lifestyle may be associated with increased oxidative stress in college age individuals. Given the established association between oxidative stress and medical conditions such as cardiovascular disease, diabetes and certain types of cancer, this may place these individuals at a greater risk for medical co-morbidities.
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3242 Board #307 June 3, 2:00 PM - 3:30 PM
Impact of Required PE Courses to Chinese College Students' Fitness

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BACKGROUND: Chinese universities and colleges require all freshmen and juniors to take physical education (PE), but the impact of these courses on students' fitness has not been carefully examined.

PURPOSE: To determine the impact of required PE courses on Chinese college students' fitness.

METHODS: During the 2007-2008 academic year, a total of 3,278 (male & female: N = 2,209 & 1,069; aged 19.4 ± 0.9 & 19.3 ± 0.8 yr.; height in cm = 173.1 ± 6.2 & 161.2 ± 5.6; weight in kg = 66.0 ± 10.3 & 55.4 ± 7.0; BMI = 22.0 ± 2.9 & 20.9 ± 2.2) college students data major Chinese university taking required physical education (PE) courses, 2 time/wk, 3hrs/wk for one year; activities of the PE courses included running, basketball, and strength training, etc. Student fitness, determined by vital capacity, step test, grip hand strength and standing long jump, was measured before and after the academic year. **RESULTS:** Overall, there was a significant improvement in the college student's fitness after attending the required PE course during the academic year.

		2007		2008		Change%	t-value	ES
Vital capacity	Male	3846.7	± 771.2	3919.0	± 734.5	1.88%	<0.001	0.14
	Female	2605.3	± 570.1	2781.7	± 542.4	6.77%	<0.001	5.88
Step test	Male	52.2	± 7.5	53.7	± 8.2	2.80%	<0.001	0.21
	Female	52.4	± 7.9	54.7	± 8.5	4.53%	<0.001	0.29
Grip strength	Male	46.1	± 7.8	49.8	± 9.9	8.07%	<0.001	0.42
	Female	29.9	± 5.6	31.1	± 6.4	4.02%	<0.001	0.20
Standing long jump	Male	2.3	± 0.1	2.4	± 0.2	1.46%	<0.001	0.23
	Female	1.7	± 0.1	1.8	± 0.1	0.95%	<0.001	0.06

CONCLUSIONS: A significant improvement in college student's physical fitness was observed after participating in the required academic year long PE courses, which reflects positively on the PE requirement in higher education in China.

3243 Board #308 June 3, 2:00 PM - 3:30 PM
Cardiorespiratory Fitness, Physical Activity Levels and Sedentary Behaviour in College Students

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BACKGROUND:

Moderate or high levels of cardiorespiratory fitness (CRF) reduce the risk of cardiovascular disease (CVD) and all-cause mortality in men and women. Prolonged sedentary time (ST) is independently associated with deleterious health outcomes and all-cause mortality. In contrast, light, moderate and vigorous, as well as combined moderate-to-vigorous physical activity (MVPA) is associated with reduced incidence of major chronic diseases and CVD.

PURPOSE:

To compare CRF, selected CVD risk factors, sedentary behaviour and physical activity levels between male and female college students, and to examine the relation between CRF and sedentary behaviour and physical activity levels.

METHODS:

Fifty six third level students (mean ± SD; age = 22.93 ± 5.9 years, 62.5% male) participated in this study. Body mass index (BMI), percent body fat, blood pressure, and estimated maximal aerobic capacity (VO2max) were assessed. Body fat was assessed using skinfold callipers, blood pressure following 5 minutes of rest, and VO2max was estimated from a 20m shuttle run test. Accelerometers were used to assess sedentary behaviour and physical activity levels over a 9 day period.

RESULTS:

Waist circumference (p<0.001), weight (p<0.05), systolic blood pressure (p<0.001) and VO2max (p<0.001) were significantly higher and percent body fat (p<0.05) was significantly lower in males than females. There was no significant difference in sedentary behaviour or minutes of daily light, moderate, or vigorous physical activity or MVPA between males and females. There was a significant relation between VO2max and minutes of daily moderate (p=0.05; r=0.32), vigorous (p=0.05; r=0.32) physical activity and MVPA (p=0.019; r=0.39).

CONCLUSIONS:

Males had significantly greater waist circumference, weight, systolic blood pressure, and VO2max and significantly lower percent body fat than females. There was no difference in sedentary behaviour or minutes of daily light, moderate, or vigorous physical activity or MVPA between males and females. VO2max accounted for only 11-14% of the variability in moderate-to-vigorous activity levels.

3244 Board #309 June 3, 2:00 PM - 3:30 PM
Effect Of Sitting, Standing, And Walking Upon Physiological Measures During A Traditional College Lecture

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PURPOSE: Recent studies have linked negative physiological adaptations to sedentary behaviors, as has the ACSM's Exercise is Medicine campaign. While they are typically young, college students are not immune to the physiological effects of sedentary

behaviors, however few studies to date have addressed the physiological effects of the traditional college experience, such as the many hours this population spends sitting in class and study on a daily basis. This investigation assessed the effect that sitting, standing, and walking had on heart rate (HR), blood pressure (BP), perceived exertion (RPE) - as well as measures of cognitive focus, perceived discomfort, and psychological stress - during a traditional college lecture. **METHODS:** Day one, eleven (11) participants completed a treadmill VO2max. Subsequent sessions the participants attended a traditional lecture and underwent each of the following conditions in a counterbalanced order: sitting, standing desk, and treadmill desk. Stress and focus were measured respectively using the visual analogue scale (VAS). Discomfort was assessed using the FACES scale, and RPE was measured using the Borg 6-20 scale. Suntech Oscar 2 ambulatory blood pressure monitor measured HR and BP every 5 minutes. Data were analyzed using within subjects AVOVA and a one-way ANOVA with significance set p < 0.05. **RESULTS:** No significant differences in HR and BP between each of the conditions for the 60 min session (p < 0.05). Stress was significantly higher for treadmill (11.20 + 13.77) compared to the sitting condition (1.45 + 2.80) p = 0.046. There were no other significant differences (p < .05). **CONCLUSIONS:** The results indicate using a standing desk and treadmill desk does not significantly alter HR, BP, RPE, discomfort, or focus compared to sitting. However, there was a greater amount of stress reported when using the treadmill desk compared to sitting. Future investigations should examine the impact that standing desks and treadmill desks have on psychophysiological variables and the potential impact on long term health.

3245 Board #310 June 3, 2:00 PM - 3:30 PM
College Students Study Habits At A Midwestern University: An Observational Study

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Purpose: Sedentary lifestyles are a major public health concern. Recent evidence has shown that breaking up sedentary time with short breaks can have influential health benefits. As such our purpose with this study was to examine current study behaviors in college students to determine break use under naturalistic conditions. We hypothesized that students will engage in more inactive breaks than active breaks overall, and that there may be a difference depending on the study environment the student is in. **Methods:** 103 male and 61 female students were observed in 2 separate study rooms in a university library over a 1-week period. 2-hour segments were completed for each room for 2 week days and 1 weekend day (12 hours). Observation was conducted using our Systematic Observation of Breaks (SOBREAK) method, developed based on similar observational methods, such as SOPARC. Two trained researchers (inter-rater reliability=93%) systematically observed two different types of study rooms, one silent and one social, scanning every 30 seconds and recording the number of active (AB) and sedentary (SB) breaks observed by gender. Types of breaks were operationalized, where AB included: stretching, getting out of chair, walking, and SB: socializing, cellphone use, snacking, switching between numerous forms of technology. Independent t-tests and an ANOVA were used to analyze the data for break use between gender, study area, time of day, and day of the week. **Results:** Students engaged in more SB than AB (9.0% vs 4.3%; p < 0.05). Overall, students were more active in the evening than in the afternoon (4.6% vs. 3.9%; p < 0.05), however, females were more active in the afternoon (4.3% vs. 1.6%; p < 0.001), and males were more active in the evening (7.6% vs. 3.6%; p < 0.001). More AB occurred in the social study setting than in the silent setting (4.5% vs. 4.1%; p < 0.001). Students took the most active breaks on a weekend day, compared to weekdays (5.0% vs. 3.8% vs. 4.1%; p < 0.001). **Conclusion:** This study provides preliminary evidence that SB are abundant in college-aged students. The goal of using this information is to form interventions to break up sedentary time and perhaps improve health and wellbeing in this population. Interventions could examine specific outcomes such as energy expenditure and productivity between active and sedentary study times.

3246 Board #311 June 3, 2:00 PM - 3:30 PM
Effectiveness of Elastic Band Fitness Combination Method on Physical Fitness in Female Graduate Students

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PURPOSE: This experiment is combined with the status and trends of public health, through the flexible elastic band resistance exercise indices of muscle strength and balanced capacity in female graduate students in intervention research for the public

health movement to find effective and rational approach to improving the level of physical fitness provide a theoretical basis.

METHODS: (1) Experiment with self-control, no control group. 30 female graduate students, in the 22-25 age group, the mean age was 23.77±1.4. The subjects in order to increase muscle strength for the purpose of large muscle groups of the body such as the back, upper arm, abdomen, shoulders, legs and buttocks with the flexible use of elastic resistance exercises: 3-5 times per week, exercise intensity 16RM/2-3 group, time of 80 min / times, each time interval 30s, the training time for a total of 12 weeks. (2) Using Questionnaires with options about "No remission" and "Complete remission" to know about relieved degree of all parts of body of subjects (n=30) by the end of the 4th, 8th and 12th week.

RESULTS: After exercise training, the body fat percentage (23.054±3.926%, P<0.01) decreased quite significantly compared to the control condition (24.281±3.663%), and WHR (0.723±0.030 kg/m², P<0.05) decreased significantly. In comparison with the control condition, most of the muscle strength indexes increased quite significantly, such as right hand grip (30.808±4.744, P<0.01), left hand grip (29.481±3.707, P<0.01), number of 1 minute crunches (30.19±7.899 times, P<0.01), and back strength (488.08±70.825 N, P<0.01). Moreover, vertical jump (25.12±3.791 cm, P<0.05) increased significantly in contrast to the control condition (23.80±3.043 cm). Except flexibility quality did not increase significantly (P>0.05), other indexes including cross jump (21.007±1.820 times, P<0.01), stand on one foot with eyes closed (112.88±74.932 s, P<0.01), reaction (0.480±0.061 s, P<0.01) improved significantly compared to the control condition.

CONCLUSION: For female graduate students, aerobic exercise is compatible with elastic band resistance training and 12-weeks combination method results in physical fitness improvement and remission of the muscle stiffness.

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3247 Board #312 June 3, 2:00 PM - 3:30 PM

Changes in BMI and Physical Fitness in Female High School Students Following Summer School Program

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(No relationships reported)

Changes in BMI and Physical Fitness in Female High School Students Following Summer School Program

The dramatic increase in the prevalence of overweight and obese children over the past several decades poses a significant public health concern, especially among low-income communities and ethnic minorities. Some evidence suggests that children gain most of their extra weight and experience declines in physical fitness during the summer months due to physical inactivity and an increase in food intake. **PURPOSE:** The purpose of this study was to investigate whether a 5-week summer school program including physical activity is beneficial for Hispanic female high school students in maintaining body weight and physical fitness through the summer break. **METHODS:** Total of 125 female students aged 14-17 year participated in measurements at the beginning and end of summer break such as height, body weight, BMI, muscular strength, and cardiorespiratory fitness. 60 students (treatment) attended a 5-week summer school including 10 hours/week of physical activity. Variables were analyzed using two way (group×time) repeated measures analysis of variance (ANOVA) with Bonferroni's correction. **RESULTS:** Non-summer school attendants gained body weight (62.0±8.2kg→63.9±8.5, P=.021, Mean±SD) and BMI (24.9±3.7→25.5±3.8, P=.03) without significant change in height. Decreases in estimated cardiorespiratory fitness (38.8±2.5ml⁻¹kg⁻¹min⁻¹→37.5±2.7, P=.043), push-up (16.9±4.2→14.8±4.5, P=.028) and sit-and-reach (30.7±6.0→27.4±6.6, P=.018) were also found in non-summer school attendants. Summer school attendants showed no significant changes in body weight and BMI; however, push-up (17.2±5.1→18.6±5.2, P=.042) and flexibility (29.2±6.2→31.1±6.4, P=.039) were slightly improved during summer break. **CONCLUSIONS:** Data analysis corroborates the initial hypothesis that summer school effectively prevents summer weight gain and declines in physical fitness among Hispanic female high school students. Results indicate that a long summer break may increase summer weight gain among Hispanic youth due to the lack of structure and unrestricted food access, which they would otherwise receive during the school year, thus encouraging physical inactivity and binge eating.

3248 Board #313 June 3, 2:00 PM - 3:30 PM

Effects Of An In-school Exercise Program For Obese Children

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PURPOSE: Assessing the effect of an in-school exercise program in obese children in public schools.

METHODS: 430 children between >2 and <3 age-related BMI standard deviations (z) according to the OMS criteria and between 5.94 to 14.35 years of age participated in this experimental study. They were assigned to a group called CETO (Exercise Centre for Children Obesity) or to a contrast group (CNTR). The impact of a 3-days per week, 4-month exercise program on basic anthropometric measurements (body weight, height, BMI (i.e body mass index), body fat %, waist circumference), and physical fitness (Standing Long Jump, Half Push-Ups, Curl-ups, Course Navette and Sit-and-Reach) was assessed. CETO and CNTR groups were compared in three time points (pretest, retest and posttest). To measure standardized effect size (ES) of ANOVA effects it was used a Cohen's (d) for pairwise comparisons. Participation of at least 90% of the sessions was set as part of the inclusion criteria.

RESULTS: CETO group (final n =193) reduced zBMI significantly after 4 months (2.65±0.37 vs 2.52±0.45 p<0.05, d=0.08) (final n= 212). Only CETO group reduced Body Fat % significantly (34.79±5.76 vs 32.68±7.36 p<0.001; small ES d=0.32). Both groups improved significantly their height (p<0.001), and body weight (p<0.05) and CNTR group increased BMI (25.20±2.56 vs 25.60±2.57 p<0.001; d=-0.16). CETO group improved significantly Half Push-Ups (14.77±8.81 vs 16.12±9.41 p<0.001; d=-0.15), Curl-Ups (7.72±8.14 vs 10.25±8.95 p<0.001; d=-0.30), Horizontal Jump (101.2 cm ±22.2 vs 106.2±26.0 p<0.001; d=-0.21) and Course Navette (1.69 min ±2.21 vs 2.32±2.84 p<0.001; d=-0.25). CNTR group improved Curl-Ups (7.41±8.56 vs 8.62±9.05 p<0.05; d=-0.14), Horizontal Jump (98.6 cm ±23.5 vs 104.8±28.1 p<0.001; d=-0.24). **CONCLUSIONS:** The program was effective in reducing zBMI and body fat, and improving Physical Fitness measures. Superior results are expected with several program implementations.

3249 Board #314 June 3, 2:00 PM - 3:30 PM

Five Days In A Health Educational Camp Reduced Basal Insulin Levels And Resistance Insulin In Obese Children

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PURPOSE:

Evaluate the influence of five days summer camp in a recreational and educational basis program above blood glucose, insulin and insulin resistance in obese children.

METHODS: 19 obese children (9,5±1,2 years) were screened to participate on the study which consisted in: 1) Visit to receive information about the program, fill an anamnesis, undergo anthropometric assessment; 2) 5-days summer camp on a farm place to develop educational and recreational activities. The recreational, social and educational activities (lectures, games, physical activities, art/handcrafts and cooking classes) were performed by a multidisciplinary team (Physical Educator, Endocrinologist, Psychologist, Educator and Nutritionist). The farm had many natural resources and appropriate structure (female and male dormitory and ample kitchen and pantry). Health and natural diet was offered to the kids during summer camp. Fasting blood collection to glucose and insulin analysis was realized before and after 5-days summer camp. The HOMA index was also registered. Paired T-student test was applied to verify differences between pre and post summer camp with a significance level set at p ≤ 0.05 (SPSS version 19.0).

RESULTS:

Glucose values were not different post CAMP. Basal Insulin was lower after CAMP, ($p=0,001$) (pre 22,86±5,15 $\mu\text{U/l/ml}$ and post 13,75±2,82 $\mu\text{U/l/ml}$). Values HOMA β were significant lower after CAMP (pre 353, 82±62,22 and post 264,69±54,58). Already values HOMA IR was lower, but not statistically significant ($p=0,026$), after CAMP (pre 4.01±0.43; post 3.05±0.60).

CONCLUSION: Five days in a summer camp, including healthy and natural diet and recreational, social and educational activities performed by a multidisciplinary team reduced insulin resistance and basal insulin levels.

3250 Board #315 June 3, 2:00 PM - 3:30 PM
Relationship Between Tennis Experience and Executive Function in Male Children, Independent of Physical Fitness Level

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PURPOSE: The purpose of this study was to evaluate the relationship between tennis experience and executive function in children while controlling for physical activity and physical fitness.

METHODS: Sixty-eight children (6-12 years, 34 males and 34 females) were studied. The subjects had participated in regular tennis lessons (mean = 2.39 years, range: 0.14-7.33 yr) prior to the study. Evaluations of executive functions, consisting of inhibitory control (Stroop Color-Word Test), working memory (2-Back Task), and cognitive flexibility (Local-Global Task) were performed. The level of daily physical activity varying from moderate to vigorous was evaluated by the use of triaxial accelerometers. The total score for physical fitness was assessed by the Tennis Field Test.

RESULTS: Hierarchical multiple regression analyses revealed the effect of interactions between sex and tennis experience on the reaction time (RT) of switch condition and switch cost of Local-Global Task after controlling for age, BMI, sex, physical activity, physical fitness, and tennis experience (RT of switch condition: $\beta = -71.74$, $\Delta R^2 = 0.06$, $p < 0.05$, switch cost: $\beta = -68.12$, $\Delta R^2 = 0.14$, $p < 0.01$). Longer total years of tennis experience were associated with better cognitive flexibility in only males with no such relationship observed in females. Greater total scores of physical fitness were positively associated with shorter interference scores for the Stroop Color-Word Test and RT of switch condition in the Local-Global Task after controlling for age, BMI, sex (interference score: $\beta = -68.37$, $\Delta R^2 = 0.12$, $p < 0.05$, RT of switch condition: $\beta = -89.20$, $\Delta R^2 = 0.07$, $p < 0.05$). No relationship was found between physical fitness, physical activity, tennis experience and 2-Back Task performance.

CONCLUSIONS: This study provides an evidence suggesting that, as compared to working memory, inhibitory control and cognitive flexibility are influenced by physical exercise to a greater extent, and further demonstrate a higher development of cognitive flexibility for boys related to tennis experience.

3251 Board #316 June 3, 2:00 PM - 3:30 PM
The Effects Of Two Recommended Levels Of Physical Activity Incorporated Into Preschool Lessons On Early Literacy

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PURPOSE: To compare the impact of lessons taught using either 30 or 60 minutes of physical activity per day on the early literacy skills in Head Start preschools.

METHODS: Eighty nine African American children (mean±SD, age 3.8±0.3y) from a low socioeconomic urban Head Start were randomized to either a low dose (LD, 150 min/wk, n=3 classrooms, n=51 F, n=29, M, n=22) or high dose (HD, 300 min/wk, n=3 classrooms, n=38 F, n=25, M, n=13) physical activity groups for 6 months. The PA program was designed to promote either 150 min/wk of moderate to vigorous PA academic lessons (3.0-6.0 METS, ~15 min each, 2 lessons/day) or 300 min/wk of moderate to vigorous PA academic lessons (3.0-6.0 METS, ~30 min each, 2 lessons/day). The Preschool Individual Growth and Development Indicator for children ages 3-5y was administered to assess academic achievement related to early literacy and phonological awareness in the areas of picture naming, rhyming, and alliteration. Intensity of classroom PA was measured by a SOFIT. All measures were assessed at baseline, 3 and 6 months. **RESULTS:** Both protocols resulted in significantly ($p < 0.05$). Picture naming (number of pictures named correctly/min) significantly ($p < 0.05$). Rhyming (number of rhymes correctly identified/two min) significantly ($p < 0.01$) improved in the HD groups from baseline (LD, 0.8±1.8 vs. HD, 2.6±3.6) to 3 (LD, 1.2±2.8 vs. HD, 4.9±6.0) and 6 (LD, 3.0±4.6 vs. HD, 7.1±5.9) months while the LD group improved only at 6 months compared to baseline, $p < 0.05$. There were significant differences between groups at baseline, 3 and 6 months, $p < 0.05$. Alliteration (number of letters sounds correctly identified/two min) significantly ($p < 0.01$) improved in the

HD group from baseline (LD, 0.8±1.8 vs. HD, 2.3±2.7) to 3 months (LD, 0.7±1.7 vs. HD, 3.2±4.0) and was maintained at 6 months (LD, 2.0±3.0 vs. HD, 2.9±4.7) while the LD group improved only at 6 months compared to baseline, $p < 0.05$. There were significant differences between groups at baseline, 3 and 6 months, $p < 0.05$. Higher scores for picture naming, rhyming, and alliteration indicate greater early literacy skills and phonological awareness. **CONCLUSION:** Physical activity incorporated into preschool academic lessons improves earlier literacy skills in African American preschoolers with higher exercise doses resulting in greater improvements.

F-38 Free Communication/Poster - Pregnancy

Friday, June 3, 2016, 1:00 PM - 6:00 PM
 Room: Exhibit Hall A/B

3252 Board #317 June 3, 3:30 PM - 5:00 PM
Heart Rate And Perceived Exertion During Exercise And Recovery In Pregnancy And Postpartum Period

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Purpose : To compare oxygen uptake (VO_2), heart rate (HR) and ratings of perceived exertion (RPE) during exercise and recovery between pregnancy and postpartum period.

Methods : Seven uncomplicated pregnant women (DP; 31.0±0.6 yrs, 68.7±7.0 kg, 162.0±3.4 cm, 33.2±8.3 %fat, at 28±5 weeks of pregnancy) walked on a treadmill intermittently at three speeds; 3, 5, and 6 $\text{km}\cdot\text{h}^{-1}$ followed by 10 min recovery. After giving a birth (PP; 62.5±7.0 kg, 30.0±9.0 %fat, at 5.9±3.5 postpartum months), they once again underwent an identical test protocol to DP. They practiced breast feeding after the child birth and did not participate in any regular physical activities. During tests, their VO_2 , HR, and RPE were monitored and oxygen pulse (OP) was calculated. **Results :** After giving a birth, their weight, body mass index (26.3±3.2 in DP, 23.7±2.9 in PP) and chest, waist, and hip circumferences were reduced ($p < 0.05$). Resting HR and VO_2 , and blood pressure were not different between DP and PP. During walking in all speed and recovery, VO_2 in $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ was not different between DP and PP. HR during walking and recovery was higher in DP than PP, but was only statistically significant during recovery after 3 (88.4±10.6 in DP, 76.0±4.8 $\text{beat}\cdot\text{min}^{-1}$ in PP) and 5 $\text{km}\cdot\text{h}^{-1}$ (95.1±13.4 in DP, 80.9±7.7 $\text{beat}\cdot\text{min}^{-1}$ in PP) walking ($p < 0.05$). OP was higher during recovery after 3 $\text{km}\cdot\text{h}^{-1}$ walking in PP (0.062±0.008) than DP (0.055±0.011 $\text{ml}\cdot\text{kg}^{-1}\cdot\text{beat}^{-1}$) ($p < 0.05$). RPE was lower during walking in PP than DP at 5 (9.2±0.6 vs. 12.4±2.5) and 6 (12.2±0.7 vs. 14.4±1.4) ($p < 0.05$) but not in 3 $\text{km}\cdot\text{h}^{-1}$.

Conclusion : Women in postpartum period reduced their weight and trunk girth compared to pregnancy by breast feeding. HR was generally lower after low intensity walking in PP compared to DP. They perceived lesser exertion during walking at 5 and 6 $\text{km}\cdot\text{h}^{-1}$ in PP than DP. Without any interventions, exercise and recovery responses of HR and RPE were subsided during postpartum period.

3253 Board #318 June 3, 3:30 PM - 5:00 PM
Exercise Training In Pregnancy For Women With Bmi ≥ 28. A Randomized Controlled Trial.

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PURPOSE: Maternal obesity is a risk factor for adverse pregnancy outcomes, and excessive gestational weight gain (GWG) is further increasing the risk. Previous lifestyles interventions during pregnancy have shown conflicting results, and have often combined effects of physical activity with dietary guidance. Our aim was to assess the effects of regular exercise training during pregnancy on gestational weight gain (GWG) and incidence of gestational diabetes mellitus (GDM) in women with pre-pregnancy body mass index (BMI) of 28 kg/m^2 or more.

METHODS: This was a randomized controlled trial, which included women with a pre-pregnancy BMI (kg/m^2) ≥ 28 . Baseline testing and randomization to exercise or control were done in gestational week 12-18. We measured weight at baseline and at birth, GDM at baseline and gestational week 36 (late pregnancy). GDM was defined by a fasting oral 75 g glucose tolerance test $\geq 6,9$ mmol/L and/or 2 hours $\geq 7,8$ mmol/L . The exercise was supervised, 3 times per week;

35 minutes of moderate treadmill walking/running and 25 minutes of resistance training for large muscle groups. The control group received standard maternity care. Statistical analyses were done on basis of «intention to treat», with use of linear mixed model and mixed-effect logistic regression.

RESULTS:

91 participants were randomized; 46 to exercise and 45 to control. 18 women were lost to follow up (8 exercise, 10 control). 47.7 % in the exercise group performed the training per protocol. At baseline mean weight in the exercise group was 95.5 ± 12.3 kg (BMI 33.9 ± 3.8 kg/m²), in the control group 98.3 ± 14.2 kg (BMI 35.2 ± 4.4 kg/m²). There was no difference in GWG between the exercise and control group (98.3 10.2 ± 5.2 kg and 9.36 ± 7.5 kg, respectively, $p = 0.84$). At baseline, 3 women in each group had GDM, whereas 2 women in exercise and 8 women in the control group had GDM in late pregnancy ($p = 0.086$). 2 of the women with GDM at baseline did not fulfill the criteria for GDM at late pregnancy.

CONCLUSIONS:

Regular exercise during the pregnancy among overweight/obese women did not reduce GWG, compared to a non-exercising control group. The women in the training group had a tendency of lower incidence of GDM in late pregnancy.

3254 Board #319 June 3, 3:30 PM - 5:00 PM
Non-occupational Physical Activity And The Risk Of Preterm Birth: A Meta-analysis Of Observational Studies

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Active participation in physical activity (PA) has been confirmed to help maintain health condition and reduce risks of developing chronic diseases in the general population. Systematic reviews and meta-analysis studies have been conducted to investigate the association between occupational physical activity and the risk of preterm birth (PTB). However, the influence of non-occupational physical activity, such as leisure-time physical activity (LTPA), domestic physical activity (DPA) and commuting physical activity (CPA), on incident preterm birth has not been evaluated separately.

Purpose: To evaluate the association between non-occupational physical activity and risk of preterm birth.

Design Meta-analysis of observational studies.

Data source PubMed and EMBASE database was searched through Oct 2015.

Eligibility criteria Observational studies published in English language, which reported relative risk (RR) and the corresponding confidence intervals (CIs) of PTB in relation to any non-occupational physical activity during pregnancy.

Results Twenty-six observational studies (18 cohort and 8 case-control studies) were included in this meta-analysis. LTPA studies include 13 cohort studies totaling 167,087 participants and 4 case-control studies totaling 966 cases and 1,685 controls. DPA studies include 7 cohort studies totaling 11,009 participants and 3 case-control studies totaling 391 cases and 651 controls. CPA studies include 5 cohort studies totaling 5,489 participants and 2 case-control studies totaling 2,558 cases and 4,144 controls. For LTPA, comparing the highest to the lowest level of PA, the pooled RR was 0.83 (95% CI=0.74-0.93) for cohort studies and 0.60 (95% CI=0.43-0.84) for case-control studies. But, no evidence of reduced risk of PTB was observed with elevated DPA or CPA during pregnancy.

Conclusions It was found in this meta-analysis that levels of leisure-time, but not domestic or commuting PA during pregnancy was inversely and significantly associated with risk of PTB. Further research is needed to confirm our findings and to determine the optimal intensity and duration of LTPA for pregnant women considering risk of PTB.

Supported by the Graduate Abroad Visiting Program from Shanghai University of Sport, China (STFX20150103).

F-39 Free Communication/Poster - Training Techniques

Friday, June 3, 2016, 1:00 PM - 6:00 PM

Room: Exhibit Hall A/B

3255 Board #320 June 3, 3:30 PM - 5:00 PM

The Association between Foster's and Banister's TRIMP Training Load Control Methods in Spanish Taekwondo Athletes

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Taekwondo is a combat Olympic sport played between two competitors. Scientific literature in this sport has focused on describing athlete's anthropometric and fitness characteristics. However, training load control methods such as those described in other sports like triathlon and athletics are missing for athletes and coaches involved in taekwondo.

PURPOSE: To study the convergent validity of Foster's and Banister's TRIMP training load methods in Spanish Taekwondo competitors.

METHODS: Taekwondo participants ($n = 22$) completed three different types of exercise training regimens aimed to developing speed, power, and aerobic power. Athletes had different training and competition experience (White to Black belts) and were categorized as either beginners (mean = 0.3 ± 0.0 yr. of practice) or experienced (mean = 4.9 ± 5.2 yr. of practice) performers. After four weeks of a familiarization period, the experimental approach consisted on training participants for 14-days before starting the speed, power and aerobic power measurements. During the first measurement session, participants were required to complete speed and power exercises. During the second measurement session, participants were required to complete aerobic power exercises. Participants were instructed to perform specific taekwondo exercises at maximum intensity. The training sessions were performed in a taekwondo gymnasium between 19:00 y 22:30 h in similar ambient conditions (mean = 20.0 ± 1.0 °C and 49.7 ± 4.0 % relative humidity). Training intensity during each exercise session and recovery periods was recorded every 5-s using a heart rate (HR) telemetric monitor (Suunto T3C, Finland) and Borg's rating of perceived exertion (RPE). Pearson correlation was used to study the convergent validity between Foster' TL and Banister's TRIMP methods.

RESULTS: A significant moderate correlation was obtained between Foster's and Banister's TRIMP methods for developing aerobic ($r = 0.60$, $p = 0.004$) and power ($r = 0.52$, $p = 0.014$) capacity. No significant small correlation was found between training load methods and speed ($r = 0.20$, $p = 0.377$).

CONCLUSIONS: The convergent validity of two available training load control methods support the use of RPE-based measurement for load control in taekwondo.

3256 Board #321 June 3, 3:30 PM - 5:00 PM

The Effects Of Ballistic And Non-ballistic Bench Press On Mechanical Variables And EMG

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PURPOSE: To investigate the effects of ballistic and non-ballistic bench press performed with loads equivalent to 30 and 90% 1-repetition maximum (1-RM) on mechanical variables and EMG.

METHODS: In a counterbalanced cross-over design, 12 resistance-trained men (age: 23.6 ± 2.1 years; height: 1.83 ± 0.10 m; mass: 97.8 ± 13.9 kg; 1-RM: 149.3 ± 20.5 kg) attended four testing sessions during a three week period where they performed one of the following sessions: 1) three sets of five non-ballistic repetitions performed with a load equivalent to 30% 1-RM (30T), 2) three sets of five ballistic repetitions performed with a load equivalent to 30% 1-RM (30B), 3) three sets of four non-ballistic repetitions with a load equivalent to 90% 1-RM (90T), 4) three sets of four ballistic repetitions with a load equivalent to 90% 1-RM (90B). Force plates and a 3-D motion analysis system were used to determine the mean vertical velocity, mean vertical force, and mean power output during each repetition. The mean activation of the anterior deltoid, pectoralis major, and triceps brachii muscles were determined from the EMG signals recorded during each set.

RESULTS: The mean power output during 30B was significantly greater than during 30T (mean difference: 319 W; $p < 0.001$), 90T (mean difference: 474 W; $p < 0.001$), and 90B (mean difference: 435 W; $p < 0.001$). Significantly greater vertical velocity (mean difference: 0.32 m/s; $p < 0.001$) and vertical force (mean difference: 262 N; $p < 0.001$) were attained during 30B compared to 30T. Significantly greater vertical velocities were attained during 30B compared to 90T (mean difference: 1.19 m/s; $p < 0.001$) and 90B (mean difference: 1.17 m/s; $p < 0.001$), although the vertical forces were significantly lower (mean differences: 459 - 516 N; $p < 0.05$). Mean muscle activation was significantly greater during the 90T and 90B conditions compared to the 30T and 30B conditions (mean differences: 480 - 682 μ V; $p < 0.001$).
CONCLUSIONS: Ballistic exercises may be an effective method for developing power output, although the benefits may be negated at higher percentages of 1-RM.

3257 Board #322 June 3, 3:30 PM - 5:00 PM
The Effects of Ballistic and Non-Ballistic Bench Press on Mechanical Work and Oxygen Uptake
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 (No relationships reported)

PURPOSE: To investigate the effects of ballistic and non-ballistic bench press performed with loads equivalent to 30 and 90% 1-repetition maximum (1-RM) on the mechanical work performed and oxygen uptake
METHODS: In a counterbalanced cross-over design, 12 resistance-trained men (age: 23.4 \pm 2.0 years; height: 1.83 \pm 0.10 m; mass: 97.8 \pm 13.9 kg; 1-RM: 149.3 \pm 20.5 kg) attended four testing sessions during a three week period where they performed one of the following sessions: 1) three sets of five non-ballistic repetitions performed with a load equivalent to 30% 1-RM (30T), 2) three sets of five ballistic repetitions performed with a load equivalent to 30% 1-RM (30B), 3) three sets of four non-ballistic repetitions with a load equivalent to 90% 1-RM (90T), 4) three sets of four ballistic repetitions with a load equivalent to 90% 1-RM (90B). Force plates and a 3-D motion analysis system were used to determine the total mechanical work performed during each session while a portable gas analysis system was used to collect expired gases.
RESULTS: Total mechanical work performed during 90T was significantly greater than that performed during 30T (mean difference: 3705 J; $p < 0.001$) and 30B (mean difference: 3330 J; $p < 0.001$). Total mechanical work performed during 90B was significantly greater than that performed during 90T (mean difference: 920 J; $p = 0.002$). VO₂ was significantly greater during 30B compared to 30T (mean difference: 0.94 L; $p = 0.034$). VO₂ during 90T was significantly greater than during 30T (mean difference: 3.30 L; $p < 0.001$) and 30B (mean difference: 2.36 L; $p < 0.001$), while the VO₂ during 90B was significantly greater than during 90T (mean difference: 1.23 L; $p = 0.006$).
CONCLUSIONS: Ballistic resistance training exercises may represent a more effective metabolic stimulus compared to traditional resistance training exercises and therefore have potential for the inclusion in an exercise program to increase fat-free mass and reduce fat mass.

3258 Board #323 June 3, 3:30 PM - 5:00 PM
Effects of Whole-Body Vibration on Muscular Performance in Young Women
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Whole-body vibration (WBV) induced mechanical oscillations have been shown to affect the musculoskeletal system. WBV platforms are categorized as side-alternating or synchronous. Few studies have compared acute muscular responses to different frequencies or types of platforms in women. **PURPOSE:** To compare the acute effects of Power Plate (PP) (synchronous) and Vibraflex (VF) (side-alternating) WBV devices on muscular performance in recreationally active women, 20-30 years. **METHODS:** Female subjects (n=12) performed 5 protocols in random order separated by 48 hour washout periods: 1) Control (no vibration); 2) VF 18 Hz; 3) VF 21 Hz; 4) PP 30 Hz; and 5) PP 50 Hz. Subjects stood barefoot on the platform for 5, 1 min bouts separated by 1 min rest. Immediately after vibration, vertical jump power and leg press 1RM were assessed. **RESULTS:** There were significant condition effects for jump velocity, jump power, and leg press strength for the VF ($p < 0.05$). The 18 Hz frequency elicited significantly greater jump velocity and jump power compared to the 21 Hz. However, 21 Hz resulted in significantly greater leg press 1RM compared to control and 18 Hz ($p < 0.05$). None of the PP conditions were significantly different from the control. Analysis of the difference scores from control determined that there was a significant frequency main effect ($p = 0.50$) for jump power, which increased after the low frequency protocols and decreased after the high frequency protocols. **CONCLUSION:** These results suggest that for the VF, the 18 Hz frequency was more

effective for improving jump power than 21 Hz, but 21 Hz was more effective for increasing leg press strength.

Table 1. Jump Power and Strength Measures (Mean SD) (n=12)

Conditions	Jump Power (W)	Leg Press (kg)
Control	627.3 \pm 100.7	118.6 \pm 32.2
VF 18Hz	659.9 \pm 131.4*	119.9 \pm 32.5
VF 21Hz	602.6 \pm 115.0	124.5 \pm 36.6***
PP 30Hz	635.2 \pm 96.6	122.1 \pm 35.0
PP 50Hz	631.7 \pm 110.4	120.5 \pm 28.2

* $p < 0.05$ vs. 21 Hz; ** $p < 0.05$ vs 18Hz; $p < 0.01$ vs. control

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Influence Of Lower Body Resistance Training On Upper Body Strength Adaptations In Trained Men.
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INFLUENCE OF LOWER BODY RESISTANCE TRAINING ON UPPER BODY STRENGTH ADAPTATIONS IN TRAINED MEN.
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PURPOSE: The aim of this study was to examine the influence of different lower body strength training schemes on upper body adaptations to resistance training.
METHODS: Twenty experienced resistance trained males were randomly assigned to either a high intensity (HI; n = 9; age = 24.9 \pm 2.9 y; body mass = 88.7 \pm 17.2 kg; height = 177.0 \pm 5.6 cm) or high volume (HV; n = 11; age = 26.0 \pm 4.7 y; body mass = 82.8 \pm 9.1 kg; height = 177.54 \pm 5.9 cm) resistance training program. HI group followed a high intensity training for both upper and lower body (5 sets of 4 reps with 90% of 1-RM), while the HV group performed high volume training sessions focused on muscle hypertrophy for lower body (5 sets of 10 reps with 70% of 1-RM) and high intensity schemes for upper body (5 sets of 4 reps with 90% of 1-RM). Anthropometric, strength (one-repetition maximal 1-RM bench press and squat, isometric mid-thigh pull) and power (expressed in counter movement jump, seated shot put and at the bench press with 30% and 50% of 1-RM) were assessed before and following a 6-week training program. A two-way analysis of variance was used to compare strength performances and hormonal variations between the groups.
RESULTS: A 5.1% greater increase ($p = 0.009$) in bench press strength was seen in HV compared to HI. Significant increases were observed in both groups in lower body strength and lean body mass, however no between group differences were noted. A significant interaction ($p = 0.009$) was observed between the groups for bench press power. In addition a significant reduction in fat mass occurred in HV group only (-0.9 kg; $p = 0.005$).
CONCLUSIONS: Results indicated that a combination of high volume lower body and high intensity upper body training scheme stimulates greater strength and power gains in the upper body compared to a high intensity program for both upper and lower body.

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Hamstring/quadriceps Ratios Following Addition Of A Single Blood Flow Restricted Exercise Vs Traditional Resistance Training
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 (No relationships reported)

Muscular deficiencies between the quadriceps and hamstrings (H:Q ratio) are highly prevalent among women and often lead to knee injury and ACL tears. **PURPOSE:** To determine whether resistance training with or without blood flow restriction (BFR) can improve the H:Q ratio in untrained young women (n=14), 18-24 yr. **METHODS:** Women were randomly assigned to: 1) a traditional resistance training group (TR: n=8); or 2) a BFR with traditional resistance training group (BFR+TR: n=6). Subjects trained 3 days/wk for 6 wks for chest press, two-leg press, lat pulldown, quadriceps extension, bicep curl, and a seated hamstring curl. TR completed 3 sets of 10 reps for each exercise at 70% 1-RM with 1 min rest between sets. BFR+TR also performed the first 5 exercises but ended with the hamstring curl with BFR at 50% of individualized

total occlusive pressure, 30% 1-RM, 4 sets (30:15:15:15 reps) with 30 sec rest between sets. 1RM strength and isokinetic H:Q ratios (60/180/240/300 %/sec) were assessed pre and post training. **RESULTS:** 1RM strength significantly ($p < 0.05$) increased pre vs. post, but there were no significant condition or condition \times time interaction effects for any exercise. H:Q isokinetic strength ratios did not change for either training group. **CONCLUSION:** 1RM values for all 6 exercises were significantly increased following training, regardless of training condition, however, the BFR condition for the hamstring curls added no additional benefit to strength gains and neither protocol was effective for improving H:Q ratios at any speed.

Table 1. Percent Changes in H:Q Ratios from Pre to Post Training (Means \pm SD)

Variables		Groups	
		RT (n=8)	BFR+RT (n=6)
%H:Q Ratio			
R	60°/s	5.4 \pm 15.5	1.0 \pm 18.2
	180°/s	9.0 \pm 25.3	11.2 \pm 23.2
	240°/s	6.4 \pm 26.4	7.6 \pm 21.3
	300°/s	8.4 \pm 27.9	8.25 \pm 11.9
L	60°/s	3.0 \pm 10.4	2.8 \pm 13.2
	180°/s	10.4 \pm 17.4	1.7 \pm 15.4
	240°/s	3.9 \pm 10.2	10.9 \pm 19.4
	300°/s	8.2 \pm 17.0	5.5 \pm 25.8

R - Right Leg; L - Left Leg

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Dynamic Balance Ability in Surfers by Stance

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(No relationships reported)

Surfing is a dynamic sport and is performed in a highly unstable and changing environment, making balance a vital surfer characteristic. It might be expected that repeated practice of particular movements in a specific stance, such as surfing, would lead to specific balance adaptations.

PURPOSE:To assess dynamic balance within surfers while also evaluating the influence of stance.

METHODS:Horizontal and directional balance were measured using a Biodex Stability System in twenty adult male recreational surfers (age 24.10 \pm 2.40 yrs, mass 74.95 \pm 8.26 kg, ht 177.11 \pm 6.13 cm). Three 20s balance trials were performed using an upright bilateral stance in the direction of their normal surfing stance (regular or goofy). Stability indices (degree of sway) in the anterior-posterior and medial-lateral directions were recorded.

RESULTS:For medial-lateral, regular stance (3.74 \pm 1.79) demonstrated significantly ($p < 0.05$) greater stability compared to goofy stance (5.39 \pm 1.56). For anterior-posterior, regular stance (4.77 \pm 2.04) demonstrated significantly ($p < 0.05$) greater stability compared to goofy stance (7.40 \pm 2.34).

CONCLUSIONS:Surf stance appears to play a large role in directional balance. These findings suggest that sport specific training and the repetition of particular movements relative to stance may induce specific balance adaptations. For example, waves that break to the surfer's right are more advantageous for regular stance surfers since it allows them to face the wave. Therefore, it is possible that wave conditions and riding those waves regularly contribute to directional balance differences by stance.

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Acute Effects of Static vs. Ballistic Stretching on Strength Between Ballet Dancers and Resistance Trained Women

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Stretching is used to increase joint range of motion but the acute effects can decrease muscle strength. However, this may depend on the mode of stretching or the tested population. Previous research has shown that ballistic and static stretching result in similar improvements in range of motion and may lead to similar effects on muscle strength. Yet, since resistance trained women and ballet dancers train differently, the acute effects of stretching on strength may also be different.

PURPOSE:To compare the acute effects of static vs. ballistic stretching on strength between ballet dancers and resistance trained women.

METHODS:15 resistance trained women (age 23.8 \pm 1.80 yrs, mass 67.47 \pm 7.77 kg, ht 168.30 \pm 5.53 cm) and 11 ballet dancers (age 22.9 \pm 3.17 yrs, mass 59.59 \pm 4.90 kg, ht 169.18 \pm 6.83 cm) performed 3 days of testing. The first day was control (no stretching) while the other two days were static or ballistic stretching in a counterbalanced order. They began with a dynamic warm up, then did 6 different stretching exercises, 3 for quadriceps and 3 for hamstrings in a counterbalanced order. Each stretching exercise consisted of 3 sets of 30 second holds and 15 seconds of rest. Immediately after stretching, they performed 5 maximal concentric knee extension/flexion repetitions at 60°/s on a Biodex isokinetic dynamometer.

RESULTS:Both groups demonstrated a significant decrease in hamstrings peak torque after static (103.82 \pm 14.91 Nm) and ballistic conditions (100.47 \pm 14.00 Nm) when compared to control (113.74 \pm 17.29 Nm). However, neither group demonstrated any change in quadriceps peak torque between control (180.08 \pm 30.89 Nm), static (178.75 \pm 26.28 Nm) and ballistic (174.60 \pm 29.30 Nm).

CONCLUSIONS:These findings suggest that stretching decreases hamstrings strength similarly in ballet dancers and resistance trained women, with no differences between modes of stretching. However, there was no significant change in quadriceps strength which may be due to greater stiffness of the quadriceps making them more resistant to stretching than hamstrings.

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Comparison of Hex Bar Deadlift vs. Back Squat Postactivation Potentiation on Vertical Jump Takeoff Velocity

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A unique form of power training is to invoke a postactivation potentiation (PAP) response, which has been extensively researched in regards to a heavy resistance stimulus. PAP is based on the premise of performing a heavy resistance exercise followed by a power exercise, resulting in increased power performance. Back squats (BS) are normally used, but a less researched tool is the hex bar deadlift.

PURPOSE:To compare the potentiating effects of a back squat vs. hex bar deadlift (HBDL) on takeoff velocity of a countermovement jump (CMJ).

METHODS:Ten resistance-trained men (age=23.36 \pm 3.80 years, ht=175.50 \pm 4.22 cm, mass=79.53 \pm 5.28 kg) volunteered to participate and performed 3 pre CMJ then 3 repetitions of back squat or HBDL at 85% 1RM. All subjects jumped with arm swing on a force plate. The back squat was performed with a standard barbell in a power rack. Participants wore the safety squat device which insured they achieved a parallel position. For HBDL, participants used the low handles but were not allowed to use straps. Following the BS or HBDL and 8 minutes rest, subjects performed 3 post CMJ. A control condition consisted of 3 pre CMJ, 8 minutes standing rest, then 3 post CMJ.

RESULTS:Repeated measures ANOVA revealed no interaction or main effects of condition or time; (Control pre 2.83 \pm 0.36 m/s vs. post 2.86 \pm 0.37 m/s; BS pre 2.96 \pm 0.33 m/s vs. post 2.92 \pm 0.30 m/s; HBDL pre 2.86 \pm 0.31 m/s vs. post 2.84 \pm 0.30 m/s).

CONCLUSIONS:Manipulation of critical variables determines PAP outcomes with proper rest, volume, and intensity playing a large role in subsequent power performance. PAP response is also highly individualized and training experience of the subjects may have been too low to demonstrate increased performance.

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Immediate Effects Of Different Warm-up Protocols In Badminton Performance

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Some suggested that dynamic stretching with external loads (e.g. weighted vests) may enhance athletic performance, comparing to other typical warm-up protocols. Since badminton is a physically demanding sport, performance is highly influenced by warm-up activities.

PURPOSE: To compare different warm-up protocols on muscular power and endurance associated with badminton-specific performance.

METHODS: Sixteen collegiate male badminton players (age: 21.7 \pm 1.5; height: 178.8 \pm 4.6; mass: 73.8 \pm 7.5) randomly experienced one of three different ten-minute warm-up protocols (static stretching: SS, dynamic stretching: DS, and resistance stretching: RS), separated by 48 hours. An average temperature of badminton courts was 23.7 °C. SS was composed of seven typical stretching and DS had nine dynamic movements with jogging. For RS, subjects had approximately 10% and 5% of body weight of a weighted vest and dumbbells on their hands, respectively. Prior to and after each warm-up protocol, subjects performed 20 trials of jump smashes (shuttlecocks

from a shooting machine) and a badminton specific endurance test (BST). Four high speed digital cameras were used to videotape both performances (frame rate: 240 fps for jump height; 480 fps for shuttle velocity; 30 fps for BST; shutter speed: 1/000 s). Dependent measurements were averaged jump heights and shuttlecock velocities during jump smashes, and times to complete the BST. To test effects of each warm-up protocol, we performed mixed model ANOVAs and calculated between-time effect sizes (ES).

RESULTS: Each warm-up protocol improved jump heights (SS: 22.1%, $p < 0.01$, ES: 0.98; DS: 30.1%, $p < 0.01$, ES: 1.49; RS: 17.7%, $p = 0.03$, ES: 0.98) but did not change shuttlecock velocities (SS: 5.7%, $p = 0.61$, ES: 0.39; DS: 3.4%, $p = 0.94$, ES: 0.28; RS: 6%, $p = 0.50$, ES: 0.66). BST times were also improved (SS: 3.7%, $p = 0.03$, ES: 0.62; DS: 3.9%, $p = 0.02$, ES: 0.63; RS: 4.4%, $p < 0.01$, ES: 0.73). However, there were no differences among warm-up protocols in all measurements.

CONCLUSIONS: All warm-up protocols improved muscular power and endurance associated with badminton-specific performance but we did not determine the best protocol. However, we suggest performing DS and RS as badminton requires high-speed movements and explosive forces in practice or matches.

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Influence Of Short-term Training On Performance And Reliability Of A 1-minute Push-up Test

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PURPOSE: A 1-minute push-up test is commonly used to assess upper-body muscular endurance for general fitness or as a construct for occupational fitness tests. However, the capacity to improve scores quickly is not known.

METHODS: Eight (female = 4, male = 4), college-aged students (23 ± 4 y) completed nine, 1-minute push-up tests. Each session was separated by ≥ 48 hours and all were completed in ≤ 4 weeks. Participants reported to each session after a ≥ 2 -hour fast and the same technician oversaw each participant's sessions.

RESULTS: There was no correlation (Spearman's $Rho = 0.08$, $p = 0.48$) between test session number and 1-min push up score. Additionally, a repeated-measures ANOVA revealed no significant effect of time on push-up score [F (0.988, 8), $p = 0.46$].

Furthermore, a pair-sampled t-test revealed no difference between session 1 (36 ± 10 push-ups) and session 9 (40 ± 10 push-ups) [$t(1.32, 7)$ $p = 0.23$]. However, test-retest reliability revealed strong ICC between session 1 and session 2 (ICC = 0.97) and session 8 and session 9 (ICC = 0.99).

CONCLUSIONS: The results of this study demonstrated that a short, specifically targeted, training/familiarization program did not improve 1-minute push up test scores in active college-aged students. However, the reliability of such tests was high. Practitioners and those who must meet fitness standards to remain employed should recognize that short-term training programs may not provide enough stimulus to improve 1-min push-up scores.

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Impact of Inserted Rest Period During Repeated Sprint Exercise on Performance Adaptation in Sprinters

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Repeated sprint training generally consists of 5-10 bouts of maximal short-duration (<10s) sprint, separated with short rest period (<30s). However, little is known about influence of different rest period length between sprints on adaptation of repeated sprint ability.

PURPOSE: The purpose of the present study was to compare the influence of inserted rest period during repeated sprint training on performance adaptation in competitive sprinters.

METHODS: Twenty-one, well-trained sprinters (age: 20.1 ± 1.1 year, height: 172.6 ± 7.5 cm, body weight: 61.9 ± 7.4 kg) were divided into either a continuous training group (CON, $n = 10$) or separated training group (SEP, $n = 11$). The training protocol in both groups consisted of 2 sets of 12×6 s maximal sprint (pedaling) with 24s rest between sprints. However, in the SEP group, 7min of active rest period was inserted every 4 sprints in order to attenuate metabolic accumulation. The training was lasted 3 days/wk for 3 weeks. Before and after training period, repeated sprint ability [12×6 s maximal sprint (pedaling) with 24s rest], VO_{2max} and time to exhaustion during submaximal pedaling at 80% of VO_{2max} were evaluated.

RESULTS: For repeated sprint test, both groups showed significant increases mean power output during latter half of the 12 sprints ($p < 0.05$). However, significant increases in power output during early part of sprints (sprints 1-2) were observed only in the SEP group only ($p < 0.05$), not in the CON group. The recovery of power output during 30 min of post-exercise period was significantly improved in both groups at

10 min of post-exercise ($p < 0.05$), while a significant improvement at 30 min of post-exercise was observed only in the SEP group ($p < 0.05$). Time to exhaustion at 80% of VO_{2max} was significantly increased in both groups ($p < 0.05$), while VO_{2max} was significantly increased only in the SEP group ($p < 0.05$).

CONCLUSIONS: The 3 weeks of repeated sprint training significantly improved repeated sprint ability in trained sprinters. However, significant increase in maximal power output during early part of 12 sprints was observed, when 7 min of active rest period was inserted every 4 sprints during 12×6 s maximal sprint training. These findings suggest that rest periods during repeated sprint training play an important role in adaptation of maximal power output.

3267 Board #332 June 3, 3:30 PM - 5:00 PM
The Effect Of A 12 Week Circuit Training Program On Amateur Collegiate Male Golfer's Performance

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PURPOSE:

Unlike the point of understanding the golf game in the past decade, the researchers, coaches and even players to the importance of golf physical conditioning program have been changing rapidly. This study was designed to research prospective golf fitness conditioning method that is undergoing the spotlight, nowadays, as a critical respect in golf competition all over the world.

METHODS:

Thirty six healthy amateur male collegiate with all handicap levels volunteered to participate in this research. The participants were randomly separated into two groups: training group ($n = 18$, TG) which was conducted of carrying out circuit training and golf practice for the session and control group ($n = 18$, CG) which was conducted of carrying out golf practice. Body composition and golf performance of two groups were measured and compared in pre and post experiment after 12 weeks circuit training session with 75% adjusted training intensity. To test the change of mean for each group pre and post training, paired Sample t-test was used. Independent Samples t-test was used to test the difference between the two groups at each period for the training method. Statistical significance was set at $p < 0.05$.

RESULTS:

1. Body compositions: (1) muscle mass - TG increased 34.1 ± 0.934 kg ($P < 0.05$), and CG increased 34.5 ± 1.044 kg ($P < 0.05$), (2) body fat - TG decreased 7.4 ± 0.690 kg ($P < 0.05$), and CG decreased 8.4 ± 0.720 kg ($P < 0.05$), were resulted in the study. However, there had no significant difference on the post comparison in both groups, but only detected significant decrease of WHR and %body fat in TG ($P < 0.05$).
2. Golf performances: (1) smash factor - TG increased to 1.291 ± 0.020 ($P < 0.05$), and CG decreased to 1.238 ± 0.019 ($P < 0.05$), (2) ball speed - TG increased to 101.3 ± 2.513 mph ($P < 0.05$), CG decreased to 96.7 ± 2.413 mph, were founded in the post measurement. Also, there had an interactive effect on ball speed, carry at measuring period and group. But, it had no comparative distinction between TG and CG in the post-measurement ($P < 0.05$).

CONCLUSION:

Even though there was improvement in body composition and golf performance in the study, it was rare to find comparative difference outcome between TG and CG after session. However, body composition variable after 12 weeks such as muscle mass could be considered to effect golf performances as a positive factor.

3268 Board #333 June 3, 3:30 PM - 5:00 PM
Impact of Various Concurrent Training Interventions on Bench Press Strength

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The inclusion of aerobic exercise into a resistance training program (i.e. concurrent training) causes the interference effect (i.e. attenuate strength). However, a resistance training circuit as the aerobic intervention has yet to be investigated. **PURPOSE:** To compare changes in 1RM strength of the bench press (BP) between resistance training (RT) only, concurrent training with: high intensity cardio (CTHI), moderate intensity cardio (CTMI), and a barbell circuit (RTC). **METHODS:** Eighteen males (age: 23 ± 3 yrs, body mass: 82.0 ± 10.0 kg, Body Fat Percentage: 11.45 ± 4.14 %) with at least two yrs. of training experience on the BP were assigned to one of four groups: 1) RT ($n = 4$), 2) CTHI ($n = 5$), 3) CTMI ($n = 4$), or RTC ($n = 5$) for 8 weeks. All groups performed the same undulating resistance training program on Mon. (8 repetitions: BP/squat; 10 repetitions: assistance movements), Wed. (6 repetitions: BP/squat; 8 repetitions: assistance movements), and Friday (4 repetitions BP/squat; 6 repetitions assistance movements) with Tues/Thurs. as the aerobic training days. CTHI consisted

of 10 one-minute cycling sprint intervals (100-110% peak power) over 30 minutes, CTMI was 30 consecutive minutes of cycling (40-50% VO₂ peak), and RTC subjects completed as many 'rounds' as possible of the BP, back squat, overhead press, barbell row, and barbell curl for 8 (Wks. 2-3), 9 (Wks. 4-5), or 10 repetitions (6-7) at 40% 1RM of BP/squat and 75% of 10-repetition day load for assistance movements. A 4x2 repeated measures ANOVA was used with significance at $p \leq 0.05$. **RESULTS:** There was a main time effect ($p < 0.01$) for 1RM BP across all groups. Specifically, there was a time effect ($p < 0.05$) for RT (109.75 \pm 12.22 to 121.63 \pm 16.29kg), CTHI (110.6 \pm 12.33 to 123.2 \pm 12.62kg), and CTMI (114.63 \pm 28.15 to 124.63 \pm 29.76kg); however, RTC (115.5 \pm 21.68 to 116.9 \pm 19.17kg) did not significantly improve BP ($p > 0.05$). No group differences existed ($p > 0.05$). **CONCLUSION:** These findings suggest that short duration cycling avoids the interference effect. However, a barbell circuit may attenuate strength due to inadequate muscle recovery.

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Effects of a Ten-Week Periodized Resistance Training Program on Speed in High School Athletes

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Strength and speed are important for athletes that perform change-of-direction sprinting. With limited pre-season time, quality short-term training is vital to high school athletes. Although inconsistent, research shows periodized resistance training (PRT) as most beneficial for athletes. **PURPOSE:** To investigate the effectiveness of short-term PRT on speed and determine the relationship between relative strength and speed. **METHODS:** Eighteen male high school football and soccer players were randomly assigned to either a PRT group (PRTG) or a control group (CG) after providing informed consent. Both groups were pre and post-tested on drills to assess speed ("Nebraska," "T," and 20 m dash) and a 3-repetition maximum back squat to assess strength. The PRTG participated in a 10-week/3-day/week PRT program while the CG independently participated in their normal training routine. Five 2x2 ANOVAs were conducted (treatment/control vs. pretest/post test) with significance set at $p < .05$ to determine differences. **RESULTS:** There was a significant difference ($p < .001$) for both absolute and relative strength with the PRTG mean (298.94 lbs \pm 58.6 lbs; 1.78 \pm 0.31) greater than the CG mean (186 lbs \pm 34.78 lbs; 1.24 \pm 0.24) after training. Nebraska drill scores approached significance ($p = .055$) after training [PRTG = 8.26 sec \pm 0.46sec; CG = 8.56 sec \pm 0.63 sec]. Relative strength was most highly correlated (-.72) with the Nebraska drill for the PRTG at the time of the pre-test. The correlation between relative strength and speed was not improved with training. Increases in absolute and thus relative strength were expected, because although independent, the CG also trained for strength. Further investigation of the results of random assignment to groups showed mostly football players in the PRTG and mostly soccer players in the CG. Sport specific training attributes of soccer and football players may have influenced the findings. **CONCLUSION:** The 10 week short-term PRT did not elicit significant differences in change-of-direction speed in this sample of football and soccer players.

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The Acute Effect Of Exposure To Barefoot Running On Vo₂peak, Fatigue, And Time To Exhaustion In Recreational Runners

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(No relationships reported)

The concept of Bare Foot (BF) is based on a naturalistic approach to promote running efficiency through forefoot striking patterns. In Contrast, Lieberman et al, 2010 showed that traditional running shoes with high cushioned heels facilitate a rear foot striking pattern. This pattern of running has been found to be relatively inefficient. Hasegawa et al, 2007, showed that 75% of half marathon runners were rear foot strikers which correlated with slower running speeds, in contrast those athletes who demonstrated mid or forefoot striking patterns were more efficient with faster running speeds. This suggests that a forefoot or mid foot striking pattern may increase performance. To date, the majority of studies investigating the effects BF running have used trained runners with multiple exposures before data collection. This limits the generalizability of the data and may not depict the physiological changes that occur with acute exposure. **Purpose:** The purpose of this study was to investigate the physiologic response during an acute exposure to BF running. **Methods:** The subjects consisted of 12 recreational runners with no previous history of BF running. The subjects reported to the lab on two separate occasions for either the shod running trial in which they wore running shoes or the BF trial in which a pair of athletic socks was

worn. The protocol for both sessions consisted of a brief warm-up followed by the Astrand Treadmill protocol. VO₂peak, local RPE (lower extremity), systemic RPE, and time to exhaustion were collected and analyzed. **Results:** The results of this study found no statistically significant differences ($p > 0.05$) for time to exhaustion 821.75 \pm 104.7 and 793.0 \pm 131.98 seconds, VO₂peak 52.05 \pm 4.69 and 52.38 \pm 7.46 ml/kg/min, local RPE 17.25 \pm 2.01 and 17.75 \pm 1.86, and systemic RPE 17.17 \pm 1.59 and 17.42 \pm 1.00 for shod and BF running respectively. The researchers found that 92% of the subjects did transition within 60 seconds from rear foot strikers to mid/ fore foot strikers. **Conclusion:** The findings of this study suggest that there is no difference in physiologic or fatigue values between shod and barefoot running during an acute exposure, however transition of running style did occur. This would suggest that novice runners with no BF experience might in fact benefit just as experienced runners do from BF running.

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Effectiveness of North Carolina Law Enforcement Training on Police Recruits: Expected Physical Fitness Improvement Guidelines

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(No relationships reported)

Physical fitness programs are an essential part of Basic Law Enforcement Training (BLET) for police recruits in North Carolina (NC). Recruits are tested for physical fitness before and after training. Currently, instructors do not have a reference to gauge how much a recruit should increase in physical fitness during training. Such data would be effective in setting recruit goals and determining a center's effectiveness. **PURPOSE:** 1. To determine pre- and post-physical fitness changes and 2. To develop an "improvement percentile ranking system" for NC. **METHODS:** Data was collected to measure muscular endurance, muscular strength, power, and cardiovascular ability. A paired sample T-Test compared pre- and post-scores of gender (females [F]: n=115, males [M]: n=593) and age groups (<30 and 30-39). The amount of change between assessments was placed into an "improvement percentile ranking table." A one-way ANOVA was used to compare gender differences in the amount of change per test. **RESULTS:** There was a significant ($P < 0.05$) improvement in pushups, sit-ups, vertical jump, bench-press ratio, 300 meter run, and 1.5 mile run. Respectively, the improvements were: M <30 - 13.2 \pm 10.7 reps, 6.8 \pm 6.3 reps, 4.8 \pm 7.2 cm, 0.13 \pm 0.15, -2.3 \pm 5.8 sec, and -1:43 \pm 2:10 min:sec.; F <30 - 15.7 \pm 9.5 reps, 8.7 \pm 6.6 reps, 5.4 \pm 6.0 cm, 0.15 \pm 0.10, -5.5 \pm 6.6 sec, and -1:59 \pm 1:48 min:sec; M 30-39 - 15.1 \pm 9.6 reps, 7.9 \pm 5.8 reps, 3.9 \pm 6.3 cm, 0.13 \pm 0.13, -4.6 \pm 7.3 sec, and -1:50 \pm 2:10 min:sec; F 30-39 - 15.6 \pm 10.0 reps, 6.7 \pm 4.5 reps, 4.9 \pm 4.5 cm, 0.12 \pm 0.11, -6.0 \pm 13.0 sec, and -2:07 \pm 2:11 min:sec. Females ages <30 changed significantly more than males ($P < 0.05$) in push-ups (13.2 \pm 10.7 vs. 15.7 \pm 9.5 reps), sit-ups (6.7 \pm 6.3 vs. 8.7 \pm 6.6 reps), and the 300 meter run (-2.3 \pm 5.8 vs. -5.5 \pm 6.6 sec. The "improvement percentile ranking table" appeared to have promise. **CONCLUSION:** This report provides the State of North Carolina Basic Law Enforcement Training program a realistic baseline as to what can be expected in physical fitness improvements. The "improvement percentile ranking system" demonstrates the variation in improvement. Expected program improvement along with the "improvement ranking system" can work synergistically for instructors and administrators for setting realistic goals and in evaluating effectiveness among training centers.

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Effect Of Varying Exercise Intensity On Sweat Lactate Excretion Rate During Simulated Team Sport Activity

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Research has been equivocal on whether exercise intensity impacts sweat lactate concentration ([Lac⁻]) and limited data are available relevant to team sport. **Purpose:** Our study looked to determine if exercise intensity effects sweat [Lac⁻] and sweat lactate excretion rate (LER) during simulated team sport activity. **Methods:** Seventeen moderately-trained male team sport athletes (24 \pm 6 y, 77.9 \pm 16.7 kg, VO₂max 49 \pm 6 ml/kg/min) completed three randomized trials in which they performed five 30-min sets of simulated team sport exercises at low (L, 65 \pm 4% HR_{max}), moderate (M, 76 \pm 4% HR_{max}), and high (H, 83 \pm 5% HR_{max}) intensities in a lab setting (23°C, 62% RH). Sterile absorbent patches (14.5 cm² absorbent pad, 42 cm² total patch including tegaderm; 3M) were applied to the right dorsal forearm immediately after

the onset of the second 30-min exercise set, and removed when sufficient sample was absorbed, but prior to complete saturation. Local sweat rates (SR) were determined gravimetrically. Sweat [Lac] was measured using ion chromatography and LER was calculated by multiplying local SR by sweat [Lac]. Repeated measures ANOVA with Bonferonni correction for multiple comparisons was used to determine the impact of exercise intensity on local SR, sweat [Lac], and LER. Pearson correlations were used to determine the relation between local SR vs. sweat [Lac] and local SR vs. LER at each intensity. Data are shown as mean \pm SD. **Results:** There was a significant effect of exercise intensity on local SR (L: 0.59 ± 0.30 , M: 1.19 ± 0.55 , H: $1.53 \text{ mg/cm}^2/\text{min}$; $L < M < H$, $p < 0.01$), sweat [Lac] (L: 17.7 ± 4.8 , M: 14.1 ± 3.6 , H: $13.0 \pm 3.5 \text{ mM}$; $L > M$ and H , $p < 0.01$), and LER (L: 9.6 ± 3.1 , M: 15.9 ± 6.6 , H: $18.9 \pm 7.2 \text{ nmol/cm}^2/\text{min}$; $L < M$ and H , $p < 0.01$). There were significant ($p < 0.05$) negative correlations between local SR and sweat [Lac] at L ($r = -0.62$), M ($r = -0.47$), and H ($r = -0.47$) exercise intensities. Significant ($p < 0.01$) positive correlations were observed between local SR and LER at L ($r = 0.81$), M ($r = 0.76$), and H ($r = 0.71$) exercise intensities. **Conclusion:** Sweat LER increased with increasing exercise intensity and local SR during team sport activity. Future research is needed to determine the potential practical application of sweat LER measurements as a non-invasive marker for monitoring exercise intensity/load in athletes.

3273 Board #338 June 3, 3:30 PM - 5:00 PM

The Effect of Warm-up with Different Blood Flow Restriction Settings on Strength and Vertical Power

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(No relationships reported)

PURPOSE: The purpose of this study was to assess the effect of different blood flow restriction (BFR) settings with a 5-min dynamic warm up on strength and power. **METHODS:** A total of 10 male and 10 female subjects between the ages of 18-40 (24.3 ± 4.3 yrs) were recruited for this study. Following the initial screening and familiarization, participants returned for 3 separate randomized sessions. Subjects were asked to perform a 5-min warm-up on a treadmill at a self-selected walking pace. After the generalized warm-up, the subject's pre-dynamic warm-up maximal voluntary contraction (MVC) was tested twice with the Biodex dynamometer. Following pre-MVC, the subject was led to the Vertec with a power analyzer attached to the waist and performed 3 pre warm-up counter movement jumps (Pre-CMJ) with 30s rest in between each jump. The highest value was recorded. Furthermore, the subject was given a 5-min rest period and was asked to perform a dynamic warm-up with either BFR using blood pressure formula, BFR using thigh circumference, or warm-up without BFR. Subjects performed the sessions in randomized order. The dynamic warm-up lasted a total of 5-min and consisted of 2 sets of the following exercises. One set included the following exercises: 20 squats, 20 step ups, and 15 standing calf raises. There was a 30s rest period in between the 2 sets. Following the dynamic warm-up subjects performed two post-MVC tests and also performed 3 post-CMJs. **RESULTS:** Results demonstrated significant interactions for condition*time*gender ($p < 0.05$) and time main effect ($p < 0.01$) for CMJ, but there was no significant condition main effect for CMJ jump height. There was a significant condition*time interaction for peak velocity ($p < 0.01$). A time main effect was observed for peak torque, however no significant condition main effect was detected. **CONCLUSION:** Implementing a 5-min dynamic warm-up with two different BFR settings did not result in any significant improvements in post-test vertical jump performance. No significant condition main effect could be because general warm-up was ample and intense enough to prepare the body for the activity and adding BFR did not result in any additional significant changes in vertical jump, strength, and power production.

3274 Board #339 June 3, 3:30 PM - 5:00 PM

The Effect Of Microclimate-Enhanced Clothing on Grip Strength: A Randomized Double Blind Study

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Compression garments have been hypothesized to amplify exercise performance by increasing muscle force, power, or contraction efficiency. Manufacturers now claim that performance enhancements are probable with an apparel technology that modifies the anti-static microclimate and may offer a strong increase in grip strength. On the other hand, the athlete can also believe that the clothing will aid them and that will help improve their grip strength. **PURPOSE:** The effect of this enhanced clothing (shirt

and shorts) on hand grip strength was evaluated using a randomized, double blind protocol with deception. **METHODS:** 15 active adult athletes (9 females, 6 males; 29 \pm 5 years of age) signed the IRB-approved consent form and completed this protocol. Following a standardized 5 min minute warm-up, the participants performed the Hand Grip Strength Test with a Microfet 4 handheld dynamometer correctly sized for their hand. They were to grip and squeeze the dynamometer with as much force as possible for 30 seconds on each hand three times; between each squeeze was a sixty second rest period. The sum of the highest right and left grip force was the dependent variable for hypothesis testing using a repeated measures ANOVA. Each participant was tested on 4 occasions (at the same time of day over 9 days) in 4 conditions: True Positive (told they were in the enhanced clothing and were in the enhanced clothing; True Negative (told they were not in the enhanced clothing and were not); False Positive (told they were not in the enhanced clothing but actually were); and False Negative (told they were not in the enhanced clothing but actually were). Assessors were also informed of these conditions. The t-shirt and shorts the participants wore appeared and felt identical except with or without the enhanced anti-static microclimate technology purported to improve strength. **RESULTS:** No significant differences were detected between the 4 conditions (main effect $P = 0.65$). The True Positive was $57.1 \pm 16.2 \text{ Kg}$, True Negative was $56.5 \pm 16.0 \text{ Kg}$; False Positive was 57.9 ± 20.0 ; False Negative was $58.4 \pm 16.5 \text{ Kg}$. **CONCLUSION:** The enhanced clothing did not appear to improve grip strength, nor did the promise of improvement introduce a priming bias for increased grip strength in this small cohort of active adults.

3275 Board #340 June 3, 3:30 PM - 5:00 PM

The Effect of Technology Enhanced Clothing on Low Back and Hamstring Flexibility

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Athletic clothing manufacturers sometimes imply that their garments improve athletic performance. Advancements in clothing have been used to modulate temperature, support and compress the vascular bed and venous return, and increase proprioception during athletic tasks. Beyond these benefits, purported innovative fabric technology enhancements may modify the electromagnetic microclimate close to the skin and claim to offer a substantial increase in flexibility through tactile modification. However, alterations may be seen in flexibility performance due to athlete preconceptions about the clothing's effect on their performance. **PURPOSE:** The effects of technologically innovative clothing (shirt and shorts) on low back and hamstring flexibility was evaluated by the Canadian Trunk Forward Flexion Test using a randomized double blind protocol, with deception. **METHODS:** 15 healthy individuals ages 21-34 (9 female) completed this IRB-approved protocol and signed approved consent forms. After a 5-minute treadmill warm-up, the athletes performed the Canadian Trunk Forward Flexion test. 4 conditions were randomly tested over the course of 9 days in t-shirts and shorts with identical appearance and tactile properties, but with (EXP) and without (CONTROL) electromagnetic microclimate (anti-static) properties: True Positive: in EXP clothing and both assessor and athlete knew; True Negative: in CONTROL clothing and both assessor and athlete knew; False Positive: in CONTROL clothing and both assessor and athlete were told it was EXP clothing; False Negative: in EXP clothing and both assessor and athlete were told it was CONTROL clothing. Flexibility measurements were evaluated using a repeated measures ANOVA. **RESULTS:** There was no statistically significant difference in the four conditions (main effect $P = 0.73$). True Positive $28.1 \pm 10.7 \text{ cm}$; True Negative $28.9 \pm 9.8 \text{ cm}$; False Positive $29.1 \pm 10.9 \text{ cm}$; False Negative $29.3 \pm 10.9 \text{ cm}$. **CONCLUSION:** These data suggest that there was no effect of the EXP clothing designed to alter the static charge near the skin to improve flexibility, and no priming effect of the expectation of improvement.

3276 Board #341 June 3, 3:30 PM - 5:00 PM

The Effect of Stroke Cadence on Power Output during a 2000 meter Rowing Trial

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>The exercise mode of rowing has become a popular training modality with athletic populations, as well as with health conscious fitness enthusiasts. Successful rowing depends upon the ability to generate and maintain a high power output. The standard

distance for comparison of rowing fitness is 2000 meters (~ 7 min). While all energy systems are engaged in the 2000 m row, the majority of energy production is from aerobic sources, thus a sustained and effective stroke rate is vital for success. There is considerable controversy regarding the optimal rowing cadence to achieve ideal power output during performance. **PURPOSE:** The purpose of this study was to determine an optimal stroke cadence to sustain the highest power output over a 2000 meter row. **METHODS:** 12 recreational rowers (age 33 ± 10.4 yr, ht 170.2 ± 10.4 cm, body mass 77.4 ± 17.3 kg) provided informed consent and reported for a familiarization trial of rowing at 20-22 (S), 25-27 (M) and 30-32 (H) strokes/minute on a WaterRower S1 machine. Continuous performance measurements (Heart Rate [HR], Wattage [W], Stroke Rate [SR], Time [T], Distance [D] and rating of perceived exertion [RPE]) were recorded at each 250 meter split during the 2000 meter trials. In a randomized cross over design, subjects performed trials at S, M, and H stroke counts. A finger stick blood lactate sample was obtained at 3 min post-trial. **RESULTS:** Mean values of HR were 118 ± 13 , 137 ± 19 , and 152 ± 16 b/min, W were 64.9 ± 27 , 96.9 ± 33 , and 125.9 ± 35 watts, T were $10:24 \pm 1:19$, $9:16 \pm 0:41$, and $8:26 \pm 0:34$ min:sec, and LA were 2.7 ± 1.5 , 4.5 ± 1.8 , and 8.4 ± 3.6 mmole for S, M, and H trials respectively. Statistical analysis by one-way ANOVA ($p < .05$) revealed a significant difference among HR and W with S vs M & H, and LA and RPE w S & M vs H trials. **CONCLUSION:** Higher stroke rates result in higher power outputs, lactate production and cardiovascular requirements, as well as a higher perception of effort at the H trial. A moderate correlation between W and SR (0.64), LA and W (0.66), LA and HR (0.79), and LA and SR (0.67) confirms the value of maintaining a high SR for metabolic stimulus and maintaining a high power output.

3277 Board #342 June 3, 3:30 PM - 5:00 PM
A Survey Of Training Techniques In Competitive Rock Climbers

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PURPOSE: The frequency of different rock climbing training techniques (RCTT) was investigated in competitive rock climbers (n = 202; 174 usable). : **METHODS:** The sample was comprised of both male (n = 117) and female (n = 57) climbers enrolled in the Triple Crown Bouldering Series and ranged from 19 to 62 years of age. A questionnaire on RCTT was created and found to be reliable with a Cronbach alpha of 0.82. Chi square analyses were used to evaluate differences between demographics for each question, while a factor analysis was used to identify key factors. : **RESULTS:** Chi square analyses revealed differences among age groups for three questions, while gender differences also existed for seven questions. Age groups and questions pertaining to using a fingerboard (p = 0.005), campus board (p = 0.05) and door frames (p = 0.008) were significant. The expected vs. observed frequencies, indicated that younger climbers tended to use this type of equipment more frequently compared to older climbers. Responses to questions related to performing pull-ups (p = 0.035), using a campus board (p = 0.029), and performing extremely difficult routes (> 5.10 YDS, > V4; p = 0.02) were significantly different between sexes. Principal component analysis revealed five factors which explained 62% of the variance in questionnaire variability. Factor one, the primary RCTT, explained 25% of the variance. Some of the primary RCTT included: performing pull-ups, dead hangs, and utilizing various rock climbing training equipment such as fingerboards, campus boards and rock rings. : **CONCLUSIONS:** Results suggested male and female climbers train differently; however, using sport-specific equipment and climbing predominate as a primary RCTT regardless of sex. Future research should investigate training differences dependent on the specific style of rock climbing. :

3278 Board #343 June 3, 3:30 PM - 5:00 PM

The Effect of Performance Enhancing Clothing on Dynamic Balance: A Randomized Double Blind Study

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The purpose of athletic clothing is to enhance performance, but published results have been equivocal. Manufacture claims that clothing with a novel electromagnetic treatment creates a micro magnetic field when in close proximity to the body intended to improve balance have not been rigorously evaluated. **PURPOSE:** To determine the legitimacy of manufactures claims of enhanced athletic clothing provides an improvement in balance. **METHODS:** A randomized double blind study with deception was conducted using the Y Balance Test to determine the performance enhancing effects of the clothing and the potential impact on results created by a priming effect. The Y Balance test was chosen based on published reliability and validity, and its multi-dimensional approach to dynamic balance, incorporating range of motion, lower extremity flexibility and strength. The instrument used was a commercially available high quality wooden Y Balance kit. The Y Balance test was performed on 15 moderately physically active healthy individuals by self-report (9 females, 6 males 29 +/-5 yrs). The study was performed over 9 days and each participant reported to the testing facility on 4 separate occasions in clothing that looked and felt identical except for microclimate-enhanced properties. Each session the participants performed a standardized warm up and completed 3 trials on each foot in 3 directions (Anterior, Posterior Lateral, Posterior Medial); all distances were summed for each clothing condition. The 4 sessions included a false positive (told treated but given untreated clothing); false negative (told untreated but given treated); true positive (told treated and given treated); and true negative (told untreated and given untreated) in random order; assessors were also told the clothing condition. Hypothesis testing was conducted using a repeated measures ANOVA. **RESULTS:** There was no significant main effect (P = 0.61). False positive 1439 ± 120 mm; False negative 1459 ± 126 mm; True negative 1462 ± 122 mm True Positive 1438 ± 118 mm. **CONCLUSION:** There was no observed effect of the clothing with purported microclimate enhancements, whether or not the participant (and assessor) believed they were in that clothing. This suggests that the participants remained skeptical of the performance improvement claims made about the clothing.

3279 Board #344 June 3, 3:30 PM - 5:00 PM

Endurance Exercise Potentially influenced by a Novel Functional Beverage

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A variety of products are available on the market with the aim to improve physical performance. Recently, a new product (JustBIO Inc, CA) allows in vitro ATP resynthesis, preserves mitochondria structure and protect cells against cell death. **PURPOSE:** To measure the effect of three different beverages on Endurance Exercise (EE). **METHODS:** Participants were randomly assigned to 3 groups: group A (n = 7; 3F 4H; 27 ± 4 years), group B (n = 7; 3F 4H; 28 ± 7 years) and group C (n = 6; 2F 4H, 27 ± 5 years). They were instructed to consume beverages (JustBIO Inc, CA) respective to their group four days, one per day, preceding the EE and the fifth beverage consumption one hour before the test. The beverage A, B and C contained respectively: blueberry extract; blueberry extract with a biological active ingredient; and juice (without blueberry) with a biological extract that accelerated ATP release. The study was double blind. The participants, after a warm-up on ergocycle, performed an EE on ergocycle, where the participant had to achieve the greatest distance to 300kJ at 150 W. **RESULTS:** A tendency of increased distance (km) in group C (15.35 ± 3.7 , 15.99 ± 3.07) was observed compared to group A (16.54 ± 2.87 , 15.83 ± 2.82) and group B (15.53 ± 2.67 ; 15.86 ± 2.30), but not significant (p = 0.395; p = 0.950 respectively). Group C was distinct for average pedaling cadence (85.4 ± 20.52 , 89.09 ± 17.16 rpm) with the other two groups (A: 91.91 ± 15.86 , 87.96 ± 15.65 ; B: 86.47 ± 14.94 , 87.47 ± 13.65), but it was not significant (p = 0.425, p = 0.901 respectively). Also, the average speed (km/h) on the EE test of the group C (31.98 ± 6.14) was higher during the second session compared to group A (31.66 ± 5.65) and group B (31.72 ± 4.6), but is not significant (p = 0.395; p = 0.950 respectively).

CONCLUSIONS: The additive juice (C) appeared to have a tendency towards improving cycling performance (distance, average pedaling cadence and speed). It is possible that the variability of our data is too high to observe a significant difference between the groups.

3280 Board #345 June 3, 3:30 PM - 5:00 PM
New Functional Beverage Influences Power during a 30s Wingate Test

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A new product (JustBIO Inc, CA) has been shown to allow ATP resynthesis that may be promising to sustain exercise endurance. **PURPOSE:** Measure the effect of three different beverage formulations (JustBIO, Inc.) on power deployed during a 30s Wingate test.

METHODS: Participants were randomly assigned to 3 groups: group A (n = 9; 4F 5H; 27±4 years), group B (n = 9; 4F 5H; 28±7 years) and group C (n = 9; 4F 5H, 27±5 years). The participants were asked to consume 5 beverages assigned to their group 1 per day beginning four days preceding the event and one hour before the 30s Wingate test. Beverages A, B and C contained, respectively: a blueberry concentrate; a blueberry concentrate with a biological extract; and a beverage (without blueberry) containing a biological extract that accelerated ATP release. The study was conducted as double blind. All participants performed a Wingate test without consuming the beverages. After one week and after consuming their respective beverages all participants performed two other Wingate tests with a one week interval between tests. One way ANOVA analysis was performed for the various measured parameters.

RESULTS: The peak power (W/kg) obtained for the C group for three sessions (7.91±1.5, 7.45±1.86, 7.65±1.54) were significantly higher (p <0.05) than in group B (7.20±1.44, 7.1±1.32, 7.22±1.00), but no significant difference was observed for those in group A (7.22±1.2; 7.72±1.33; 7.3±0.73). The average power (W/kg) for group C (5.53±1.11, 5.64±1.44, 5.90±1.27) was significantly higher (p <0.05) than group A (5.24 ±0.97, 5.43±0.81, 5.24±0.65), but not for group B (5.38±0.96, 5.55±1.06, 5.51±0.84). In addition, a relative improvement (%) of the maximum power as a function of sessions 2 and 3 (consumption of juice) from the session 1 (without juice consumption) showed a significant difference (p <0.05 and p <0.01 respectively) with group C (93.3±11.77, 96.06±11.38), group A (102.63±9.77; 101.97±7.84) and B (104.21±21.21, 106.29±36.64).

CONCLUSIONS: The blueberry Juice (A and B) seems to improve the average power (significantly different from C, group without blueberry) when the groups are normalised to their initial performance in the absence of a juice consumption. It seems that blueberry extract helps to maintain power.

3281 Board #346 June 3, 3:30 PM - 5:00 PM
Beverage Composition Influences Ad Libitum Consumption, Hydration Status And Affect During Exercise In The Heat

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Maintaining a sufficient level of hydration can have a substantial effect on performance outcomes, especially in endurance exercise. How an exerciser feels (pleasure vs. displeasure) could in theory, depend on their ability to maintain fluid balance, ultimately affecting their performance.

PURPOSE: To determine the effect of ad libitum consumption of either a carbohydrate-electrolyte beverage (CES), water (WAT), or a electrolyte-free, non-caloric, flavor-matched placebo drink (PLA) on hydration status and affective responses.

METHODS: Seventeen trained men (mean±SD; 25.4±4.0 y, VO₂peak = 53.3±6.8 mL kg⁻¹ min⁻¹) completed three intervention trials in a randomized, double-blind, counter-balanced, cross-over design. Trials involved two hours of steady state (SS) cycle ergometry at 68.4±9.3% VO₂peak in the heat (WBGT=24.4±1.7°C) with ad libitum WAT, PLA, or CES. Indices of affective responses and fluid balance were recorded prior to and every 30 min during SS cycling exercise.

RESULTS: Physiologically, plasma glucose was significantly greater with CES than WAT and PLA for all time points during SS (p<0.05). A significant difference was found in plasma sodium levels at 120 min (p<0.05). Plasma osmolality was significantly greater with CES compared to WAT at 90 min (p<0.05), and significantly greater than WAT and PLA at 120 min (p<0.05). Greater fluid intake was observed at

all time points with CES compared to water (p<0.05). CES elicited significantly greater mean affective response than PLA and WAT only at 120 min (p<0.05).

CONCLUSION: Greater affect during CES appears to be supported by a greater fluid intake and plasma osmolality, possibly due to the higher plasma glucose and sodium levels compared to other treatments. Thus, the improved fluid balance in the CES condition may have contributed to the improved feelings of affect (more pleasure) at the end of 2 hrs of SS cycling exercise, which was independent of flavor due to the flavor-matched PLA. Collectively, affective responses appear sensitive to changes in indices of hydration status during prolonged endurance exercise in hot environmental conditions. As such, affect may reflect a signal to induce drinking behaviors that maintain fluid balance and protect bodily homeostasis. Funded by The Coca-Cola Company NCT01893853

3282 Board #347 June 3, 3:30 PM - 5:00 PM
Effects of 3-week Respiratory Muscle Training on Sport Performance in College Basketball Athletes

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Respiratory muscle fatigue is one of the important factors limiting sports performance due to metaboreflex. This reflex will cause a decrease in blood flow to the extremities and accelerate exercising limb fatigue. Systematic review of the literature found that respiratory muscle training can effectively enhance the respiratory muscle endurance and reduce fatigue during exercise, thereby enhancing athletic performance. Previous studies focused on endurance type of exercise. However, its effect on high intensity intermittent exercise such as basketball is still unclear.

PURPOSE: To investigate the effects of 3-week respiratory muscle training on exercising limb blood flow and sports performance in college basketball players.

METHODS: Nine healthy college basketball players (Height: 173.67±5.33 cm; Weight: 67.44±2.67 kg; Age: 21.67±2.21 years) underwent respiratory muscle training (K2, POWERbreathe International Ltd, UK) twice a day, 5 days/week with intensity at 60%, 70% and 80% of maximum inspiratory pressure for week 1, 2 and 3, respectively. Before and after the 3-week training, Beep Test was conducted to examine sport performance and Impedance Plethysmography (Rheoscreen compact (Medis, Ilmenau, Germany) was performed to evaluate limb blood flow after respiratory muscle fatigue. Pre versus post-training data were compared using paired-t tests (SPSS Inc., Chicago, IL, USA). P-values of less than 0.05 were considered to be statistically significant.

RESULTS: Results of Beep test were transformed from level to VO₂ maximum. VO₂ maximum significantly increased from 45.16(L/min) to 49.4(L/min) after respiratory muscle training (p=0.045). Change of blood flow on lower limb decreased from 28.37% to 18.46% (p=0.14) after respiratory muscle training.

CONCLUSIONS: 3-week respiratory muscle training enhanced respiratory muscle endurance and improve athletes' sport performance. Although the decline in blood flow did not decrease significantly after training, the results had a downward tendency after training, suggesting respiratory muscle training could enhance sport performance by delaying respiratory muscle metaboreflex.

3283 Board #348 June 3, 3:30 PM - 5:00 PM
Effects Of Differing 2 Minute Pacing Strategies On VO₂, Muscle Deoxygenation And Performance

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 (No relationships reported)

PURPOSE: To examine the physiological and performance responses of 3 different pacing strategies during a 2 min cycling trial on well trained collegiate track athletes.

METHODS: 5 Male (VO₂peak = 54.81±7.49 ml/kg/min; Power output peak (POpeak) = 402.5±57.57 watts) and 6 female (VO₂peak = 43.36±5.54 ml/kg/min; POpeak = 274.33±27.93 watts) varsity track athletes performed 3 pacing strategies on a cycle ergometer within a 10 day period. Test 1: A 3 min all out trial (AO) determined critical power and 2 min performance. Test 2: A constant power strategy (CON) calculated from the CP test with a final 30 s maximal effort. Test 3: A parabolic race strategy (PRS) utilising an initial 30 s period performed 5% above CON, followed by 60 s at 5% below CON and then a 30 s maximal effort finish. Breath by breath pulmonary VO₂ and muscle deoxygenation (HHb) data from the vastus lateralis were collected from -10 to 120 s during the 3 pacing strategies. Blood lactate concentrations were collected pre and post all trials.

RESULTS: Mean VO₂ was different across the 3 trials (AO: 2.87±0.74L/min, CON: 2.56±0.68L/min, PRS: 2.71±0.71L/min, p<0.05). As was mean VO₂ from -10 to 30 s, where AO elicited the highest VO₂ and CON elicited the lowest (AO: 2.1±0.43L/min, CON: 1.61±0.46L/min, PRS: 1.76±0.47L/min, p<0.05). VO₂ from 31 to 60 s in all trials was observed to be greater in AO than in both CON and PRS (AO: 3.06±0.82L/min, CON: 2.60±0.71L/min, PRS: 2.73±0.73L/min, p<0.05). Only AO VO₂ was different from CON during 61 to 90 s of all trials (AO: 3.15±0.88L/min, CON: 2.95±0.79L/min, PRS: 3.06±0.82L/min, p<0.05), while there were no differences

in mean VO₂ over the final 30 seconds. Differences in % HHb change were only observed from -10 to 30 s of all trials. AO had a greater change than both CON and PRS from baseline (AO: 83.72±5.26%, CON: 74.42±8.27%, PRS: 73.39±10.41%, $p < 0.05$). Mean PO of CON and PRS were higher than AO (AO: 335.88±88W, CON: 342.56±86.67W, PRS: 341.39±85.9W, $p < 0.05$). Post-trial lactate levels for AO were higher than CON, but no differences were observed between CON and PRS (AO: 15.78±1.89mmol/L, CON: 13.84±2.1mmol/L, PRS: 14.19±2.34mmol/L, $p < 0.05$). CONCLUSION: CON and PRS are superior strategies compared to AO for 2 min performance, despite the slower rate of adjustment of VO₂ and HHb, and the lower glycolytic phosphorylation contributions.

3284 Board #349 June 3, 3:30 PM - 5:00 PM

Blood Flow Restriction Fails to Alter Adiponectin Response to an Acute Low-Intensity Resistance Exercise Session

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Blood flow restriction (BFR) combined with low-intensity resistance training has been shown to improve muscle strength and hypertrophy, providing a potential important training tool for those incapable of completing more intense resistance training. Adiponectin appears to play a role in exercise-induced improvements in insulin sensitivity and inflammatory state, however little is known regarding the effects of BFR and low-intensity resistance training on adiponectin following exercise. **PURPOSE:** To determine the effects of bilateral BFR on the salivary adiponectin response to a single session of low-intensity leg press exercises. **METHODS:** Thirteen healthy males and females aged 18-28 yrs completed two low-intensity resistance exercise sessions (control and BFR) in randomized order with 5-7 d between trials following screening and the determination of 1-RM. Blood pressure cuffs were placed in the uppermost portion of each thigh and were inflated just enough to keep them from falling off the legs (control) or to 90 to 100 mm Hg (BFR). The low-intensity resistance exercise session consisted of four sets of leg press (30 reps first set and 15 reps for following three sets) at 30% 1-RM at 30 reps/min with 30 s of rest between each set. Salivary samples were collected from 3-4 h fasted subjects at baseline, immediately after, and 30 min after the end of exercise for the determination of adiponectin concentration. **RESULTS:** Salivary adiponectin concentration did not significantly increase from baseline (4.2 ± 2.0 ng/ml) to post exercise in the control condition (9.4 ± 6.7 and 2.5 ± 0.6 ng/ml, immediately and 30 min post, $p > 0.05$). While BFR appeared to result in higher salivary adiponectin concentrations after exercise, they did not change significantly from baseline nor were they significantly different from control at corresponding time points (6.9 ± 3.5, 17.4 ± 13.1, and 4.4 ± 2.1 ng/ml, baseline, immediately and 30 min post, $p > 0.05$). **CONCLUSION:** Bilateral BFR combined with low-intensity leg press exercise is not sufficient to produce a significant increase in post exercise salivary adiponectin. Future studies should evaluate whether BFR combined with low-intensity resistance exercise sessions with a greater volume of work have the potential of increasing the adiponectin response.

3285 Board #350 June 3, 3:30 PM - 5:00 PM

The Effects Of Traditional, Contrast, And Pre-exhaustive Training Methods On Performance Variables

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Manipulating order of resistance exercise has been used to improve training adaptations, increase training session efficiency, prevent injuries, and improve recovery time in subsequent same-day training sessions. **PURPOSE:** This study investigated the extent of recovery from the acute effect of three resistance-training modalities, Traditional Training (TT), Contrast Training (CT) and Pre-Exhaustive Training (PE), using three performance measures critical to power performance sports. **METHODS:** Ten (7 male and 3 female) participants age 22.2 ± 1.62 yrs, height 180.66 ± 9.08 cm, weight 75.85 ± 8.2 kg, percent body fat 16.5 ± 7.22 % participated in the study. The average 1-RM squat was 105.23 ± 37.76 kg. Training modalities were randomized prior to testing. One hour following training sessions, participants were tested on three performance measures in the following order: vertical jumping (VJ; height, cm), T-test for agility (T-test; time, sec), and repeated sprint (RS; time, sec).

RESULTS: Time to complete training protocols was significantly different between all 3 protocols ($P < 0.001$); importantly though, there was no difference in volume of total weight lifted during each protocol. Following the protocols, performance tests revealed significant differences between Control VJ performance (59.56 ± 11.71cm) and TT (56.52cm ± 11.90cm) ($p < 0.05$), CT (55.38cm ± 12.88cm) ($p < 0.01$), and PE (57.02cm

± 11.95cm) ($p < 0.05$), respectively. Our results also demonstrated significantly slower times to complete T-test following TT (11.49s ± 1.13s) and CT (11.41s ± 0.95s) protocols, compared to Control (11.27s ± 0.77s) ($P < 0.05$). Furthermore, significant differences in sprint times were evident between TT and CT protocols compared to PE and Control ($p < 0.05$).

CONCLUSIONS: Significant differences in performance were found between the TT, CT, and PE treatments and Control protocols in maximal vertical jump height, agility capabilities, and repeated sprint ability. These data suggest that modifying exercise order beyond traditional resistance-training protocols might improve performance variables due to improved recovery and improved efficiency during subsequent same-day training.

3286 Board #351 June 3, 3:30 PM - 5:00 PM

Is Grip Strength Related to Metabolic Risk Factors

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PURPOSE: Grip strength is easy, quick and cheap to measure people's muscle strength, and it may be related to metabolic risk factors. This study aimed at detecting if there are relationships between grip strength and metabolic risk factors. **METHODS:** Eight hundred and twenty people were recruited from three big health management centers in China, and 787 people finished all the medical examination and grip strength test. People's grip strength was tested in their dominant hand by using the same method and equipment, their body composition was measured by BIA, and their fasting blood glucose and blood lipid were detected. The correlations between grip strength and body weight, body composition (body fat percentage, fat-free body mass), waist circumference, rest heart rate, blood fasting glucose, blood pressure, blood lipid (total cholesterol, triglyceride, LDL and HDL), were analyzed. **RESULTS:** The average age of 787 people (men: 636, women: 151) finished all the tests is 40.55±9.33 yrs (20-60yrs), the average grip strength was 35.44±9.31 kg. Grip strength was negatively related to age ($r = -0.126$, $P = 0.000$), and men's grip strength was larger than women's. We divided all the people into several groups by gender and each age of 10 years (20-29yrs, 30-39yrs, 40-49yrs, 50-60yrs), and found some results. Grip strength of all men was related to body weight and fat-free body weight ($P < 0.05$), except that there were relationships between grip strength and body weight, body fat percentage and fat-free body weight in 50-60yrs group ($P < 0.05$). **CONCLUSIONS:** Grip strength decreased with age, and men's is larger than women's. Grip strength is related to body composition and a few metabolic risk factors in men, especially is related to fast blood glucose in 50-60yrs men, but they are not existed in women although 50-60yrs women's grip strength is related to body composition. The results indicated that grip strength may be a predicted factor of metabolic risk, but more researches are needed. Sponsored by China Health Promotion Foundation (CHPF2014-FITEX)

3287 Board #352 June 3, 3:30 PM - 5:00 PM

Comparing the Straight Punch between Chinese Wushu and other Martial Arts

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PURPOSE: Many believe that routine exercises in Wushu routine (Kungfu) are mere acrobatics and have no fighting value compared to other martial arts. The aim of this study was to compare the straight punch force between Wushu and other martial artists. **METHODS:** 35 male college students who have equal sport experiences were eligible for this study. Boxing $n=7$, San Da (Chinese Sparring) $n=7$, Wushu routine $n=7$, Karate $n=7$, control group (College Physical education students) $n=7$ took part in this trial. Subjects age were 21±1 years old, weight 66.7±6.4 kg, height 1.71±0.23 cm. Except for the control group, the average of training years was 6±3 years. Subjects were asked to deliver a straight punch under 2 conditions. 1) A free punch was tested for subjects' maximum punch force. 2) A reaction punch with a signal was used to test subjects' reaction and punch force. A punch test device was used to collect punch force and acceleration. The sampling frequency of force and acceleration was 10,000 Hz respectively. Subjects test order was randomized prior to the experiment begin. Punch force was normalization. Statistical analyses were performed using SPSS 19.0. ANOVA repeat measures were used to compare the differences of two punch conditions and groups. Data were reported as mean values (SD), and the significance level was set to $p < 0.05$.

RESULTS: The results showed that the maximum punch force was highest for boxers (2689 N), followed by practitioners of San Da (2653 N), Wushu routine (2258

N), karate (1914 N) and PE students (1380 N). The results for the reactive punch force showed slight differences with San Da players (2532 N) now scoring higher than boxers (2481 N). Also for the free punch acceleration the highest scores were registered among San Da players (122 m/s²), followed by Wushu routine (119 m/s²), boxing (113 m/s²), karate (89 m/s²) and the control group (68 m/s²). The same order was found for the reactive acceleration: San Da (122 m/s²), Wushu routine (119 m/s²), Boxing (113 m/s²), Karate (89 m/s²) and the control group (68 m/s²).

CONCLUSIONS: This comparison indicated that the straight punch force of Wushu routine was lower than that of boxing and San Da, but higher than that of karate and P.E students. Wushu routine is a promising self-defense sport that can be known by more people.

3288 Board #353 June 3, 3:30 PM - 5:00 PM
The Effect of Multiple Sessions of Resistance Training on Strength Performance and Anaerobic Capacity of the Upper Body

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PURPOSE: This study examined the effect of daily one single bout versus triple bouts of resistance exercise for 12 weeks on muscular strength and anaerobic performance of the upper body.

METHODS: Young adult participants (n = 20, age: 22.0 ± 1.0 years, bench press: 44.0 ± 10.3 kg) were randomly assigned to one single bout (SB) or triple-bout (TB) of resistance exercise group. The maximal strength and anaerobic performance of the upper body using the bench press (one-repetition maximum) and the modified 30-sec Wingate test were determined before and after the intervention, respectively. Additionally, the changes in the lactate levels before and after the Wingate test were measured.

RESULTS: Although the SB and TB groups showed a significant increase in the maximal strength (post-intervention, SB: 67.2 ± 9.2, TB: 67.6 ± 7.6 kg) compared with the values at pre-intervention (SB: 44.6 ± 11.4, TB: 43.9 ± 8.7 kg), there was no significant difference for this parameter between the two groups post-intervention (p > 0.05). Additionally, the results of the Wingate test in the SB and TB groups also displayed similar significant improvements after the completion of different training regimes. Concerning the change in lactate from pre- to post-Wingate test, no significant differences were found between the two groups.

CONCLUSIONS: On the basis of the same training volume, multiple bouts of resistance training showed similar improvements in the maximal strength and anaerobic performance to tradition one bout of resistance training in young men without prior experience in resistance training.

3289 Board #354 June 3, 3:30 PM - 5:00 PM
The Link Between Remote Ischemic Preconditioning, Performance And Oxygen Uptake Kinetics

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PURPOSE: One of the first assumption was that remote ischemic preconditioning (RIPC) acts on different mechanisms such as the stimulation of adenosine and the opening of mitochondrial ATP-sensitive potassium channels and therefore could result in a better oxygen distribution in sports performance. Even if RIPC did result in better time-trial performance, subsequent studies reported that RIPC does not affect maximal O₂ consumption, hemodynamics and the anaerobic metabolism. Our hypothesis is that the better performance is due to a smaller oxygen deficit. Therefore, this study investigates if RIPC could reduce the oxygen deficit on the oxygen uptake kinetics.

METHODS: Fifteen healthy participants were randomly assigned in a crossover design to an RIPC intervention and a control intervention (CON) before performing two consecutive bouts of 8-minute exercise at 75% and 115% of gas exchange threshold (GET) separated by a 20-minute passive rest.

RESULTS: The primary time constant (τ_1) of the fast component at moderate and heavy intensity is significantly different between RIPC and control intervention. At 75% of GET the mean SD of τ_1 for RIPC is 27.2 ± 4.6 seconds vs. 33.7 ± 6.2 seconds for CON (p < 0.001). At 115% of GET, τ_1 for RIPC is 29.9 ± 4.9 seconds vs. 33.5 ± 4.1 seconds for CON (p < 0.01); the amplitude of the fast component for RIPC is 2.09 ± 0.42 L O₂/min and 2.24 ± 0.42 L O₂/min (p = 0.031).

CONCLUSIONS: RIPC speeds the O₂ kinetics at moderate and high intensity level of exercise.

3290 Board #355 June 3, 3:30 PM - 5:00 PM
Comparison Of Propulsive Power During Loaded Countermovement Jumps Performed In Water Versus Land In Males

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As the use of an aquatic environment in exercise training and rehabilitative tool increases, evaluating the ability to generate power in water may provide additional insights toward the relative benefits of aquatic plyometrics. **PURPOSE:** The purpose of this study was to assess peak and mean propulsive power in loaded countermovement jumps (CMJ) in water compared to land. **METHODS:** 20 college aged (24.6 ± 3.6 years) recreationally active males performed 4 randomized countermovement jumps on a force plate. A weighted vest was used to establish load conditions: (bodyweight [BW], BW+10%, BW+20%, BW+30%). Jumps were performed on land and immersed in water at the xiphoid process. Absolute and normalized to body weight peak power (PP) and mean power (MP) were assessed for all jumps. A 2 (environment) by 4 (load) repeated measures ANOVA was employed to identify main effects and interactions, while LSD post hoc tests identified location of significance. **RESULTS:** Absolute PP was greater (p < 0.001) in water for all loading conditions compared to land (13.1 ± 3.4, 12.3 ± 3.6, 10.4 ± 3.4, 9.9 ± 3.1 kW vs 5.8 ± 1.4, 5.7 ± 1.4, 5.8 ± 1.4, 5.9 ± 1.4 kW) for the BW, BW+10%, BW+20% and BW+30% conditions, respectively. Absolute MP was significantly greater (P < 0.001) in water vs land (5.5 ± 1.7, 5.2 ± 2, 4.4 ± 1.5, 4.1 ± 1.6 kW vs 2.6 ± 0.8, 2.4 ± 0.8, 2.5 ± 0.8, 2.5 ± 0.7 kW), respectively. A significant trend for decrease in PP and MP with increasing load in water was identified but not for land (p = 0.76). Normalized PP and MP were also significantly greater in water vs land. **CONCLUSION:** These results suggest when performing CMJ on land, adding 10-30% BW has no detrimental impact on PP and MP measures, but results in a significant reduction when performed in water. Potential decreases in movement velocities during takeoff may account for these differences due to greater drag forces in water compared to air. This added resistance may provide a mechanism for increasing resistance during explosive activities while providing a potentially safer environment.

3291 Board #356 June 3, 3:30 PM - 5:00 PM
Physiological Responses To The Aerobic Exercise Using Balance Ball And Walking.

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PURPOSE: To clarify the physiological responses to various movement in aerobic exercise using balance ball. And to clarify the differences between walking and aerobic exercise using balance ball.

METHODS: Eight healthy men performed walking and aerobic exercise using balance ball (BB). Respiratory metabolism and heart rate were measured during walking and aerobic exercise using BB. Subjects walked 5 speeds (4km/h, 5km/h, 6km/h, 7km/h and 8km/h) on treadmill ergometer. During aerobic exercise using BB, subject was sitting on the BB and bounding with upper and lower limb movements. The movements were fourteen patterns; bounding only, four upper limb movements, five lower limb movements and four upper and lower limb movements.

RESULTS: There were no differences on the exercise intensity between upper limb movements (3.7 ± 0.5 Mets) and lower limb movements (3.7 ± 0.6 Mets) in aerobic exercise using BB. The exercise intensity during upper and lower limb movement (5.0 ± 0.6 Mets p < 0.001) was significantly higher compared with upper limb movement only and lower limb movement only. There was no significant difference on heart rate between upper limb movement (114 ± 22 beats/min) and upper and lower limb movement (119 ± 19 beats/min). On the other hand, heart rate was significantly lower in lower limb movement (106 ± 15 beats/min, p < 0.001) compared with upper and lower limb movement. The exercise intensity and heart rate while upper and lower limb movement were nearly to walking at 5-6km/h. The exercise intensity and heart rate while upper and lower limb movement were nearly to walking at 6-7km/h.

CONCLUSIONS: The exercise intensity and heart rate during aerobic exercise using BB was nearly to moderate-intensity walking. Therefore, the aerobic exercise using BB is appropriate exercise to health promotion.

- 3292 Board #357 June 3, 3:30 PM - 5:00 PM
Land-based Warm-up Is Inferior To Water-based Warm-up For 100m Freestyle Swimming Performance
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In swimming competitions, athletes must usually complete their pool-based warm-up 20 minutes before their race time, and spend the intervening time out of the water in a call room. It is possible that some of the beneficial effects of completing a warm-up may be lost during this time.

PURPOSE:

The aim of this study was to investigate the effect of a land-based warm up (LAND) on 100m freestyle swimming performance, compared to a traditional water-based warm-up (WATER).

METHODS:

Twenty-two national level swimmers (11 female, age 17.9 ± 2.5 years, 100m freestyle personal best 59.8 ± 2.8 s; 11 male, age 18.6 ± 2.8 years, 100m freestyle personal best 52.8 ± 1.91 s) completed both WATER and LAND warm-ups prior to a 100m race, in a randomised cross-over design. WATER consisted of 2100m of drills at various intensities, taking approximately 30 minutes to complete, and followed by a 20-minute call-room wait. LAND consisted of a time-matched programme of dynamic mobility exercises, pulse-raisers, and muscle activation exercises, again followed by a 20-minute call-room wait. Race time, stroke rate (SR) and distance per stroke (DPS) were obtained from race video analysis; heart rate (HR) and rating of perceived exertion (RPE) were recorded before and after the warm-up and race. Paired T-tests were performed to test for significant differences between conditions.

RESULTS:

Race time was faster after WATER than LAND (58.10 ± 4.39 s vs. 59.00 ± 4.04 s, $p = 0.001$, Cohen's d ES 0.2), there were no significant differences in SR or DPS. HR was higher after WATER than LAND (153 ± 14 bpm vs. 140 ± 21 bpm, $p = 0.024$, Cohen's d ES 0.7); RPE was lower after WATER than LAND (median RPE 13 vs. 15, $p = 0.01$).

CONCLUSIONS:

The land-based warm-up was not sufficient to prepare swimmers for a 100 m freestyle race; this may be due to the lower physiological intensity (as determined by HR), or perhaps the absence of 'water feel' (not measured). Further work should investigate the effect of a combined water and land warm-up to more closely replicate the call-room scenario.

- 3293 Board #358 June 3, 3:30 PM - 5:00 PM
A Laboratory-Based Protocol to Simulate Basketball Training at Progressively Increased Intensity Levels
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Reported Relationships: A.J. Reimel: Salary: Gatorade Sports Science Institute, a division of PepsiCo. The views expressed in this abstract are those of the authors and do not necessarily reflect the position or policy of PepsiCo, Inc..

Few studies have conducted research to develop lab-based protocols to simulate physiological and subjective exertion during team sports. Therefore, we developed an intermittent protocol to simulate the demands of basketball training; 3 levels of protocol intensity were designed to include the full range of practice types (e.g., walk-through to scrimmage/conditioning). **PURPOSE:** To determine whether this protocol achieves 3 distinct progressive levels of intensity based on various physiological and subjective measures of exertion. **METHODS:** 21 male basketball players (24 ± 10 y, 77.2 ± 13.5 kg) completed 3 randomized trials [low (L), moderate (M), and high-intensity (H)] consisting of 5 X 30-min bouts of intermittent exercise in a temperate room (23°C , 62% rh). The L, M, and H trials differed in the percentage of time running (9 mph), sprinting (12 mph), and performing drills (lateral slides, jumping, footwork drills, pushups, basketball passes) (L: 11%, M: 26%, and H: 45%) and time standing, walking (3.5 mph), and jogging (7 mph) (L: 89%, M: 74%, and H: 55%). Heart rate (Polar) and RPE (Borg 6-20 scale) were recorded every 5 min (reported as mean \pm SD). Before and after exercise subjects rated their muscle fatigue, tiredness, effort, and physical demand on a 100-point visual analog scale (VAS, reported as mean change \pm SD). Repeated measures ANOVA with Bonferroni correction was used to determine the effect of exercise intensity on HR, RPE, and VAS ratings. **RESULTS:** Exercise intensity had a significant effect on HR (L: 63 ± 6 , M: 75 ± 6 , and H: 82 ± 6 % HR_{max}), RPE (L: 9 ± 1 , M: 12 ± 1 , 14 ± 1), muscle fatigue (L: 18 ± 3 , M: 41 ± 5 , H: 62 ± 4), tiredness (L: 10 ± 4 , M: 34 ± 6 , H: 67 ± 4), effort (L: 21 ± 3 , M: 46 ± 3 , H: 72 ± 4), and physical demand (L: 21 ± 4 , M: 44 ± 4 , H: 67 ± 5), where $L < M < H$ (all p values were < 0.01). **CONCLUSION:** Our lab-based, basketball-simulated protocol achieved 3 distinct progressive levels of intensity, based on HR, RPE, and ratings of muscle fatigue, tiredness, effort and physical demand. The HR and RPE observed during H were similar to that reported during live basketball scrimmages/games (~80-

90% and ~14, respectively). Further research is needed to determine the ecological validity and repeatability of our basketball protocol and whether these measures could be used in a predictive model for the assessment of on-court training intensity.

- 3294 Board #359 June 3, 3:30 PM - 5:00 PM
Core Neuromuscular Training; a Physical Activity Intervention for Individuals with Patellofemoral Pain Syndrome
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Patellofemoral Pain Syndrome (PFPS) is a common musculoskeletal disorder affecting a large population of clinical patients, with a higher prevalence among women. Patellar maltracking may lead to inappropriate timing of quadriceps muscle activity. In addition, core neuromuscular control especially hip muscles appears to be impaired in patients with PFPS, which may decrease neuromuscular system efficiency and dynamic stability.

Purpose: To determine the effects of core neuromuscular training on pain, balance and performance in women with patellofemoral pain syndrome (PFPS).

Method: This parallel, single-blinded randomized clinical trial (RCT) was designed to compare the effects of different treatment protocols on balance, function and pain in patients with PFPS. A convenience sample consisting 28 women with unilateral PFPS participated in this trial. Pain intensity, functional ability, functional performance and balance were evaluated before and after the intervention with a VAS, Kujala questionnaire, step-down test and Y balance test.

All participants were assigned randomly to the intervention and control group. Control group's intervention was merely focused on lower extremity strengthening exercises, while interventional group received core neuromuscular training in addition to control group exercises. All data were analyzed with SPSS software (version 16), and the alpha level was set as 0.05. Wilcoxon signed rank and Mann-Whitney tests were used respectively for within-group and between-group comparisons.

Results: In both groups the pain score decreased significantly after treatment ($P=0.001$). The slope of this trend was greater in the intervention group. The Kujala and step-down scores improved significantly after treatment in both groups, although the improvements were greater in the intervention group. The Y balance score improved in all three directions after therapy in both groups; improvement was greater in the intervention group only in the posteromedial direction ($P<0.05$). **Conclusion:** Core neuromuscular training exercises may be beneficial in improving pain, function and balance in women with PFPS. Because of the importance of core muscles in the control of loads imposed on the lower extremities, core training may be essential for rehabilitation in these patients.

F-60 Thematic Poster - EMG

Friday, June 3, 2016, 3:15 PM - 5:15 PM
Room: 104

- 3358 **Chair: Roger Enoka. University of Colorado, Boulder, CO.**
 (No relationships reported)

- 3359 Board #1 June 3, 3:15 PM - 5:15 PM
Examination Of The Corollary Discharge Mechanism Using Electromyographic Signals From The First Dorsal Interosseous Muscle
 Nathan Wages, Travis Beck, Xin Ye, Joshua Carr. *University of Oklahoma, Norman, OK.*
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 (No relationships reported)

ABSTRACT: Perception is the conscious recognition of internal/external sensory stimuli and is not only dependent upon the evaluation of sensory stimuli, but also on the interpretation of those same stimuli. This means that our sensory system not only responds to stimuli from the internal/external environment, but also to cues generated by our own mental states during which receives this sensory input.

PURPOSE: The purpose of the present investigation was to examine, using surface electromyography (sEMG), whether the corollary discharge mechanism is dependent primarily on visual stimuli, auditory stimuli or tactile stimuli.

METHODS: Ten healthy, college-aged men and women (5 males and 5 females; mean \pm SD age = 27.8 ± 2.66 years; height = 172.1 ± 8.16 cm; weight = 72.05 ± 17.92 kg; BMI = 24.06 ± 4.41 kg/m²; FDI skinfold thickness = 3 ± 0.71 mm) were measured (using sEMG amplitude) during one bout of pinching exercises. During this visit,

subjects were asked to perform a maximum voluntary contraction (MVC) for the first dorsal interosseous (FDI) muscle. Following this MVC, the subjects were asked to pinch (using only thumb and index finger) a predetermined randomized dumbbell weight sequence (between 1-5 lbs) using a predetermined randomized sensory stimuli sequence (visual, auditory or tactile) and in a randomized hand order (dominant or non-dominant).

RESULTS: The results indicated (from 1lb to 5 lb dumbbells) that there was a significant decrease in sEMG amplitude of 15.9uV, 13.8uV, 14.3uV, 14.0uV, and 25.3uV, from the visual cue to the auditory cue; a significant decrease of 12.8uV, 10.6uV, 8.57uV, 9.4uV, and 20.6uV, from the visual cue to the tactile cue; and a significant increase of 3.13uV, 3.22uV, 5.747uV, 4.65uV, and 4.73uV, from the auditory cue to the tactile cue, respectively.

CONCLUSIONS: The sEMG amplitude responses from the FDI muscles appeared to support the role of corollary discharge as being primary dependent on auditory cues, followed by tactile cues, and finally visual cues (when performing the appropriate force output for pinching a particular weight). Furthermore, when compared to the dominant FDI muscle, the non-dominant FDI muscle appeared to have significantly lower fine-tuned motor control strategies (during all pinching measurements, as well as across all sensory stimuli).

3360 Board #2 June 3, 3:15 PM - 5:15 PM
Fatiguing a Single Limb leads to Bilateral Changes in Postural Tremor and Forearm Muscle Activity

Steven Morrison¹, Karl M. Newell², Justin Kavanagh³. ¹Old Dominion University, Norfolk, VA. ²University of Georgia, Athens, GA. ³Griffith University, Gold Coast, Australia.
(No relationships reported)

For healthy adults, the physiological tremor within a single limb segment is uncorrelated to that in the contralateral limb. However, it has been suggested that some bilateral relation for tremor does exist, but that this would only emerge under conditions where the neuromuscular system is perturbed such as during unilateral fatigue.

PURPOSE: To assess the effect of externally loading the index finger on bilateral tremor dynamics and forearm muscle activity.

METHODS: Eighteen young adults participated in the study (mean age 22.4±4.2 yrs.). For all tasks, bilateral hand and finger tremor and forearm surface EMG activity (extensor digitorum) were collected. Subjects were seated with both forearms resting on a flat surface and their hands and index fingers extended (unsupported). Three 30 s trials were collected under this condition. For the fatigue conditions, a 400 gram weight was suspended from the index finger of one limb. Subjects were required to hold both fingers in an extended (horizontal) position with the weight attached for two, 2-min trials (rests were given between trials). The fatigue protocol was then repeated for the opposite limb.

RESULTS: As expected, fatiguing a single limb led to significant increases in tremor amplitude (pre-fatigue: 0.18±0.04 ms⁻²; post: 0.37±0.08 ms⁻², p<0.02), extensor muscle activity (pre: 0.11±0.04 mV; Post: 0.24±0.06 mV, p<0.05). In addition, fatiguing a single limb led to changes in the contralateral (un-weighted) limb, significant increases in the amount of muscle activity (pre: 0.10±0.03 mV; Post: 0.17±0.03 mV, p<0.05) and the amplitude of finger tremor (pre: 0.16±0.05 ms⁻²; post: 0.27±0.04 ms⁻², p<0.05). However, these contralateral effects were observed even though there was no evidence of inter-limb coupling of tremor (r²=0.08-0.18, p=0.64).

CONCLUSION: Overall, the results demonstrated that the effects of fatiguing a single, distal limb segment are not restricted to that effector unit. Loading the index finger of one limb led to bilateral increases in both tremor amplitude and related forearm muscle activity. However, these changes were present even though there was no evidence of any tremor coupling between limbs. The findings illustrate that these bilateral effects may be mediated by an overflow effect caused by increased neural drive to the exercising limb.

3361 Board #3 June 3, 3:15 PM - 5:15 PM
Comparative Analysis of Hip Muscle Activation During Common Load Bearing Rehabilitation Exercises

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(No relationships reported)

Poor pelvic control during the loading portion of the running cycle has been linked with lower extremity injury risk. Specifically, increased hip adduction and internal rotation can increase stress at the patellofemoral joint and strain within the iliotibial band. Both the gluteus maximus (GMA) and gluteus medius (GME) eccentrically control these motions during stance. Common rehabilitation protocols include non-load bearing hip external rotation exercises, however, it is unknown as to which load bearing exercises elicit the strongest GMA and GME activations. **PURPOSE:** The purpose of this study was to investigate the relationship between GMA and GME surface electromyography (sEMG) amplitude during running and the following three

load bearing exercises: resisted hip external rotation in two-footed stance (BER), single leg squat with ipsilateral trunk rotation (SLS), and forward lunge with resisted abduction (FL). **METHODS:** Twenty-two runners (14M; 21.6 ± 2.3 yrs; 60.7 ± 7.1 kg) granted informed consent and participated. Four surface electrodes were placed bilaterally on the GMA and GME, and sEMG was full-wave rectified and smoothed with a 50 ms window. All subjects ran on a treadmill for 5-min at a self-selected moderate intensity while sEMG was collected at 1500 Hz for 30 seconds. Using a counter-balanced design, subjects completed three repetitions each of the BER, SLS, and FL with 2-min rest period between each exercise. All sEMG data was normalized to the maximum amplitude recorded during running (MRC). A multivariate ANOVA was utilized to compare peak, normalized GMA and GME amplitudes. Significance level was set a priori at p<0.05. Statistics were processed with SPSS software. **RESULTS:** Both GMA and GME were significantly affected by exercise (F(5,14)=2.67, 7.20; p<0.01). Maximum GMA and GME amplitudes were recorded during the FL concentric phase respectively (61.5±59.1%, 55.1±36.4% MRC). Post-hoc pairwise comparisons revealed that: (1) GMA amplitudes during the FL were only significantly greater than the in-phase of the BER (p=0.03), (2) GME amplitudes were significantly greater during the FL than both BER (p<0.01) and SLS (p=0.03). **CONCLUSION:** The forward lunge with resisted abduction elicits the greatest GME activity, however, it is substantial less than its activity during running.

3362 Board #4 June 3, 3:15 PM - 5:15 PM
Comparisons Of Contraction Intensity On Temporal Changes In Surface-electromyography Frequency Domains During Isometric Knee Extensions

David R. Haley¹, Melissa K. Roti, FACSM², Jacob E. Earp¹.
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(No relationships reported)

Discrete wavelet transform (DWT) of collected electromyography (EMG) signals provides time-frequency resolution of those signals. Saturation of the measured frequency domains has been linked to motor unit conduction velocity and can provide information of the motor units activated. **PURPOSE:** To compare EMG frequency domain saturation during isometric contractions performed with 50%, 75% and 100% peak torque and to determine how frequency domains change when these contractions are performed to volitional failure. **METHODS:** Seven subjects had their peak torque determined during a maximal voluntary isometric knee extension (MVIC). On a subsequent day subjects performed isometric knee extensions during which they were required to maintain 50%, 75% or 100% MVIC for as long as possible during which vastus lateralis activity was measured using EMG. Subjects were given visual and auditory feedback of their torque and each contraction was maintained until their torque dropped below 5%. During the 100% condition the contraction was held for at least 10 s even if torque dropped below this value. Four second EMG windows were extracted from the first and last 5 s of the contraction and went through DWT analysis. Signal saturation was determined in 6 frequency domains labeled Bands 2-7 (Band 2, 125-250 Hz; Band 3, 63-125 Hz; Band 4, 31-63 Hz; Band 5, 16-31 Hz; Band 6, 8-16 Hz; Band 7, 4-8 Hz). Differences between intensities and contraction duration were determined using 2-way repeated measures ANOVA with Bonferroni post-hoc. **RESULTS:** During the initial contraction band saturation was greater in bands 2-5 and 7 in 100% than 50%. Over time band saturation increased in all domains with significant increases in bands 3-7 with 50% MVIC, bands 3-7 at 75% MVIC, and only band 5 at 100% MVIC. No significant differences were observed in the final time point. **CONCLUSIONS:** While the maximal contraction showed greater overall activation at the onset of the motion, the sustained contractions did show greater relative activation in all but the highest frequency domains when their contractions were performed to failure. These results support the notion that higher frequency domain motor units will become more active during sustained low intensity contractions.

3363 Board #5 June 3, 3:15 PM - 5:15 PM
The Relationship Between Rate of Force Development and Surface EMG Measures in Tibialis Anterior

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(No relationships reported)

Early electrophysiology studies showed that a motor neuron exhibits a bilinear firing rate response to injected current. **PURPOSE:** To determine if measures from surface electromyography (sEMG) reveal a similar bilinear pattern at increasing RFDs, and if so, what EMG parameter best describes such behavior. **METHODS:** 9 females and 3 males (20.7 ± 2.6 yrs) performed three maximal voluntary contractions (MVC) in isometric dorsiflexion. They then performed isometric force matching tasks to 40%MVC with varying RFDs (10%MVC/s, 20%MVC/s, 40%MVC/s, 80%MVC/s, and most-rapid force pulses). EMG measures from tibialis anterior were EMGmax, maximum rate of EMG rise (RERmax), area under the rectified EMG burst from

baseline to peak force, and RMS amplitude of the EMG burst in the first 10, 20, 30 and 50 ms of the contraction. **RESULTS:** Plots with EMG measures regressed against mean or peak RFD revealed the strongest evidence of a bilinear fit for RER and RMS-50ms. Each plot contained an approximate breakpoint at RFD = 150 %MVC/s. For each pair of variables, linear regressions were applied to data both below and above the breakpoint to compare the resulting primary range and secondary range slopes. Secondary range slopes were consistently greater than primary range slopes for these variables (*=slope >0).

IV	DV	< 150 %MVC/s		> 150 %MVC/s	
		Slope	R-square	Slope	R-square
RFD max	RERmax	.56	.01	1.86*	.29
RFD mean	RERmax	1.24*	.05	3.13*	.32
RFD max	RMS-50ms	.074*	.10	.096*	.34
RFD mean	RMS-50ms	.095*	.24	.156*	.32

CONCLUSION: Even though surface EMG represents more than rate coding, these results are consistent with the bilinear relationship between input to the neuron and firing rate. If increased secondary range behavior is sought through training or rehabilitation, these measures may provide indirect estimates of such change. Motor unit recordings are necessary to confirm the underlying firing behavior.

3364 Board #6 June 3, 3:15 PM - 5:15 PM
Regional Activation within the Vastus Medialis in Dynamic Contractions: an Investigation Using High-density Surface Electromyography
 Alessio Gallina, Tanya D. Ivanova, S Jayne Garland. *University of British Columbia, Vancouver, BC, Canada.*
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 (No relationships reported)

PURPOSE: Regions within the vastus medialis (VM) are known to preferentially produce knee extension force and patellar stabilization. In dynamic tasks, the central nervous system may recruit different VM regions preferentially to cope with changes in mechanical demand resulting from knee movement. The purpose of this study was to determine the effect of knee angle during the concentric and eccentric phases of dynamic movement on the regional activation within the VM.

METHODS: Ten healthy women performed two tasks: A) 10 knee flexion-extension open-kinetic chain (OKC) movements between 90 and 10 degrees of knee flexion against an isotonic resistance (10% isometric maximal voluntary contraction); B) 5 closed-kinetic chain (CKC) single-leg squats. Each of the concentric and the eccentric phases of both tasks were performed in 3s. A high-density surface electromyography grid (13x5 electrodes spaced 8 mm apart) was placed across the VM. For each task, the knee angle excursion was segmented in intervals of 10 degrees, and an amplitude distribution was calculated using the average rectified value (ARV) for each channel of the grid. The location of the most active region within the VM was calculated as the barycenter of the three electrodes with the largest ARV. Two-way ANOVAs with repeated measures were used to test the effect of knee angle and phase of the movement on the location of the barycenter, separately for the two tasks.

RESULTS: In the OKC task, the barycenter was more distal at more flexed knee positions ($P < 0.05$; total shift: 7 ± 17 mm) and more so in the eccentric than the concentric phase ($P < 0.05$; 9 ± 17 mm). Similarly, the barycenter was more distal at more flexed knee positions in the CKC task ($P < 0.01$; total shift: 21 ± 18 mm) and in the eccentric phase but only between 30 and 10 degrees ($P < 0.01$; 13 ± 16 mm).

CONCLUSIONS: This study reveals differences in regional activation within the VM during dynamic contractions. Although large variability was observed across participants, preferential activation of the proximal VM was observed in both tasks at more extended knee positions and in the concentric phase. As regional activation may result in a different contribution of the VM as a patellar stabilizer, these findings may have implications for therapeutic exercise and for the study of mechanisms of patellofemoral pain syndrome.

3365 Board #7 June 3, 3:15 PM - 5:15 PM
Greater Intensity Of Downslope Walking Exercise Increases Walking EMG Activity And H-reflex Depression
 Taylor Rigel, Benjamin Farmer, Dustin Lee, Melissa Keightley, Elizabeth Arnold, Maruf Hoque, Manning Sabatier. *Emory University, Atlanta, GA.* (Sponsor: Kevin McCully, FACSM)
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 (No relationships reported)

We recently found that 20 minutes of downslope walking (DSW) at a -15 percent (perc) slope causes soleus (Sol) H-reflex depression. It is not known if this effect is augmented with a steeper decline, or if characteristics of DSW EMG activity can predict H-reflex depression after DSW. **PURPOSE:** To test the hypotheses that 1) H-reflex depression is increased with -25 vs -15 perc slope, and 2) increased

muscle co-contraction correlates with increased Sol H-reflex depression after DSW. **METHODS:** Sol H-reflex and M-response recruitment curves were collected in twelve healthy adults while seated, before and after DSW on a treadmill (2.5 mph for 20 minutes) at -15 and -25 perc on two separate visits. The maximum H-reflex (Hmax) was expressed as a ratio with the maximum M-response (Mmax). Sol and tibialis anterior (TA) EMG activity was measured during DSW and 1) average burst amplitudes and 2) Sol-TA co-activation across the step cycle were computed. **RESULTS:** Although Sol Hmax/Mmax ratios were decreased after DSW at both slopes (-25 perc, 0.65 ± 0.14 vs 0.38 ± 0.02 , $p < 0.001$; -15 perc, 0.62 ± 0.12 vs 0.42 ± 0.12 , $p < 0.001$), there was 34 perc more depression after -25 perc slope compared to -15 perc slope (-41.5 ± 2.0 vs -31.1 ± 13.2 perc change, $p = 0.01$). Sol and TA EMG burst amplitude was increased at -25 versus -15 perc DSW (Sol, 20.4 ± 8.6 perc increase, $p = 0.01$; TA, 18.2 ± 9.5 perc increase, $p = 0.01$), and Sol-TA co-activation was increased (10.5 ± 3.2 vs 6.2 ± 1.6 perc of the step cycle, $p = 0.01$). More perc change in Hmax/Mmax was correlated with more Sol-TA co-activation ($r = -0.57$, $p = 0.04$). **CONCLUSION:** Steeper DSW results in more H-reflex depression, supporting the idea that there is a dose-response relationship for DSW and H-reflex depression. Previous studies have found that physical activity involving Sol-TA co-activation results in increased presynaptic inhibition and depressed H-reflexes. Since the current study found that steeper DSW results in more Sol-TA co-activation during walking, H-reflex depression resulting from DSW is likely at least in part driven by neural factors associated with Sol-TA co-activation occurring during DSW.

3366 Board #8 June 3, 3:15 PM - 5:15 PM
Lower Extremity Kinematic and EMG Activity Changes With Fatigue During An Agility Test.
 Ernest Eusebio, Christopher Rago, Thomas Martin, Karen Myrick, David Wallace, Richard Feinn, Ryan Spencer, Juan C. Garbalosa. *Quinnipiac University, Hamden, CT.*
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 (No relationships reported)

PURPOSE: To determine the effect of fatigue on the knee muscle activity and lower extremity kinematics during an agility test.

METHODS: The displacements of markers located over specific lower extremity bony landmarks were recorded concurrently with EMG activity of the vastus medialis and lateralis, rectus femoris, semitendinosus and biceps femoris and using surface electrodes (at 240 and 2400 Hz, respectively) in 29 DI soccer players (16 female, 19.7 ± 1.1 yrs and 13 male, 19.7 ± 1.1 yrs), during an agility test. Subjects completed 4 trials of the test, alternating sides. Rest between trials ensured non-fatigue.

Subjects then ran trials starting every 30s, alternating sides, until a 5% decrement in performance from their non-fatigue times occurred on 2 successive runs. Two trials from each side were then run and recorded as the fatigue trials. For each muscle, the EMG data were filtered, the root mean square (RMS) obtained and normalized to the peak RMS value of a maximal voluntary contraction. The average normalized EMG from 67 ms pre- to 33 ms post-heel strike was obtained and the quadriceps to hamstrings (Q/H) ratio calculated along with the hip and knee joint angular positions at 33 ms post heel strike. The Q/H ratios and joint angles were grouped according to gender and fatigue status. Linear mixed models, with trial period as a repeated factor, were used to test for differences in EMG activity between gender and fatigue status.

RESULTS: Both females ($40.9^\circ \pm 2.4^\circ$ and $36.0^\circ \pm 2.4^\circ$) and males ($44.3^\circ \pm 2.6^\circ$ and $34.0^\circ \pm 2.6^\circ$) were in a significantly more extended hip position when fatigued. At the knee, fatigued athletes were significantly ($p < 0.05$) less abducted ($1.7^\circ \pm 0.8^\circ$ abducted versus $0.5^\circ \pm 0.8^\circ$ adducted) and extended ($43.0^\circ \pm 1.2^\circ$ versus $35.0^\circ \pm 1.2^\circ$) than non-fatigued athletes. Regardless of fatigue females had a significantly ($p < .05$) greater Q/H ratio than males and in females this ratio significantly ($p < .05$) increased with fatigue (1.6 ± 0.1 and 1.8 ± 0.1), but did not change in males (0.9 ± 0.1 and 0.8 ± 0.1).

CONCLUSIONS: Females regardless of activity status appear to be in more at-risk postures and exhibit greater Q/H ratios.

F-61 Thematic Poster - Energy Balance and Weight Control

Friday, June 3, 2016, 3:15 PM - 5:15 PM

Room: 110

3367 Chair: Melinda Manore, FACSM. *Oregon State University, Corvallis, OR.**(No relationships reported)***3368 Board #1 June 3, 3:15 PM - 5:15 PM**
Changes In Spontaneous Physical Activity During Supplemental Feeding And Exercise Training In Overweight /Obese MalesWesley J. Tucker, Catherine L. Jarrett, Andrew C. D'Lugos, Siddhartha S. Angadi, Jared M. Dickinson, Glenn A. Gaesser, FACSM. *Arizona State University, Phoenix, AZ.* (Sponsor: Glenn Gaesser, FACSM)

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*(No relationships reported)***PURPOSE:** It is unclear whether spontaneous physical activity (PA) changes during periods of excess caloric intake with or without supervised exercise training. We hypothesized that spontaneous PA would not change significantly during four weeks of supplemental feeding and exercise training.**METHODS:** 13 overweight/obese males (mean age: 27.9 ± 8.4 y, BMI: 30.0 ± 3.5 kg/m²) underwent 4 weeks of supplemental feeding (+14,595 ± 229 kcal), in the form of 12 donuts per week added to their regular diet. In addition, participants were randomized to one of three conditions: 1,000 kcal supervised moderate-intensity (MOD) continuous cycling (50% VO₂ peak) (n=4), 1,000 kcal supervised high-intensity interval (HIE) cycling (90-95% maximum heart rate) (n=6), or sedentary control (CON) (n=3). All participants wore a validated PA monitor for a 7-day period at baseline and during the 4th week of the intervention to assess changes in daily physical activity energy expenditure (PAEE), steps per day, and moderate-intensity (MOD) PA minutes. A two-way repeated measures ANOVA (Condition x Time) was used to determine differences between PAEE, steps per day and MOD PA min by condition over time during the intervention.**RESULTS:** There were no significant time (p=0.64), condition (p=0.50) or condition x time interaction effects (p=0.39) for PAEE in the MOD (Pre: 816 ± 450 kcal, Post: 915 ± 409 kcal), HIE (Pre: 602 ± 188 kcal, Post: 561 ± 185 kcal) or CON groups (Pre: 761 ± 676 kcal, Post: 610 ± 496 kcal). Similarly, there were no significant time (p=0.91), condition (p=0.45) or condition x time interaction effects (p=0.57) for steps per day in the MOD (Pre: 7545 ± 3079 steps, Post: 8412 ± 3307 steps), HIE (Pre: 6393 ± 2739 steps, Post: 5802 ± 8412 steps) or CON groups (Pre: 6128 ± 323 steps, Post: 5802 ± 2525 steps). We observed no significant time (p=0.72), condition (p=0.45) or condition x time interaction effects (p=0.30) for MOD PA min.**CONCLUSIONS:** Spontaneous physical activity does not change during a 4 week period of supplemental feeding with or without supervised moderate-intensity or high-intensity interval training in overweight/obese males.**3369 Board #2 June 3, 3:15 PM - 5:15 PM**
High-Intensity Interval Training with Energy Restriction Preserves Lean Tissue and Improves Glucose Tolerance in ObesityRachel A. Harley, Jacob E. Halbrooks, Timothy R. Nagy, Gordon Fisher, Gary R. Hunter, FACSM, Eric P. Plaisance. *University of Alabama at Birmingham, Birmingham, AL.*

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*(No relationships reported)*Energy restriction (ER) reduces body weight (BW) and adiposity, but is often less than expected due to hypometabolism produced by reductions in lean body mass (LBM). A comparable energy deficit created by combining ER and exercise energy expenditure (EE) has been shown to attenuate the reduction in EE produced by ER. Continuous moderate-intensity training (MIT) is commonly used to sustain energy balance or expedite weight loss, but high-intensity interval training (HIIT) may produce greater results. **PURPOSE:** The purpose of this investigation was to determine if HIIT preserves LBM and improves energy metabolism to a greater extent than MIT in the presence of ER. **METHODS:** Thirty-two 5-wk old male C57BL/6J mice were placed on a 45% kcal high-fat diet (HFD) for 11 weeks (*ad libitum*). Mice were then randomized to 4 groups for 14 weeks: 1) HFD (n = 8; remain on HFD); 2) HFD with 25% ER (n = 8); 3) HFD with 25% energy deficit induced by 12.5% ER and 12.5% EE through HIIT (n = 8); and 4) HFD with 12.5% energy deficit induced by 12.5% ER and 12.5% EE through MIT. HIIT consisted of 9-12 intervals of 2.5-minutes of treadmill running at 0.18-0.30 m/s with 1 minute of passive recovery between intervals. MIT consisted of 35-50 minutes of continuous treadmill running at 0.13-0.21m/s. Body composition was assessed by Quantitative Magnetic Resonance (QMR) and resting energy expenditure (REE) by indirect calorimetry. Glucose tolerance tests were performed on all groups at 1.0 g/kg BW (i.p.), while insulin tolerance tests were performed at 0.75 mU/g BW (i.p.). **RESULTS:** HFD increased BW from 20.2±0.2 to 38.8±0.8 g (92.3% increase in BW). REE was 11.2% lower in the ER group compared to Control (73.0±1.7 to 64.8±1.6 kJ/hr LBM, p<0.05). HIIT, but not MIT, preserved LBM and rescued ER-mediated reductions in REE. The increase in LBM was associated with improvements in glucose tolerance and insulin sensitivity. **CONCLUSION:** Twenty-five percent ER produced reductions in LBM and REE, whereas HIIT preserved LBM, increased REE and improved glucose tolerance and insulin sensitivity. These results suggest that HIIT may produce a hypermetabolic state in the presence of ER, which could lead to long-term success in weight loss interventions.

Supported by UAB Department of Human Studies Pilot Award.

3370 Board #3 June 3, 3:15 PM - 5:15 PM
Influence of Physical Fitness Levels in Circulating IrisinAmy Hurtado¹, Maria Fernandez del-Valle¹, Shelby Kloiber¹, Matthew Short¹, Eunhee Chung¹, Eneko Larumbe-Zabala², Jacalyn J. McComb, FACSM¹. ¹Texas Tech University, Lubbock, TX. ²Texas Tech University Health Sciences Center, Lubbock, TX. Email: amy.hurtado@ttu.edu*(No relationships reported)*Obesity has a large economic cost on the nation. As of 2008, the annual medical cost of obesity was \$3.38 billion. The protein hormone irisin has been shown to increase the mitochondrial density of adipose tissue, a process known as browning. As irisin was found to improve metabolism, it is thought that it may help prevent and/or treat overweight, obesity, and other conditions associated with obesity. **PURPOSE:** To investigate the association of physical fitness (PF) levels with circulatory levels of irisin in both healthy males and females. **METHODS:** Our sample was comprised of a total of 32 unpaid male and female volunteers with 21.3 ± 2.2 years, 65.2 ± 8.8 kg of body weight (BW), 22.2 ± 1.99 kg/m² body mass index (BMI). The subjects were taken through a series of tests: a cardiopulmonary maximal fitness test on a treadmill, a one repetition maximum (1RM) strength test, and dual-energy x-ray absorptiometry (DXA) to assess their PF levels. To study the irisin levels, blood was taken from the subject via venous puncture. **RESULTS:** We found large correlations between irisin levels and maximal oxygen uptake (VO₂max) (r = -0.59, p=0.025) and lean body mass (LBM) (r = -0.41, p=0.140) in males (n=14). However, we did not obtain the same results in females. In addition, percentage of body fat was not correlated with irisin (r=0.04 and r = -0.04 in male and female, respectively). **CONCLUSION:** Irisin levels in males seem to be positively associated to increased fat content, negatively associated to increased PF (VO₂max and LBM), and these results were different for females. Therefore, the secretion mechanisms of this hormone should be studied on a greater sample size, with more varied body composition profiles (health vs. unhealthy), and, contrary to prior studies, taking into account sex differences.**3371 Board #4 June 3, 3:15 PM - 5:15 PM**
Comparing Autophagy Regulation After Weight Loss Interventions In Non-alcoholic Fatty Liver DiseaseMegan E. Rosa¹, Matthew R. Harris², David E. Lee¹, Jacob L. Brown¹, Kaylee E. Poole², Andrew Seija², Lemuel A. Brown¹, Richard A. Rerry, Jr.¹, Tyrone A. Washington¹, Joshua S. Wooten², Nicholas P. Greene¹. ¹University of Arkansas, Fayetteville, AR. ²Southern Illinois University-Edwardsville, Edwardsville, IL. (Sponsor: Stephen F Crouse, FACSM)

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*(No relationships reported)*Along with the rise in obesity, rates of non-alcoholic fatty liver disease (NAFLD) have also increased. NAFLD may begin with fat accumulation in the liver, but can progress to non-alcoholic steatohepatitis (NASH), fibrosis, and eventual cirrhosis. With no pharmacological treatment for NASH, lifestyle interventions appear vital to maintaining liver health. Previous work has shown aberrant mitochondrial content/quality and autophagy in models of NAFLD. Exercise is known to increase basal autophagy in muscle as well as mitochondrial health, thus autophagy may be a key regulatory factor for treatment of obesity induced-NAFLD. **PURPOSE:** The purpose of the study was to examine how weight loss from diet or diet combined with physical activity impacts hepatic mitochondrial content, autophagy and mitochondrial autophagy (mitophagy) markers in a murine model of NAFLD. **METHODS:** 48 Male C57BL/6J mice were divided into 1 of 4 groups: low fat diet (LFD, 10% fat, 18 wks), high fat diet (HFD, 60% fat diet, 18 wks.), weight loss by diet (D, 60% fat diet for 10 wks then 10% fat diet for 8 wks) or weight loss by diet and physical activity (D/PA, 60% fat diet for 10 wks, then 10% fat diet plus a running wheel for 8 wks). After interventions, livers markers for mitochondrial quality control (COX-IV, PGC-1α, and BNP3) and autophagy (p62) were analyzed via Western blot. Data were assessed

by one-way analysis of variance (ANOVA) with α set at 0.05. **RESULTS:** COX-IV protein content (marker for mitochondrial content) was approximately 50% lower in HFD compared to LFD, and was restored to LFD levels with D/PA. PGC-1 α (regulator of mitochondrial biogenesis) content was 45% lower in HFD mice; D restored PGC-1 α content, whereas D/PA resulted in ~50% greater PGC-1 α content than LFD. BNIP3 (mitophagy) content was 40% lower in HFD compared to LFD; D/PA had 50% more BNIP3 compared to LFD controls. p62 (marker of autophagic flux) protein content was 2.5 fold higher in HFD animals compared to LFD, D, and D/PA. **CONCLUSION:** Prolonged high-fat diet causes disruptions in mitochondrial content, mitophagy, and macroautophagy. While weight loss through diet may ameliorate some of these disruptions, combined diet and physical activity can restore mitochondrial content, mitophagy and macroautophagy derangements.

3372 Board #5 June 3, 3:15 PM - 5:15 PM

Effect of Acute High Intensity Interval Exercise on Plasma Acylated Ghrelin Concentrations

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(No relationships reported)

Ghrelin is a gastric hormone that plays a role in stimulating hunger and fat accumulation because the hyperinsulinemia associated with obesity fails to suppress ghrelin. High intensity exercise has been shown to acutely decrease plasma acylated ghrelin concentrations in normal weight individuals. However, the evidence for how exercise affects ghrelin in obese individuals is lacking.

PURPOSE: To compare the effects of high intensity interval exercise on acute plasma acylated ghrelin levels in an obese and non-obese male population.

METHODS: Eighteen subjects with a mean age of 29.8 yr. (\pm 7.6), including 9 non-obese men (BF% mean = 13.7 \pm 3.6) and nine obese men (BF% mean = 31.7 \pm 4.7) participated in this study. Using a crossover design, participants were randomly assigned to an exercise or control condition, with each subject acting as their own control. The exercise trial consisted of participants cycling in high intensity intervals for 20 minutes (not including warmup and cool down) at a rate of 60% to 85% of their heart rate reserve on a cycle ergometer followed by sixty minutes of rest. The control trial consisted of ninety minutes of rest. Blood samples (3-4ml) were collected at baseline, 0.5, 1, and 1.5 hours post-intervention. Acylated ghrelin concentrations were determined from plasma. Hunger was assessed while blood samples were being drawn using a 10-point Likert-type scale. Group means for plasma ghrelin concentrations between groups were analyzed using an independent t-test. The effect of exercise on ghrelin was analyzed using paired t-test and the relationship between perceived hunger and ghrelin were determined using Pearson correlations.

RESULTS: Baseline plasma ghrelin levels were significantly higher in the non-obese group ($t = 3.43$, $p = .036$) when compared to the obese group. Exercise was effective in reducing plasma acylated ghrelin levels in the non-obese group ($t = 2.34$, $p = .047$), however no significant changes were found in the obese group.

CONCLUSIONS: The low resting levels of plasma ghrelin concentrations exhibited by the obese population when compared to non-obese subjects may lead to long fasting periods. Furthermore, the lack of reduction in ghrelin following exercise may cause an overconsumption of energy. Both of these occurrences may result in increased fat storage in obese populations.

3373 Board #6 June 3, 3:15 PM - 5:15 PM

Variation in Individual Responses to Time-Restricted Feeding and Resistance Training

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Time-restricted feeding (TRF) is a form of intermittent fasting which limits all caloric intake to a certain period of time each day in an attempt to reduce daily energy intake, promote weight loss, and improve health. Resistance training (RT) has been reported to increase muscular strength and improve body composition. Very limited information is available on the combination of TRF and RT.

PURPOSE: To examine the variation in individual body composition, dietary intake, and muscular performance responses to an 8-wk TRF and RT program.

METHODS: Healthy males ($n = 20$; age = 22 \pm 3 y; BMI = 27 \pm 6 kg/m²; % fat = 22 \pm 6 % wt) were randomized to TRF + RT or RT alone for 8 wks. RT was performed 3 d/week and consisted of alternate workouts of upper and lower body using a resistance progression scheme. TRF limited energy intake to a 4-hr period on the 4 d/week when RT was not performed. Energy intake was not restricted in either group, and eating times were not specified in the RT alone group. Body composition, muscular

performance, and dietary records were assessed at 0, 4, and 8 wks. Inter- and intra-individual variations in outcome measures were estimated by hierarchical linear growth modeling. The amount of variability attributable to characteristics between or within participants was evaluated from variance estimates.

RESULTS: For TRF + RT, percent changes ranged from -5.5 to +2.6% for body weight, -22.1 to +9.4% fat mass, -7.7 to +4.6% for lean body mass, +3.4 to +30.4% for bench press 1-RM, and +10.1 to +67.6% for leg press 1-RM. For RT alone, percent changes ranged from -6.6 to +2.1% for body weight, -14.4 to +12.6% for fat mass, -4.1 to +3.9% for lean body mass, +4.9 to +12.9% for bench press 1-RM, and +14.3 to +37.7% for leg press 1-RM. Percentages of total variability attributed to inter-individual factors ranged from 3.3 to 49.2% for dietary measures, 59.0 to 93.9% for muscular performance, and 97.0 to 99.6% for body composition. Remaining variability was attributed to intra-individual factors.

CONCLUSION: Individual responses to the study interventions varied widely. Differences between individuals were an important source of variability, indicating participant samples should be homogenous and/or quite large to examine changes in body composition or muscular performance using nutrition and exercise interventions.

3374 Board #7 June 3, 3:15 PM - 5:15 PM

Exercise and Caloric Dilution: Effect on Feed Intake and Body Weight Regulation in the Rat

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(No relationships reported)

PURPOSE: Considerable experimental data support the role exercise (E) plays in long-term regulation of body weight (BW). Overeating and sedentary lifestyle contribute as primary determinants of obesity with diet source, caloric density, palatability of diets, and a variety of endocrine, environmental, and genetics as additional determinants. The purpose of this investigation was to examine the effect of ad libitum feed intake (FI) regulation on BW in rats fed caloric dilutions of a single dietary food source during controlled forced daily exercise. **METHODS:** Eighty male Sprague-Dawley rats (150-200g) were divided into 8 weight matched groups ($n=10$). Four E and four control (C) groups on three liquid Ensure® high caloric density (H - 1.47 Kcal/ml-1), normal caloric density (N - .05 Kcal/ml-1), and a low caloric density (L - 0.63 Kcal/ml-1) diets and a control rat chow (Ch) groups. Exercise consisted of 60 min. Treadmill running at 20 m/min and 8% grade for 12 weeks. Water and diets were provided ad libitum. Feed was measured daily and weights taken weekly. **RESULTS:** Animals regulated feed intake monotonically with increasing consumption accompanying diet dilution ($P < 0.001$). All E groups showed suppressed FI when expressed as g-d-1 (76.0 \pm 0.5 vs. 67.8 \pm 0.5, $P < 0.0001$) or Kcal (632.3 \pm 5.1 vs. 573.0 \pm 5.1, $P < 0.0001$) when compared to their respective C. When feed intake was expressed as Kcal-gBW-1-d-1 There still existed a D effect ($P < 0.001$) with a significant DxE interaction ($p < 0.015$) with the E groups marginally greater (1.86 \pm 0.01 vs. 1.83 \pm 0.01, $P < 0.013$) compared to C. All E animals weighed less than their respective C with EL and CL groups lower than all the rest ($P < 0.001$). **CONCLUSION:** These data support the suppression effect of E on caloric consumption and further document that rats are able to sustain the exercise hypophagia in the face of very low caloric density diets, significant reduction in BW, and enhanced palatability of the diet.

3375 Board #8 June 3, 3:15 PM - 5:15 PM

Unforeseen Energy Balance Metabolic Efficiency Success In Overweight/obese 25 To 54 Year Old Females.

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Purpose: The objective of this study was to determine practical diet and exercise strategies for energy balance and metabolic efficiency leading to weight loss in overweight/obese 25 to 54 year old females. **Methods:** The sample included 29 overweight/obese 25 to 54 year old sedentary women (median: 42 years, 77.6 kg, 165 cm, 38.11 %BF) stratified and permuted block randomized by age and % body fat (% BF). All participants were prescribed a plant-based diet (set menu plan) with a 200 kcal deficit determined by indirect calorimetry below resting energy expenditure (REE). Following the first 2 weeks, participant's REE was re-measured to analyze diet effect on energy balance. Participants were then randomized into three different exercise intensities and effort was set by VO₂max test determined from the respiratory quotient ($RQ = CO_2/O_2$) and controlled via corresponding heart rate response. Participants exercise consisted of either low continuous walking (LCW $n=9$), moderate interval walking (MIW $n=8$) or high interval walking (HIW $n=12$) with heart rates corresponding to $RQ .75$ (83% Fat utilization), $RQ .85$ (50/50 Fat/Carb utilization), or $RQ .95$ (83% Carb utilization) respectively. Participants in the LCW group were limited to walking in their prescribed exercise intensity group. Interval training (short exercise bouts mixed with short periods of rest) was used for the MIW and HIW

groups. Results: Repeated-measures ANOVA analysis was used to assess outcome variables between the groups. There were no significant group differences in age, height, weight, % BF, REE, RQ, VO2max or fitness level. Resting REE demonstrated a significant change ($R = -0.539, p = 0.031$) in all groups due to the first 2 weeks of the plant based diet alone. Additionally, significant change was noted in all participants for % BF change ($F_{1,29} = 28.041, p = 0.000, \eta^2 = 0.651$), but no significant differences were noted between the three exercise groups. Conclusion: Plant based diet of 200 calorie deficit together with LCW, MIW or HIW exercise are equally effective for increased REE and % BF loss. However further investigation is warranted to look at additional parameters of metabolic efficiency, physical activity motivation and injury complications of the high intensity exercise group in the overweight / obese population. Funded by Grant # ARC 122751

F-62 Thematic Poster - Muscle - Fiber Type, Quality, and Function

Friday, June 3, 2016, 3:15 PM - 5:15 PM
Room: 109

3376 **Chair:** Charles L. Dumke, FACSM. *University of Montana, Missoula, MT.*

(No relationships reported)

3377 **Board #1** June 3, 3:15 PM - 5:15 PM
Localization And Quantification Of Intramuscular Damage Using Statistical Parametric Mapping And Skeletal Muscle Parcellation

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Magnetic resonance (MR) imaging is a method of choice to investigate *in vivo* the extent of muscle damage in healthy subjects or patients with neuromuscular diseases. The increase in muscle proton transverse relaxation time (T_2) has been identified as a relevant biomarker of muscle damage illustrating inflammatory/edematous processes. Although local T_2 changes have been previously assessed among and along damaged skeletal muscles, no study provided accurate information on the 3D localization and extent of intramuscular damage.

PURPOSE: To objectively and accurately localize and quantify the extent of tissues alterations within the four heads of the *quadriceps femoris* (QF) using an original and robust methodology which combines the spatial normalization of skeletal muscle MR images, the statistical parametric mapping (SPM) analysis and the use of a specific muscle parcellation.

METHODS: T_2 maps of QF muscles were characterized before, two (D2) and four (D4) days after 40 maximal isometric electrically-evoked contractions inducing muscle damage in 25 healthy young males.

RESULTS: On the basis of SPM analysis of coregistered T_2 maps, the alterations were similarly detected at D2 and D4 in the superficial and distal regions of the *vastus medialis* whereas the proportion of altered muscle was higher in deep muscle regions of the *vastus lateralis* (VL) at D4 (deep: $35 \pm 25\%$, superficial: $23 \pm 15\%$) as compared to D2 (deep: $18 \pm 13\%$, superficial: $17 \pm 13\%$).

CONCLUSIONS: This original method clearly illustrates that deep muscle areas of the VL were mainly altered likely due to potential shear stress imposed during the damaging exercise. The present methodology used for the first time on skeletal muscle would be of utmost interest to detect subtle intramuscular alterations for the diagnosis and to quantify the severity/progression of muscular diseases but also for assessing the efficacy of potential therapeutic interventions and clinical treatment strategies.

3378 **Board #2** June 3, 3:15 PM - 5:15 PM
Simvastatin Alters the RhoA Adaptation to Skeletal Muscle Stress Conditions

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(No relationships reported)

Statin lipid-lowering drugs have been shown to induce muscular stress conditions and increase the incidence of myopathy, especially in exercising individuals. RhoA, a GTPase involved in muscle repair and intracellular damage signaling, adapts both acutely (increased activation) and chronically (increased protein expression) to muscular stress conditions. Statins inhibit production of mevalonate, upstream of geranylgeranyl pyrophosphate (GGPP), which anchors newly translated RhoA to the

cell membrane. This inhibition may suppress the ability to chronically increase RhoA expression.

PURPOSE: To determine if exercise and statin treatment elicit different RhoA adaptations to muscular stress conditions.

METHODS: Mice were randomized into vehicle (Veh) control, one of three simvastatin doses (60, 200, or 400 mg · kg⁻¹), or Veh plus intense eccentric exercise (Veh+EX). After two weeks, tibialis anterior muscle was harvested and analyzed via western blot for RhoA activity (percentage activated) and total RhoA expression.

RESULTS: Both the Veh+EX and all statin groups had elevated RhoA activity ($p < 0.05$). RhoA expression increased in the Veh+EX group ($p < 0.01$), but was unchanged between Veh and statin groups. There were no significant differences between statin doses.

CONCLUSIONS: The increased RhoA activity with statin treatment and exercise shows a similar acute adaptation to stress, but the expected increase in RhoA expression was suppressed by all doses of simvastatin. This may play a role in the increased myopathy rate observed in exercising statin users. Future study should investigate if other signaling proteins modified by GGPP are also affected.

	Control (Veh)	Exercise (Veh+EX)	Statin 60 mg · kg ⁻¹	Statin 100 mg · kg ⁻¹	Statin 200 mg · kg ⁻¹
RhoA Expression (AU)	527 ± 12	801 ± 22*	470 ± 73	541 ± 15	497 ± 22
RhoA Activity (%)	14.7 ± 1.1	20.0 ± 1.2*	22.9 ± 1.7*	19.5 ± 1.6*	18.5 ± 1.5*

3379 **Board #3** June 3, 3:15 PM - 5:15 PM

Dithiothreitol Reverses Contractile Dysfunction Of Diaphragm Single Fibers Caused By Chronic Heart Failure

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(No relationships reported)

Patients with chronic heart failure (CHF) suffer from exercise intolerance and shortness of breath, which are partially caused by weakness of the main respiratory muscle - diaphragm. CHF increases oxidants in the diaphragm, and excess oxidants are known to cause sarcomeric protein dysfunction. However, there is limited understanding of molecular mechanisms of sarcomeric protein dysfunction that contributes to diaphragm weakness in CHF patients.

PURPOSE: The purpose of our study was to determine the impact of reversible thiol oxidation on diaphragm single fiber contractile dysfunction in CHF.

METHODS: We caused myocardial infarction via ligation of the left anterior descending coronary artery to induce CHF in mice, while sham animals received identical surgical procedures except ligation. We performed experiments 14-16 weeks post-surgery, and tested contractile properties of permeabilized diaphragm single fibers with or without exposure to the thiol-reducing agent dithiothreitol (DTT, 10 mM for 10min) prior to calcium activation.

RESULTS: Maximal specific force (sFo) of diaphragm fibers was decreased in CHF compared to sham (in kN·m⁻², 132.3 ± 6.5 and 96.9 ± 6.0), and sFo of fibers from CHF mice was increased by DTT treatment (126.3 ± 6.6 kN·m⁻²). The rate constant of tension redevelopment (Ktr) was slower in CHF diaphragm fibers than sham (in s⁻¹ 44.12 ± 3.9 and 31.26 ± 2.4), and DTT treatment increased Ktr (41.4 ± 1.7 s⁻¹). Calcium sensitivity was unchanged by either CHF or DTT treatment. DTT had no effect on the single fiber contractile parameters (sFo, Ktr and pCa₅₀) in sham animals.

CONCLUSIONS: Our findings suggest that reversible thiol oxidation of sarcomeric proteins is a molecular mechanism of diaphragm fiber contractile dysfunction in CHF.

3380 **Board #4** June 3, 3:15 PM - 5:15 PM

Exercise Reverses the Effects of Hyperhomocysteinemia on Adverse Vascular and Skeletal Muscle Remodeling.

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Background: Hyperhomocysteinemia (HHcy) is associated with inflammation and pathological vascular remodeling through production of reactive oxygen species (ROS) and matrix metalloproteinase-9 (MMP-9). Elevated HHcy has also been strongly associated with skeletal muscle weakness and functional impairment. HHcy induced inflammation may promote skeletal muscle fibrosis through induction of inflammatory factors and destructive macrophages. Exercise reduces homocysteine levels and could serve as a promising intervention for HHcy. **Purpose:** To investigate if HHcy causes skeletal muscle fibrosis through induction of inflammation and determine if

exercise can mitigate these effects. **Methods:** C57, CBS+/-, FVB, MMP-9 -/-, and CBS/MMP-9 double KO mouse models were used. A 6 week treadmill exercise protocol was used as intervention for HHcy. Blood pressure, arterial blood flow and plasma homocysteine levels were measured. Skeletal muscle protein expression was determined by western blot and immunohistochemistry. Skeletal muscle mRNA expression was determined via PCR and qPCR. Collagen deposition in skeletal muscle was measured using Masson's trichrome staining. **Results:** In CBS+/- mice, increased plasma HHcy levels were associated with decreased body weight (23.7 g vs 27.3 g), femoral artery perfusion (1775 vs 2055 AU), femoral artery lumen diameter (.204 mm vs .264 mm) and a 20% decline in oxidative metabolism (as determined by expression of cytochrome c oxidase). These mice displayed increased wall to lumen ratio (.45 vs .27), mean arterial blood pressure (122.0 vs 83.8 mmHg), collagen deposition (14.0% vs 2.4% in controls) and a 2-fold increase in myostatin protein expression, compared to C57 controls. CBS/MMP-9 mice did not display any of these conditions. Skeletal muscle from CBS+/- mice had elevated markers of inflammation and hypoxia including VEGF (1.32 fold), iNOS (1.44 fold), EMMPRIN (1.53 fold), MMP-9 (2 fold), and a 46% elevation of IL-1 β . In CBS +/- mice, it was determined that HHcy causes increased elevations in F4/80 and TNF- α expression (1.4 fold), indicating an increased presence of M1 macrophages. Exercise was capable of reducing many of these effects in CBS +/- mice. **Conclusions:** We conclude that HHcy causes skeletal muscle fibrosis and exercise is capable of mitigating these effects.

3381 Board #5 June 3, 3:15 PM - 5:15 PM
Effects of Ibuprofen on the Passive Properties of Musculotendinous Stiffness in the Plantar Flexor Muscle Group

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EFFECTS OF IBUPROFEN ON PASSIVE PROPERTIES OF MUSCULOTENDINOUS STIFFNESS IN THE PLANTAR FLEXOR MUSCLE GROUP

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 Ibuprofen, a non-steroidal anti-inflammatory drug, is one of the most commonly used over the counter drugs. Ibuprofen has been shown increase skeletal muscle hypertrophy/strength while at the same time decreasing measures of delayed onset muscle soreness and inflammation. Ibuprofen has a number of effects on the properties of skeletal muscle, yet few studies have investigated changes musculotendinous stiffness (MTS) resulting from Ibuprofen ingestion. **PURPOSE:** Therefore, the purpose of this study was to investigate the effects of ibuprofen (IBU) intake on musculotendinous stiffness (MTS) in the plantar flexors. **METHODS:** 15 participants (age 18-30) completed the study (8 male; 7 female). Subjects visited the lab on two separate occasions. Each visit consisted of two maximum voluntary contractions (MVC) followed by three passive range of motion tests (ROM), on a Biodex System 3 Isokinetic Dynamometer. On the first visit, subjects were given either a placebo or maximum over the counter dose of ibuprofen (1200mg/day) to be ingested in three doses (400mg/dose). Ibuprofen was taken for three days. Multifactorial ANOVA's were used for all analyses; significance was set at $p < .05$. **RESULTS:** There were no significant treatment by time interactions for ROM, MTS, or Torque. No significant individual interactions for time or treatment existed for ROM, MTS, or Torque. There were no significant changes in MVC. **CONCLUSION:** Ingesting maximal values of Ibuprofen for a 3-day period does not appear to impact MTS and related measures. Given chronic ingestion is commonly recommended by healthcare professionals for maladies from headache to muscle pain to menstrual cramps, it is recommended that future research investigate the impact of chronic ingestion at maximal and supra-maximal doses. With the propensity of tears in the Achilles tendon and other soft tissue in adults who chronically ingest ibuprofen, this research could provide pertinent information as to the mechanism of tendon matrix remodeling as well as a safe timeframe for consumption.

3382 Board #6 June 3, 3:15 PM - 5:15 PM
Bilateral Fiber Type And Performance Differences In The Leg Muscles Of Resistance Trained Men

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Structural and functional asymmetries exist between limbs. Previous research on cadavers and sedentary individuals indicates a possible link between these asymmetries and muscle fiber type composition. However, no study has utilized the highly accurate method of single fiber sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE), nor addressed the question in exercise-trained humans. **PURPOSE:** Investigate differences in leg dominance and fiber type composition of the left and right vastus lateralis (VL) of resistance-trained men. **METHODS:** Five resistance-trained men (age=23.5 \pm 3.4yrs; height=180.2 \pm 8.7cm; mass=82.9 \pm 12.2kg) volunteered to undergo whole-muscle performance testing and muscle biopsies (at the identical location) of their left and right VL. Myosin heavy chain (MHC) isoform composition (MHC I, I/IIA, IIA, IIA/IIX, IIX, I/IIA/IIX) of 141.9 \pm 36.2 isolated muscle fibers (per leg) was determined via SDS-PAGE. **RESULTS:** Paired sample T-tests revealed a significantly higher percentage of MHC I fibers in the right leg compared to the left leg (right=33.4 \pm 9.7% vs. left=25.0 \pm 14.3%). Four participants displayed no difference in MHC IIA distribution between the left and right VL. However, two participants showed a \geq 13% difference in MHC I distribution, with one of the two also showing a 12% difference in MHC IIA/IIX (hybrid) fibers. Split file paired sample T-test revealed a significantly higher percentage of MHC I fibers in the dominant leg when dominance was identified as "Which leg do you prefer to kick a ball with?" All participants identified as right leg dominant while kicking. **CONCLUSION:** These observations indicate some individuals possess substantial differences in muscle fiber type composition between their left and right VL, yet others do not. This could be related to the amount of time each participant spends performing unilateral or bilateral physical activities. It is difficult to interpret the relationship between MHC I percentage and dominant kicking leg as all participants answered the question uniformly (right leg). Our findings may have important bearing on studies that use biopsies from the left and right VL interchangeably.

3383 Board #7 June 3, 3:15 PM - 5:15 PM
Longitudinal Changes in Muscle Cross-Sectional Area Following Different Resistance Training Programs in Resistance Trained Men.

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 Improvements in muscle strength are related to changes in the muscle's cross sectional area (CSA). Resistance training (RT) programs are often focused on improvements in muscle CSA. Whether changes in CSA are symmetrical across the length of the muscle is not well understood. **PURPOSE:** To examine changes in muscle CSA following 8 weeks of resistance training in experienced, resistance trained men (age: 24.0 \pm 3.0 y; mass: 90 \pm 13.8 kg; height: 174.9 \pm 20.7 cm) **METHODS:** Following a 2-week preparatory phase, 29 RT men completed pre-testing (PRE) ultrasound CSA measures of the rectus femoris (RF) and vastus lateralis (VL) that were assessed using a 12 MHz linear probe scanning head. Participants were then randomly selected to complete either a high volume, low intensity (HV, n = 14, 4 x 10-12RM, 1min rest) or a high intensity, low volume (HI, n = 15, 4 x 3-5RM, 3min rest) whole body RT program. Participants completed post-testing (POST) following 8 weeks (4 d \cdot wk⁻¹) of training. The exercises (and their order) were identical for both HV and HI. At both PRE and POST testing, muscle architecture was assessed using ultrasonography, including measures of CSA of both the RF and VL at 30%, 50%, and 70% of the muscle's length. Separate three-way (length \times time \times group) analysis of variance was employed to compare changes in CSA for each muscle. **RESULTS:** No significant length \times time \times group interactions were noted for RF or VL CSA. However, a significant main effect for time was found ($p=0.005$ and $p<0.001$, respectively) with increases in CSA for both the RF and VL (mean difference: RF: 0.50 \pm 0.16 cm²; VL: 2.30 \pm 0.50

cm²). **CONCLUSION:** The findings of this study indicated that an 8-week RT program resulted in symmetrical increases in CSA along the longitudinal axis (at 30, 50, and 70% of muscle length) of the RF and VL.

3384 Board #8 June 3, 3:15 PM - 5:15 PM
Aquatic Treadmill Exercise Combined With Resistance Exercise Yields Different Cytokine Responses Compared To Land Treadmill
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 (Sponsor: Stephen F. Crouse, FACSM)
 (No relationships reported)

We have previously shown that aquatic treadmill (ATM) running may alter acute inflammatory responses when performed after resistance exercise (RT). **PURPOSE:** To investigate the effects of RT alone and combined with either land treadmill (RT-LTM) or ATM exercise (RT-ATM) on TNF α , IL-6, IL-8, IL-10, INF γ , and GM-CSF. **METHODS:** Forty-seven untrained men (n=23, 37 \pm 11yrs, 182.7 \pm 6.7cm, 98.9 \pm 16.1kg) and women (n=24, 38 \pm 12yrs, 165.6 \pm 4.8cm, 82.1 \pm 19.1kg) were randomized into three groups: RT-LTM, RT-ATM, and RT, then assigned progressive RT (2/wk, 3 x 8-12 repetitions, 60 \pm 85% 1RM) for 12wk. The RT-ATM and RT-LTM groups progressively added ATM or LTM immediately following RT sessions and in isolation on a 3rd day to total up to 500 kcal/bout. Muscular strength, body composition, and VO $_{2max}$ were measured before and after training. Fasting blood samples were obtained before and 24h after acute exercise before and after training for analysis serum cytokines. A 3(group) x 2(time) mixed model ANCOVAs (covaried on baseline values) were used to detect acute changes in serum cytokines and chronic changes in VO $_{2max}$, strength, and body composition (α =0.05). **RESULTS:** In the untrained state, acute RT-LTM exercise was found to significantly increase IL-6 (+71.04% \pm 31.23). Acute RT-ATM exercise yielded greater increases in IL-10 in the untrained state (+44.11% \pm 18.41) than RT-LTM (-1.15% \pm 13.39). Additionally, acute RT-ATM exercise was observed to increase INF γ in the untrained state (+111.42% \pm 48.55). In the trained state, RT-ATM exercise elicited a greater increase in IL-10 (+67.77% \pm 21.72) than RT-LTM (-2.81% \pm 10.77) and RT (-4.29% \pm 9.45). All groups were found to have significant increases in total strength with RT-ATM (+608.53lbs \pm 75.0) eliciting a greater increase than RT-LTM (+364.38lbs \pm 39.0) and RT (+432.78lbs \pm 46.0). All groups were found to have significant increases in VO $_{2max}$ with RT-LTM (+2.79ml/kg/min \pm 0.6), RT-ATM (+3.36 ml/kg/min \pm 0.6), and RT (+5.85 ml/kg/min \pm 0.7) being statistically different from the other. Both RT-ATM (-1.71 \pm 0.4) and RT-LTM (-2.79 \pm 0.4) exercise were found to decrease body fat. **CONCLUSION:** Cytokine responses related to pro-inflammatory, anti-inflammatory, and metabolic signaling are mode dependent and may affect training adaptations.

F-63 Thematic Poster - Training Techniques

Friday, June 3, 2016, 3:15 PM - 5:15 PM
 Room: 101

3385 Chair: Chantal Vella, FACSM. *University of Idaho, Moscow, ID.*
 (No relationships reported)

3386 Board #1 June 3, 3:15 PM - 5:15 PM
The Effect Of Four Different Abdominal Exercises On Concentric Versus Eccentric Electromyographic Activity
 William Sullivan, Peter A. Hosick, Fredrick A. Gardin, Steven Leigh. *Montclair State University, Montclair, NJ.*
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 (No relationships reported)

We previously found that a modified sit-up emphasizing the abdominal muscles elicited greater abdominal muscle electromyographic activity (EMG). **Purpose:** This study was conducted to examine the effects of exercise & muscle action on repetition time & EMG. **Methods:** Male subjects (n = 20, 23.8 \pm 3.5 years) performed each exercise for 30 seconds in a counterbalanced order with 5 minutes rest between exercises. The exercises were: modified sit-up (MS), freestyle sit-up (FS), trunk curl (TC), & trunk curl on an exercise ball (TCB). Muscle actions were: concentric (CON) & eccentric (ECC). Rectus abdominis (RA), external oblique (EO), & rectus femoris (RF) EMG were recorded during exercise. Normalized data were compared via a two-way, repeated measures ANOVA with *post-hoc* comparisons. **Results:** There was an interaction between muscle action & exercise on repetition time (F $_{3,17}$ = 42.97, p < 0.001). Repetition time was greater for CON than ECC (F $_{1,19}$ = 103.24, p < 0.001). Repetition time for MS was greater than other exercises during CON (F $_{3,17}$ = 24.48, p < 0.001)

& ECC (F $_{3,17}$ = 16.60, p < 0.001). There was an interaction between muscle action & exercise on mean EO EMG (F $_{3,17}$ = 4.07, p = 0.011). Mean EO EMG was greater during CON than ECC (F $_{1,19}$ = 6.33, p = 0.021), & there were differences among exercises during CON (F $_{3,17}$ = 4.07, p = 0.024), but not ECC (F $_{3,17}$ = 2.44, p = 0.100). During CON mean EO EMG was greater for MS than FS (p = 0.046), TC (p = 0.004), & TCB (p = 0.004); greater for FS than TC (p = 0.005) & TCB (p = 0.007); & similar for TC & TCB. Mean RA EMG was greater during CON than ECC (F $_{1,19}$ = 22.29, p < 0.001), & different among exercises (F $_{3,17}$ = 5.23, p = 0.003). Mean RA EMG was greater for FS than TC (p = 0.009) & TCB (p = 0.003), but not MS; & similar for MS, TC, & TCB. Mean RF EMG was similar during CON & ECC (F $_{1,19}$ = 0.38, p = 0.546), but different among exercises (F $_{3,17}$ = 7.67, p < 0.001). Mean RF EMG was greater for FS than MS (p = 0.012), TC (p = 0.002), & TCB (p = 0.014); greater for MS than TC (p = 0.024) but not TCB (p = 0.111); & similar for TC & TCB. **Conclusion:** The concentric part of each exercise elicits the greatest response from the trunk flexors, so this action should be prioritized to train those muscles. Both MS & FS have strong contributions from the RA, but the MS engages the EO whereas the FS engages the RF, suggesting the MS is a better exercise for abdominal muscle training.

3387 Board #2 June 3, 3:15 PM - 5:15 PM
Examining Fundamental Movement Competency And Closed Chain Upper Extremity Dynamic Stabilization In High School And College Swimmers

Robert J. Butler¹, Garrett Bullock¹, Nate Brookreson², Amy Knab³. ¹Duke University, Durham, NC. ²North Carolina State University, Raleigh, NC. ³Queens University of Charlotte, Charlotte, NC. (Sponsor: William Garrett, MD, PhD, FACSM)
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Reported Relationships: R.J. Butler: Consulting Fee; Functional Movement Systems, LLC.

Fundamental movement patterns and upper quarter dynamic stabilization are proposed mechanisms affecting upper extremity injury risk in swimming. To date, there are few studies investigating fundamental movement competency and closed chain upper extremity dynamic stabilization in swimmers.

PURPOSE: To understand normative values and determine differences in fundamental movement competency and closed chain upper extremity dynamic stabilization, utilizing the Functional Movement Screen (FMS) and Upper Quarter Y-Balance Test (YBT-UQ), between high school (HS) and collegiate (COL) swimmers.

METHODS: Movement competency and upper extremity dynamic stabilization was investigated in 70 HS and 43 COL swimmers as part of pre-participation physicals. Subjects completed the FMS using the standardized 7 movement tests. The YBT-UQ was completed on the right and left limbs in the medial, inferolateral and superolateral directions. Performance for each reach direction on the YBT-UQ was standardized to right upper extremity length (%LL). Variables of interest from the two tests were the individual movement tests on the FMS, and the average normalized reach for each direction and overall for the YBT-UQ. Statistical analysis was completed utilizing a chi-square for the independent test scores on the FMS while independent samples t-test were utilized to examine performance on the YBT-UQ (p<0.05)

RESULTS: HS swimmers exhibited a statistically significant greater percentage of below average performance on the following FMS tests: lunge (HS:22.5%, COL:4.7%), hurdle step (HS:32.8%, COL:6.9%) and push up (HS:61.4 %, COL:30.2%). HS swimmers also had a greater incidence of pain with spinal extension (HS: 8.6%, COL: 0.0%). HS swimmers also exhibited statistically lower scores for the medial direction of the YBT-UQ (HS: 97.9 \pm 9.0 %LL, COL: 101.5 \pm 7.6% LL).

CONCLUSIONS: Individual fundamental movement patterns that involved lumbopelvic neuromuscular control differed between HS and COL swimmers. Furthermore, general upper extremity dynamic stabilization differed between competition levels. This data may be helpful in developing training programs to optimize performance in HS and COL swimmers.

3388 Board #3 June 3, 3:15 PM - 5:15 PM
Optimizing Resistance During Multiple-Set Weight Training to Increase Training Volume for Rural Firefighters

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 (No relationships reported)

PURPOSE: In this study, we hypothesized that a greater training volume would be produced using a training protocol where resistance is decreased with each set (DR) compared to a constant resistance (CR) protocol. In order to develop DRs, we used the subject's fatigue ratio (using an individualized regression equation) from a CR training protocol where the number of repetitions declines with each set.

METHODS: 20 active-duty male firefighters (mean \pm SD, age = 32 \pm 7yr, height = 180 \pm 5 cm, body mass = 96 \pm 16 kg, fire service = 9 \pm 7 yr) completed 4 sets at 65% of their 1RM CR and DR bench press, lat pulldown, and leg press exercises to

failure with 30 second rest intervals. Exercise trials were performed in a random counterbalanced order. Data were analyzed using paired sample t-tests.

RESULTS: There was a greater training volume ($P < 0.01$) when subjects trained with DR sets compared to training with CR sets at all three exercises (table 1).

CONCLUSIONS: In male firefighters, a greater training volume is attained using this DR method based on subject's fatigue ratio than when using a CR training method suggesting that this may be a more effective training method.

	Bench Press	Lat Pulldown	Leg Press
CR	1742±481	2027±603	13414±5258
DR	2548±588*	2993±815*	19993±7298*

* $p < 0.01$, value is different from CR

3389 Board #4
Abstract Withdrawn

3390 Board #5 June 3, 3:15 PM - 5:15 PM
Flexibility Improves As A Result Of Participating In General Pa Classes Among University Students
Istvan Kovacs, Ethan Hull, Wenhao Liu, FACSM. *Slippery Rock University, Slippery Rock, PA.*
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(No relationships reported)

PURPOSE: While flexibility is widely investigated among children and adolescents, few studies have examined the impact of general physical activity (PA) classes on flexibility performance among university students. This study was intended to examine how flexibility would change during a semester-long PA class among college students. **METHODS:** At the beginning (pretest) and end (posttest) of a semester, back-saver sit and reach test, shoulder stretch test and trunk lift test were administered for 82 university students (53 males, 21.21±1.61 yrs; and 29 females, 21.17±2.67 yrs) who were enrolled in general PA classes in a university in the USA. Classes were held twice a week and included approximately 45 minutes of PA to improve health-related physical fitness. Flexibility exercise took place as part of the warm-up and cool down procedures. In addition, body weight and the 20-meter Progressive Aerobic Cardiovascular Endurance Run (PACER) were assessed at both assessment points. Comparisons of means between pretest and posttest were analyzed using paired-sample t-tests.

RESULTS: Both males and females significantly improved their back-saver sit and reach performances at the end of the semester ($p < .001$). Specifically, males improved from 12.21±3.03 to 14.23±3.28 in. and females from 13.78±2.87 to 15.76±2.56 in. with right foot forward position. Similar trends were observed with left foot forward position, from 12.00±3.19 to 13.85±3.43 in. for males and from 13.88±2.63 to 15.63±2.54 in. for females. There was no significant difference between the two foot positions for either sex. The trunk lift showed significant improvements ($p < .01$) as well with males from 11.08±1.63 to 11.61±1.17 in. and females from 10.78±1.54 to 11.61±1.63 in. However, no significant changes were found for shoulder stretch. As for body weight and PACER, while body weight remained unchanged, PACER performance increased significantly ($p < .001$) from 56.09±17.23 to 66.78±16.61 laps for males and from 38.96±11.71 to 46.64±12.11 laps for females.

CONCLUSION: When arranged appropriately, general PA classes can positively impact university students' health-related physical fitness in a more comprehensive way, including cardiorespiratory performance and flexibility improvement in the lower extremity and lower back area.

3391 Board #6 June 3, 3:15 PM - 5:15 PM
Differential Effects of Training Intensity and Volume on Rate of Force Development in Resistance Trained Men
Ran Wang¹, Jay R. Hoffman, FACSM¹, Gerald T. Mangine², Kyle S. Beyer¹, Michael B. La Monica¹, David H. Fukuda¹, Jeffrey R. Stout¹. ¹University of Central Florida, Orlando, FL. ²Kennesaw State University, Kennesaw, GA. (Sponsor: Jay R. Hoffman, FACSM)
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(No relationships reported)

Resistance training programs focusing on intensity have been shown to produce greater increases in muscular strength than those focused on volume. However, whether the rate of force development (RFD), assessed via isometric mid-thigh pull (IMTP), responds in the same way is still unclear. **PURPOSE:** This study compared the effect of two different resistance training protocols (high training intensity [INT] versus high training volume [VOL]) on IMTP performance. **METHODS:** Following a 2-week

preparatory phase, participants were randomly assigned to either INT ($n = 15$, 4 × 3-5 repetitions with 90% of one repetition maximum [1RM], 3-min rest intervals) or VOL ($n = 14$, 4 × 10-12 repetitions with 70% of 1RM, 1-min rest intervals) training group for 8 weeks. IMTP tests were performed pre- and post-training. Force and RFD measurements were calculated at specific time bands from 0 to 30, 50, 90, 100, 150, 200, and 250 milliseconds (ms). Peak force (PF) and peak RFD (pRFD) were also determined. Data were analyzed using magnitude based inferences. **RESULTS:** Changes in force and RFD measurements are depicted in Table 1. INT had a *very likely positive* effect on PF, force at 30, 50, 90 and 100 ms, as well as a *likely positive* effect on force at 150 and 200 ms when compared to VOL. Differences in force at 250 ms were *unclear* between two groups. INT had a *likely positive* effect on pRFD, RFD at 30, 50, 90, 100, 150 and 200 ms in comparison to VOL. Differences in RFD at 250 ms were *unclear* between groups. **CONCLUSIONS:** The results of this study indicate that INT is more advantageous than VOL for improving peak force as well as RFD in resistance-trained men after 8 weeks of training.

Measurements	HVY (mean ± SD)	VOL (mean ± SD)	Percent			Interpretation
			Positive	Trivial	Negative	
Peak Force (N)	424 ± 323	46 ± 324	97.56	2.43	0.01	Very Likely Positive
Force at 30ms (N)	88 ± 134	-55 ± 131	96.59	3.38	0.03	Very Likely Positive
Force at 50ms (N)	142 ± 187	-62 ± 211	96.29	3.66	0.05	Very Likely Positive
Force at 90ms (N)	179 ± 299	-86 ± 242	95.95	3.95	0.10	Very Likely Positive
Force at 100ms (N)	181 ± 313	-76 ± 242	95.04	4.80	0.16	Very Likely Positive
Force at 150ms (N)	179 ± 355	-56 ± 230	89.55	10.09	0.35	Likely Positive
Force at 200ms (N)	267 ± 544	-39 ± 324	86.04	13.16	0.80	Likely Positive
Force at 250ms (N)	122 ± 412	23 ± 303	41.82	52.86	5.32	Unclear
Peak RFD (N/s)	1585 ± 3801	-739 ± 3928	80.29	18.45	1.26	Likely Positive
RFD at 30ms (N/s)	1249 ± 4259	-1514 ± 4256	83.63	15.42	0.95	Likely Positive
RFD at 50ms (N/s)	1835 ± 3768	-1058 ± 4154	88.59	10.82	0.59	Likely Positive
RFD at 90ms (N/s)	1430 ± 3192	-851 ± 2565	91.74	7.79	0.47	Likely Positive
RFD at 100ms (N/s)	1310 ± 3017	-673 ± 2313	90.17	9.13	0.70	Likely Positive
RFD at 150ms (N/s)	861 ± 2315	-310 ± 1542	79.47	19.20	1.33	Likely Positive
RFD at 200ms (N/s)	1084 ± 2604	-150 ± 1576	79.17	19.23	1.59	Likely Positive
RFD at 250ms (N/s)	286 ± 1621	129 ± 1131	28.25	59.41	12.34	Unclear

3392 Board #7 June 3, 3:15 PM - 5:15 PM
Critical Power Measurement: Comparison And Validation Of Five Time-to-exhaustion Trials Versus A 3-minute All-out Test
Felipe Mattioni Maturana¹, Daniel A. Keir², Kaitlin M. McLay², Guillaume Y. Millet¹, Juan M. Murias¹. ¹University of Calgary, Calgary, AB, Canada. ²The University of Western Ontario, London, ON, Canada. (Sponsor: Donald H Paterson, FACSM)
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(No relationships reported)

Critical Power (CP) represents the highest sustainable power output (PO) at which physiological steady-state can be achieved. In cycling exercise, CP is traditionally derived from the PO versus time-to-exhaustion (TTE) relationship based on 3-5 TTE trials ranging from 1 to 20 min. Recently, a 3-min all-out test (3M) has been proposed for CP estimation. However, CP derived from this test has not been externally validated (i.e., corroborating steady-state lactate concentration [La] for prolonged durations of cycling at the value associated to CP).

PURPOSE: To compare CP derived from 5 TTE and the 3M test, and to validate these values against a maximal lactate steady-state (MLSS) test.

METHODS: Seven healthy young subjects (28±3 yrs; 68.4±7.3 kg; 175±9 cm) were tested. A ramp incremental test to exhaustion was performed on a cycle ergometer

(Velotron Dynafit Pro, Racer Mate, Seattle, WA, USA) to determine VO₂peak, gas exchange threshold (GET) (Quark CPET, Cosmed, Rome, Italy), and peak power output (POpeak). CP from the 5 TTE test was calculated with a 2-parameter hyperbolic model (HYP). The 3M test was performed using the linear mode of the cycle ergometer, and CP was calculated as the mean PO of the last 30 s of the test. MLSS was considered as the highest PO during a 30-min constant load ride with a variation in [La] ≤ 1.0 mM·L⁻¹ between the last 20 min of exercise ([La] measured every 5 min). **RESULTS:** Mean VO₂peak, GET, and POpeak were 4.30±0.67 L·min⁻¹, 2.60±0.30 L·min⁻¹, and 383±53 W, respectively. PO at CP HYP (267±39 W), CP 3M (258±52 W), and MLSS (246±37) were not different (p>0.05). Bland-Altman plots comparing CP from HYP and 3M against the PO at MLSS showed no significant biases but wide limits of agreement (LOA) ranging from -8 to 51 W (bias=21 W) and from -43 to 68 W (bias=13 W), for HYP and 3M, respectively. When comparing CP from 3M to HYP, the LOA ranged from -43 to 26W (bias=-9 W). **CONCLUSIONS:** Although the POs associated to CP as estimated from the 5 TTE, the 3-min all-out test, and MLSS were not different, the large variability in the CP amongst methods results in poor accuracy of CP estimation and detracts from the practical application of this test.

3393 Board #8 June 3, 3:15 PM - 5:15 PM
Impact of Various Concurrent Training Interventions on Squat Strength

Jared H. Perlmutter, Chad Dolan, Justin M. Quiles, Rocky Blanco, Jacob A. Goldsmith, Kristin M. Mendez, Ryan K. Byrnes, Robert F. Zoeller, Michael Whitehurst, FACSM, Michael C. Zourdos. *Florida Atlantic University, Boca Raton, FL.*

(No relationships reported)

Data has demonstrated the inclusion of aerobic exercise into a resistance training program (i.e. concurrent training) to cause the interference effect (i.e. attenuate strength). However, a resistance training circuit as the aerobic intervention has yet to be investigated. **PURPOSE:** To compare changes in one-repetition maximum (1RM) strength of the back squat between resistance training (RT) only, concurrent training with: high intensity cardio (CTHI), moderate intensity cardio (CTMI), and a barbell circuit (RTC). **METHODS:** Eighteen males (age: 23±3yrs, body mass: 82.0±10.0kg, Body Fat Percentage: 11.45±4.14%) with at least two yrs. of training experience on the squat were assigned to one of four groups: 1) RT (n=4), 2) CTHI (n=5), 3) CTMI (n=4), or 4) RTC (n=5) for 8 weeks. All groups performed the same undulating resistance training program on Mon. (8 repetitions: squat/bench; 10 repetitions: assistance movements), Wed. (6 repetitions: squat/bench; 8 repetitions: assistance movements), and Friday (4 repetitions squat/bench; 6 repetitions assistance movements) with Tues/Thurs. as the aerobic training days. CTHI consisted of 10 one-minute cycling sprint intervals (100-110% VO₂ peak) over 30 minutes, CTMI was 30 consecutive minutes of cycling (40-50% VO₂ peak), and in RTC subjects completed as many 'rounds' as possible of the squat, bench press, overhead press, barbell row, and barbell curl for 8 (Wks. 2-3), 9 (Wks. 4-5), or 10 repetitions (6-7) at 40% 1RM of squat/bench and 75% of 10-repetition day load for assistance movements. A 4x2 repeated measures ANOVA was used with significance set at p≤0.05. **RESULTS:** There was a time effect (p<0.01) for 1RM squat in RT (133.5±13.59 to 157.0±21.49kg), CTHI (139.5±24.53 to 153.6±19.78kg), CTMI (130.75±20.45 to 159.38±27.57kg), and RTC (144.8±27.71 to 162.0±25.46kg). No group differences existed (p>0.05). **CONCLUSION:** Our findings indicate that short duration aerobic exercise avoids the interference effect and a barbell circuit does not further enhance strength.

F-64 Free Communication/Slide - Novel Approaches for Physical Activity Interventions

Friday, June 3, 2016, 3:15 PM - 5:15 PM
 Room: 313

3394 Chair: John M. Jakicic, FACSM. University of Pittsburgh, Pittsburgh, PA.

(No relationships reported)

3395 June 3 3:15 PM - 3:30 PM
Feasibility of the Addition of Yoga to a Standard Behavioral Weight Control Program

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(No relationships reported)

Lifestyle interventions for weight control have been shown to be effective for eliciting changes in body weight; however, there is variability in the response to these interventions, particularly with regard to engagement in physical activity. Yoga is a popular form of physical activity that may enhance response to weight loss interventions; however, the feasibility and effectiveness of including yoga within a comprehensive weight loss intervention has not been adequately examined.

PURPOSE: To examine the feasibility of adding yoga to a standard behavioral weight control program (SBWP).

METHODS: Thirty-seven women (age=46.8±6.0 years; BMI=30.6±2.9 kg/m²) were randomized to SBWP (n=18) or Yoga plus SBWP (YOGA) (n=19). Both groups were prescribed a reduced-energy diet (1200-1500 kcal/wk) and moderate-to-vigorous physical activity (40 min/day, 5 days/wk). The YOGA group was also prescribed Hatha yoga for 30 min/day, 3 days/wk. In-person weekly group meetings were held for the first 6 months, with contact reduced to telephone calls one time per month throughout months 7-12.

RESULTS: Retention in YOGA was 94.7% across 12 months and 61.1% in SBWP (chi-square p=0.01). Reductions in body weight at 6 months were -9.2±4.8 kg and -12.7±4.9 kg for SBWP (n=13) and YOGA (n=18), respectively (p=0.07); and -9.3±8.2 kg and -12.7±6.8 kg at 12 months for SBWP (n=11) and YOGA (n=18), respectively (p=0.20). At 6 months 77.8% of participants in YOGA reported engaging in yoga on 2.1±0.8 days/wk for 32.1±5.8 min/day; however, participant engagement in yoga dropped to 11.1% at 12 months.

CONCLUSIONS: YOGA resulted in a non-significant additional weight loss of approximately 3 kg compared to SBWP, and YOGA demonstrated greater retention. While adding yoga to a behavioral intervention appears to be feasible, the reduction of in-person contact also resulted in decreased yoga participation. Sustaining engagement in yoga and its effect on long-term weight control warrant further investigation.

3396 June 3 3:30 PM - 3:45 PM
Active Science Pilot Study: A Multi-Site, Controlled Trial to Assess Program Feasibility and Effectiveness

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(No relationships reported)

One of the major factors contributing to childhood obesity is physical inactivity. It is recommended that children and adolescents participate in sixty minutes of moderate-to-vigorous physical activity (MVPA) daily. Recently, afterschool programs have been identified as ideal settings where children (5-14 years) can accumulate a significant portion of their total daily, recommended level of moderate-to-vigorous physical activity. **PURPOSE:** The purpose of the current study was to assess the effectiveness of the Active Science program delivered in different site locations across the U.S. The program integrates physical activity with science learning for children in the afterschool setting. **METHODS:** Participants were 72 children (35 females, mean age=9.2 years, SD=0.9) from five YMCA afterschool childcare sites located in five states. The six-week Active Science program was implemented twice per week for 60 minutes at a YMCA afterschool site. The participants completed thirty minutes of physical activity followed by a science lesson delivered through the Active Science Mobile App. Sites were randomly assigned to Active Science and the control (i.e., regular after school program). After six weeks, the sites switched to enable both groups to receive the intervention. Science tests and accelerometers were used to measure science performance, steps, and MVPA minutes. **RESULTS:** For the Active Science group, the pre and post improvement was significant, p<.05. Average science test scores for pre and post-tests were M=58.46, SD=21.79 and M=69.39, SD=14.07, respectively. For physical activity, participants had significantly higher

steps/hour when they completed the Active Science program compared to when they were in the regular afterschool program, $M=1826$, $SD=571$, $M=685$, $SD=161$, respectively, $F(1,55)=280$, $p<.001$. Significant differences were found of MVPA%, $M=38.16\%$, $SD=20.05\%$, $M=30.03\%$, $SD=14.83\%$, respectively, $F(1.55)=44.8$, $p<.001$. **CONCLUSION:** The results supported that Active Science promotes physical activity participation and facilitates science learning for children in the afterschool environment, and can be effectively delivered by minimally trained staff in multiple locations.

3397 June 3 3:45 PM - 4:00 PM

Diabetes Prevention Program (Insulin Superheroes Club): Metabolic Parameters and Physical Fitness Improvements Among Latino Youth.

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(No relationships reported)

Given the rise in obesity and type 2 diabetes mellitus (T2DM) among youth in America, particularly Latino and African American populations, culturally tailored and comprehensive prevention strategies are vital to address the growing epidemic of T2DM on-set in ethnic minority youth.

PURPOSE:

To determine the impact of a diabetes prevention program (DPP) for youth (Insulin Superheroes Club) on: metabolic parameters and physical fitness outcomes among Latino youth.

METHODS:

The sample of 28 Latino youth (10.0±1.9yrs, 52% female) received 16 weekly comprehensive lifestyle sessions designed to supplement the CDC's adult DPP to engage the whole family. Non-parametric paired samples sign tests were used to determine if there were statistically significant changes in metabolic parameters and physical fitness post intervention.

RESULTS:

Significant improvements were observed for metabolic parameters and physical fitness over 16-weeks (t1:pretest and t2:posttest; M(SD)). Metabolic parameters: systolic blood pressure (mmHg) (t1: 109(12), t2: 103(6), $p<.01$), diastolic blood pressure (mmHg) (t1: 68(8), t2: 63(8), $p<.0001$), hemoglobin A1c (%) (t1: 5.9(0.3), t2: 5.3(0.2), $p<.0001$), non-HDL cholesterol (mg/dL) (t1: 106(26), t2: 99(21), $p<.001$), percent body fat (%) (t1: 31.9(10.7), t2: 28.9(11.3), $p<.001$), and waist circumference (cm) (t1: 78.2(16.2), t2: 75.7(16.9), $p=0.01$). Physical fitness outcomes: six minute walk test (m) (t1: 369.1(109.0), t2: 451.9(109.8), $p<.0001$), shuttle run (s) (t1: 10.19(2.29), t2: 9.29(1.52), $p<.0001$), sit-and-reach (cm) (t1: 21.8(7.8), t2: 27.6(6.1), $p<.0001$), and combined handgrip (kg) (t1: 36.3(11.8), t2: 39.9(12.8), $p<.0001$).

CONCLUSIONS:

Findings showed that the Insulin Superheroes Club curriculum significantly improved metabolic and physical fitness outcomes. All subjects transitioned from a pre-diabetic status to normal hemoglobin A1c levels. Future diabetes prevention programs should focus on a comprehensive approach, including diet, physical fitness, motivation, and family involvement strategies.

3398 June 3 4:00 PM - 4:15 PM

Time and Intensity of Physical Activity During an After-School Jump Rope Program

Jessica Albers¹, Beth Lewis². ¹Minnesota State University Mankato, Mankato, MN. ²University of Minnesota, Minneapolis, MN.

(No relationships reported)

Childhood obesity has increased significantly in the U.S. over the past two decades. After-school programs can provide opportunities for increasing moderate to vigorous physical activity (MVPA) among children, which could potentially decrease the incidence of obesity. After-school jump rope programs may be one ideal setting to help increase physical activity (PA) among children; however, few studies have evaluated these programs. **PURPOSE:** The purpose of this study was to examine the amount and intensity of PA students received during an after-school jump rope program.

METHODS: Students, ages 8-12 years old, from two elementary schools (n=28) participated in a 12-week after-school jump rope program that met twice a week for 90 minutes each session. Participants practiced individual and group jump rope skills and learned a team routine that they performed at the end of the 12 weeks. Accelerometers were used to assess PA time and intensity and were worn during three session at weeks three, six, and nine. Using the accelerometer counts, intensity cut points were assigned (Freedson et al., 1997). The relationship between PA intensity and gender and minority status was also explored.

RESULTS: There was no significant difference between the three accelerometer sessions and data was averaged. In the 90-minute session, participants spent 17.3 minutes (19.2%) in vigorous activity, 28.0 minutes (31.1%) in moderate activity, 8.0 minutes (8.9%) in light activity, and 36.7 (40.8%) in sedentary behavior. Between groups ANOVA indicated that males (n=7) spent less time in sedentary behavior ($p<.05$) and more time in vigorous activity ($p<.01$) than females (n=21). Minority participants (n=7) spent less time in sedentary activity ($p<.05$) and more time in light ($p<.05$) and moderate activity ($p<.001$) than non-minority participants (n=21). **CONCLUSIONS:** Participants received 45.3 minutes of MVPA suggesting that after-school jump rope programs may be an effective venue for helping children achieve the recommended 60 minutes of physical activity per day.

3399 June 3 4:15 PM - 4:30 PM

The Impact of NFL PLAY 60 Programming on Youth Fitness Outcomes

Gregory J. Welk, FACSM¹, Yang Bai¹, Pedro F. Saint-Maurice², Kelly Allums-Featherston³, Norma Candelaria³. ¹Iowa State University, Ames, IA. ²University of Minho, Braga, Portugal. ³The Cooper Institute, Dallas, TX.

Email: gwelk@iastate.edu

Reported Relationships: G.J. Welk: Contracted Research - Including Principle Investigator; Subcontract from The Cooper Institute.

The NFL PLAY 60 program offers schools an array of options for promoting physical activity and healthy eating in school children. Programs such as Fuel up to PLAY 60 and the PLAY 60 Challenge are both widely used, but there is little information about the impact of these programs on youth fitness outcomes.

PURPOSE: The study evaluates the impact of NFL PLAY 60 programming on longitudinal trajectories of youth aerobic capacity and Body Mass Index (BMI) **METHODS:** Data were collected through the NFL PLAY 60 FITNESSGRAM Partnership Project, a large participatory research project involving samples of schools in each of the 32 NFL franchise cities. A total of 497 schools completed assessments of aerobic capacity and BMI annually from 2011 to 2015. The percentage of students meeting the Fitnessgram Healthy Fitness Zone (HFZ) were calculated for each test.

Adoption of NFL PLAY 60 programming was encouraged in the project, but not required. Schools were considered to be a "programming school" if they reported using either the Fuel up to PLAY 60 program or the PLAY 60 Challenge at least 2 years over the 4 years of tracking. Gender-specific growth curve models were used to estimate the change in the longitudinal trajectories of aerobic capacity and BMI HFZ achievement for both programming and non-programming schools after controlling for baseline school demographic and policy variables.

RESULTS: Approximately 19% of schools met the criteria of being an NFL PLAY 60 programming school. Annual improvements in aerobic capacity HFZ achievement were significantly greater in programming schools for both boys (2.35%, $P<.01$) and girls (2.61%, $P<.01$), compared to non-programming schools. Smaller, but statistically significant, differences in annual trajectories of BMI HFZ achievement were also evident in programming schools for both girls (1.30%, $P<.05$) and boys (1.05%, $P<.05$), compared to non-programming schools. Schools implementing programming across 4 years had improvements in aerobic capacity than schools implementing programs for only 2 or 3 years.

CONCLUSIONS: The longitudinal results support the utility of NFL PLAY 60 programs for improving youth fitness and health outcomes. The findings are particularly noteworthy considering the participatory nature of the project and the naturalistic design

3400 June 3 4:30 PM - 4:45 PM

Parental Support for Physical Activity in African-American Girls

Lauren Reid¹, Marsha Dowda, FACSM¹, Melinda Forthofer¹, Daheia Barr-Anderson, FACSM², Russell R. Pate, FACSM¹. ¹University of South Carolina, Columbia, SC. ²University of Minnesota, Minneapolis, MN.

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(No relationships reported)

African-American girls exhibit a steep decline in physical activity from childhood to adolescence. Few studies have examined the mothers' influences on their African-American daughters' physical activity. **PURPOSE:** The purpose of this study was to examine the influences of child-reported parent support and encouragement for physical activity and mother-reported support for physical activity on objectively measured physical activity two years later in African-American girls. **METHODS:** Mothers' support of physical activity and encouragement to be active were reported via survey by 92 5th grade African-American girls (mean age 10.52±0.52 years) from the Transitions and Activity Changes in Kids (TRACK) study. Mothers reported their own support of physical activity when their daughter was in 5th grade via survey. Total physical activity and MVPA were measured by a waist-mounted ActiGraph accelerometer (GT1M and GT3X, Pensacola, FL) that was worn for 6 consecutive

days in 7th grade. A linear mixed model analysis with school as a random effect variable was used to examine the relationships between variables. **RESULTS:** The mean total physical activity and mean MVPA were 20.77±3.98 minutes per hour and 1.57±0.79 minutes per hour, respectively. A significant correlation was observed between child-reported mother's support and total physical activity (p= 0.01). After adjustment for encouragement, mothers' support reported by the child was positively associated with total physical activity two years later (p=0.04). Parent support reported by the mother was not associated with total physical activity. None of the independent variables were associated with MVPA two years later. **CONCLUSION:** These findings suggest that African-American girls who perceive they are supported by their mother to be physically active may exhibit higher physical activity levels long term. Further research is needed to evaluate the longitudinal relationship between parental support of physical activity and physical activity in African-American girls. Additionally, an understanding of parental influence on MVPA in African-American girls is necessary to improve their physical activity intensity. Supported By: NIH Grant 3R01 HL091002-07S1

3401 June 3 4:45 PM - 5:00 PM
Effect Of Increased School- Based Physical Activity At Children'S Executive Function. The «Active School» Study
 Silje E. Kvalo¹, Edvin Bru¹, Kolbjorn Bronnack², Sindre Dyrstad¹. ¹University in Stavanger, Stavanger, Norway. ²Stavanger University Hospital, Stavanger, Norway.
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 (No relationships reported)

>Even though several studies have found positive effects of physical activity (PA) on children's cognition, more research is needed to confirm and understand how physical activity and cognition are connected.

Purpose: To study if increased PA in school affected children's executive function.
Methods: The Active school- study was a 10-month randomized controlled trial studying effects of increased PA. The sample included 450 children (10-11 years old) in five intervention- and four control schools. The weekly interventions was 2x45 min physically active academic lessons, 5x10 min physically active breaks and 5x10 min PA homework. Aerobic fitness was measured by a 10 min interval-running test. Executive functions were tested using four cognitive test (Stroop, verbal fluency, digit span and Trail Making). A composite score for executive functions was computed and used in analyses. Mixed MANOVA was performed to analyze changes in scores for aerobic fitness and executive function. A linear regression analysis was conducted to analyze the relationship between the change in aerobic fitness and the score for executive function, independent of the intervention.
Results: Teachers at the intervention schools reported approximately 45% (120 minutes) more PA than control schools every week. The intervention group had a significantly higher gain in scores for executive functions than the control group (Time x condition: F(1, 266) =5.02, p=.026) which gave a Cohens d' of .28. The difference in aerobic fitness was not significant between the two groups. Regression analysis indicated a weak, but significant association between improvement in aerobic fitness and gains in scores for executive functions (β =.12, p=.049).
Conclusion: Increased PA level in school resulted in a small but positive effect on children's' executive functioning, even though no difference between the groups' aerobic fitness was found. The relationship between improvement in aerobic fitness and improved executive functions independent of the intervention, indicate that larger differences between groups' executive functioning might have occurred with a larger difference in groups PA level. Further studies should examine how and to what degree different quantity and quality of PA could affect executive functioning.

3402 June 3 5:00 PM - 5:15 PM
The Impact of SkiKu on Physical Activity and Sleep Quality in Alaska Native Youth
 Lars Flora¹, Ross MacDougall², Tyler Keshel², Robert Coker².
¹SkiKu, Anchorage, AK. ²University of Alaska Fairbanks, Fairbanks, AK.
 (No relationships reported)

Introduction: The incidence of obesity has risen in conjunction with decreased levels of physical activity in Alaska Native children living in remote villages. SkiKu and the NANA regional corporation have recently supported cross-country skiing that provides instruction and equipment in the northwest region of Alaska. We hypothesized that biannual instruction and unrestricted access to equipment would promote favorable levels of physical activity and sleep quality in Alaska Native youth in Shungnak, AK.
Methods: Children (n=15; 7 males, 8 females) ages 10-15 were recruited from Shungnak, Alaska (262 residents). Multiple variables related to physical activity and sleep quality were monitored using GT3X+ ActiGraph accelerometers. The SkiKu coaches and staff provided one week of ski instruction and continual access to equipment for six months prior to data collection. Following this period, the

accelerometers were worn for six days by participants. The ActiLife v6 software was then used for data analysis and interpretation.

Results: The participants in the present study spent 161±20 min•day, 92±12 min•day and 725±32 min•day in moderate to vigorous activity (MVPA), vigorous activity and sedentary activity, respectively. There was a trend for less MVPA (P=0.09) and a significantly lower level of vigorous activity (P=0.03) in females (76±13 min•day) compared to males (110±9 min•day). Sleep efficiency was 87±2% with no difference in males and females. The number of awakenings and mean awakening length was 16±5 and 4±1 min, respectively, and there was no significant difference between males and females.

Conclusions: In conjunction with the SkiKu program, our study provides the first evidence for healthy levels of physical activity and sleep quality in Alaska Native youth. Future studies are needed to measure gender differences, and pre- and post-introduction benefits of participation in the SkiKu program.

F-65 Clinical Case Slide - Cardiovascular Issues III

Friday, June 3, 2016, 3:15 PM - 4:55 PM
 Room: 202

3403 **Chair:** Benjamin D. Levine, FACSM. *Texas Health Presbyterian Hospital Dallas, Dallas, TX.*
 (No relationships reported)

3404 **Discussant:** Sameer Dixit. *Johns Hopkins University, Lutherville, MD.*
 (No relationships reported)

3405 **Discussant:** Robert Baker, FACSM. *MSU-KCMS, Kalamazoo, MI.*
 (No relationships reported)

3406 June 3 3:15 PM - 3:35 PM
Lightheadedness in a Collegiate Rower
 Amy Kreykes, Amy Miller. *University of Michigan, Ann Arbor, MI.* (Sponsor: Robert Kiningham, FACSM)
 (No relationships reported)

HISTORY: An 18-year-old freshman collegiate rower presents to athletic medicine clinic for pre-participation physical examination with history of lightheadedness on standing and shortness of breath with exertion. She has a history of multiple prior syncopal episodes (the last of which was 2 years ago). When moving from sitting to standing she says her vision goes "black" for approximately 20 seconds and then spontaneously recovers. This is associated with palpitations and shortness of breath but no chest pain. Her past medical history is notable for syncope, asthma, and iron deficiency anemia. Family history is significant for a maternal aunt with Wolf-Parkinson-White syndrome. The athlete does not smoke, drink alcohol, or use drugs. She is not taking any medications.

PHYSICAL EXAMINATION: Notable for orthostasis with a blood pressure that decreases from 108/61 when lying to 94/67 with standing with an associated increase in heart rate from 63 to 98. Cardiopulmonary examination is normal.

DIFFERENTIAL DIAGNOSIS: 1. Arrhythmia, 2. Orthostatic hypotension, 3. Postural Orthostatic Tachycardia Syndrome, 4. Structural or ischemic heart abnormality.

TEST AND RESULTS: Unremarkable labs including CBC, BMP, TSH, and iron studies. Normal echocardiogram. Electrocardiogram notable for sinus bradycardia with sinus arrhythmia. Holter monitor with sinus tachycardia, a few PVCs and PACs but no arrhythmia. Stress test reproduced symptoms but without ischemia or structural abnormalities and with normal blood pressure and heart rate response. Tilt table test resulted in syncopal episode and heart rate increase over 30bpm.

FINAL WORKING DIAGNOSIS: 1. Orthostatic hypotension
TREATMENT AND OUTCOMES: 1. Compression stockings
 2. Liberalize water intake
 3. Liberalize salt intake
 4. Exercise
 5. Improvement of symptoms, will follow-up with Electrophysiology Cardiologist in 3 months.

FRIDAY, JUNE 3, 2016

3407 June 3 3:35 PM - 3:55 PM

General Medicine- BaseballAirika J. Phillips. *University of Arkansas, Fayetteville, AR.*

(Sponsor: Stavros A. Kavouras, FACSM)

Email: ajp016@uark.edu

(No relationships reported)

General Medicine- Baseball

Airika J. Phillips, J. Bonacci, B. McDermott, C. Wood

University of Arkansas, Fayetteville, AR.

Email: ajp016@uark.edu

(Sponsor: Stavros A Kavouras, FACSM)

History: A 20-year-old baseball player presented deep right axillary soreness while pitching in a baseball game. Initial evaluation revealed no specific mechanism, paresthesia or numbness. The patient revealed no pertinent personal or family history. Pain was presented after removal from the game.

Physical Examination: On Initial evaluation, no observable defects were noted and shoulder range of motion, special tests, and ligamentous stress tests were within normal limits. The patient complained of increased pain, an observable increase in swelling and redness in the right axilla the following day. Based on these progressive observable changes, the team physician advised immediate transport to an emergency care hospital.

Differential Diagnosis:

1. Latissimus Dorsi Muscle Strain
2. Pectoralis Major Muscle Strain
3. Intercostal Muscle Strain
4. Systemic Infection

Tests and Results

Diagnostic Ultrasound:

Occlusion right upper extremity venous plexus

Venography:

-Initial – Nonocclusive thrombus in basilic and axillary vein

-Subsequent – Extensive thrombus of the Subclavian and Axillary vein, narrowing of subclavian vein to brachiocephalic junction with thrombus extending to proximal brachiocephalic vein

Final/Working Diagnosis: Upper Extremity Deep Vein Thrombosis caused by Thoracic Outlet Syndrome.

Treatment and Outcomes:

1. Catheter Directed Thrombolysis of the Subclavian, Axillary, Brachial, Cephalic, and Brachiocephalic Veins through the Superior Vena Cava
2. Balloon angioplasty – unsuccessful
3. Anti-coagulation Medication (Cumadin- first month, Levonox- 3 months after cessation of cumadin, Aspirin- daily)
4. Thoracic Outlet Surgery (first rib resection and fascial release relief of the scalene muscles.) Brachial plexus neurolysis and exploratory lysis subclavian vein/artery
5. Shoulder range of motion and strengthening exercises
6. A reduced progressive throwing program
7. Athlete return participation in subsequent season

3408 June 3 3:55 PM - 4:15 PM

Shortness Of Breath - Soccer, BasketballJoshua G. Burkhardt, Mark Johnson. *SIU Pediatric Residency, Springfield, IL.*

Email: jburkhardt@siu.med.edu

(No relationships reported)

HISTORY: 14 year old female aerobic athlete (soccer and basketball) presents with shortness of breath and fatigue of 5 months duration. It occurs with running and presents suddenly. It worsens if she tries to push through with worsening fatigue, shortness of breath, pallor, and lightheadedness. BR>

PHYSICAL EXAMINATION: Alert female with a normal respiratory exam without wheezing, crackles, or stridor. Cardiovascular exam showed a normal rhythm with a 2/6 systolic murmur heard best at the left upper sternal border at the 2nd intercostal space. Point of maximal impulse was normal. Pulses were normal at the radial and posterior tibial arteries bilaterally; capillary refill was within normal limits. Abdominal exam showed no hepatosplenomegaly, no edema or swelling. Mild scoliosis noted. BR>

DIFFERENTIAL DIAGNOSIS:

1. Aortic stenosis
2. Coarctation of the aorta
3. Atrial septal defect
4. Pulmonary hypertension
5. Pulmonary artery stenosis
6. Vocal cord dysfunction
7. Exercise induced asthma
8. Mitral valve regurgitation
9. Anomalous pulmonary venous return

BR>

TEST AND RESULTS:

Spirometry: Normal

Electrocardiogram: Normal

Pre-exercise echo: Mildly dilated right ventricle, 3 of 4 pulmonary veins noted and drain into left atrium, normal left ventricular function, no evidence of pulmonary hypertension seen

Cardiopulmonary Exercise Test: VO₂ 108% predicted. 35 mL O₂/kg, V_eO₂: 39, Flow-volume loops normal

Post-Exercise echo: No evidence of mitral valvular pathology; only 2 pulmonary veins visualized. Enlarged right atrium.

Chest MRA: Drainage of the left superior pulmonary vein into the left brachiocephalic vein with minimal enlargement of the left brachiocephalic vein, all other pulmonary veins drain into left atrium.

BR>

FINAL WORKING DIAGNOSIS:

Partial anomalous pulmonary venous return BR>

TREATMENT AND OUTCOMES:

1. Referral to cardiology
2. Continued participation in sports
3. Surgical transposition of the left superior pulmonary vein into the left atrium.

BR>

3409 June 3 4:15 PM - 4:35 PM

Abnormal Echocardiogram Finding On Pre-participation Screening In An Asymptomatic Collegiate Football PlayerDavid Hryvniak, John MacKnight, FACSM, Walter Hoyt, Robert Battle. *University of Virginia, Charlottesville, VA.* (Sponsor:

John MacKnight, FACSM)

Email: djh3f@virginia.edu

(No relationships reported)

History: 18 year old male elite football player presented for pre-participation exam. He denied any significant past medical history except for an “innocent” heart murmur discovered on a routine physical in 2014 with follow-up negative EKG and echocardiography. He has never had any symptoms performing physical activity throughout his athletic career and denied any shortness of breath, palpitations, edema, syncope, near syncope, chest pain, or peripheral edema. As per pre-participation protocol at UVA, all student athletes undergo screening EKG and congenital echocardiography by the team cardiologist prior to participation.

Physical Exam:

Healthy appearing male in no acute distress. Vital signs were normal.

2+ carotid pulses and no bruits.

Cardiac: RRR No murmur, gallop, rub, or ectopy. Valsalva maneuver was performed in forward flexed position with no change in exam.

Lungs: CTAB

Extremities: no edema with 2+ distal pulses.

EKG: Sinus bradycardia with an RSR' in V1. No evidence of significant RV volume load.

Echocardiogram: Complete congenital imaging identified RV dilation and a vertical vein connecting to an innominate vein and PAPVR.

Differential Diagnosis:

1. Partial anomalous pulmonary vein
2. Total anomalous pulmonary vein
3. Atrial septal defect
4. Arrhythmogenic right ventricular cardiomyopathy

Tests and results:

Cardiac MRI: Partial anomalous pulmonary venous return, left upper pulmonary vein drains into vertical vein which drains into innominate vein into right SVC. Qp:Qs = 1.5 :1

Final Working Diagnosis: Partial anomalous pulmonary vein

Treatment/Outcomes:

1. Consulted with sports cardiologist regarding partial anomalous pulmonary vein and small left to right shunt with associated mild right ventricular dilation.
2. Concluded that there is no increased risk for sudden cardiac death.
3. Addressed rationale for potential surgical correction to improve performance by augmenting left ventricular cardiac output and eliminating the left to right shunt.
4. Athlete and cardiologist discussed risks and benefits of open heart surgery as a football player in relation to loss of fitness and the risks of sternotomy for a contact/collision sport. They mutually decided upon no intervention at this time.
5. Cleared for full participation.
6. Repeat echocardiogram in 1 year.

3410 June 3 4:35 PM - 4:55 PM

Chest Injury - Boxing

Jonathan D. McKrell. *Heritage Valley Family Medicine, Beaver Falls, PA.*

Email: jmckrell@hvhs.org

(No relationships reported)

History: A 20 year old boxer in training for the US Olympic Trials was struck in the left chest while sparring. He was inhaling and took a direct blow to the left ribs. He felt as if he had lost his breath but continued boxing. He noted a "funny feeling" in his chest for the remainder of the training session. After arriving at home he had to remove his weighted vest since he felt like his heart was "being suffocated". He heard rattling in his chest and had increased pain in his chest when he was lying down. He felt better when he sat up or stood up. He presented to the Emergency Department because of the chest pain.

PHYSICAL EXAMINATION: Temperature 99, Pulse 78, Respiratory rate 18, Blood Pressure 128/75, O2 saturation 97% on room air. No erythema, swelling, ecchymosis or abrasion of the left chest wall. Middle left lateral ribs and left anterior chest tender to palpation. Lungs clear to auscultation. Heart with regular rate and rhythm, normal S1 and S2, multi-phase friction rub noted along the left sternal border both supine and sitting.

DIFFERENTIAL DIAGNOSIS

1. Fractured ribs
2. Pneumothorax
3. Pneumomediastinum
4. Pulmonary contusion
5. Chest Wall contusion:

TEST AND RESULTS

Chest x-ray, 2 view: no pneumothorax

Left rib films: no rib fractures

12 lead EKG: subtle ST segment elevation V2 - V6

Echocardiogram: thickening of the posterior parietal and visceral pericardium with a small pericardial effusion

:

FINAL WORKING DIAGNOSIS

Acute Pericarditis:

TREATMENT AND OUTCOMES

1. Cardiology consult, who initiated colchicine 0.6mg daily and ibuprofen 800mg 3 times daily. Sent home from hospital the next day.
2. Office visit with Cardiology 4 days later. Still had some chest discomfort but much improved. No friction rub on exam. Cleared to return to training.
3. Office visit with Family Medicine that afternoon. Creatinine was 1.6 and the ibuprofen was held.
4. Repeat creatinine 2 days later was 1.2
5. Echocardiogram 1 week later showed no pericardial abnormalities, no effusion
6. Western PA Gold Gloves Champion 2 months later :

F-66 Clinical Case Slide - Head and Neck II

Friday, June 3, 2016, 3:15 PM - 5:15 PM

Room: 203

3411 **Chair:** Peter Sedgwick, FACSM. *Central Maine Sports Medicine, Lewiston, ME.*

(No relationships reported)

3412 **Discussant:** John C. Hill, FACSM. *University of Colorado, Denver, CO.*

(No relationships reported)

3413 **Discussant:** Wayne Franklin Sease. *Steadman Hawkins Clinic of the Carolinas, Greer, SC.*

(No relationships reported)

3414 June 3 3:15 PM - 3:35 PM

Upper Extremity Neurological Symptoms In A Dancer

Joana Fraser, Kathryn Ackerman, FACSM. *Boston Children's Hospital, Boston, MA.* (Sponsor: Kathryn Ackerman, FACSM)

Email: joana.fraser@childrens.harvard.edu

(No relationships reported)

HISTORY: 18-year old female dancer at a performing arts school presents with right arm numbness and tingling and neck and arm pain that started after a neck/back hyperextension move in dance class 3 days prior. Since the incident she has been

unable to dance due to her symptoms. She was seen by her physical therapist at school and sent for further evaluation.

PHYSICAL EXAM: She had full active range of motion of her cervical spine with a positive Spurling's test on the right. She was tender diffusely over the midline of her cervical spine. Strength and reflexes in the right upper extremity were normal but she reported decreased sensation to light touch in all of her fingers, primarily in the 2nd, 3rd and 4th fingers. Shoulder exam was normal. Tinel's and Phalen's tests were negative.

DIFFERENTIAL DIAGNOSIS:

1. Cervical disk pathology
2. Brachial plexus injury
3. Cervical strain/sprain

TESTS AND RESULTS:

Cervical spine AP, lateral flexion and extension views

1. Straightening of the normal lordosis
2. Partial fusion of the left aspect of C4 and C5 vertebral bodies and facet joints
3. Mild forward positioning of C3 on C4 on flexion views and mild posterior positioning of C3 on C4 on extension views

MRI Cervical spine

1. Incomplete segmentation of C4 and C5 vertebrae with a rudimentary C4-5 disc, consistent with a Klippel-Feil anomaly
2. No disc herniation, thecal sac effacement or foraminal narrowing

FINAL WORKING DIAGNOSIS

Klippel-Feil anomaly of cervical vertebrae with nerve root(s) irritation

TREATMENT AND OUTCOME

1. Evaluated for other abnormalities associated with Klippel-Feil syndrome showed mild scoliosis, no renal abnormalities
2. Medrol dose pack prescribed for alleviation of acute symptoms
3. Gentle physical therapy for neck range of motion and strengthening
4. Currently restricted from full dance until symptoms resolve

3415 June 3 3:35 PM - 3:55 PM

Neck Injury- Football

Steven Makovitch, Daniel Cushman, Brandon Lawrence, David Petron. *University of Utah, Salt Lake City, UT.*

(No relationships reported)

HISTORY: A 16 year old male high school football player presented 10 days after a leftward hyperextension cervical spine injury while performing a tackle. He experienced immediate burning pain down the left arm to the level of the lateral elbow which resolved after 30 seconds. However, he noted persistent weakness with overhead lifting and performing a bench press. Cervical extension and rotation to the left continued to produce achy left sided neck pain.

PHYSICAL EXAMINATION: Athletic appearing male. Cervical motion was mildly limited with extension and left lateral side bending due to pain, otherwise full. No spinous process tenderness. Sensation and reflexes were intact throughout the upper extremities. A Spurling's test was negative and a Hoffman's sign was absent. Strength was diminished at 4/5 with left shoulder abduction and external rotation along with elbow flexion.

DIFFERENTIAL DIAGNOSIS:

1. Transient peripheral neuropraxia (stinger)
2. Cervical radiculopathy
3. Brachial plexopathy
4. Rotator cuff tear

TEST AND RESULTS:

Four view radiographs of the cervical spine including flexion and extension were obtained.

-widening of the atlantodontoid interval in flexion which reduced on neutral and extension views

MRI of the cervical spine without contrast

- cranio-cervical segmentation anomaly with a hypoplastic clivus and assimilation of the left and right C1 lateral masses and occipital condyles (left greater than right)
 - mild posterior angulation of the dens resulting in crowding of the foramen magnum
- Electrodiagnostics, performed 3 weeks post injury
- increased insertional activity with fibrillation potentials and sharp waves to the left deltoid and infraspinatus consistent with a C5 and/or C6 radiculopathy versus upper trunk lesion

FINAL/WORKING DIAGNOSIS:

1. Left C5 and/or C6 radiculopathy versus upper trunk brachial plexopathy
2. Incidental finding of hypoplastic clivus and assimilation of C1 lateral masses and occiput
3. Foramen magnum stenosis

TREATMENT AND OUTCOMES:

1. Rest from football. Noted to have improving strength at the time of electrodiagnostic testing.
2. Met with orthopedic spine surgeon and was strongly encouraged to stop all contact sports based on cervical spine anatomic anomalies.
3. After thoughtful discussion with his family, the patient decided to retire from football.

3416 June 3 3:55 PM - 4:15 PM

Upper Extremity Paresthesias in a High School Football Player

Asad R. Siddiqi, Matthew A. Close. *Greenville Health System, Greenville, SC.*

(No relationships reported)

HISTORY: A 16 year old male football player presents with recurrent episodes of bilateral arm paresthesias. This first occurred six weeks prior to presentation after he was tackled with his neck axially loaded in a flexed position, and was associated with mild subjective weakness. This lasted a few minutes and resolved spontaneously. This happened four more times with each episode lasting longer in duration. He denied any lower extremity symptoms. One week prior to presentation, he was blocking an opposing player and had a hyperflexion injury which precipitated paresthesias which lasted for hours. He denied any bowel/bladder incontinence or saddle anesthesia.

PHYSICAL EXAMINATION: No malalignment or rotational deformity of the neck. No bony tenderness or cervical paraspinal tenderness. Full cervical range of motion in all planes without pain. Spurling test is negative bilaterally. Full motor power in the bilateral upper and lower extremities except for slight weakness in right shoulder abduction and right hand finger abduction. No Hoffman sign present. Sensation intact to light touch bilaterally

DIFFERENTIAL DIAGNOSIS: Cervical cord neurapraxia

- Spinal stenosis
- Cervical radiculopathy
- Stinger/Burner
- Brachial plexopathy
- Parsonage Turner Syndrome

TEST AND RESULTS: Cervical cord neurapraxia without cord contusion in the setting of congenital stenosis of the cervical spine

FINAL WORKING DIAGNOSIS: X-rays of the cervical spine showed normal lordosis, proper alignment, preserved intervertebral disc height, and no acute osseous abnormalities. An MRI showed significant central canal stenosis at C3-4, C5-6, and C6-7 with loss of surrounding CSF fluid signal at these levels. Smallest canal diameter is 8mm at C5-6. There was no cord edema noted.

TREATMENT AND OUTCOMES: Though a validated risk stratification mechanism or return to play criteria does not presently exist in the literature, the results of the MRI and the progressively increasing duration of symptoms suggest an increased risk of future spinal cord injury with continued participation in contact sports. He does score in the "Moderate risk" category based on the Cervical Spine Injury Rating Scale proposed by Watkins, et al in 1990. He was held from participation and referred to spine surgery to discuss additional treatment options and return to play prognosis.

3417 June 3 4:15 PM - 4:35 PM

Neck Injury - Rugby

Phathokuhle C. Zondi, Dina C. Janse Van Rensburg, FACSM. *University of Pretoria, Hatfield, South Africa.*

Email: Phatho.Zondi@up.ac.za

(No relationships reported)

HISTORY: A 19-year-old rugby player sustained a neck injury while tackling. The mechanism of injury involved axial compression followed by lateral flexion of the neck. He suffered no loss of consciousness and immediately reported bilateral parasthesia of the upper limbs with no associated neck pain. His cervical spine was stabilised and the player was removed from the field in a spine board.

PHYSICAL EXAMINATION: His symptoms lasted approximately 45 seconds and by the time he arrived in the medical room for secondary examination, he had no residual symptoms of parasthesia. The athlete was non tender on palpation of the cervical spinous processes, his neck movements were within normal range and no specific neurological symptoms were noted on flexion, extension or lateral rotation. He had normal sensation, reflexes and strength of his upper and lower extremities.

DIFFERENTIAL DIAGNOSIS:

- 1. Cervical Spinal Cord Injury
- 2. Cervical Disc Lesion
- 3. Cervical Spondylosis

TESTS AND RESULTS:

XRAY showed no obvious structural lesions, no fractures, subluxations, or displaced vertebrae. MRI and myelogram confirmed bulging intervertebral discs at C3/4, C4/5 and C5/6 level. Central disc herniation and an annular tear was noted at C4/5. There was no CSF anteriorly over C4-C6. Measurement of his spinal canal diameter on these levels indicated a width of 8-10mm. He had a reduced TORG ratio of 0.6.

FINAL/WORKING DIAGNOSIS:

Congenital Cervical Stenosis

TREATMENT AND OUTCOMES:

The player consulted two orthopedic spine specialists for opinion and was advised to discontinue rugby and refrain from any future participation in contact sport. Although the athlete experienced no further symptoms, athletes who have cervical spine stenosis are at increased risk for serious nerve injuries. On further enquiry, the athlete reported a 2 year history of intermittent symptoms following rugby-related neck trauma. A

history of recurrent episodes of temporary paraplegia or quadriplegia is an ominous sign and justifies the decision to withdraw the athlete from future participation in contact sport.

3418 June 3 4:35 PM - 4:55 PM

Neck Pain in a Performing Arts Student

Michael Beasley, Joana Fraser. *Boston Children's Hospital, Boston, MA.* (Sponsor: Pierre D'Hemecourt, FACSM)

Email: joana.fraser@childrens.harvard.edu

(No relationships reported)

HISTORY: 24-year old female operatic student at a performing arts school with history of C5-6 left paracentral disc protrusion presented with worsening left-sided neck pain that began 1 day after a low impact motor vehicle accident (MVA). At the visit she denied any upper extremity tingling, numbness or weakness. She denied headaches, head injury or symptoms of concussion.

PHYSICAL EXAM: She had full active range of motion of her cervical spine but some left-sided neck discomfort with right lateral flexion and rightward rotation. Her C-spine was tender in the midline at C7. Spurling's was negative and upper and lower extremity neurological exams were normal.

DIFFERENTIAL DIAGNOSIS:

- 1. Cervical disk pathology (worsened from previous)
- 2. Cervical muscle strain/soft tissue sprain
- 3. Bony injury

TESTS AND RESULTS:

Cervical spine AP, lateral flexion and extension views: Normal MRI Cervical spine

1. Concentric T1 hyperintense signal involving the left vertebral artery at the C5-6 level suspicious for focal dissection with intramural hematoma

2. Small left paracentral disc protrusion, largely unchanged from prior study

MRA: Vertebral artery dissection at the V2 level with intramural hematoma and <33% artery narrowing

MRI Brain obtained to evaluate for occult stroke: normal

FINAL WORKING DIAGNOSIS

Traumatic left vertebral artery dissection

TREATMENT AND OUTCOME

- 1. Started on oral aspirin, discharged to outpatient follow up
- 2. At follow up 1 week later, MRA showed worsening vertebral artery dissection with concern for complete occlusion
- 3. CTA ordered to further assess artery lumen, confirmed that artery was not completely occluded
- 4. Admitted and started on IV anticoagulation; discharged on rivaroxaban
- 5. Currently restricted from dance and any vigorous activities or exercise, will reassess activity level at 3mo follow up with Neurology

3419 June 3 4:55 PM - 5:15 PM

Facial Injury - Cricket

Philipp J. Underwood, Kyle T. Lennon. *North Shore University Hospital, Manhasset, NY.*

(No relationships reported)

Facial Injury – Cricket

Philipp Underwood North Shore University Hospital, Manhasset, New York

Kyle Lennon North Shore University Hospital, Manhasset, New York

Email – punder@optonline.net

HISTORY: A 35 year old male playing cricket was hit in the face from a batted ball. He had removed his helmet and mouth piece because of heat. His teammates brought him to the ED, bleeding from the mouth. With difficulty speaking because of pain, he complained of jaw and teeth pain. He denied: headache, dizziness, nausea, neck pain, difficulty breathing or swallowing.

PHYSICAL EXAMINATION: In the ED, the patient was alert and oriented with normal vital signs. There was a 1 cm laceration of the lower central lip through to the buccal mucosa, and swelling of the upper lip. There was no obvious facial deformity. Pupils were 4 mm, equal and reactive. The nose was non-tender and without epistaxis or septal hematoma or deformity. There was no midface instability. Teeth # 7, 8 had Ellis class III fractures. Teeth # 24-26 were lingually displaced with bleeding from the gingiva. The mandible was tender over the symphysis, but not over body, angle or TMJ. There was no malocclusion. The oral-pharynx and tongue were normal. Neck was non-tender and full active range of motion. The anterior neck was normal and there was no airway compromise or stridor.

DIFFERENTIAL DIAGNOSIS: Dental fracture, alveolar fracture, mandibular fracture, mandibular contusion, lip laceration.

TESTS AND RESULTS: Maxillo-facial CT scan without contrast, Panorex – mildly displaced comminuted fracture of symphysis menti with fracture line extending along the alveolar ridge from teeth # 24-26 and displaced posteriorly

TREATMENT AND OUTCOMES: Dental consultation for the patient. The laceration was repaired and the dental fractures were covered with Vitrebond and flowable. The patient was admitted and taken to the OR where an arch bar was placed and screwed

to stabilize the fracture. The patient returned to the dental clinic the following week where root canal and crown were performed. The patient has recovered fully and has returned to all activities including cricket.

F-67 Clinical Case Slide - Medical Issues II

Friday, June 3, 2016, 3:15 PM - 5:15 PM
Room: 206

3420 **Chair:** Lisa Barkley, FACSM. *University of Central Florida, Orlando, FL.*
(No relationships reported)

3421 **Discussant:** Joshua Blomgren. *Rush University Medical Center, Chicago, IL.*
(No relationships reported)

3422 **Discussant:** Cindy J. Chang, FACSM. *University of California San Francisco, San Francisco, CA.*
(No relationships reported)

3423 June 3 3:15 PM - 3:35 PM
Case Study: Utilizing A Low Fodmap Diet To Combat Exercise-induced Gastrointestinal Symptoms
 Dana M. Lis, Kiran D.K. Ahuja, Trent Stellingwerff, FACSM, Cecilia M. Kitic, James Fell. *University of Tasmania, Launceston, Australia.*
(No relationships reported)

Case Study: Utilizing a Low FODMAP Diet to Combat Exercise-Induced Gastrointestinal Symptoms
Athletes employ various dietary strategies in attempts to attenuate exercise-induced gastrointestinal (GI) symptoms to ensure optimal performance. **PURPOSE:** This case-study outlines a novel GI-targeted approaches via the implementation of a short-term low FODMAP (Fermentable Oligosaccharides, Disaccharides, Monosaccharides and Polyols) diet, with the aim to attenuate persistent running-specific GI symptoms in a competitive multisport athlete (male, 86kg, 57.9 ml.kg.min⁻¹.VO_{2max}, 10-15 hrs. week⁻¹ training, with no diagnosed GI disorder). **METHODS:** Using a single blinded approach, a habitual diet was compared to a 6-day low FODMAP intervention diet (8 ± 5g vs 7.2 ± 5.7g FODMAPs.day⁻¹) for their effect on GI symptoms and perceptual wellbeing. Training was similar during the habitual and dietary intervention period. Daily GI symptom ratings were recorded after exercise (*During*) and at the end of the day (*Daily*) as well as the Daily Analysis of Life Demands for Athletes (DALDA). **RESULTS:** *Daily* and *During* GI symptom scores (scale 0-9) ranged from 0-4 in level of severity during the habitual dietary period while during the low FODMAP dietary period all scores were 0 (no symptoms at all). DALDA scores for ‘worse than normal’ ranged from 3-10 vs 0-8 in the habitual and low FODMAP dietary periods, respectively, indicating improvement. **CONCLUSION:** This intervention was effective for this GI symptom prone athlete; however, appropriately designed large sample research is required to assess the suitability of low FODMAP diets for reducing GI distress in other symptomatic athletes.

3424 June 3 3:35 PM - 3:55 PM
Abdominal Pain in a Collegiate Football Player
 Wes Sohns, Scott Lynch, Scott Armen, Peter Seidenberg, FACSM. *Penn State University, University Park, PA.* (Sponsor: Peter Seidenberg, FACSM)
(No relationships reported)

Hx: A 23 y/o NCAA football player who was unable to catch his breath after being hit in the abdomen at practice. He continued for 10 more plays prior to reporting the injury. He stated that he had increasing LUQ pain and shortness of breath.
 PE: Pox 99%, HR 104, lungs CTAB but shallow. Abdomen: BS (+), TTP LUQ, no mass or rebound, Kehr’s sign (+). Evaluated in ER and released.
 Next morning: c/o LUQ and suprapubic pain, did not sleep well. Appetite and urination decreased, no N/V/D; afebrile; HR 90-100, BP 128/74, Pox 98%. Waves of diaphoresis; TTP suprapubic and LUQ areas. BS (+), no rebound. No rash or bruising. That afternoon: continued pain and urine retention; diaphoretic and intermittently pale with BP 148/94, HR 100, Pox 96%, afebrile, shallow breathing due to pain.
 DD:
 1. Rib fracture
 2. Splenic injury
 3. Pancreatic injury
 4. Small bowel injury

5. Traumatic ileus
 6. Renal trauma
 7. Left lung injury
 8. Retroperitoneal hemorrhage
- TESTS/RESULTS:
 - US fast scan - WNL
 - Istat – Hgb and Cr WNL
 - Stat CT abd – only showed 12th rib fracture
- FINAL/WORKING Dx:
 Jejunum perforation
- Tx /OUTCOMES:
 1. Transported to the ER. Fast scan US was normal. CT scan showed 12th rib fracture. Given IV dilaudid, toradol, Percocet for overnight pain.
 2. Next morning reported urinary retention and decreased appetite which he felt due to the medication. Had an US which showed full bladder and no splenic injury.
 3. D/c meds and gave IM toradol and PO tramadol for the pain.
 4. No improvement and was admitted to the hospital for IV hydration and pain control, further lab testing, observation.
 5. Pain continued into the night. Labs showed increased pancreatic enzymes and CPK. CXR and AAS showed B pleural effusion and possible free air under diaphragm.
 6. Local surgeon consulted did not think there was free air but concerned with pancreatic injury.
 7. Transferred to tertiary care center.
 8. Observed in the SICU for a day and started declining in status. An MR cholangiogram ordered to evaluate the pancreatic duct but stopped due to the presence of free air.
 9. Emergent exploratory laparotomy showed a jejunum perforation. Rresected and repaired.
 10. Two days postop, taken back to OR for a leak at the repair site.
 11. Small abscess developed under the diaphragm; treated percutaneously.
 12. Currently doing great. Working out at pre-injury levels.

3425 June 3 3:55 PM - 4:15 PM
Genitourinary - Softball
 Spencer Jones, Wade Rankin, Kelly Evans-Rankin. *University of Kentucky, Lexington, KY.*
 Email: spencer.r.jones@uky.edu
(No relationships reported)

History and Presentation:
 27-year-old male recreational softball player sustained an injury during a playoff game. He was struck in the groin by a hard-hit come-back ball while not wearing any protective equipment. He complained of some immediate stinging at the point of contact on the penile shaft, but denied bruising or swelling. He was able to return to the game during the same inning. He denied urinary difficulty or straining, hematuria, or dysuria. Three days later he suffered sudden-onset of exquisite penile pain with difficulty urinating, dysuria & dark-colored urine. It was not associated with any systemic symptoms. He was sexually active in the week prior, but denied any history of STD. He did report recent resolution of cold symptoms for which he took OTC anti-histamines.

Physical Examination:
 Well-appearing male in mild distress with excess fidgeting. He had no flank tenderness but did have some suprapubic tenderness. GU exam did not reveal any lesions or urethral discharge, & scrotal contents were normal. There was some bruising and tenderness at the urethral meatus but no overt external swelling or edema noted. There was some shoddy bilateral inguinal lymphadenopathy.

- Differential Diagnosis:**
1. Bacterial urethritis
 2. Urethrolithiasis
 3. Trauma-induced urethral meatitis
 4. Urethral herpes eruption
 5. UTI
 6. Adenoviral urethritis
 7. Corpus cavernosum disruption

Testing and Results:
 Urinalysis negative for blood, leukocyte esterase, or bacteria. Urine gonorrhea/chlamydia were negative, & urethral culture was negative for HSV. A non-contrast CT failed to show any calcific obstruction (note that CT did not extend inferiorly to the level of the urethra), & blood work was normal apart from a modestly elevated creatinine. Prostate exam was negative for tenderness or swelling. A urology referral with in-office intraurethral visual examination revealed significant ecchymosis and swelling at the anterior urethral meatus.

- Final Diagnosis:**
 Trauma-induced urethral meatitis
- Treatment & Outcomes:**
1. Intra-urethral lidocaine for comfort
 2. Prednisone burst for 5 days
 3. NSAIDs and ice to area 3 times daily
 4. Pain-free urination at day 8 of symptoms

5. Physical exam returned to baseline at 10-day follow-up
6. Able to return to sport at 2 weeks with use of athletic cup

3426 June 3 4:15 PM - 4:35 PM

Testicular Swelling In A Collegiate Athlete - Mens Soccer

Michael Bauer, Jeffrey Holloway, David Jenkinson. *University of South Carolina, Columbia, SC.*
(No relationships reported)

HISTORY: A 20-year-old male collegiate soccer player presented to the Sports Medicine Clinic complaining of right testicular pain and swelling. He first noticed the pain in his testicle about 2 days ago during a run. The pain in his testicle improved after he stopped running but never fully abated. Pain was sharp but not severe during his run or thereafter. Over the next 2 days, the pain persisted and his right testicle became swollen. His pain was exacerbated by exertion and urination. He denied fevers, chills, hematuria, penile discharge, or previous occurrence. His pain radiated up into the right side of his abdomen. He ultimately decided to seek medical attention at the recommendation of his girlfriend due to the amount of swelling in his right testicle and not necessarily the pain. He was immediately referred for an ultrasound of testicle which demonstrated an enlarged right testicle with minimal blood flow surrounding it. Urology took him to the OR for reduction of the right testicular torsion. The patient also underwent fixation bilaterally as an attempt to prevent further occurrences of testicular torsion. He was discharged from the hospital the next day. Unfortunately, 4 days later, he returned to the emergency department with fevers and a painful, swollen right testicle. Repeat ultrasound demonstrated the persistent absence of blood flow. He was taken back to the OR where he underwent right orchiectomy.

PHYSICAL EXAMINATION: Examination at initial presentation demonstrated a non-tender, enlarged, firm right testicle situated higher in the scrotum as compared to the left testicle.

DIFFERENTIAL DIAGNOSIS:

1. Testicular torsion
2. Testicular tumor
3. Orchitis
4. Epididymitis
5. Varicocele
6. Inguinal Hernia

TEST AND RESULTS:

Enlarged right testicle with minimal blood flow surrounding the testicle.

FINAL DIAGNOSIS:

Testicular torsion

TREATMENT AND OUTCOMES:

- Reduction of right testicular torsion (orchidopexy)
- Bilateral fixation of spermatoceum
- Subsequent right orchiectomy
- Discussion with athlete regarding long-term outcomes and precautions such as sperm banking and techniques to protect remaining testicle
- Discussion with athlete regarding single organ status and future in competitive athletics

3427 June 3 4:35 PM - 4:55 PM

Urine Pain: Managing Blunt Abdominal Trauma In A Lacrosse Player

Mary Tierney¹, Bronson E. Delasobera². ¹*VCU-Fairfax Sports Medicine Fellowship, Fairfax, VA.* ²*MedStar Georgetown University Hospital, McLean, VA.* (Sponsor: Francis O'Connor, MD, FACSM)
(No relationships reported)

HISTORY

19-year-old male collegiate lacrosse player presented to the training room with abdominal pain, emesis, and gross hematuria following a cross-check to his abdomen during a game one day prior. Symptoms cleared with a negative urine dipstick 48 hours after injury and he was cleared for competition. One week later, he was cross-checked again in the abdomen, resulting in similar symptoms including hematuria, abdominal pain, anorexia, and emesis. He denied significant medical history, denied taking medications, previous trauma, surgeries or smoking. He reported a history of split urinary stream. Symptoms persisted 4 days post injury at which time he was sent to the ER for further evaluation.

PHYSICAL EXAM

Gen: No acute distress, well-appearing

GU: uncircumcised penis, normal descended testes bilaterally, no mass/hernias, normal phallus, normal epididymis, normal scrotum, urethral meatus normal without blood. Abdomen: no ecchymosis, normal bowel sounds, abdomen tender to palpation in the LUQ, suprapubic area, and left flank. No rigidity, guarding, or organomegaly.

DIFFERENTIAL DIAGNOSIS

Bladder wall hematoma/contusion/perforation

Renal contusion

Splenic injury

Ureteral/urethral Injury

FINAL/WORKING DIAGNOSIS

Abdominal pain, hematuria, and trace intraperitoneal free fluid status post blunt abdominal trauma without evidence of bladder, ureteral, urethral, or kidney injury

TESTS AND RESULTS

CBC and BMP normal

Urine analysis moderate blood with >50 RBCs

FAST ultrasound - normal

CT abdomen/pelvis with contrast - trace intraperitoneal free fluid behind bladder, no bladder injury

CT/cystogram - negative for bladder rupture or injury

TREATMENT AND OUTCOMES

Urology consulted in the ED and discharged following CT cystogram failed to show organ damage. At one week, he was asymptomatic and had a negative urine dipstick. Urology suggested cystoscopy if hematuria re-occurred. He was cleared for gradual return to play and recommended to use abdominal guarding in the future. While hematuria following abdominal trauma is not rare, subsequent free fluid spurs questions of whether there were predisposing factors (i.e. stricture) or if an acute injury resulted in the clinical and diagnostic findings. This is an unusual problem following such an injury and a unique workup with questions on his safe return to play.

3428 June 3 4:55 PM - 5:15 PM

Abnormal Vital Signs - Soccer

Erika Sadeghi. *St. Joseph's Hospital and Health Center, Syracuse, NY.*

Email: erika.sadeghi@sjhsyr.org

(No relationships reported)

HISTORY: 21 year old male with unremarkable past medical history presents for a preseason physical. Patient is a senior in college playing Division I soccer. He has no medical complaints. Patient denies usage of medications, recreational drugs, alcohol, energy drinks or excessive caffeine intake. He denies chest pain, palpitations, skin changes, anxiety, or weight changes.

PHYSICAL EXAMINATION: Patient's height is 68 inches, weight 193.6 lbs, BMI 29.4, blood pressure 134/76, and pulse 104. He is a young black male in no acute distress. His skin is smooth, soft, and warm. He has slight lid retraction but no proptosis or lid lag. There is no thyromegaly or tracheal deviation of the neck. His heart has regular rhythm with no murmurs, rubs, or gallops. His lungs are clear to auscultation and abdomen is soft, nontender, and nondistended. He has a fine tremor and slightly hyperreflexic primarily in the upper extremities.

DIFFERENTIAL DIAGNOSIS:

1. cardiovascular: tachycardia with pre-hypertensive
2. endocrine: hyperthyroidism, pheochromocytoma
3. metabolic: dehydration, volume depletion
4. hematologic: anemia
3. pulmonary: pulmonary embolism, hypoxia
5. psychiatric: anxiety
6. iatrogenic: anticholinergic drugs, beta blocker withdrawal
7. other: exposure to stimulants (nicotine, caffeine, amphetamines) or illicit drugs

TESTS AND RESULTS:

Unremarkable laboratory findings of CBC and differential, sedimentation rate, and urine toxicology. TSH <0.008 mIU/ml, freeT4 5.44 ng/dl, Free T3 >10.0 pg/ml. CMP unremarkable except ALP 141, ALT 73, AST 42.

FINAL/WORKING DIAGNOSIS: Hyperthyroidism

TREATMENT AND OUTCOMES:

1. Athlete instructed to monitor pulse and blood pressure twice daily for two weeks.
2. Athlete may travel, may be team manager, may play as 4th string goalie if needed, and advised to stay hydrated.
3. Referral to endocrinology. Full set of thyroid antibodies including a TSH receptor antibody to exclude Grave's disease as well as thyroid autoantibodies are pending. Patient started on atenolol 50 mg daily.

F-68 Clinical Case Slide - Upper Extremity- Shoulder II

Friday, June 3, 2016, 3:15 PM - 5:15 PM
Room: 102

3429 **Chair:** Pierre Rouzier, FACSM. *University of Massachusetts, Amherst, MA.*
(No relationships reported)

3430 **Discussant:** Dennis Khalili-Borna, FACSM. *Kaiser Permanente, Fontana, CA.*
(No relationships reported)

3431 **Discussant:** Melody Hrubes. *Schwab Rehabilitation Hospital, Chicago, IL.*
(No relationships reported)

3432 June 3 3:15 PM - 3:35 PM
Shoulder Pain in a Swimmer
 Amy Rabatin, Edward Laskowski, FACSM, Daniel Lueders, Cara Prideaux. *Mayo Clinic, Rochester, MN.* (Sponsor: Edward Laskowski, FACSM)
 Email: rabatin.amy@mayo.edu
(No relationships reported)

HISTORY: A 17 year old male, right hand dominant, competitive swimmer presented to clinic with a 2 week history of right shoulder pain. Initial pain was associated with coughing secondary to an upper respiratory infection and localized to the right upper trapezius and scapula. Several days later, he playfully lifted a heavy friend, felt more pain in the same area, and dropped his friend due to severe pain. Pain occasionally radiated down posterior arm. Exacerbating factors included overhead activities including swimming, shoulder abduction, cross body reaching, deep breathing and coughing. Past history included possible right shoulder dislocation in fifth or sixth grade, when shoulder "popped in and out".

PHYSICAL EXAM: Peripheral pulses intact, normal capillary refill. Breathing unlabored; pain with deep breathing. Strength, reflexes, and sensation normal. No evidence of atrophy, scapular winging, or swelling. No obvious tenderness to palpation. Full active shoulder range of motion with pain at terminal arc of forward flexion and abduction. No glenohumeral internal rotation deficit. Pain with horizontal cross-body adduction, Neer's maneuver and resisted shoulder external rotation.

DIFFERENTIAL DIAGNOSIS:

1. Rotator cuff injury
2. Shoulder impingement
3. Labral tear
4. Myofascial pain
5. Cervical strain or radiculopathy
6. Brachial plexitis/Parsonage turner
7. Spontaneous pneumothorax
8. Rib injury

TEST AND RESULTS:

Shoulder radiograph

- Complete transverse fracture right 1st rib with associated soft tissue swelling.
- Flattening of greater tuberosity of right humerus posterolaterally suspicious for a Hill-Sachs fracture. Slight deformity of tuberosity on external rotation view raises possibility of fracture.

FINAL/WORKING DIAGNOSIS:

Right first rib fracture

TREATMENT AND OUTCOMES:

1. Initial treatment: No swimming. Encouraged rest, analgesia with Tylenol and avoidance of overhead activities and activities that caused pain including lifting.
2. Return visit 5 weeks after initial pain onset: Right rib radiograph showed a slightly comminuted and displaced fracture of the lateral aspect of the right 1st rib. On physical exam, full non-painful range of motion and strength of shoulder.
3. At 6 weeks, he gradually re-introduced upper body activity.
4. Returned successfully to competitive swimming.

3433 June 3 3:35 PM - 3:55 PM

Shoulder Injury - Water Skiing

Colin P. Murphy¹, Ashanth Thomas², Kyubo Choi³, Matt Baker³, Edward G. McFarland³. ¹*Georgetown University School of Medicine, Washington, DC.* ²*The Commonwealth Medical College, Scranton, PA.* ³*The Johns Hopkins University, Baltimore, MD.* (Sponsor: Joe Martire MD, FACSM)

(No relationships reported)

HISTORY: A 42-year old male presented to the emergency department after an accident while water skiing. He was barefoot skiing and fell, which jerked his right dominant arm above his head and caused an onset of pain in his shoulder. He was taken to the emergency room where radiographs revealed a shoulder dislocation. The shoulder could not be reduced with IV sedation, so he was taken to the operating room for a closed reduction under anesthesia. He was found postoperatively to have a fracture and also some evidence of a nerve injury. He was given a sling and told to see an orthopaedic surgeon. He arrived at our office 10 weeks after his injury.

PHYSICAL EXAMINATION: At the time of the first visit to our office the patient was alert and not in distress with his arm in a sling. He had no shoulder deformity but had atrophy of his deltoid, supraspinatus and infraspinatus muscles. His vascular examination was normal but his sensory exam revealed decreased sensation in the axillary nerve distribution along with his anteromedial forearm and into his thumb. He had weakness in external rotation and abduction. His shoulder was extremely stiff with elevation to only 60 degrees passively and with external rotation at the side of 10 degrees. His elbow was also stiff with range of motion of 0 to 140 degrees of flexion.

DIFFERENTIAL DIAGNOSIS:

1. Unreduced shoulder dislocation
2. Shoulder fracture dislocation
3. Brachial plexopathy
4. Rotator cuff tear
5. Cervical spine injury

TEST AND RESULTS:

1. Plain radiographs revealed a reduced shoulder with a comminuted greater tuberosity fracture
2. EMG-NCS revealed incomplete lesion of the axillary nerve only
3. Magnetic resonance imaging revealed comminuted greater tuberosity fracture with supraspinatus tear
4. Outside radiographs obtained which showed luxatio erecta prior to reduction

FINAL WORKING DIAGNOSIS:

Luxatio erecta with axillary nerve palsy

TREATMENT AND OUTCOMES:

1. Recommended immediate range of motion of shoulder, elbow and entire UE
2. Physical therapy directed at range of motion of shoulder with no limits
3. Pain control to improve motion included NSAID's, narcotics and oral steroids
4. At one year no instability but continued stiffness in abduction and rotations

3434 June 3 3:55 PM - 4:15 PM

An Elusive Cause of Shoulder Pain in a Baseball Pitcher

Daniel R. Lueders, Jacob L. Sellon. *Mayo Clinic, Rochester, MN.*
 Email: lueders.daniel@mayo.edu

(No relationships reported)

HISTORY:

A 17 year-old right-handed baseball pitcher presented with 5 years of diffuse posterolateral right upper arm pain provoked with high-velocity throwing that could radiate into the forearm and posterior shoulder. He felt that he could no longer play because of this pain. No pain at rest or without pitching. Pain frequency and intensity increased linearly with increasing pitching volume. No inciting event or trauma was recalled.

PHYSICAL EXAMINATION:

Normal shoulder musculature without asymmetry. Tender in supraspinous fossa over suprascapular nerve. Shoulder ranges of motion were full and symmetric. Mild right scapulothoracic dyskinesia. Mild weakness in shoulder external rotation, otherwise normal strength. Normal radial pulses. Mild sensation decrement over right lateral shoulder. No reproduction of typical pain with labral and rotator cuff provocative maneuvers.

DIFFERENTIAL DIAGNOSIS:

- Axillary Neuropathy
- Thoracic Outlet Syndrome
- Rotator tendinopathy
- Labral tear
- Cervical radiculopathy

TEST AND RESULTS:

Normal right humerus Xray and MRI. Right shoulder MRI showed mild degenerative superior glenoid labrum free edge fraying. Vascular ultrasound found dynamic bilateral axillary artery and vein occlusion at the thoracic outlet with Adson's maneuver but no fixed lesions or anatomic areas of thoracic outlet obstruction. EMG identified reduced

recruitment and neurogenic, polyphasic MUPs without fibrillations in the right teres minor but normal right deltoid, infraspinatus, and C5 paraspinal muscles. Diagnostic ultrasound found no discrete right suprascapular or axillary nerves abnormalities.

FINAL WORKING DIAGNOSIS:

The clinical presentation, physical examination, and EMG findings raised concern for coinciding quadrangular space syndrome and suprascapular nerve entrapment at the shoulder.

TREATMENT AND OUTCOMES:

Vascular Medicine, Vascular Surgery, and Orthopedic Surgery were consulted. Open quadrangular space decompression with axillary neurolysis and arthroscopic suprascapular nerve release were performed without complication. Shoulder movements and activities were pain-free at four weeks after surgery and strength returned to normal in the shoulder external rotators. Return to throwing program is ongoing.

3435 June 3 4:15 PM - 4:35 PM

Non-Contact First Rib Fracture In A High School Baseball Infielder

Wally Walstrom¹, Kyle Goert². ¹Via Christi Sports Med, Wichita, KS. ²Via Christi, Wichita, KS.
Email: wwals02@yahoo.com
(No relationships reported)

Right handed 16 yr old HS sophomore baseball infielder presents for evaluation of 2 months of insidious right shoulder pain and weakness. He had to switch positions to 2nd base from 3rd due to loss of velocity and control. No history of trauma. Was taking ibuprofen with no benefit. He reports that the pain started over his anterior shoulder & clavicle & is now diffuse over shoulder. Denies numbness & tingling. He has been doing rotator cuff exercises, but has otherwise been resting for the last 4 weeks because of worsening pain.

PE:

Right Shoulder Exam:

Inspection: No Effusion, Swelling, Skin/scars, atrophy, spasm, nor deformity.

Posture: kyphotic T spine and shoulders predominantly rolled forward.

Palpation: TTP posterior to mid-clavicle & biceps tendon

Range of Motion: shoulder full passive, active flexion limited to 165 otherwise normal Cervical, thoracic, elbow & wrist ROM: normal

Strength: 5/5 forward flexion, abduction, internal and external rotation

Special Tests:

Neg Apprehension, Relocation, Anterior glide, Posterior glide, Sulcus, Hawkins, Cross arm AC, Lift off test, Speed's, & Yergason's

Positive scapulothoracic winging

Neurovascular: UE exam normal

DDx:

1. Scapular dyskinesia
2. Labral tear
3. Rotator cuff tear
4. Biceps tendinopathy
5. First rib stress fracture

TEST & RESULTS:

XR of right shoulder. non-displaced transverse fracture of the first rib, otherwise normal

FINAL/WORKING Dx:

Right 1st rib stress fracture

TX & OUTCOMES: For the first 4 weeks pt was limited to no overhead activities, but was allowed to do cardio, lower extremity & core work as long as it did not stress the upper ext. Pt was asked to take Calcium 2000mg & Vitamin D 800 IU daily, & no NSAIDs. FU at 4 & 8 weeks, XR showed only limited bone healing. Bone stimulator was added & he followed up in 4 weeks with good callus formation. Pt was no longer having any pain at his 3 month visit. After 4 months pt was only having mild scapular winging and pt was released with baseball progression back to full activity & cont on his Vit D and Calcium supplementation.

3436 June 3 4:35 PM - 4:55 PM

Posterior Shoulder Pain in a High School Football Lineman

Scott Annett, Franklin Sease. *Greenville Health System, Greenville, SC.* (Sponsor: Kyle Cassas, FACSM)
(No relationships reported)

HISTORY: 16yo high school football lineman presented with right shoulder pain. He initially noticed moderate pain after squatting 350lbs and placing the weight back down. The pain was sharp and painful when turning his head to the left. He was evaluated at an urgent care facility and felt to have a muscular injury and placed on muscle relaxants and anti-inflammatories. His pain improved transiently. He then re-injured this area when he was in gym class running hurdles and brought his arms across his chest in the front of him. He states that he heard a pop in his shoulder and had

excruciating pain, and presented to the sports medicine clinic for further evaluation.

The pain was pleuritic and still localized to the posterior shoulder.

PHYSICAL EXAMINATION: BMI 33.5RR 17O2 Sat 99%

He appeared moderately uncomfortable. He had full motion at the neck with no tenderness of the cervical spine. Bending to the left was mildly painful. He had a negative Spurling's maneuver. He had tenderness over the medial rhomboids, trapezius, and overlying the scapular body. He had no scapular winging. He had full range of motion at the shoulder and 5/5 rotator cuff strength. He had no AC tenderness or pain with cross arm adduction. His lung fields were clear to auscultation with good air movement throughout.

DIFFERENTIAL DIAGNOSIS:

1. Strain or partial tear of scapular stabilizer
2. Snapping Scapula (scapulothoracic bursitis)
3. First Rib Fracture

TEST AND RESULTS: Three views of the right shoulder (AP, scapular Y, and lateral axillary)

-Non-displaced, oblique fracture through mid-portion of the first right rib

Two views of clavicles (AP and 15 degree cephalic)

-Fracture confirmed; no pneumothorax is visualized

FINAL WORKING DIAGNOSIS: 1st Rib Stress Fracture secondary to scalene and serratus anterior contraction**TREATMENT AND OUTCOMES:**

1. Patient was placed in sling and provided with narcotic analgesia; pendulum exercises were emphasized.
2. At three weeks, repeat XR showed minimal displacement of the fracture. His sling was discontinued and he was allowed to start back light weight training (30lbs max). Physical therapy was ordered.
3. At 7 weeks, he was pain free with normal strength and allowed to resume normal weight lifting.
4. At 3 month follow up, repeat XR showed some callus formation. He was allowed to resume contact sports, such as football.

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Suprascap Mishap - Shoulder Pain In A Former Athlete

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HISTORY: A 45-year-old right hand dominant former college football player presented with a one-month history of progressive left shoulder pain and weakness. He complained of difficulty raising his arm overhead with a generalized ache in the shoulder. There was no concomitant numbness or tingling and no associated neck, elbow, or hand injury or history of trauma.

PHYSICAL EXAMINATION: The patient had full active and passive range of motion of the arm at the shoulder in all planes. Inspection revealed subtle infraspinatus atrophy. AC joint was non-tender. Empty can testing revealed mild pain and subtle weakness possibly secondary to pain. Abduction strength was normal. External rotation power with the arm at the side revealed obvious weakness on the left (3+/5) compared to normal strength (5/5) on the right. Neer and Hawkins impingement signs were negative bilaterally. Lift-off test was negative as were O'Brien's test, crank test, Speed's test, apprehension, Jerk test and cross-body maneuvers. There was no direct tenderness along his cervical spine. Spurling's was negative, neck range of motion full and no pain with active neck hyperextension. Deep tendon reflexes and sensation were normal.

DIFFERENTIAL DIAGNOSIS:

- 1) Suprascapular Nerve Palsy
- 2) Large rotator cuff tear (supraspinatus and infraspinatus)
- 3) Cervical Radiculopathy
- 4) Parsonage Turner Syndrome

TEST AND RESULTS:

Left Shoulder 3 view xrays : no arthritis, no proximal migration of humeral head, no fracture or dislocation

Left Shoulder MRI:

-Large SLAP tear of the labrum

-3.0 x 2.5 x 1.2 cm paralabral cyst extending posteriorly to the glenoid into the spinoglenoid notch

-Rotator cuff tendinosis with no tear

FINAL/WORKING DIAGNOSIS:

Compressive Suprascapular Nerve Palsy (secondary to paralabral cyst in the spinoglenoid notch) and resulting compressive neuropathy

TREATMENT AND OUTCOMES:

- 1) CT guided cyst decompression minimally improved pain and strength at 3 weeks
- 2) Arthroscopic exploration for cyst marsupialization with labral debridement and repair (to prevent cyst re-accumulation)
- 3) Physical therapy